Ugu District Municipality

UMZIMKHULU BULK WATER AUGMENTATION SCHEME: PHASE 2

TENDER N°: UGU-07-1631-2023

CONSTRUCTION OF THE BACKWASH WATER RECOVERY FACILITY AT BHOBHOYI WATER TREATMENT WORKS

CIDB CLASSIFICATION: 7ME OR HIGHER

TENDERING PROCEDURES AND RETURNABLE DOCUMENTS

VOLUME 1 OF 4

ISSUED BY:

Ugu District Municipality

P O Box 33
Port Shepstone
4240

Contact Name : Ms Noncedo Gidimisani

Telephone : 039 688 5700

Email Address : Noncedo.Gidimisani@ugu.gov.za

PREPARED BY:

Royal HaskoningDHV (Pty) Ltd

P O Box 1066
Pietermaritzburg
3200

Contact Name : Mr Selemo Sefehle

Telephone : 087 357 7582

Email Address : Selemo.Sefehle@rhdhv.com

APRIL 2023

CLOSING DATE & TIME:	**12:00 on Friday, 19 May 2023**
COMPULSORY TENDER MEETING:	**10:00 on Wednesday, 26 April 2023**

PROCUREMENT DOCUMENT

(Based on the CIDB Standard for Uniformity in Engineering and Construction Works Contracts August 2019 as published by CIDB and the General Conditions of Contract for Construction Works (Third Edition 2015) as published by the South African Institution of Civil Engineering)

NAME OF TENDERER : .....

SUMMARY FOR TENDER OPENING PURPOSES

[To facilitate the reading out of tender parameters at the opening of tenders, the tenderer shall complete this form and submit it with his tender. This form does not replace the Form of Offer, C1.1, which must be completed]

Name of Contractor submitting the Tender: .....

Tender Amount *(as stated in the Form of Offer)*: R .....

Time for Completion Offered: .....

Alternative Tender Offered? ..... (*Yes / No*)

If "Yes" state amount: R ..... Alternative Tender Nº. 1

R ..... Alternative Tender Nº. 2

R ..... Alternative Tender Nº. 3

Alternative Time for Completion Offered: ..... (*Yes / No*)

If "Yes" state duration: ..... Alternative Tender Nº. 1

..... Alternative Tender Nº. 2

..... Alternative Tender Nº. 3

Details of Contact Person:

Name *(Print):* .....

Telephone Nº: ..... Fax No *:* .....

Cell Phone Nº*:* .....

Email Address*:* .....

Is Form of Offer signed by Tenderer and Witnesses? ..... (*Yes / No*)

SIGNATURE*:* .....
(of person authorised to sign the tender)

Note: In the event of conflict between the data provided in this summary and that given in the Form of Offer, C1.1, the latter shall prevail.

CHECK-LIST FOR TENDER SUBMISSION

The Tenderer is to indicate in the check-boxes provided that he/she has completed the required section of the tender document. Completion of this check-list will assist the Tenderer in ensuring that he/she has attended to all the required items for submission with this tender.

		Yes	No	Yes	No	Comments
Cover	Name of Tenderer					
TP.5	MBD1: Invitation to Bid					
RD.5	Compulsory Site Inspection Certificate and Declaration					
RD.7	MBD2: Tax Clearance Certificate Requirements					
RD.8	MBD4: Bidder's Disclosure					
RD.11	MBD5 : Declaration For Procurement Above R10 Million					
RD.14	MBD6.1 : Preference Points Claim Form ITO the Preferential Regulations					
RD.18	Sworn Affidavit – B-BBEE Exempted Micro Enterprise - General					
RD.20	Sworn Affidavit – B-BBEE Qualifying Small Enterprise – General MBD8					
RD.22	Compulsory Enterprise Questionnaire					
RD.24	Company Registration Certificate and Shareholding Details					
RD.25	Contractor's Certificate of Registration with CIDB					
RD.26	Contractor's COID Registration Details					
RD.27	Form of Intent to Provide a Performance Guarantee					
RD.28	Joint Venture Agreement					
RD.29	Good Standing with Municipal Accounts					
RD.30	Experience of Tenderer and Current Projects					
RD.34	Proposed Organization and Staffing					
RD.35	Experience of Key Personnel					
RD.41	Construction Methodology and Preliminary Programme					
RD.42	Financial Resources					
RD.43	Quality Control and Environmental Management					
RD.44	Contractor's Health and Safety Declaration					
RD.46	Construction Health and Safety Plan					
RD.48	Certificate of Authority					
RD.50	Schedule of Sources of Supply of Materials					
RD.51	Sub-Contracting for Local EME or QSE					
RD.54	Schedule of Proposed Sub-Contractors					
RD.55	Schedule of Construction Equipment					
RD.56	Amendments, Qualifications and Alternatives					
RD.57	Record of Addenda to Tender Document					

Page	Description	Completed		For office use		
		Yes	No	Yes	No	Comments
C.3	Form of Offer					
C.8	Contract Data					
PD.7	Bill of Quantities					

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T1.1 TENDER NOTICE AND INVITATION TO TENDER

T1.1 TENDER NOTICE AND INVITATION TO TENDER

UGU DISTRICT MUNICIPALITY

UMZIMKHULU BULK WATER AUGMENTATION SCHEME - PHASE 2

CONSTRUCTION OF THE BACKWASH WATER RECOVERY FACILITY AT BHOBHOYI WATER TREATMENT WORKS

CIDB CLASSIFICATION: 8ME OR HIGHER

Contract Ugu-07-1631-2023

The Ugu District Municipality invites tenders for the Construction of the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works. The minimum specifications are detailed in the Tender Document. It is required that tenderers must have a CIDB registration of **8ME** or higher. Joint ventures that satisfy the criteria stated in the tender data are eligible to tender.

Tender documents will be available from the Cashier's Office in the Ugu District Municipality's Offices at 28 Connor Street, Port Shepstone, during the working hours (10H00 to 15H00 from Monday to Friday) from the **17th April 2023 until 21st April 2023**. **No documents will be distributed at the tender clarification meeting**. A non-refundable document fee of **R1000,00** payable in cash or by bank guaranteed cheque made out in favour of Ugu District Municipality is required on collection of the tender documents. The tender will also be advertised on the National Treasury's e-Tender portal **(www.etenders.gov.za)** and Ugu District Municipality website. Tender documents can be downloaded from the websites, free of charge. Bidders who download the tender document must follow the standard CIDB colour coding requirements when printing the documents. The Municipal offices can be contacted by telephone on 039-688-5700.

Queries relating to the technical issues of these documents may be addressed to **Mr Selemo Sefehle of Royal HaskoningDHV on email at selemo.sefehle@rhdhv.com.**

A compulsory clarification meeting with representatives of the employer will take place at the **Bhobhoyi Waterworks site (GPS coordinates E 30°26' 6.25" S 30°45' 09.25")** Port Shepstone on **Wednesday, 26th April 2023** at 10h00 am. The Employer's Agent will not be available for inspection purposes on any other occasion. Prospective Contractors are required to bring their copies of the tender documents to the compulsory briefing and site visit for signing by the Employer. Failure to obtain a Tender Specification Document or non-attendance of the compulsory briefing and site visit will result in the disqualification of your tender.

Ugu District Municipality subscribes to the Preferential Procurement Regulations 2022, pertaining to the Preferential Procurement Policy Framework Act (PPPFA) 5/2000 principles whereby a bidder's submission will be evaluated according to the sum of the award of points in respect of the tender value and preference.

Tenders shall be evaluated for functionality before acceptance for further evaluation and consideration in terms of Price and Preference Points.

Minimum points of 60 must be obtained for functionality. Bids scoring below 60 points will not be evaluated further. The following will form criteria utilised for functionality assessment:

Functionality Criteria (Sub-Criteria)	**Maximum Points that Can Be Scored**
Relevant Experience of Tenderer	40
Experience of Key Personnel	30
Construction Methodology and Preliminary Programme	5
Financial Resources	15
Quality Control and Environmental Management	5
Construction Health & Safety Plan	5
Maximum possible Points Score for Functionality (W_2)	**100**

The 90/10 preferential point system will be applicable, with 90 points for price and 10 points for Preference in terms of the Preferential Procurement Regulations 2022 in effect from 16 January 2023, Gazette Notice No. 47452 dated 4 November 2022 and to Ugu District Municipality's Preferential Policy Framework Act Policy Number 5/21/P (dated December 2022).

In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations 2022, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goals stated in the table below as must be supported by proof/ documentation stated in the conditions of this tender: The maximum points to be allocated for this tender are allocated as follows:

The Specific Goals Allocated Points in Terms of This Tender	Number of Points Allocated by Ugu District Municipality (90/10 System)	Number of Points Claimed by Tenderer (90/10 System)
Ownership:		
BBBEE Level 1	10	
BBBEE Level 2	8	
BBBEE Level 3-8	4	
Empowerment		
1. an EME or QSE which is at least 100% owned by black people;	4	
2. an EME or QSE which is at least 51% owned by black people;	2	
3. an EME or QSE which is at 25% - 50% owned by black people;	1	
RDP		
1. Enterprise Located within the District Municipality - Rural	4	
2. Enterprise Located within the District Municipality - Urban	3	
2. Enterprise Located within the Province	1	
Other Specific Goal		
1. Enterprise 100% owned by Youth/Women/Disabled/ Military V	2	

Failure on the part of a tenderer to submit proof or documentation required in terms of this tender to claim points for specific goals with the tender, will be interpreted to mean that preference points for specific goals are not claimed.

Tenderers shall take **note** of the following tender conditions:

- *Ugu District Municipality does not bind itself to accept the lowest or any tender.*
- *Tenders submitted are to remain valid for **90** days from the closing date for submission of tenders.*

NB: Regulation 44 of the Municipal Supply Chain Management Regulations states that the Municipality may not make any award to a person who is in the service of the state.

The closing time and date for receipt of tenders is not later than **12h00 on Friday, 19th May 2023.** Only tenders deposited in the official tender box by the closing time and date will be accepted.

Tenders, completed as prescribed, shall be sealed in an envelope marked **"uMzimkhulu Bulk Water Augmentation Scheme - Phase 2, Construction of the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works"** and deposited in the official tender box in the **foyer of Ugu District Municipality at 96 Marine Drive, Phase 2 Building, Oslo Beach, where bids will be opened in public.** Requirements for sealing, addressing, delivery, opening and assessment of bids are stated in the Tender data.

Mr V O Mazibuko
Acting Municipal Manager
Ugu District Municipality

MBD 1

PART A

INVITATION TO BID

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF UGU DISTRICT MUNICIPALITY					
BID NUMBER:	**UGU-07-1631-2023**	**CLOSING DATE:**	**FRIDAY, 19 MAY 2023**	**CLOSING TIME:**	**12H00 NOON**
DESCRIPTION	**UMZIMKHULU WATER AUGMENTATION SCHEME: PHASE 2: CONSTRUCTION OF THE BACKWASH WATER RECOVERY FACILITY AT BHOBHOYI WATER TREATMENT WORKS**				
THE SUCCESSFUL BIDDER WILL BE REQUIRED TO FILL IN AND SIGN A WRITTEN CONTRACT FORM (MBD7).					
BID RESPONSE DOCUMENTS MAY BE DEPOSITED IN THE BID BOX SITUATED AT *(STREET ADDRESS*			**FOYER OF UGU DISTRICT MUNICIPALITY AT 96 MARINE DRIVE, PHASE 2 BUILDING, OSLO BEACH**		

SUPPLIER INFORMATION					
NAME OF BIDDER					
POSTAL ADDRESS					
STREET ADDRESS					
TELEPHONE NUMBER	**CODE**		**NUMBER**		
CELLPHONE NUMBER					
FACSIMILE NUMBER	**CODE**		**NUMBER**		
E-MAIL ADDRESS					
VAT REGISTRATION NUMBER					
TAX COMPLIANCE STATUS	**TCS PIN:**		**AND**	**CSD Nº:**	
B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE [TICK APPLICABLE BOX]	☐ Yes ☐ No		B-BBEE STATUS LEVEL SWORN AFFIDAVIT	☐ Yes ☐ No	
[A B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE/ SWORN AFFIDAVIT (FOR EMES & QSEs) MUST BE SUBMITTED IN ORDER TO QUALIFY FOR PREFERENCE POINTS FOR B-BBEE]					
ARE YOU THE ACCREDITED REPRESENTATIVE IN SOUTH AFRICA FOR THE GOODS /SERVICES /WORKS OFFERED?	☐Yes ☐No [IF YES ENCLOSE PROOF]		**ARE YOU A FOREIGN BASED SUPPLIER FOR THE GOODS /SERVICES /WORKS OFFERED?**	☐Yes ☐No [IF YES, ANSWER PART B:3]	
TOTAL NUMBER OF ITEMS OFFERED			**TOTAL BID PRICE**	**R.**	
SIGNATURE OF BIDDER	.....		**DATE**		
CAPACITY UNDER WHICH THIS BID IS SIGNED					

BIDDING PROCEDURE ENQUIRIES MAY BE DIRECTED TO:		**TECHNICAL INFORMATION MAY BE DIRECTED TO:**	
DEPARTMENT		DEPARTMENT	
CONTACT PERSON		CONTACT PERSON	
TELEPHONE NUMBER		TELEPHONE NUMBER	
FACSIMILE NUMBER		FACSIMILE NUMBER	
E-MAIL ADDRESS		E-MAIL ADDRESS	

MBD1

PART B

TERMS AND CONDITIONS FOR BIDDING

1. BID SUBMISSION:

1.1. BIDS MUST BE DELIVERED BY THE STIPULATED TIME TO THE CORRECT ADDRESS. LATE BIDS WILL NOT BE ACCEPTED FOR CONSIDERATION.

1.2. **ALL BIDS MUST BE SUBMITTED ON THE OFFICIAL FORMS PROVIDED–(NOT TO BE RE-TYPED) OR ONLINE**

1.3. THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT AND THE PREFERENTIAL PROCUREMENT REGULATIONS, 2022, THE GENERAL CONDITIONS OF CONTRACT (GCC) 2015 AND, IF APPLICABLE, ANY OTHER SPECIAL CONDITIONS OF CONTRACT.

2. TAX COMPLIANCE REQUIREMENTS

2.1 BIDDERS MUST ENSURE COMPLIANCE WITH THEIR TAX OBLIGATIONS.

2.2 BIDDERS ARE REQUIRED TO SUBMIT THEIR UNIQUE PERSONAL IDENTIFICATION NUMBER (PIN) ISSUED BY SARS TO ENABLE THE ORGAN OF STATE TO VIEW THE TAXPAYER'S PROFILE AND TAX STATUS.

2.3 APPLICATION FOR THE TAX COMPLIANCE STATUS (TCS) CERTIFICATE OR PIN MAY ALSO BE MADE VIA E-FILING. IN ORDER TO USE THIS PROVISION, TAXPAYERS WILL NEED TO REGISTER WITH SARS AS E-FILERS THROUGH THE WEBSITE WWW.SARS.GOV.ZA.

2.4 FOREIGN SUPPLIERS MUST COMPLETE THE PRE-AWARD QUESTIONNAIRE IN PART B:3.

2.5 BIDDERS MAY ALSO SUBMIT A PRINTED TCS CERTIFICATE TOGETHER WITH THE BID.

2.6 IN BIDS WHERE CONSORTIA / JOINT VENTURES / SUB-CONTRACTORS ARE INVOLVED; EACH PARTY MUST SUBMIT A SEPARATE TCS CERTIFICATE / PIN / CSD NUMBER.

2.7 WHERE NO TCS IS AVAILABLE BUT THE BIDDER IS REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.

3. QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS

3.1.	IS THE ENTITY A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?	☐ YES ☐ NO
3.2.	DOES THE ENTITY HAVE A BRANCH IN THE RSA?	☐ YES ☐ NO
3.3.	DOES THE ENTITY HAVE A PERMANENT ESTABLISHMENT IN THE RSA?	☐ YES ☐ NO
3.4.	DOES THE ENTITY HAVE ANY SOURCE OF INCOME IN THE RSA?	☐ YES ☐ NO
3.5.	IS THE ENTITY LIABLE IN THE RSA FOR ANY FORM OF TAXATION?	☐ YES ☐ NO

IF THE ANSWER IS "NO" TO ALL OF THE ABOVE, THEN IT IS NOT A REQUIREMENT TO REGISTER FOR A TAX COMPLIANCE STATUS SYSTEM PIN CODE FROM THE SOUTH AFRICAN REVENUE SERVICE (SARS) AND IF NOT REGISTER AS PER 2.3 ABOVE.

NB: FAILURE TO PROVIDE ANY OF THE ABOVE PARTICULARS MAY RENDER THE BID INVALID. NO BIDS WILL BE CONSIDERED FROM PERSONS IN THE SERVICE OF THE STATE.

SIGNATURE OF BIDDER: ……

CAPACITY UNDER WHICH THIS BID IS SIGNED: ……

DATE: ……..

T1.2 TENDER DATA

T1.2 TENDER DATA

The Conditions of Tender are the Standard Conditions of Tender as contained in Annex C of SANS 294, the CIDB Standard for Uniformity in Construction Procurement, as printed in Board Notice 423 of 2019 in the Government Gazette No. 42622 of 2019 dated 08 August 2019.

The Standard Conditions of Tender make several references to the Tender Data for details that specifically apply to this tender. The Tender Data shall be read with the Standard Conditions of Tender in order to expand on the Tenderer's obligations and the Employer's undertakings in administering the tender process in respect of the project under consideration

The Tender Data hereafter shall have precedence in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender. Each item of Tender Data given below is cross-referenced to the relevant clause in the Standard Conditions of Tender .

Each item of Tender Data given below is cross-referenced to the relevant clause in the Standard Conditions of Tender.

The following variations, amendments and additions to the Standard Conditions of Tender as set out in the Tender Data below shall apply to this tender.

C1 GENERAL

C.1.1 Actions

C.1.1.1 The Employer for this Contract is:

Ugu District Municipality
P O Box 33
Port Shepstone
4240

Telephone N° : 039 688 5700
Fax N° : 039 682 4820

C.1.2 Tender Documents

The tender documents issued by the Employer comprise:

THE TENDER (Volume 1)

T1: Tendering Procedures
- T1.1: Tender Notice and Invitation to Tender
- T1.2: Tender Data

T2: Returnable Schedules and Documents
- T2.1: List of Returnable Documents
- T2.2: Returnable Documents, Schedules and Forms

THE CONTRACT (Volume 2)

Part C1: Agreements and Contract Data
- C1.1: Form of Offer and Acceptance
- C1.2: Confirmation of Receipt
- C1.3: Contract Data
- C1.4: Performance Guarantee
- C1.5: Schedule of Deviations
- C1.6: Agreement in terms of Section 37(2) of the OHS Act Nº 85 of 1993
- C1.8: Transfer of Rights and Indemnity in terms of GCC 6.10.1.5

Part C2: Pricing Data
- C2.1: Pricing Instructions
- C2.2: Bill of Quantities

Part C3: Scope of Work
- C3.1: Description of Works
- C3.2: Engineering
- C3.3: Procurement
- C3.4: Construction
- C3.5: Management
- C3.6: Standard Specifications
- C3.7: Project Specifications
- C3.8: Particular Specifications
- C3.9 Mechanical Standard Specifications (Blue)
- C3.10 Mechanical General Specifications (Blue)
- C3.11 Mechanical Project Specifications (Blue)
- C3.12 Electrical Project Specifications (Blue)
- C3.13 General Electronic Specifications (Blue)
- C3.14 Commissioning Plan Standard Specification (Blue)
- C3.15 Operation and Control Philosophy of the Backwash

Part C4: Site Information
- C4.1: Site of Works and Site Conditions
- C4.2: Geotechnical
- C4.3: Atmospheric / Climatic
- C4.4: Environmental
- C4.5: Locality Plan
- C4.6: Nameboard
- C4.7: Geotechnical Report
- C4.8: Environmental Management Plan

THE DRAWINGS (Volume 3)

Part D1: The Drawings
- D.1: Book of Tender Drawings

C.1.2 Relevant Standard Specifications:

a) "General Conditions of Contract for Construction Works – 3rd Edition 2015" 3rd Print edition issued by the South African Institution of Civil Engineering (Short title "General Conditions of Contract 2015" or" GCC 2015"). This document is obtainable separately, and Tenderers shall obtain their own copies.

b) "SANS 1200 – Standardised Specification for Civil Engineering Construction". This document is obtainable separately, and Tenderers shall obtain their own copies.

In addition, Tenderers are advised, in their own interest, to obtain their own copies of the following acts, regulations, and standards referred to in this document as they are essential for the Tenderer to get acquainted with the basics of construction management, the implementation of preferential construction procurement policies, and the participation of targeted enterprise and labour.

i) The Occupational Health and Safety Act No 85 and Amendment Act No 181 of 1993, and the Construction Regulations 2014 (Government Gazette No 37305 of 7 February 2014, Notice No R84).

ii) The Construction Industry Development Board Act No 38 of 2000 and the Regulations in terms of the CIDB Act 38/2000, Government Notice No 692 of 9 June 2004 and No 464 of 2 July 2013.

iii) The Preferential Procurement Policy Framework Act No 5 of 2000, and the Preferential Procurement Policy Framework Act Regulations (2022).

iv) SANS 1921:2004 – Construction and Management Requirements for Works Contract, Parts 1 to 3.

v) SANS 1914:2003 - Targeted Construction Procurement, Parts 1 to 6

The Tender Documents including Drawings shall be obtained from the Employer or his/her authorised representative at the physical address stated in the Tender Notice, upon payment of the non-refundable deposit stated in the Tender Notice.

C.1.4 Communication and Employer's Agent

Royal HaskoningDHV (Pty) Ltd; represented by:

Name : Mr Selemo Sefehle

Address : 460 Town Bush Road
3rd Floor Block C
Town Bush Office Park
Pietermaritzburg
3201

Tel : 087 350 6776
e-mail : selemo.sefehle@rhdhv.com

C.1.6.1 General

The contract will not necessarily be concluded with the tenderer who, in terms of Clause C.3.11, is the highest ranked or the tenderer scoring the highest number of tender evaluation points, but to the tenderer meeting the criteria as listed in C.2.1 below.

C.1.6.2 Competitive Negotiation Procedure

The Ugu District Municipality's Preferential Procurement Policy, as included in their Supply Chain Management Policy Document, and included in T.1.4, shall apply, subject to F.3.13 in terms of Section III of the Local Government Municipality Finance Management Act (Act N° 56 of 2003).

C.1.6.3 Proposal procedure using the two-stage system

The two-stage system will not be applied to this tender.

C2 TENDERER'S OBLIGATIONS

C.2.1 Eligibility

Only those Tenderers who satisfy the following eligibility criteria and who provide the required evidence in their tender submissions are eligible to submit tenders and have their tenders evaluated:

(a) Only those Tenderers who are registered with the CIDB (at the time of tender closing), or are capable of being so prior to the evaluation of submissions, in a contractor grading designation equal to or higher than a **8ME** contractor grading designation determined in accordance with Regulation 25 (1B) or 25(7A) of the Construction Industry Development Regulations, for an **ME** class of construction work, are eligible to have their tenders evaluated.

(b) The Tenderer submits an original valid Tax Clearance Certificate, Income Tax Reference Number, Security Pin and TCC Number issued by the South African Revenue Services.

(c) The Tenderer is registered on the Central Supplier Database (CSD) for the South African Government (see https://secure.csd.gov.za/) unless it is a foreign supplier with no local registered entity;

(d) The Tenderer has purchased the tender document or has downloaded free version of the complete set of the tender document from the National Treasury E-tenders website and has attended the Compulsory Clarification Meeting and Compulsory Site Visit;

(e) The Tenderer has completed form "Certificate of Attendance at Clarification Meeting / Site Inspection" in Part T2.2 - Returnable Schedules and Forms and it has been signed by the PMU Manager, or his or her representative;

(f) The Tenderer submits a letter of intent from an approved insurer undertaking to provide the Performance Guarantee to the format included in Part C1.4 of this procurement document;

(g) The Tenderer is not in arrears for more than three months with municipal rates and taxes and municipal service charges. The latest municipal account is to be attached;

(h) The Tenderer complies with the legal requirements stated in the Employer's Procurement Policy;

(i) The Tenderer provides proof that he/she is in good standing with respect to duties, taxes, levies and contributions required in terms of legislation applicable to the work in the Contract.

(j) The Tenderer or any of its directors / shareholders is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector;

(k) The Tenderer has not:

(1) abused the Employer's Supply Chain Management System; or

(2) failed to perform on any previous contract and has been given a written notice to this effect;

(l) The Tenderer has completed the Compulsory Enterprise Questionnaire Declaration of Tenderer's Past Supply Chain Management Practices and the Declaration of Interest and there are no conflicts of interest which may impact on the tenderer's ability to perform the contract in the best interests of the Employer or potentially compromises the tender process;

(m) The Tenderer or any of its principals, directors or managers is not employed in the service of the State or any Municipality. In the event that such principals are investigated, official approval from the Executing Authority regarding the carrying out of remunerative work outside of the public service must be included in the tender submission;

(n) The Tenderer is registered and in good standing with the compensation fund or with a licensed compensation insurer;

(o) Joint ventures are eligible to submit tenders provided that the Tenderer has submitted a copy of a joint venture agreement (if applicable);

(1) every member of the joint venture is registered with the CIDB;

(2) the lead partner has a contractor grading designation in the **8ME** class of construction work; and

(3) the combined contractor grading designation calculated in accordance with the Construction industry Development Regulations is equal to or higher than a contractor grading designation determined in accordance with the sum tendered for a **8ME** class of construction work or a value determined in accordance with Regulation 25 (1B) of 25(7A) of the Construction Industry Development Regulations

(p) The tender offer is signed by a person authorised to sign on behalf of the Tenderer;

(q) The Tenderer has completed and signed all returnable documents where relevant;

(r) The Tenderer submitting the tender shall not be insolvent, in receivership, bankrupt or being wound up, have their affairs administered by a court or judicial officer, have suspended their business activities, or be subject to legal proceedings.

(s) The Tenderer has met the following minimum criteria:

(1) Only those Tenderers who shall be eligible for further consideration in terms of Functionality scoring and thereafter in terms of Preference Points scoring.

(2) Only Tenderers scoring **60 points** or more for Functionality will be considered eligible to tender;

(3) The Tenderer has as a minimum a **Bank Rating of D**, or above;

(4) The Tenderer's health and safety professionals must be registered with SACPCMP;

(t) The Employer is reasonably satisfied that the Tenderer has in terms of the Construction Regulations 2014, issued in terms of the Occupational Health and Safety Act, 1993, the necessary competencies and resources to carry out the work safely.

(u) The Tenderer has complied with Subcontracting as Condition of Tender as stated below:

to subcontract a maximum of **30%** of the value of the contract to the following designated groups:

(a) an EME or QSE which is at least 100% owned by black people;

(b) an EME or QSE which is at least 51% owned by black people;

(c) an EME or QSE which is at least 25% - 50% owned by black people;

(d) an EME or QSE which is at least 51% owned by black people who are youth;

(e) an EME or QSE which is at least 51% owned by black people who are women;

(f) an EME or QSE which is at least 51% owned by black people with disabilities;

(g) an EME or QSE which is 51% owned by black people living in rural or underdeveloped areas or townships;

(h) a cooperative which is at least 51% owned by black people;

(i) an EME or QSE which is at least 51% owned by black people who are military veterans;

(j) more than one of the categories referred to in paragraphs (a) to (i).

C.2.2.2 Cost of tendering

The non-refundable cost of the tender document will be as stated in the Tender Notice and Invitation to Tender.

Tender documents will be available for electronic download from the National Treasury's E-Tender portal and documents can be downloaded from the website free of charge.

Failure to apply instructions contained in any addenda issued will render a Tenderer's offer non-responsive in terms of Conditions of Tender.

C.2.7 Clarification meeting

The arrangements for the Compulsory Clarification Meeting and Compulsory Site Visit are as follows:

Location : As per the Tender Notice and Invitation to Tender

Date and time : As per the Tender Notice and Invitation to Tender

The onus rests with the Tenderer to ensure that the person attending the Compulsory Clarification Meeting and Compulsory Site Visit on its behalf is appropriately qualified to understand all directives and clarifications given at that meeting.

The Compulsory Clarification Meeting shall commence at the time advertised. Only then will the Employer's Agent's Representative circulate the attendance register for completion by those present. During this time latecomers may enter and complete the register. On completion of the register by all present, the Employer's Representative will:

(a) read out from the collected attendance register calling for confirmation that all have signed:
(b) close the door and not allowed any latecomers to enter.

Tenderers must sign the attendance registers for both the Compulsory Clarification Meeting and the Compulsory Site Visit in the name of the tendering entity. The signature of the Employer or his representative on the attendance registers and duly completed and signed Compulsory Site Inspection Certificate and Declaration form in the Returnable Schedules shall be considered proof that the tenderer attended the whole meeting and was available to hear all directives and clarifications given at the meeting.

Addenda will be issued to and completed tenders will be received only from those tendering entities appearing on the attendance registers.

C.2.8 Seek clarification

Request(s) for clarification of the tender documents, if necessary, shall be by notifying the Employer by not less than five working days before the closing time stated in the Tender Data. Working days shall be from Monday to Friday and shall exclude all gazetted public holidays.

C.2.9 Insurance

Details of the insurance to be provided by the Employer is stated in Clause 8.6.1 of the Contract Data.

The Employer will not provide any insurances for the Works.

C.2.10 Pricing the tender offer

C.2.10.4 Rates and currency to be stated

Tenderers are required to state the rates and currencies in Rands.

C.2.11 Alterations to documents

No unauthorised alterations or additions shall be made to any portion of the tender document. Any unauthorised alterations, additions or notes will be ignored and only the text as printed will be adhered to. The tender document itself shall not have pages removed or be separated in any way. Should a tender document be submitted in any other manner except as an originally bound document, it will be liable for rejection by the Employer.

C.2.12 Alternative tender offers

If a Tenderer wishes to submit an alternative tender offer, the only criteria permitted for such an alternative tender offer If a tenderer wishes to submit an alternative tender offer, the only criteria permitted for such alternative tender offer is that it demonstrably satisfies the Employer's standards and requirements, the details of which may be obtained from the Employer's Agent.

Calculations, drawings and all other pertinent technical information and characteristics as well as modified or proposed Pricing Data must be submitted with the alternative tender offer to enable the Employer to evaluate the efficacy of the alternative and its principal elements, to take a view on the degree to which the alternative complies with the Employer's standards and requirements and to evaluate the acceptability of the pricing proposals. Calculations must be set out in a clear and logical sequence and must clearly reflect all design assumptions. Pricing Data must reflect all assumptions in the development of the pricing proposal.

Acceptance of an alternative tender offer will mean acceptance in principle of the offer. It will be an obligation of the contract for the tenderer, in the event that the alternative is accepted, to accept full responsibility and liability that the alternative offer complies in all respects with the Employer's standards and requirements.

The modified Pricing Data must include an amount equal to 5% of the amount tendered for the alternative offer to cover the Employer's costs in confirming the acceptability of the detailed design.

C.2.13 Submitting a tender offer

C.2.13.3 Tender offers shall be submitted as an original only.

C.2.13.4 The copies of tenders to be submitted shall be signed by all appointed signatories.

C.2.13.5 Delivery of Tender
C.2.15

The Employer's address for delivery of tender offers and identification details to be shown on each tender offer package are:

Location of tender box	**:**	Ugu District Municipality
Physical address	**:**	96 Marine Drive, Phase 2 Building, Oslo Beach
Identification details	**:**	Tender N°: UGU-07-1631-2023 uMzimkhulu Bulk Water Augmentation Scheme - Phase 2: Construction of the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works

C.2.13.6 A two-envelope procedure will not be followed.

C.2.13.9 Telephonic, telegraphic, telex, facsimile or e-mailed tender offers will not be accepted.

C.2.15 Closing time

The closing time for submission of Tender Offers is as stated in the Tender Notice and Invitation to Tender.

C.2.16 Tender offer validity

The tender offer validity period is **90** days from the closing time for submission of tenders.

C.2.22 Return of other tender documents

Return all retained tender documents within **28** days after the expiry of the tender validity period.

C.2.23 Certificates

All certificates as listed under Part T2.2 – Returnable Documents and documents required for tender evaluation purposes must be completed and submitted with the tender.

C3 THE EMPLOYER'S UNDERTAKINGS

C.3.1.1 Respond to requests from the Tenderer

The Employer will respond to requests for clarification received up to **5** working days before the tender closing time stated in the Tender Data / Tender Notice and Invitation to Tender.

C.3.2 Issue addenda

The Employer shall issue addenda until **3** working days before the tender closing time stated in the Tender Data/ Tender Notice and Invitation to Tender.

C.3.4 Opening of tender submissions

Tenders will be opened immediately after the closing time of tenders, at the location of the tender box (see Tender Notice and Invitation to Tender).

C.3.7 Grounds for rejection and disqualification

Determine whether there has been any effort by the tenderer to influence the processing of the tender offers and instantly disqualify a tenderer (and his/her tender offer) if it is established that he/she engaged in corrupt or fraudulent practises.

C.3.8 Test for responsiveness

C.3.8.1 Determine, after opening and before detailed evaluation whether each tender offer properly received

a) Complies with the requirements of these Conditions of Tender.
b) Has been properly and fully completed and signed and
c) Is responsive to the other requirements of the tender document.

C.3.8.2 A responsive tender is the one that conforms to all the terms, conditions and specifications of the tender document without material deviation or qualification. A material deviation or qualification is one which, in the Employer's opinion would

a) Detrimentally affect the scope, quality or performance of the Works, services or supply identified in the Scope of Works,
b) Significantly changes the Employer's or tenderer's risk and responsibilities under the Contract or
c) Affects the competitive position of the tenderer's presentation responsive tenders, if it were to be rectified.

Reject a non-responsive tender offer, and not allow it to be subsequently made responsive by correction or withdrawal of the non-conforming deviation or reservation.

C.3.9 Arithmetical errors, omissions and discrepancies

C.3.9.1 Check the highest ranked tender or tenderer with the highest number of tender evaluation points after the evaluation of tender offers in accordance with C.3.11 for:

a) The gross misplacement of a decimal point in any unit rate;
b) Omissions made in completing the pricing schedule or Bill of Quantities, or
c) Arithmetic errors in
    i) Line items total resulting from product of a unit rate and a quantity in the Bill of Quantities or schedules of prices or
    ii) The summation of prices

C.3.9.2 The Employer must correct the arithmetical errors in the following manner:

a) Where there is a discrepancy between the amounts in words and amounts in figures, the amount in words shall govern.

b) If Bill of Quantities or pricing schedules apply and there is an error in the line item total resulting from the product of the unit rate and the quantity, the line item total shall govern, and the rate shall be corrected. Where there is an obviously gross misplacement of the decimal point in the unit rate, the line item total as quoted shall govern, and the unit rate shall be corrected.

c) Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern, and the tenderer will be asked to revise selected item prices (and their rates if a Bill of Quantities applies) to achieve the tendered total of the prices.

Consider the rejection of a tender offer if the tenderer does not correct or accept the correction of the arithmetical error in the manner described above.

C.3.10 Clarification of a tender offer

Obtain clarification from a tenderer on any matter that could give rise to ambiguity in a Contract arising from the tender offer.

C.3.11 Evaluation of tender offers

C.3.11.1 General

Ugu District Municipality has adopted the tender evaluation methods and associated evaluation criteria and weightings that are specified in C3.11.5 to C3.11.9 below.

The procedure for evaluation of responsive Tender Offers will be in accordance with the Ugu District Municipality's Supply Chain Management Policy document that was adopted by full Council with reference to the Participation and Conditions Pertaining to Preferential Procurement, the Preferential Procurement Policy Framework Act N° 5 of 2000, and the Preferential Procurement Policy Framework Act Regulations (2022).

C.3.11.2 Confirmation of tender offers for preference claimed

Confirm that tenderers are eligible for the preferences claimed in accordance with the provisions of the tender data and reject all claims for preferences where tenderers are not eligible for such preferences.

C.3.11.3 Scoring functionality points

Where functionality is part of the evaluation procedure:

1) Score functionality, rejecting all tender offers that fail to achieve the minimum number of points for functionality

2) All tender offers that fail to achieve the minimum qualifying score for functionality shall be regarded as non-responsive

Tenders that have achieved the minimum qualification score for functionality must be evaluated further in terms of the **90/10** preference points system as described in C.3.11.4.

C.3.11.4 Procedure for evaluating responsive tenders based on price and preference

The following formula shall apply – as needed:

$N_{fo} = W_1 \times A$

Where: N_{fo} = *is the number of tender evaluation points awarded for the financial offer;*

W_1 = *is the maximum possible number of tender evaluation points awarded for the financial offer, which in this case is 90;*

A = *is a number calculated using Formula 2 and Option 1 in Table C.1 below:*

The following formula must be used to calculate the points for price in respect of tenders (including price quotations) with a Rand value inclusive of VAT above R50 000 000;

Table C.1: Formulae for the Value of A

Formula	Basis for Comparison	Value of "A"
		Option 1
2	Lowest price or percentage commission/fee	$P_s = 90[1-(P_t-P_{min}) / P_{min}]$

Where: *Ps* = *is points scored for price of tender under consideration;*

Pt = *is price of tender under consideration; and*

Pmin = *is price of lowest acceptable tender.*

Tenders that do not meet the Eligibility Criteria, as stated under Clause C.2.1 will be disqualified and not considered any further for tender award.

A total number of tender evaluation points (T_{ev}) will be calculated in accordance with the following formula:

$T_{ev} = P_s + N_p$

Where: P_s = *is the number of tender evaluation points awarded for the financial offer;*

N_p = *is the number of tender evaluation points awarded for the specific goals claimed in accordance with C.3.11.5.*

C.3.11.5 Preference points system for preference claimed

The **90/10** preference point system for acquisition of services, works or goods where the financial value inclusive of VAT of one or more responsive tenders has a value above R50 000 000; and

(1) (a) (i) Points (P_S) for the financial offer will be scored in accordance with the formula stated in clause 5.(1) of the Preferential Procurement Regulations 2022;

(2) A maximum of 10 points may be awarded to a tenderer for the specific goals specified for the tender.

(3) The points scored for the specific goal must be added to the points scored for price and the total must be rounded off to the nearest two decimal places.

(4) Subject to section 2(1)(f) of the Act, the contract must be awarded to the tenderer scoring the highest points.

The financial offers of the remaining responsive tender offers will be scored using Formula 2 (Option 1) found in Table C.1 where the value of W1 is:

1) 90 where the financial value inclusive of VAT of one or more responsive tenders has a Rand value above R50 000 000:

In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations 2022, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goals stated in the table below as must be supported by proof/ documentation stated in the conditions of this tender: The maximum points to be allocated for this tender are allocated as follows:

The Specific Goals Allocated Points in Terms of This Tender	Number of Points Allocated by Ugu District Municipality (90/10 System)	Number of Points Claimed by Tenderer (90/10 System)
Ownership:		
BBBEE Level 1	10	
BBBEE Level 2	8	
BBBEE Level 3-8	4	
Empowerment		
1. an EME or QSE which is at least 100% owned by black people;	4	
2. an EME or QSE which is at least 51% owned by black people;	2	
3. an EME or QSE which is at 25% - 50% owned by black people;	1	
RDP		
1. Enterprise Located within the District Municipality - Rural	4	
2. Enterprise Located within the District Municipality - Urban	3	
3. Enterprise Located within the Province	1	
Other Specific Goal		
1. Enterprise 100% owned by Youth/Women/Disabled/ Military V	2	

Failure on the part of a tenderer to submit proof or documentation required in terms of this tender to claim points for specific goals with the tender, will be interpreted to mean that preference points for specific goals are not claimed.

C.3.11.6 Decimal places for scoring

Score price and preference to two decimal places.

C.3.11.7 Scoring functionality

Score each of the criteria and sub-criteria for functionality in accordance with the provisions in Table C.1.

C.3.11.8 The value of W_2

The value of W_2 is **100 points**. The functionality criteria and maximum score in respect of each of the criteria are as stated below under Points Scoring for Functionality.

C.3.11.9 Scoring functionality

Functionality shall be scored by three evaluators from the Employer's Agent and the scores of each of the evaluators will be averaged, weighted and then totalled to obtain the final score for Functionality. The Functionality criteria and maximum score in respect of each of the criteria are as follows:

POINTS SCORING FOR FUNCTIONALITY

Functionality Scorecard

Points for functionality will be based on the following Functionality Scorecard. Only Tenderers scoring **60% or more** for functionality will be considered eligible for further evaluation in the tender process. Tenderers must supply supporting documentation and information to prove points claimed where it is not available in other Returnable Schedules.

Table C.1: Functionality Scorecard

Criteria Nº	Functionality Criteria (Sub-criteria)	Maximum Points That Can Be Scored	Points awarded by Evaluator
1	Relevant Experience of Tenderer	40	
2	Experience of Key Personnel	30	
3	Construction Methodology and Preliminary Programme	5	
4	Financial Resources	15	
5	Quality Control and Environmental Management	5	
6	Construction Health & Safety Plan	5	
Maximum possible Points Score for Functionality (W_2)		**100**	

The value of W_2 is 100.

Criteria Nº 1: Relevant Experience of Tenderer

Refer to Page RD.34 - 37: Experience of Tenderer. (Applicable to the last eight years only):
Maximum Score = 40 Points

List below up to four high-value (> R 10 million) contracts of > Backwash Water Recovery Facility Works projects successfully completed as main contractor within the last eight years. Projects listed must be selected from those listed in the Prior Experience Schedule. The key criteria is to have successfully completed four (i.e. on time, within budget and to specification) > Backwash Water Recovery Facility Contracts priced at > R 10 million of Wastewater Works projects, or of a more complex nature in relation to the Scope of Works, over the past eight years. (Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of listed Contracts. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete.)

Points will be scored for each of the four contracts in terms of the scores achieved in the **Assessment of Performance on Four Previous > Backwash Water Recovery Facility Projects** listed in the next four pages. The points scored for Relevant Experience shall be included on this page from the **Assessment of Performance on Four Previous > Backwash Water Recovery Facility Works Projects.** The information will be checked by the Employer to confirm the veracity of the scores claimed by the Tenderer.

Points Claimed by Tenderer for Relevant Experience of Tenderer

Contract Nº / Name	Contract Amount	Points that can be claimed per contract	Tenderer to enter points claimed here	Points awarded by Evaluator
		Tenderer can claim up to 10 points per contract completed priced at > R 10 million of a similar or more complex nature		
Total Points:		**Maximum = 40 Points**		

The points scored for the above-mentioned contracts shall be verified from information provided below in the **Assessment of Performance on Four Previous > Backwash Water Recovery Facility Projects** undertaken within the last eight years.

NAME : ..... (Block Capitals)

SIGNATURE : ……..……..…… DATE: .....
(of person authorised to sign on behalf of the Tenderer)

Assessment of Performance on Four Previous > Backwash Water Recovery Facility Projects undertaken within the last eight years: **Maximum Points per Project = 10**

PROJECT Nº 1

Notes: The project scored here shall be the projects listed above in **Criteria Nº 1: 1 Relevant Experience of Tenderer**. The information will be checked by the Employer to confirm the veracity of the scores claimed by the Tenderer. Attached relevant documentation from the reference to verify points claimed.

The Employer will independently contact the references listed in **Criteria 1: Relevant Experience of Tenderer** and in the **Assessment of Contractors** forms to confirm information provided and to determine the final points scored based on the responses received from the references.

(> R 10 million) contracts of **>** Backwash Water Recovery Facility projects successfully completed as main contractor within the last eight years. Projects listed must be selected from those listed in the Prior Experience Schedule. The key criteria is to have successfully completed four (i.e. on time, within budget and to specification) > Backwash Water Recovery Facility Contracts priced at > R 10 million of wastewater works projects, or of a more complex nature in relation to the Scope of Works, over the past eight years. (Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of listed Contracts. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete).

(Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of the contract. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete).

Project Name: _____

Value of work carried out by Contractor: R _____

Detail of work carried out by Contractor: _____

Reference: Name_____ **Organisation**: _____

Contact Details: _____ Signature: _____

	Qualitative Statements as assessed by Reference	Points that can be scored per item	Reference to enter points here
1	"Contractor's Management was adequate for the contract"	Not true 0 True 1	
2	"Contractor provided suitably qualified Site personnel"		
3	"Contractor's financial resources was good for the contract duration"		
4	"Contractor complied with Health & Safety requirements"		
5	"Contractor's provided adequate resources for the contract"		
6	"Contractor's communication and compliance to instructions was good"		
7	"Quality of work produced was to drawings and specification"		
8	"Contractor complied with Environmental requirements"		
9	"Contract was completed on time"		
10	"There is no hesitation in recommending the Tenderer for our Project"		
TOTAL POINTS CLAIMED BY TENDERER (INCLUDE ON PAGE TP28)		**MAXIMUM = 10 POINTS**	

NAME : ..... (Block Capitals)

SIGNATURE : …… DATE: .....
(of person authorised to sign on behalf of the Tenderer)

PROJECT Nº 2

Notes: The project scored here shall be the projects listed above in **Criteria Nº 1: 1 Relevant Experience of Tenderer**. The information will be checked by the Employer to confirm the veracity of the scores claimed by the Tenderer. Attached relevant documentation from the reference to verify points claimed.

The Employer will independently contact the references listed in **Criteria 1: Relevant Experience of Tenderer** and in the **Assessment of Contractors** forms to confirm information provided and to determine the final points scored based on the responses received from the references.

(> R 10 million) contracts of **> Backwash Water Recovery Facility** projects successfully completed as main contractor within the last eight years. Projects listed must be selected from those listed in the Prior Experience Schedule. The key criteria is to have successfully completed four (i.e. on time, within budget and to specification) > Backwash Water Recovery Facility Contracts priced at > R 10 million of wastewater works projects, or of a more complex nature in relation to the Scope of Works, over the past eight years. (Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of listed Contracts. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete.)

(Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of the contract. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete.)

Project Name: _____

Value of work carried out by Contractor: R _____

Detail of work carried out by Contractor: _____

Reference: Name_____ **Organisation**: _____

Contact Details: _____ Signature: _____

	Qualitative Statements as assessed by Referees	**Points that can be scored per item**	**Reference to enter points here**
1	"Contractor's Management was adequate for the contract"		
2	"Contractor provided suitably qualified Site personnel"		
3	"Contractor's financial resources was good for the contract duration"		
4	"Contractor complied with Health & Safety requirements"	Not true 0	
5	"Contractor's provided adequate resources for the contract"	True 1	
6	"Contractor's communication and compliance to instructions was good"		
7	"Quality of work produced was to drawings and specification"		
8	"Contractor complied with Environmental requirements"		
9	"Contract was completed on time"		
10	"There is no hesitation in recommending the Tenderer for our Project"		
TOTAL POINTS CLAIMED BY TENDERER (INCLUDE ON PAGE TP28)		**MAXIMUM = 10 POINTS**	

NAME : ..... (Block Capitals)

SIGNATURE : …… DATE: .....
(of person authorised to sign on behalf of the Tenderer)

PROJECT Nº 3

Notes: The project scored here shall be the projects listed above in **Criteria Nº 1: 1 Relevant Experience of Tenderer**. The information will be checked by the Employer to confirm the veracity of the scores claimed by the Tenderer. Attached relevant documentation from the reference to verify points claimed.

The Employer will independently contact the references listed in **Criteria 1: Relevant Experience of Tenderer** and in the **Assessment of Contractors** forms to confirm information provided and to determine the final points scored based on the responses received from the references.

Score below a high-value (> R 10 million) contracts of **> Backwash Water Recovery Facility** projects successfully completed as main contractor within the last eight years. Projects listed must be selected from those listed in the Prior Experience Schedule. The key criteria is to have successfully completed four (i.e. on time, within budget and to specification) > Backwash Water Recovery Facility Contracts priced at > R 10 million of wastewater works projects, or of a more complex nature in relation to the Scope of Works, over the past eight years. (Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of listed Contracts. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete.)

(Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of the contract. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete.)

Project Name: _____

Value of work carried out by Contractor: R _____

Detail of work carried out by Contractor: _____

Reference: Name_____ **Organisation**: _____

Contact Details: _____ Signature: _____

	Qualitative Statements as assessed by Referees	Points that can be scored per item	Reference to enter points here
1	"Contractor's Management was adequate for the contract"	Not true 0 True 1	
2	"Contractor provided suitably qualified Site personnel"		
3	"Contractor's financial resources was good for the contract duration"		
4	"Contractor complied with Health & Safety requirements"		
5	"Contractor's provided adequate resources for the contract"		
6	"Contractor's communication and compliance to instructions was good"		
7	"Quality of work produced was to drawings and specification"		
8	"Contractor complied with Environmental requirements"		
9	"Contract was completed on time"		
10	"There is no hesitation in recommending the Tenderer for our Project"		
TOTAL POINTS CLAIMED BY TENDERER (INCLUDE ON PAGE TP28)		**MAXIMUM = 10 POINTS**	

NAME : ..... (Block Capitals)

SIGNATURE : ..... DATE: .....
(of person authorised to sign on behalf of the Tenderer)

PROJECT Nº 4

Notes: The project scored here shall be the projects listed above in **Criteria Nº 1: 1 Relevant Experience of Tenderer**. The information will be checked by the Employer to confirm the veracity of the scores claimed by the Tenderer. Attached relevant documentation from the reference to verify points claimed.

The Employer will independently contact the references listed in **Criteria 1: Relevant Experience of Tenderer** and in the **Assessment of Contractors** forms to confirm information provided and to determine the final points scored based on the responses received from the references.

Score below a high-value (> R 10 million) contracts of **> Backwash Water Recovery Facility** projects successfully completed as main contractor within the last eight years. Projects listed must be selected from those listed in the Prior Experience Schedule. The key criteria is to have successfully completed four (i.e. on time, within budget and to specification) > Backwash Water Recovery Facility Contracts priced at > R 10 million of wastewater works projects, or of a more complex nature in relation to the Scope of Works, over the past eight years. (Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of listed Contracts. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete.)

(Signed Completion Certificates or Final Approval Certificates must be included to confirm the successful completion of the contract. It is the Tenderer's responsibility to ensure that information captured on these certificates is accurate and complete.)

Project Name: _____

Value of work carried out by Contractor: R _____

Detail of work carried out by Contractor: _____

Reference: Name_____ **Organisation**: _____

Contact Details: _____ Signature: _____

	Qualitative Statements as assessed by Referees	Points that can be scored per item	Reference to enter points here
1	"Contractor's Management was adequate for the contract"		
2	"Contractor provided suitably qualified Site personnel"		
3	"Contractor's financial resources was good for the contract duration"		
4	"Contractor complied with Health & Safety requirements"	Not true 0	
5	"Contractor's provided adequate resources for the contract"	True 1	
6	"Contractor's communication and compliance to instructions was good"		
7	"Quality of work produced was to drawings and specification"		
8	"Contractor complied with Environmental requirements"		
9	"Contract was completed on time"		
10	"There is no hesitation in recommending the Tenderer for our Project"		
TOTAL POINTS CLAIMED BY TENDERER (INCLUDE ON PAGE TP28)		**MAXIMUM = 10 POINTS**	

NAME : ..... (Block Capitals)

SIGNATURE : ..... DATE: .....
(of person authorised to sign on behalf of the Tenderer)

Criteria Nº 2: Experience of Key Personnel:

Refer to page RD.38: Proposed Organisation and staffing and to RD.39 - 43: Experience of Key Personnel. Maximum Score = 30 Points

The key criteria are as stated in the Experience column for each discipline. Years of relevant experience means experience in the fields of construction of > Backwash Water Recovery Facility Contracts priced at > R 10 million of Wastewater Works projects, or of a more complex nature in relation to the Scope of Works, over the past eight years. Only one of the items in each of the five sections listed in the table below will be scored

Experience of Key Personnel

Proposed Key Personnel		Experience of Key Personnel			Points that can be scored per key personnel			Evaluator to enter points awarded here
1	Contracts Director / Manager Civil/Mechanical/Electrical Engineering Degree, ECSA Registered.	No Experience	=	Poor	Poor	=	0 point	
		0-2 years relevant experience	=	Poor	Poor	=	0 point	
		2-4 years relevant experience	=	Acceptance	Acceptable	=	4 points	
		4-8 years relevant experience	=	Good	Good	=	6 points	
		>8 years relevant experience	=	Excellent	Excellent	=	8 points	
2	Construction Manager Civil/Mechanical/Electrical Engineering or Project Management Diploma and NQF Level 5 certified for Labour Intensive Work Skill Programme.	No Experience	=	Poor	Poor	=	0 point	
		0-2 years relevant experience	=	Poor	Poor	=	0 point	
		2-4 years relevant experience	=	Acceptable	Acceptable	=	3 points	
		4-8 years relevant experience	=	Good	Good	=	4 points	
		>8 years relevant experience	=	Excellent	Excellent	=	6 points	
3	Construction Supervisor Construction of > Backwash Water Recovery Facility Contracts and NQF Level 4 certified for Labour Intensive Work Skill Programme.	No Experience	=	Poor	Poor	=	0 point	
		0-4 years relevant experience	=	Poor	Poor	=	1 point	
		4-8 years relevant experience	=	Acceptable	Acceptable	=	2 points	
		8-12 years relevant experience	=	Good	Good	=	3 points	
		>12 years relevant experience	=	Excellent	Excellent	=	5 points	
4	Assistant Construction Supervisor Construction of > Backwash Water Recovery Facility Contracts and NQF Level 4 certified for Labour Intensive Work Skill Programme.	No Experience	=	Poor	Poor	=	0 point	
		0-4 years relevant experience	=	Poor	Poor	=	1 points	
		4-8 years relevant experience	=	Acceptable	Acceptable	=	2 points	
		8-12 years relevant experience	=	Good	Good	=	3 points	
		>12 years relevant experience	=	Excellent	Excellent	=	5 points	
5	Health and Safety Officer Full-time on-site and registration with SACPCMP at a professional Level. (Candidate Registration not acceptable)	No Experience	=	Poor	Poor	=	0 point	
		0-2 years relevant	=	Poor	Poor	=	0 points	
		2-4 years relevant experience	=	Acceptable	Acceptable	=	2 points	
		4-8 years relevant experience	=	Good	Good	=	4 points	
		>8 years relevant experience	=	Excellent	Excellent	=	6 points	
TOTAL POINTS CLAIMED BY THE TENDERER					**MAXIMUM = 30 POINTS**			

Note: Curricula Vitae to be included in Returnable Documents: Key Personnel Form C.
Certified copies of Degrees or Diplomas and stipulated registrations to be attached for where points are claimed.

NAME : ..... (Block Capitals)

SIGNATURE : ..... DATE: .....
(of person authorised to sign on behalf of the Tenderer)

Criteria Nº 3: Construction Methodology and Preliminary Programme:

Refer to Page RD.44: Construction Methodology and Preliminary Programme.
Maximum Score = 5 Points

Tenderer is to provide the Construction Methodology and Preliminary Programme which outlines programmed activities and resources, including sub-contractors if applicable, for the construction processes.

The key criteria is to show that the Tenderers understands what the sequencing and tempo of the Scope of Works entails and that he/she is able to properly compile a detailed Construction Programme. The preliminary Programme must outline the sequence of individual activities and durations that are linked to the Construction Methodology, in line with Clause 1.1.1.14 of the Conditions of Contract (time for achieving Practical Completion). The Tenderer shall detail below or attach a preliminary programme reflecting the proposed sequence and tempo of execution of the various activities comprising the work for this Contract. The programme shall be in accordance with the information supplied in the Contract, requirements of the Project Specifications and with all other aspects of his/her tender. Only one of the five items listed in the table below will be scored:

Construction Methodology and Preliminary Programme

	Assessment of the Construction Methodology and Preliminary Programme	Points that can be scored for an item	Evaluator to enter points awarded here
1	Construction Methodology and Preliminary Programme are inadequate and unrealistic	Poor = 0 point	
2	Unacceptable sequence of events for both Construction Methodology and Preliminary Programme	Poor = 1 point	
3	Construction Methodology and Preliminary Programme are generic for similar works	Acceptable = 2 points	
4	Construction Methodology and Preliminary Programme sub-tasks are in line with Scope of Works	Good = 4 points	
5	Construction Methodology is precise and specific to this Project and the Preliminary Programme has correct linkages to relevant activities	Excellent = 5 points	
POINTS CLAIMED BY THE TENDERER		**MAXIMUM = 5 POINTS**	

Note: The Construction Methodology and Preliminary Programme must be based on the completion time as specified in the Contract Data. No other completion time that may be indicated in the documents will be regarded as an alternative offer, unless it is listed in Table (b) of Form “Amendments, Qualifications, and Alternatives” and supported by a detailed statement to that effect, all as specified in the Tender Data.

NAME : ..... (Block Capitals)

SIGNATURE : ……..……..…… DATE: .....
(of person authorised to sign on behalf of the Tenderer)

Criteria Nº 4: Financial Resources (Tenderer's Bank Rating):

Refer to Page RD.45: Financial Resources.
Maximum Score = 15 Points

The bank rating shall be for the price tendered for this tender, and not for any lesser amount. A bank stamped and signed original letter from the tenderer's bank shall be included with the tender. The letter must include contact details of the person at the bank who issued the bank rating. No points will be awarded if the Employer is unable to contact the relevant person at the bank to confirm the bank rating. Only one of the six items listed in the table below will be scored:

Financial Resources – Bank Rating

Nº	Score one of the ratings listed below as reflected on the rating received from the Tenderer's bank – See Section F1 of T2.2.1	Points that can be awarded for an item	Points Awarded by Evaluator
1	Bank Rating A – Undoubted for the amount of enquiry	15 Points	
2	Bank Rating B – Good for the amount of enquiry	13 Points	
3	Bank Rating C – Good for the amount quoted if applied strictly in the way of business	11 Points	
4	Bank Rating D – Fair trade for the amount of enquiry	6 Points	
5	Bank Rating E, F, G or H – Considered too high . Financial Position Unknown / Frequently Dishonours	0 Points	
6	Non-responsive – No official bank rating submitted, or information provided cannot be proven	0 Points	
TOTAL POINTS CLAIMED BY THE TENDERER		**MAXIMUM = 15 POINTS**	

NAME : ..... (Block Capitals)

SIGNATURE : ……..……..…… DATE: .....
(of person authorised to sign on behalf of the Tenderer)

Criteria Nº 5: Quality Control and Environmental Management:

Refer to Page RD.46: Quality Control and Environmental Management.
Maximum Score = 5 Points

The key criteria is to show that the Tenderer has both a Quality Control Plan and an Environmental Management Plan in place that can be implemented for the Contract. Tenderers are to provide accredited ISO 9001 and/or ISO 14001 Certificate(s) with their tender. Failing which, Tenderers are to provide detailed documentation of their Quality Control Plan and Environmental Management Plan with their tender. These are to meet the requirements of the specification. Only one of the six items listed in the table below will be scored:

Quality Control and Environmental Management

Nº	Score one of the Items listed below as reflected in the documented proof provided	Points that can be scored for an item	Points awarded by Evaluator
1	No ISO certificates and irrelevant own documents	0 Points	
2	No ISO certificates and less than acceptable own generic documents	0 Points	
3	No ISO certificates and acceptable own documents	1 Point	
4	One of either ISO 9001 or 14001and no acceptable own documents	2 Points	
5	One of either ISO 9001 or 14001 and acceptable own documents acceptable	3 Points	
6	Both ISO 9001 and 14001 accredited certificates	5 Points	
TOTAL POINTS CLAIMED BY THE TENDERER		**MAXIMUM = 5 POINTS**	

NAME : ..... (Block Capitals)

SIGNATURE : ……..……..…… DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

Criteria Nº 6: Construction Health and Safety Plan:

Refer to Page RD.47 - 48: Contractor's Health and Safety Declaration and to RD.49 Construction Health and Safety Plan.
Maximum Score = 5 Points

The key criteria is to show that the Tenderer has a Construction Health and Safety Plan in place that can be implemented for the Contract. Tenderers are to provide accredited ISO 18001 Certification, or a document describing risk assessments of the works, risk items, work methods and procedures in terms of Regulations 9 to 30; identification of hazards, provision of safe working conditions for employees, sub-contractors and visitors, monitoring health and safety on the site of works and keeping of records and registers. These are to meet the requirements of the specification. Score only one of the six items listed in the table below:

Construction Health and Safety Plan

Nº	Score one of the Items listed below as reflected in the documented proof provided	Points that can be Scored For An Item	Points Scored by Evaluator
1	No ISO certificate and irrelevant own document	0 Points	
2	No ISO certificate and less than acceptable own generic document	0 Points	
3	No ISO certificate and acceptable own document	1 Point	
4	No ISO certificate and reasonably well detailed own document	2 Points	
5	No ISO certificate and well detailed own document	3 Points	
6	ISO 18001 accredited certificates	5 Points	
TOTAL POINTS CLAIMED BY THE TENDERER		**MAXIMUM = 5 POINTS**	

NAME : ..... (Block Capitals)

SIGNATURE : ……..……..…… DATE: .....
(of person authorised to sign on behalf of the Tenderer)

C.3.13 Acceptance of tender offer

Tenderer offers will only be accepted from:

(i) tenderers who satisfy the eligibility criteria listed in C.2.1; and
(ii) who provide the required evidence in their tender submissions to be eligible to submit tenders and have their tenders evaluated.

C.3.15 Complete adjudicator's contract

Refer to Clause 10.3.2 of the General Conditions of Contract and the Contract Data.

C.3.17 Providing copies of Contract

The number of paper copies of the signed contract to be provided by the Employer is **ONE**.

C.3.19 The additional conditions of tender are:

C.3.19.1 Appeal process

In terms of Regulation 49 of the Municipal Supply Chain Management Regulations persons aggrieved by decisions or actions taken by the Municipality, may lodge an appeal within 14 days of the decision or action, in writing to the Municipality. In dealing with these appeals, the Municipal Manager will follow the following procedure:

(a) All appeals (clearly setting out the reasons for the appeal) and queries with regard to the decision of award are to be directed to:

The Municipal Manager
Ugu District Municipality
28 Connor Street
Port Shepstone
4240

(b) A copy of the appeal will be forwarded to the Chairperson of the Bid Adjudication Committee, who must provide a response in writing within seven working days.
(c) In the event that there are allegations made against third parties, they will also be given an opportunity, to respond to the allegations within seven days.
(d) These responses will then be sent to the appellant for a reply within five working days.
(e) The appeal will be considered on these written submissions, unless the appeal authority is of the view that there is a need for oral submissions, in which case, the appellant will be notified of the date, place and time of such hearing.

C.3.19.2 Prohibition on awards to persons in the service of the state

Clause 44 of the Supply Chain Management Regulations states that the Municipality or Municipal Entity may not make any award to a person:

(a) Who is in the service of the State;
(b) If that person is not a natural person, of which a director, manager, principal shareholder or stakeholder is a person in the service of the state; or
(c) Who is an advisor or consultant contracted with the municipality or a municipal entity.

Should a contract be awarded, and it is subsequently established that Clause 44 has been breached, the Employer shall have the right to terminate the contract with immediate effect.

C.3.19.3 Code of conduct and local labour

The Tenderers shall make themselves familiar with the requirements of the following policies of Ugu District Municipality with regard to the recruitment of local labour. Item 4.10.1 of the Contract Data has reference.

C.3.19.4 Subcontracting as Condition of Tender

require organs of State to identify tenders, where it is feasible, to subcontract a minimum of 30% of the value of the contract to the following designated groups:

(a) an EME or QSE which is at least 100% owned by black people

(b) an EME or QSE which is at least 51% owned by black people;

(c) an EME or QSE which is at least 25% - 50% owned by black people.

(d) an EME or QSE which is at least 51% owned by black people who are youth;

(e) an EME or QSE which is at least 51% owned by black people who are women;

(f) an EME or QSE which is at least 51% owned by black people with disabilities;

(g) an EME or QSE which is 51% owned by black people living in rural or underdeveloped areas or townships;

(h) a cooperative which is at least 51% owned by black people;

(i) an EME or QSE which is at least 51% owned by black people who are military veterans;

(j) an EME or QSE;

or

C.3.19.5 Joint ventures and joint venture agreements

Joint ventures are eligible to submit tenders provided that:

(i) every member of the joint venture is registered with the CIDB;

(ii) the Lead Member has a Contractor grading designation in the **8ME** class of construction work;

(iii) the combined Contractor grading calculated in accordance with the Construction Industry Development Regulations is equal to or higher than a Contractor grading designation determined in accordance with the sum tendered for a **M**E class of construction work;

(iv) when the joint venture is dissolved, the Lead Member will remain liable in terms of the Contract including for latent defects. The Lead Member shall be nominated in the returnable document and shall have at least a **8ME** classification. The Lead Member accepts all liability in terms of the Contract and that this liability will continue for 10 years, after completion of the Contract.

(v) included in their tender is a letter from each of the proposed joint venture members stating their undertaking that in the event of the joint venture tender being successful, the said members will enter into a joint venture agreement, which shall be based on and comply with the CIDB Sample Joint Venture Agreement.

C.3.20 Additional conditions applicable to the tender

C.3.20.1 Resources

1. The Employer / Employer's Agent may also request that the Tenderer provide written evidence that his/her financial, labour and other resources are adequate for carrying out the Contract.
2. The Employer reserves the right to appoint a firm of chartered accountants and auditors and/or execute any other financial investigations on the financial resources of any Tenderer. The Tenderer shall provide all reasonable assistance in such investigations.

C.3.20.2 Compliance with Occupational Health and Safety Act 1993

Tenderers are to note the requirements of the Occupational Health and Safety Act No. 85 of 1993 and the Construction Regulations 2014 issued in terms of Section 43 of the Act. The tenderer shall be deemed to have read and fully understood the requirements of the above Act and Regulations and to have allowed for all costs in compliance therewith.

In terms of Clause 5(1)(h), no Employer shall appoint a Principal Contractor to perform construction work, unless the Employer is reasonably satisfied that the Principal Contractor which he/she intends to appoint has the necessary competencies and resources to carry out the work safely.

In this regard the Tenderer shall submit with his/her tender, appended to Form 2.2.26: Form Concerning Fulfilment of the Construction Regulations, 2014 in T2.2 Returnable Schedules, a detailed Health and Safety Plan in respect of the Works in order to demonstrate the necessary competencies and resources to perform the construction work all in accordance with the Act and Regulations. Such Health and Safety Plan shall cover inter-alia the following details:

(1) Management structure, site supervision and responsible persons including a succession plan;
(2) Contractor's induction training programme for employees, Sub-contractors and visitors to the site;
(3) Health and safety precautions and procedures to be adhered to in order to ensure compliance with the Act, Regulations and Safety Specifications;
(4) Regular monitoring procedures to be performed;
(5) Regular liaison, consultation and review meetings with all parties;
(6) Site security, welfare facilities and first aid;
(7) Site rules and fire and emergency procedures;
(8) Medical surveillance and monitoring;
(9) Adequate Hazard Identification and risk assessment process to ensure adequate control and mitigation measures;
(10) Health and Safety Policy and procedures;
(11) Method statements and safe work procedures; and
(12) CV's & Training of Key Personnel.

Tenderers are to note that the appointed Contractor is required to ensure that all Sub-contractors or others engaged in the performance of the Contract also comply with the above requirements.

The appointed Contractor shall prepare and maintain a Health and Safety File in respect of the Contract, which shall be available for inspection on site at all times and handed over to the Employer on the Final Completion of the Contract.

The Contractor is required to submit to the Employer the Occupational Health and Safety Agreement (included in C1.5.2 of the Contract Document) and a letter of good standing from the Compensation Commissioner, or a licensed compensation insurer, within fourteen days from the Commencement Date of the Contract.

C.3.20.3 Quality Management

Only Contractors capable of testing and commissioning of equipment to the quality standards required under this tender will be considered. Materials and components used by the Contractor shall comply with the requirements of the specification and, in addition, shall be of demonstrated quality for the purpose for which they are intended. Tenderers will be required, to understand and demonstrate compliance with these requirements by the submission of their Quality System at the time of tender.

The Quality System shall take the form of a coordinated and formally documented statement and shall include quality management objectives, policies, organisation, procedures and work instructions that demonstrate the Contractor's implementation of the requirements of IS0 9001/2000 Code for Quality Management Systems.

The tenderer shall submit an assessment report on his/her Quality System with his/her tender. The assessment report shall be issued by an independent quality assurance authority and shall have been carried out not more than twelve (12) months prior to the date of submission of this tender.

The tenderer shall at the time of tender submit the names of all staff responsible for administration of the Contract, the quality assurance procedures, and control of the quality of material and components to be used in the manufacture of the equipment. Curricula Vitae for each employee so nominated and the Quality Manager responsible for implementation of the Quality System shall also be submitted.

C.3.20.4 Claims arising after submission of tender

Unless allowed for in the Contract, no claim for any extras arising out of any doubt or obscurity as to the true intent and meaning of anything shown on the Tender Drawings or contained in the Conditions of Contract, Scope of Work and Pricing Data, will be admitted by the Employer / Employer's Agent after the submission of any tender and the Tenderer shall be deemed to have:

1) inspected the Tender Drawings and read and fully understood the Conditions of Contract,
2) read and fully understood the whole text of the Scope of Work and Pricing Data and thoroughly acquainted himself with the nature of the Works proposed and generally of all matters which may influence the Contract,
3) visited the site of the proposed Works, carefully examined existing conditions, the means of access to the site, the conditions under which the Works is to be done, and acquainted himself/herself with any limitations or restrictions that may be imposed by the Municipal or other Authorities in regard to access and transport of materials and equipment to and from the site and made the necessary provisions for any additional costs involved thereby, and
4) requested the Employer or his/her duly authorised agent to make clear the actual requirements of anything shown on the Tender Drawings or anything contained in the Scope of Work and Pricing Data, the exact meaning or interpretation of which is not clearly intelligible to the Tenderer.

Before submission of any tender, the tenderer should check the number of pages, and if any are found to be missing or duplicated, or the figures or writing indistinct, or if the Pricing Data contain any obvious errors, the tenderer must apply to the Employer/Employer's Agent at once to have the same rectified, as no liability will be admitted by the Employer/Employer's Agent in respect of errors in any tender due to the foregoing.

T2: RETURNABLE DOCUMENTS

TABLE OF CONTENTS **Page**

T2.1: List of Returnable Documents.....RD.2
T2.2: Returnable Schedules and Documents RD.4

T2.1 LIST OF RETURNABLE DOCUMENTS

The Tender Document must be submitted as a whole. All forms must be properly completed as required, and the document shall not be taken apart or altered in any way whatsoever.

The list of returnable documents comprises the following: tick ☑

1. RETURNABLE SCHEDULES AND OTHER DOCUMENTS REQUIRED FOR TENDER EVALUATION PURPOSES

MBD1: Invitation to Bid	TP.5
Compulsory Site Inspection Certificate and Declaration	RD.5
MBD2: Tax Clearance Certificate	RD.7
MBD4: Bidder's Disclosure	RD.8
MBD5: Declaration for Procurement above R10 Million	RD.11
MBD6.1: Preferential Points Claim Form ITO the Preferential Regulations	RD.13
Sworn Affidavit – B-BBEE Exempted Micro Enterprise - General	RD.18
Sworn Affidavit – B-BBEE Qualifying Small Enterprise – General MBD8	RD.20
Compulsory Enterprise Questionnaire	RD.22
Company Registration Certificate and Shareholding Details	RD.24
Contractor's Certificate of Registration with CIDB	RD.25
Contractor's COID Registration Details	RD.26
Form of Intent to Provide a Performance Guarantee	RD.27
Joint Venture Agreement	RD.28
Good Standing with Municipal Accounts	RD.29
Experience of Tenderer and Current Projects	RD.30
Proposed Organization and Staffing	RD.34
Experience of Key Personnel	RD.35
Construction Methodology and Preliminary Programme	RD.41
Financial Resources	RD.42
Quality Control and Environmental Management	RD.43
Contractor's Health and Safety Declaration	RD.44
Construction Health and Safety Plan	RD.46

2. RETURNABLE SCHEDULES AND OTHER DOCUMENTS THAT WILL BE INCORPORATED INTO THE CONTRACT

Company Registration Certificate and Shareholding Details	RD.24
Contractor's Certificate of Registration with CIDB	RD.25
Contractor's COID Registration Details	RD.26
Form of Intent to Provide a Performance Guarantee	RD.27
Joint Venture Agreement	RD.28
Contractor's Health and Safety Declaration	RD.44
Certificate of Authority	RD.48
Schedule of Sources of Supply of Materials	RD.50
Sub-Contracting for Local EME or QSE	RD.62
Schedule of Proposed Sub-Contractors	RD.54
Schedule of Construction Equipment	RD.55
Amendments, Qualifications and Alternatives	RD.56
Record of Addenda to Tender Document	RD.57
Form of Offer	C.3
Contract Data	C.8
Bill of Quantities	PD.7

Failure to complete the forms as directed may lead to the Tender being rejected.

T2.2.1 RETURNABLE SCHEDULES AND DOCUMENTS REQUIRED FOR TENDER EVALUATION PURPOSES

COMPULSORY SITE INSPECTION CERTIFICATE AND DECLARATION

A compulsory site inspection will be held as set out in the Tender Notice and Invitation to Tender

CERTIFICATE OF ATTENDANCE

It is hereby certified that I have attended the Compulsory Site Inspection and have satisfied myself of the conditions and circumstances which may influence the Works and the cost thereof.

NAME OF REPRESENTATIVE : _____

ON BEHALF OF (TENDERER) : _____

ADDRESS : _____

_____

TELEPHONE NUMBER : _____

EMAIL ADDRESS : _____

SIGNATURE (FOR TENDERER) : _____

SIGNATURE (FOR EMPLOYER) : _____

DECLARATION

I/We the undersigned do hereby certify as follows:

1. Inspection of Site and Examination of Site Data

1.1. I/We have inspected and examined the Site and its surroundings.

1.2. I/We have examined the Site Data made available by the Employer (if applicable).

2. Comprehension of Documents

2.1. I/We have acquainted myself/ourselves with the Tendering Procedures, General Conditions of Contract, Contract Data, Scope of Work, Site information, Drawings, and Specifications for the above Contract for which I/We have submitted this Tender.

2.2. I/We note that the Ugu District Municipality is not bound to accept the lowest or any tender that may be received.

2.2 I/We note that the Ugu District Municipality may for any reason withdraw this tender and re-tender without having to furnish any reason therefor.

Signature(s) _____ _____

Name(s) _____ _____

For the Tenderer _____

(Name and address of organization)

Name and signature of witness _____ **Date** _____

The Tenderer shall attach to this page their proof of purchase of the tender documents in the form of an official receipt or any other acceptable form of proof of purchase, unless downloaded from the National Treasury E-Tender portal.

MBD 2: TAX CLEARANCE CERTIFICATE

It **Is a condition of bid that the taxes of the successful bidder must be in order, or that satisfactory arrangements have been made with South African Revenue Service (SARS) to meet the bidder's tax obligations.**

1 In order to meet this requirement bidders are required to complete in full the TCC 001 "Application for a Tax Clearance Certificate" form and submit it to any SARS branch office nationally. The Tax Clearance Certificate Requirements are also applicable to foreign bidders/ individuals who wish to submit bids.

2 SARS will then furnish the bidder with a Tax Clearance Certificate that will be valid for a period of 1(one) year from the date of approval.

3 The original Tax Clearance Certificate must be submitted together with the bid. Failure to submit the original and valid Tax Clearance Certificate will result in the invalidation of the bid. Certified copies of the Tax Clearance Certificate will not be acceptable.

4 In bids where Consortia / Joint Ventures/ Sub-contractors are involved; each party must submit a separate Tax Clearance Certificate.

5 Copies of the TCC 001 "Application for a Tax Clearance Certificate" form are available from any SARS branch office nationally or on the website www.sars.gov.za.

6 Applications for the Tax Clearance Certificates may also be made via eFiling. In order to use this provision, taxpayers will need to register with SARS as eFilers through the website www.sars.gov.za.

NOTE: Failure to do so will lead to your tender being disqualified.

Tenderers are to note that copies, including certified copies, will not be accepted.

Attach valid, original Tax Clearance Certificate(s) , the unique Personal Identification Number (PIN) and proof of registration with CIPC's CSD to this page.

SIGNATURE: ..... **DATE: ……..……...**
(of person authorised to sign on behalf of the Tenderer)

MBD 4: BIDDER'S DISCLOSURE

1. PURPOSE OF THE FORM

Any person (natural or juristic) may make an offer or offers in terms of this invitation to bid. In line with the principles of transparency, accountability, impartiality, and ethics as enshrined in the Constitution of the Republic of South Africa and further expressed in various pieces of legislation, it is required for the bidder to make this declaration in respect of the details required hereunder.

Where a person/s are listed in the Register for Tender Defaulters and / or the List of Restricted Suppliers, that person will automatically be disqualified from the bid process.

2. BIDDER'S DECLARATION

2.1 Is the bidder, or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest1 in the enterprise, employed by the state? **YES/NO**

2.2 If so, furnish particulars of the names, individual identity numbers, and, if applicable, state employee numbers of sole proprietor/ directors / trustees / shareholders / members/ partners or any person having a controlling interest in the enterprise, in table below.

Full Name	Identity Number	Name of State institution

1 the power, by one person or a group of persons holding the majority of the equity of an enterprise, alternatively, the person/s having the deciding vote or power to influence or to direct the course and decisions of the enterprise.

2.3 Do you, or any person connected with the bidder, have a relationship with any person who is employed by the procuring institution? **YES/NO**

2.3.1 If so, furnish particulars:

……

……

2.4 Does the bidder or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest in the enterprise have any interest in any other related enterprise whether or not they are bidding for this contract? **YES/NO**

2.4.1 If so, furnish particulars:

……

……

3. DECLARATION

I, …… the …… undersigned, (name) in submitting the accompanying bid, do hereby make the following statements that I certify to be true and complete in every respect:

3.1 I have read and I understand the contents of this disclosure.

3.2 I understand that the accompanying bid will be disqualified if this disclosure is found not to be true and complete in every respect.

3.3 The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However, communication between partners in a joint venture or consortium2 will not be construed as collusive bidding.

3.4 In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications, prices, including methods, factors or formulas used to calculate prices, market allocation, the intention or decision to submit or not to submit the bid, bidding with the intention not to win the bid and conditions or delivery particulars of the products or services to which this bid invitation relates.

3.5 The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.

3.6 There have been no consultations, communications, agreements or arrangements made by the bidder with any official of the procuring institution in relation to this procurement process prior to and during the bidding process except to provide clarification on the bid submitted where so required by the institution; and the bidder was not involved in the drafting of the specifications or terms of reference for this bid.

3.7 I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No 12 of 2004 or any other applicable legislation.

I CERTIFY THAT THE INFORMATION FURNISHED IN PARAGRAPHS 1, 2 and 3 ABOVE IS CORRECT.

I ACCEPT THAT THE STATE MAY REJECT THE BID OR ACT AGAINST ME IN TERMS OF PARAGRAPH 6 OF PFMA SCM INSTRUCTION 03 OF 2021/22 ON PREVENTING AND COMBATING ABUSE IN THE SUPPLY CHAIN MANAGEMENT SYSTEM SHOULD THIS DECLARATION PROVE TO BE FALSE.

.....	.....
Signature	Date
.....	.....
Position	Name of Bidder

2 Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.

MBD 5: DECLARATION FOR PROCUREMENT ABOVE R10 MILLION
(ALL APPLICABLE TAXES INCLUDED)

For all procurement expected to exceed R10 million (all applicable taxes included), bidders must complete the following questionnaire:

1 Are you by law required to prepare annual financial statements for auditing? *** YES / NO**

1.1 If yes, submit audited annual financial statements for the past three years or since the date of establishment if established during the past three years.

……

……

2 Do you have any outstanding undisputed commitments for municipal services towards any municipality for more than three months or any other service provider in respect of which payment is overdue for more than 30 days? *** YES / NO**

2.1 If no, this serves to certify that the bidder has no undisputed commitments for municipal services towards any municipality for more than three months or other service provider in respect of which payment is overdue for more than 30 days.

2.2 If yes, provide particulars.

……

……

……

……

3 Has any contract been awarded to you by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract? *** YES / NO**

3.1 If yes, furnish particulars

……

……

4 Will any portion of goods or services be sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the municipality / municipal entity is expected to be transferred out of the Republic? *** YES / NO**

4.1 If yes, furnish particulars

……

……

CERTIFICATION
(Please use block capitals when completing the section below)

I, THE UNDERSIGNED (NAME) ……

CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS CORRECT.

I ACCEPT THAT THE STATE MAY ACT AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

SIGNATURE: .....……. **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

NAME: **.....…….**

POSITION: **.....…….**

MBD 6.1: PREFERENTIAL POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS, 2022

This preference form must form part of all tenders invited. It contains general information and serves as a claim form for preference points for specific goals.

NB: BEFORE COMPLETING THIS FORM, TENDERERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF THE TENDER AND PREFERENTIAL PROCUREMENT REGULATIONS, 2022

1. GENERAL CONDITIONS

1.1 The following preference point systems are applicable to invitations to tender:

- the 80/20 system for requirements with a Rand value of up to R50 000 000 (all applicable taxes included); and
- the 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included).

1.2 To be completed by the organ of state

a) The applicable preference point system for this tender is the 90/10 preference point system.

1.3 Points for this tender (even in the case of a tender for income-generating contracts) shall be awarded for:

(a) Price; and

(b) Specific Goals.

1.4 To be completed by the organ of state:

The maximum points for this tender are allocated as follows:

	POINTS
PRICE	90
SPECIFIC GOALS	10
Total points for Price and SPECIFIC GOALS	**100**

1.5 Failure on the part of a tenderer to submit proof or documentation required in terms of this tender to claim points for specific goals with the tender, will be interpreted to mean that preference points for specific goals are not claimed.

1.6 The organ of state reserves the right to require of a tenderer, either before a tender is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the organ of state.

2. DEFINITIONS

(a) **"tender"** means a written offer in the form determined by an organ of state in response to an invitation to provide goods or services through price quotations, competitive tendering process or any other method envisaged in legislation.

(b) **"price"** means an amount of money tendered for goods or services and includes all applicable taxes less all unconditional discounts.

(c) **"rand value"** means the total estimated value of a contract in Rand, calculated at the time of bid invitation, and includes all applicable taxes.

(d) **"tender for income-generating contracts"** means a written offer in the form determined by an organ of state in response to an invitation for the origination of income-generating contracts through any method envisaged in legislation that will result in a legal agreement between the organ of state and a third party that produces revenue for the organ of state, and includes, but is not limited to, leasing and disposal of assets and concession contracts, excluding direct sales and disposal of assets through public auctions; and

(e) **"the Act"** means the Preferential Procurement Policy Framework Act, 2000 (Act No. 5 of 2000).

3. FORMULAE FOR PROCUREMENT OF GOODS AND SERVICES

3.1. POINTS AWARDED FOR PRICE

3.1.1 THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

A maximum of 80 or 90 points is allocated for price on the following basis:

80/20 **or** **90/10**

$$Ps = 80\left(1 - \frac{Pt - P\,min}{P\,min}\right) \quad \text{or} \quad Ps = 90\left(1 - \frac{Pt - P\,min}{P\,min}\right)$$

Where

Ps = Points scored for price of tender under consideration

Pt = Price of tender under consideration

Pmin = Price of lowest acceptable tender

3.2. FORMULAE FOR DISPOSAL OR LEASING OF STATE ASSETS AND INCOME GENERATING PROCUREMENT

3.2.1. POINTS AWARDED FOR PRICE

A maximum of 80 or 90 points is allocated for price on the following basis:

80/20 **or** **90/10**

$$Ps = 80\left(1 + \frac{Pt - P\,max}{P\,max}\right) \quad \text{or} \quad Ps = 90\left(1 + \frac{Pt - P\,max}{Pmax}\right)$$

Where

Ps = Points scored for price of tender under consideration

Pt = Price of tender under consideration

Pmax = Price of highest acceptable tender

4. POINTS AWARDED FOR SPECIFIC GOALS

4.1. In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goals stated in table 1 below as may be supported by proof/ documentation stated in the conditions of this tender:

4.2. In cases where organs of state intend to use Regulation 3(2) of the Regulations, which states that, if it is unclear whether the 80/20 or 90/10 preference point system applies, an organ of state must, in the tender documents, stipulate in the case of—

(a) an invitation for tender for income-generating contracts, that either the 80/20 or 90/10 preference point system will apply and that the highest acceptable tender will be used to determine the applicable preference point system; or

(b) any other invitation for tender, that either the 80/20 or 90/10 preference point system will apply and that the lowest acceptable tender will be used to determine the applicable preference point system,

then the organ of state must indicate the points allocated for specific goals for both the 90/10 and 80/20 preference point system.

Table 1: Specific goals for the tender and points claimed are indicated per the table below.

(Note to organs of state: Where either the 90/10 or 80/20 preference point system is applicable, corresponding points must also be indicated as such.

Note to tenderers: The tenderer must indicate how they claim points for each preference point system.)

The specific goals allocated points in terms of this tender	Number of points allocated (90/10 system) (To be completed by the organ of state) PART A	Number of points allocated (80/20 system) (To be completed by the organ of state) PART A	Number of points claimed (90/10 system) (To be completed by the tenderer)	Number of points claimed (80/20 system) (To be completed by the tenderer)
Ownership:				
BBBEE Level 1	10	5		
BBBEE Level 2	8	4		
BBBEE Level 3-8	4	2		
Empowerment				
1. an EME or QSE which is at least 100% owned by black people;	4	2		
2. an EME or QSE which is at least 51% owned by black people;	2	1		
3. an EME or QSE which is at 25% - 50% owned by black people;	1	0.5		
RDP				
1. Enterprise Located within the District Municipality - Rural	4	2		
2. Enterprise Located within the District Municipality - Urban	3	1.5		
3. Enterprise Located within the Province	1	0.5		
Other Specific Goal				
1. Enterprise 100% owned by Youth/Women/Disabled/ Military	2	1		

DECLARATION WITH REGARD TO COMPANY/FIRM

4.3. Name of company/firm……

4.4. Company registration number: ……..

4.5. TYPE OF COMPANY/ FIRM

- ϒ Partnership/Joint Venture / Consortium
- ϒ One-person business/sole propriety
- ϒ Close corporation
- ϒ Public Company
- ϒ Personal Liability Company
- ϒ (Pty) Limited
- ϒ Non-Profit Company
- ϒ State Owned Company

[TICK APPLICABLE BOX]

4.6. I, the undersigned, who is duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the specific goals as advised in the tender, qualifies the company/ firm for the preference(s) shown and I acknowledge that:

i) The information furnished is true and correct;

ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form;

iii) In the event of a contract being awarded as a result of points claimed as shown in paragraphs 1.4 and 4.2, the contractor may be required to furnish documentary proof to the satisfaction of the organ of state that the claims are correct;

iv) If the specific goals have been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the organ of state may, in addition to any other remedy it may have –

(a) disqualify the person from the tendering process;

(b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct;

(c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation;

(d) recommend that the tenderer or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted from obtaining business from any organ of state for a period not exceeding 10 years, after the *audi alteram partem* (hear the other side) rule has been applied; and

(e) forward the matter for criminal prosecution, if deemed necessary.

SIGNATURE(S) OF TENDERER(S): .....

SURNAME AND NAME: .....

DATE: .....

ADDRESS: .....

.....

.....

SWORN AFFIDAVIT – B-BBEE EXEMPTED MICRO ENTERPRISE - GENERAL

I, the undersigned,

Full name & Surname	
Identity number	

Hereby declare under oath as follows:

1. The contents of this statement are to the best of my knowledge a true reflection of the facts.
2. I am a Member / Director / Owner (**Select one**) of the following enterprise and am duly authorised to act on its behalf:

Enterprise Name:	
Trading Name (If Applicable):	
Registration Number:	
Vat Number (If applicable)	
Enterprise Physical Address:	
Type of Entity (CC, (Pty) Ltd, Sole Prop etc.):	
Nature of Business:	
Definition of "Black People"	As per the Broad-Based Black Economic Empowerment Act 53 of 2003 as Amended by Act No 46 of 2013 "Black People" is a generic term which means Africans, Coloureds and Indians – (a) who are citizens of the Republic of South Africa by birth or descent; or (b) who became citizens of the Republic of South Africa by naturalisation- i. before 27 April 1994; or ii. on or after 27 April 1994 and who would have been entitled to acquire citizenship by naturalization prior to that date;"
Definition of "Black Designated Groups"	"Black Designated Groups means: (a) unemployed black people not attending and not required by law to attend an educational institution and not awaiting admission to an educational institution. (b) Black people who are youth as defined in the National Youth Commission Act of 1996. (c) Black people who are persons with disabilities as defined in the Code of Good Practice on employment of people with disabilities issued under the Employment Equity Act. (d) Black people living in rural and under developed areas. (e) Black military veterans who qualifies to be called a military veteran in terms of the Military Veterans Act 18 of 2011;"

3. I hereby declare under Oath that:

   - The Enterprise is _____% Black Owned using the flow-through principle as per Amended Code Series 100 of the Amended Codes of Good Practice issued under section 9

     (1) of B-BBEE Act No 53 of 2003 as Amended by Act No 46 of 2013,

   - The Enterprise is _____ % Black Female Owned as per Amended Code Series 100

     of the Amended Codes of Good Practice issued under section 9 (1) of B-BBEE Act No 53 of 2003 as Amended by Act No 46 of 2013,

   - The Enterprise is _____% Black Designated Group Owned as per Amended Code Series 100 of the Amended Codes of Good Practice issued under section 9 (1) of B-BBEE Act No 53 of 2003 as Amended by Act No 46 of 2013,

   - Black Designated Group Owned % Breakdown as per the definition stated above:

     - Black Youth % = _____%
     - Black Disabled % =_____%
     - Black Unemployed % =_____%
     - Black People living in Rural areas % = _____%
     - Black Military Veterans % =_____%

   - Based on the Audited Financial Statements/Financial Statements and other information available on the latest financial year-end of __(DD/MM/YYYY), the annual Total Revenue was R10,000,000.00 (Ten Million Rands) or less

   - Please Confirm on the below table the B-BBEE Level Contributor, **by ticking the applicable box.**

100% Black Owned	**Level One** (135% B-BBEE procurement recognition level)	
At least 51% Black Owned	**Level Two** (125% B-BBEE procurement recognition level)	
Less than 51% Black Owned	**Level Four** (100% B-BBEE procurement recognition level)	

4. I know and understand the contents of this affidavit and I have no objection to take the prescribed oath and consider the oath binding on my conscience and on the Owners of the Enterprise which I represent in this matter.

5. The sworn affidavit will be valid for a period of 12 months from the date signed by commissioner.

.....

Commissioner of Oaths Signature & stamp Date

SWORN AFFIDAVIT – B-BBEE QUALIFYING SMALL ENTERPRISE - GENERAL

I, the undersigned,

Full name & Surname	
Identity number	

Hereby declare under oath as follows:

1. The contents of this statement are to the best of my knowledge a true reflection of the facts.
2. I am a Member / Director / Owner (**Select one**) of the following enterprise and am duly authorised to act on its behalf:

Enterprise Name:	
Trading Name (If Applicable):	
Registration Number:	
Vat Number (If applicable)	
Enterprise Physical Address:	
Type of Entity (CC, (Pty) Ltd, Sole Prop etc.):	
Nature of Business:	
Definition of "Black People"	As per the Broad-Based Black Economic Empowerment Act 53 of 2003 as Amended by Act No 46 of 2013 "Black People" is a generic term which means Africans, Coloureds and Indians – (a) who are citizens of the Republic of South Africa by birth or descent; or (b) who became citizens of the Republic of South Africa by naturalisation- iii. before 27 April 1994; or iv. on or after 27 April 1994 and who would have been entitled to acquire citizenship by naturalization prior to that date;"
Definition of "Black Designated Groups"	"Black Designated Groups means: (a) unemployed black people not attending and not required by law to attend an educational institution and not awaiting admission to an educational institution. (b) Black people who are youth as defined in the National Youth Commission Act of 1996. (c) Black people who are persons with disabilities as defined in the Code of Good Practice on employment of people with disabilities issued under the Employment Equity Act. (d) Black people living in rural and under developed areas. (e) Black military veterans who qualifies to be called a military veteran in terms of the Military Veterans Act 18 of 2011;"

3. I hereby declare under Oath that:

   - The Enterprise is _____% Black Owned using the flow-through principle as per Amended Code Series 100 of the Amended Codes of Good Practice issued under section 9 (1) of B-BBEE Act No 53 of 2003 as Amended by Act No 46 of 2013,
   - The Enterprise is _____% Black Female Owned as per Amended Code Series 100
   - of the Amended Codes of Good Practice issued under section 9 (1) of B-BBEE Act No 53 of 2003 as Amended by Act No 46 of 2013,
   - The Enterprise is _____% Black Designated Group Owned as per Amended Code Series 100 of the Amended Codes of Good Practice issued under section 9 (1) of B-BBEE Act No 53 of 2003 as Amended by Act No 46 of 2013,
   - Black Designated Group Owned % Breakdown as per the definition stated above:
     - Black Youth % = _____%
     - Black Disabled % =_____%
     - Black Unemployed % =_____%
     - Black People living in Rural areas % = _____%
     - Black Military Veterans % =_____%
   - Based on the Audited Financial Statements/ Financial Statements and other information available on the latest financial year-end of _(DD/MM/YYYY), the annual Total Revenue was between R10,000,000.00 (Ten Million Rands) and R50,000,000.00 (Fifty Million Rands),
   - Please confirm on the table below the B-BBEE level contributor, **by ticking the applicable box.**

100% Black Owned	**Level One** (135% B-BBEE procurement recognition level)	
At Least 51% black owned	**Level Two** (125% B-BBEE procurement recognition level)	

4. I know and understand the contents of this affidavit and I have no objection to take the prescribed oath and consider the oath binding on my conscience and on the owners of the enterprise which I represent in this matter.

5. The sworn affidavit will be valid for a period of 12 months from the date signed by commissioner.

Deponent Signature: .....

Date: .....

.....
Commissioner of Oaths Signature & stamp Date

COMPULSORY ENTERPRISE QUESTIONNAIRE

The following particulars must be furnished. In the case of a joint venture, separate enterprise questionnaires in respect of each partner must be completed and submitted.

Section 1: Name of enterprise:

Section 2: VAT registration number, if any:

Section 3: CIDB registration number, if any:

Section 4: CSD number:

Section 5: Particulars of sole proprietors and partners in partnerships:

Name*	Identity number*	Personal income tax number*

***** *Complete only if sole proprietor or partnership and attach separate page if more than 3 partners*

Section 6: Particulars of companies and close corporations

Company registration number:

Close corporation number:

Tax reference number:

Section 7: SBD4 issued by National Treasury must be completed for each tender and be attached as a tender requirement.

Section 8: SBD 6 issued by National Treasury must be completed for each tender and be attached as a tender requirement.

COMPULSORY ENTERPRISE QUESTIONNAIRE (*Continued*)

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise:

i) authorizes the employer to verify the tenderers tax clearance status from the South African Revenue Services that it is in order.

ii) confirms that the neither the name of the enterprise or the name of any partner, manager, director or other person, who wholly or partly exercises or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004.

iii) confirms that no partner, member, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears, has within the last five years been convicted of fraud or corruption.

iv) confirms that I / we are not associated, linked or involved with any other tendering entities submitting tender offers and have no other relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest; and

v) confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

Signed		Date	
Name		Position	
Enterprise name			

COMPANY REGISTRATION CERTIFICATE AND SHAREHOLDING DETAILS

Certified copies of the Tenderer's Company Registration details are to be attached here, including shareholding details. Certified copies of Identity Documents of all Directors and Shareholders are also to be attached to this page.

SIGNATURE: ..... **DATE: …….....……....**
(of person authorised to sign on behalf of the Tenderer)

CONTRACTOR'S CERTIFICATE OF REGISTRATION WITH CIDB

The Tenderer shall insert his/her CIDB CRS N°. Failure to submit the number with the tender document will lead to the conclusion that the Tenderer is not registered with the CIDB, and the tender offer will be deemed as not valid/incomplete. The registration must be valid at the time of tender closing.

CRS N°: .....

SIGNATURE: ..... **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

CONTRACTOR'S COID REGISTRATION DETAILS

The Tenderer shall attach hereto a certified copy of their COID Registration details. Failure to submit the Letter of Good Standing (COID) with the tender document will lead to the conclusion that the Tenderer is not registered, and the tender offer will be deemed as not valid / incomplete.

SIGNATURE: ..... **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

FORM OF INTENT TO PROVIDE A PERFORMANCE GUARANTEE

The Tenderer must attach hereto an original and signed letter from the bank or financial institution with whom he has made the necessary arrangements, to the effect that the said bank or institution will be prepared to provide the required performance guarantee when requested to so do.

Only a Performance Guarantee in the format indicated in Section C1.3 on pages F2 and F3 will be accepted by the Employer.

Failure to provide the required letter with his tender will lead to the conclusion that the Tenderer does not have necessary financial resources at his disposal to complete the contract and will render the tender liable for disqualification.

SIGNATURE: .....…… DATE: …….....……....
(of person authorised to sign on behalf of the Tenderer)

JOINT VENTURE AGREEMENT

The Tenderer must attach to this page a certified copy of a joint venture agreement, if applicable.

SIGNATURE: .....…… DATE: ……..……..…
(of person authorised to sign on behalf of the Tenderer)

GOOD STANDING WITH MUNICIPAL ACCOUNTS

The tenderer is to affix to this page:

- Proof that they are not in arrears for more than 3 months with municipal rates and taxes and municipal service charges. The latest municipal account is to be attached.

Note:

1. Failure to affix such documentation as prescribed to this page shall result in this tender not being further considered for the award of the contract.

2. Should this tender be considered for award of the contract, based on proof of submission and should proof of such submission be found to be invalid, erroneous or inaccurate, then this tender will no longer be considered for the award of the contract.

Attach latest municipal account statement to this page.

SIGNATURE: .....…… DATE: …….....……....
(of person authorised to sign on behalf of the Tenderer)

EXPERIENCE OF TENDERER AND CURRENT PROJECTS

Detail below a high-(> R 10 million) contracts of >1 Ml/d Wastewater Works projects successfully completed as main contractor within the last eight years. Projects listed must be selected from those listed in the Prior Experience Schedule. The key criteria is to have successfully completed four (i.e., on time, within budget and to specification) >1 Ml/d Wastewater Works Contracts priced at > R 10 million of wastewater works projects, or of a more complex nature in relation to the Scope of Works, over the past eight years:

Contract that have already been Completed

ENGINEER: CONTACT PERSON AND TELEPHONE NUMBER	EMPLOYER NAME & DESCRIPTION OF WORK	VALUE OF WORK (inclusive of VAT)	COMPLETION DATE
(name)			
(tel.)			
(e-mail)			
(fax)			
(name)			
(tel.)			
(e-mail)			
(fax)			
(name)			
(tel.)			
(e-mail)			
(fax)			
(name)			
(tel.)			
(e-mail)			
(fax)			

A separate schedule, clearly referenced, may be inserted here. Tenderers are to note that the Employer will submit the Assessment of Contractor's performance schedule that follows to four of the references listed in the above (or attached) table.

It is a requirement that tenderers list at least up to four successfully completed projects of a similar nature. Failure to do so may render any submission as being non-responsive. Successfully completed contracts have a bearing on points achieved in terms of Functionality Criteria Nº 1: Relevant Experience of Tenderer.

The form is continued below with more space to list completed contracts.

SIGNATURE: .....…….....…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

EXPERIENCE OF TENDERER AND CURRENT PROJECTS (Continued)

Detail below a high-value (> R 10 million) contracts of >1 Ml/d Wastewater Works projects successfully completed as main contractor within the last eight years. Projects listed must be selected from those listed in the Prior Experience Schedule. The key criteria is to have successfully completed four (i.e. on time, within budget and to specification) >1Ml/d Wastewater Works Contracts priced at > R 10 million of wastewater works projects, or of a more complex nature in relation to the Scope of Works, over the past eight years:

Contracts that have already been Completed

ENGINEER: CONTACT PERSON AND TELEPHONE NUMBER	EMPLOYER NAME & DESCRIPTION OF WORK	VALUE OF WORK (inclusive of VAT)	COMPLETION DATE
(name)			
(tel.)			
(e-mail)			
(fax)			
(name)			
(tel.)			
(e-mail)			
(fax)			
(name)			
(tel.)			
(e-mail)			
(fax)			
(name)			
(tel.)			
(e-mail)			
(fax)			

A separate schedule, clearly referenced, may be inserted here. Tenderers are to note that the Employer will submit the Assessment of Contractor's performance schedule that follows to four of the references listed in the above (or attached) table.

It is a requirement that tenderers list at least up to four successfully completed projects of a similar nature. Failure to do so may render any submission as being non-responsive. Successfully completed contracts have a bearing on points achieved in terms of Functionality Criteria Nº 1: Relevant Experience of Tenderer.

SIGNATURE: .....…….....…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

EXPERIENCE OF TENDERER AND CURRENT PROJECTS (Continued):

Current Committed Projects Schedule

Employer and Contract Description	Contract Amount	Duration and Completion Date	Consulting Engineer

A separate schedule, clearly referenced, may be inserted here.

SIGNATURE: .....…….…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

EXPERIENCE OF TENDERER AND CURRENT PROJECTS (Continued): ASSESSMENT OF CONTRACTOR'S PERFORMANCE BY INDEPENDENT REFERENCE (CONSULTING ENGINEER)

Tenderers are to send this form to at least four of the references listed in The Experience of Tenderer schedule For Contracts That Have Already Been Completed) for relevant projects. The Employer will verify the information provided. The completed forms are to be attached to this page.

Please assess the Contractor (Name:) .....

on his/her performance on the following Contract.

Contract No. .....

Name of Contract: ..... Year of execution: .....

Contract value: ..... Employer: .....

Contract duration: ..... Engineer: .....

Reference's Position in Contract: .....

Your assessment of the Contractor's performance in the following areas: *(please tick **one** of the blocks on the right hand side)*	**Not true**	**True**
"Contractor's Management was adequate for the contract"		
"Contractor provided suitably qualified site personnel"		
"Contractor's financial resources was good for the contract duration."		
"Contractor complied with Health & Safety requirements"		
"Contractor's provided adequate resources for the contract"		
"Contractor's communication and compliance to instructions was good"		
"Quality of work produced was to specification"		
"Contractor complied with Environmental requirements"		
"Contract was completed on time"		
"There is no hesitation on recommending the Tenderer for our Project"		

Any other comments:

.....

.....

Name of person completing this assessment form (Reference): .....

ECSA Professional Reg. No: ..... Representing firm: .....

Please return by fax to: ..... or e-mail to: .....

Signature of Reference/Validator..... Date of Assessment: .....

NOTE: If the tenderer receives 3 or more negative responses, the tenderer shall be disqualified.

PROPOSED ORGANISATION AND STAFFING

The Tenderer should propose the structure and composition of their team i.e., the main disciplines involved, the key staff member / expert responsible for each discipline, and the proposed technical and support staff and site staff.

The roles and responsibilities of each key staff member / expert should be set out as job descriptions. In the case of an association / joint venture / consortium, it should, indicate how the duties and responsibilities are to be shared.

The Tenderer must attach his/her organization and staffing proposals to this page. (this is to include both the on-site and off-site staffing resources used for this project)

In addition to any lists, this information should also be shown in an organogram format (flow chart) clearly indicating the staff hierarchy and reporting lines, again for on- and off-site resources.

The undersigned, who warrants that he/she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

SIGNATURE: .....……..…….. **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

EXPERIENCE OF KEY PERSONNEL

The Tenderer shall list below the personnel which he/she intends to utilize on the Works, including key personnel which may have to be brought in from outside if not available locally.

Key Personnel To Be Employed For The Contract

Category of Employee	Number of Persons					
	Key Personnel, Part of the Contractor's Organisation		Key Personnel to be Imported if not Available Locally		Unskilled Personnel to be Recruited from Local Community	
	HDI	NON-HDI	HDI	NON-HDI	HDI	NON-HDI
Contracts Director / Manager						
Construction Manager						
Construction Supervisor						
Assistant Construction Supervisor						
Construction Health and Safety Officer						
Quality & Environmental Site Officer(s)						
Technicians, Surveyors, etc.						
Artisans and other Skilled workers						
Plant Operators						

The Tenderer shall attach hereto the *curricula vitae*, in the form included hereafter, of at least the Contracts Director/Manager, Construction Manager, Construction Supervisor(s) and Construction Safety Officer. The information is necessary for evaluation of the tender. (Refer to Tender Data page TP33; Criteria Nº2: Experience of Key Personnel for experience requirements).

In terms of the Project Specification and the Conditions of Tender, unskilled workers may not be brought in from outside the local community. They will need to be employed from the local community.

SIGNATURE: .....…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

EXPERIENCE OF KEY PERSONNEL (continued): CURRICULUM VITAE OF CONTRACTS MANAGER

CONTRACTS DIRECTOR / MANAGER	
Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record pertinent to required service:	

The Contracts Director / Manager is required to have an approved degree/diploma in civil engineering. (Refer to Tender Data page TP33; Criteria Nº2: Experience of Key Personnel for experience requirements).

Certified copies of qualifications are to be attached to this schedule. (Certification not to be older than 3 months)

Declaration: I, the undersigned, declare that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

....
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

EXPERIENCE OF KEY PERSONNEL (continued): CURRICULUM VITAE OF CONSTRUCTION MANAGER

CONSTRUCTION MANAGER	
Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record pertinent to required service:	

Construction Manager is required to have an approved degree / diploma in will engineering. (Refer to Tender Data page TP33; Criteria Nº2: Experience of Key Personnel for experience requirements).

Certified copies of qualifications are to be attached to this schedule (Certification not to be older than 3 months).

Declaration: I, the undersigned, declare that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

…… ……

SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

EXPERIENCE OF KEY PERSONNEL (continued): CURRICULUM VITAE OF CONSTRUCTION SUPERVISOR

CONSTRUCTION SUPERVISOR	
Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record pertinent to required service:	

(Refer to Tender Data page TP33; Criteria Nº2: Experience of Key Personnel for experience requirements).

Certified copies of qualifications and relevant experience are to be attached to this schedule. (Certification not to be older than 3 months).

Declaration: I, the undersigned, declare that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

..... **……..……**
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

EXPERIENCE OF KEY PERSONNEL (continued): CURRICULUM VITAE OF ASSISTANT CONSTRUCTION SUPERVISOR

ASSISTANT CONSTRUCTION SUPERVISOR	
Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record pertinent to required service:	

(Refer to Tender Data page TP33; Criteria Nº2: Experience of Key Personnel for experience requirements).

Certified copies of qualifications and relevant experience are to be attached to this schedule. (Certification not to be older than 3 months).

Declaration: I, the undersigned, declare that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

…….. ……

SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

EXPERIENCE OF KEY PERSONNEL (continued): CURRICULUM VITAE OF CONSTRUCTION HEALTH AND SAFETY OFFICER

CONSTRUCTION HEALTH AND SAFETY OFFICER	
Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record pertinent to required service:	
SACPCMP registration Number:	

Safety Officer is required to be registered with the South African Council for Project and Construction Management Professions. (Refer to Tender Data page TP33; Criteria Nº2: Experience of Key Personnel for experience requirements).

Certified copies of qualifications and relevant experience are to be attached to this schedule. (Certification not to be older than 3 months).

Declaration: I, the undersigned, declare that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

…….. ……..……

SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

CONSTRUCTION METHODOLOGY AND PRELIMINARY PROGRAMME

The Tenderer shall attach a Construction Methodology and a Preliminary Programme reflecting the proposed sequence and duration of the various activities comprising the work for this Contract. The Construction Methodology and the Preliminary Programme shall be in accordance with the information supplied in the Contract, requirements of the Project Specifications and with all other aspects of this Tender.

Note: The Construction Methodology and the Preliminary Programme must be based on the completion time as specified by the Tenderer in the Contract Data.

No other completion time that may be indicated on this Construction Methodology and a Preliminary Programme will be regarded as an alternative offer, unless it is listed on Form G: Alternative Offers, in the Returnable Schedules section and supported by a detailed statement to that effect, all as specified in the Tender Data.

SIGNATURE: .....……..…….. **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

FINANCIAL RESOURCES

In terms of the Tender Data the Employer will make enquiries to obtain a valid bank rating from the Tenderer's bank. The bank rating shall be for the price tendered for this tender, and not for any lesser amount.

A bank stamped and signed original letter from the tenderer's bank shall be included with the tender. The letter must include contact details of the person at the bank who issued the bank rating. No points will be awarded if the Employer is unable to contact the relevant person at the bank to confirm the bank rating.

To that end the Tenderer must also provide his bank account details as well as his Banker's contact details.

Failure to provide the required information with his/her tender, will lead to the conclusion that the Tenderer does not have the necessary financial resources at his/her disposal to complete the Contract successfully within the specified time for completion.

The Employer undertakes to treat the information thus obtained as confidential, strictly for the use of evaluation of the tender submitted by the Tenderer.

SIGNATURE: .....……..…….. **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

QUALITY CONTROL AND ENVIRONMENTAL MANAGEMENT

The Tenderer is to attach both a Quality Control Plan and an Environmental Management Plan to this page. Tenderers are also to attach accredited ISO 9001 and/or ISO 14001 Certificate(s) to this page if they do have the accreditation. Tenderers are to provide detailed documentation of their Quality Control Plan and Environmental Management Plan with their tender. These are to meet the requirements of the specification. Each of the Quality Control and the Environmental Management Plans should at least address the following per plan:

(a) Construction procedures / methodology for quality / environmental management
(b) Resources (personnel) to be used for quality / environmental management
(c) Materials and construction equipment to be used for quality / environmental management
(d) Storage of materials to enhance quality / environmental management
(e) Risk management for quality / environmental management
(f) Health and Safety measures to be taken for quality / environmental management

The above -mentioned plans may be in the form of a summary for each plan but should not exceed five pages per plan.

SIGNATURE: .....……..…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

CONTRACTOR'S HEALTH AND SAFETY DECLARATION

In terms of Clause 4(4) of the OHSA 1993 and the Construction Regulations 2014 (referred to as "the Regulations" hereafter), a Contractor may only be appointed to perform construction work if the Employer is satisfied that the Contractor has the necessary competencies and resources to carry out the work safely in accordance with the Occupational Health and Safety Act No 85 of 1993 and the Construction Regulations 2014 (Government Gazette Nº 37305 of 7 February 2014, Notice Nº R84).

To that effect a person duly authorised by the tenderer must complete and sign the declaration hereafter in detail.

Declaration by Tenderer

1. I the undersigned hereby declare and confirm that I am fully conversant with the Occupational Health and Safety Act No 85 of 1993 (as amended by the Occupational Health and Safety Amendment Act No 181 of 1993), and the OHSA 1993 and the Construction Regulations 2014.

2. I hereby declare that my company has the competence and the necessary resources to safely carry out the construction work under this contract in compliance with the Construction Regulations and the Employer's Health and Safety Specifications. In particular the requirement of Section 5(7) of the Construction Regulations 2014 that health and safety professionals are registered with SACPCMP.

3. I hereby confirm that adequate provision has been made in my tendered rates and prices in the Bill of Quantities to cover the cost of all resources, actions, training and all health and safety measures envisaged in the OHSA 1993 Construction Regulations 2014, including the cost of the specific items listed in the tables hereafter.

TABLE 1: SAFETY PERSONNEL

PERSONNEL	SACPCMP Registered		Registration Nº
Construction Supervisor	Yes	No	
Construction Safety Officer	Yes	No	
Health and Safety Representatives			
Health and Safety Committee			

TABLE 2: SAFETY EQUIPMENT (As applicable)

EQUIPMENT
Hard Hats
Safety Boots
Masks
Gloves
Personal Protective Equipment
Other items deemed necessary due to the nature of the contract/site

4. I hereby undertake, if my tender is accepted, to provide, before commencement of the works under the contract, a suitable and sufficiently documented Health and Safety Plan in accordance with Regulation 7(1) of the Construction Regulations, which plan shall be subject to approval by the Employer.

5. I confirm that copies of my company's approved Health and Safety Plan, the Employer's Safety Specifications as well as the OHSA 1993 Construction Regulations 2014 will be provided on site and will at all times be available for inspection by the Contractor's personnel, the Employer's personnel, the Engineer, visitors, and officials and inspectors of the Department of Labour.

6. I hereby confirm that, I will be liable for any penalties that may be applied by the Employer in terms of the said Regulations (Regulation 33) for failure on the Contractor's part to comply with the provisions of the Act and the Regulations.

7. I agree that my failure to complete and execute this declaration to the satisfaction of the Employer will mean that I am unable to comply with the requirements of the OHSA 1993 Construction Regulations 2014 and accept that my tender will be prejudiced and may be rejected at the discretion of the Employer.

SIGNATURE: .....……..…….. **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

CONTRACTOR'S HEALTH AND SAFETY PLAN

In terms of Clause 4(4) of the OHSA 1993 and the Construction Regulations 2014 (referred to as "the Regulations" hereafter), a Contractor has to provide a comprehensive Health and Safety Plan that is to be successfully operated on site for the duration of the Contract, all in accordance with Occupational Health and Safety Act No 85 of 1993 and the Construction Regulations 2014 (Government Gazette Nº 37305 of 7 February 2014, Notice Nº R84).

The Tenderer is to attach a summary of their proposed OHS Site Plan to this page. Tenderers are also to attach an accredited ISO 18001 Certificate to this page if they do have the accreditation. Tenderers are to provide a summary documentation of their OHS Site Plan with their tender. This is to meet the requirements of the specification. The OHS Site Plan should at least address the following:

(a) Construction procedures / methodology for site health and safety management
(b) Resources (personnel) to be used for site health and safety management
(c) Materials and construction equipment to be used for site health and safety management
(d) Storage of materials to enhance site health and safety management
(e) Risk management for site health and safety management
(f) Health and Safety measures to be taken to control daily site health and safety management

The abovementioned plan may be in the form of a summary but should not exceed five pages.

SIGNATURE: .....……. **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

T2.2.2 RETURNABLE SCHEDULES AND OTHER DOCUMENTS THAT WILL BE INCORPORATED INTO THE CONTRACT

Form **Page N°**

T2.2 Returnable Documents

Company Registration Certificate and Shareholding Details	RD.24
Contractor's Certificate of Registration with CIDB	RD.25
Contractor's COID Registration Details	RD.26
Form of Intent to Provide a Performance Guarantee	RD.27
Joint Venture Agreement	RD.28
Contractor's Health and Safety Declaration	RD.44
Certificate of Authority	RD.48
Schedule of Sources of Supply of Materials	RD.50
Sub-Contracting for Local EME or QSE	RD.51
Schedule of Proposed Sub-Contractors	RD.54
Schedule of Construction Equipment	RD.55
Amendments, Qualifications and Alternatives	RD.56
Record of Addenda to Tender Document	RD.57
Form of Offer	C.3
Contract Data	C.8
Bill of Quantities	PD.7

CERTIFICATE OF AUTHORITY

Indicate the status of the tenderer by ticking the appropriate box hereunder. The tenderer must complete the certificate set out below for the relevant category.

A Company	B Partnership	C Joint Venture	D Sole Proprietor	E Close Corporation

A. Certificate for Company

I, ……....., chairperson

of the board of …… , hereby confirm that

by resolution of the board (copy attached) taken on …… 20……..,

Mr/Ms ……..……, acting

in the capacity of ……..…… , was authorised to sign all documents in connection with this tender for Tender N°: Ugu-07-1631-2023 and any contract resulting from it on behalf of the company.

As witnesses:

1. …….. Chairman: ……..
2. …….. Date: ……..

B. Certificate for Partnership

We, the undersigned, being the partners in the business trading as ……

……..……....., hereby authorize

Mr/Ms ……..……, acting

in the capacity of ……..……., to sign all documents in connection with this tender for Tender N°: Ugu-07-1631-2023 and any contract resulting from it on our behalf.

Name	Address	Signature	Date

Note: This certificate is to be completed and signed by all partners upon whom rests the direction of the affairs of the Partnership as a whole.

C. Certificate for Joint Venture

We, the undersigned, are submitting this tender offer in Joint Venture and hereby authorize

Mr/Ms ……..……..……, authorised signatory of the company

……..……, acting in the capacity of lead partner, to sign all documents in connection with this tender for Tender N°: Ugu-07-1631-2023 and any contract resulting from it on our behalf.

This authorisation is evidenced by the attached power of attorney signed by legally authorised signatories of all the members to the Joint Venture.

Name of Firm	Address	Authorizing Name and Capacity	Authorizing Signature
Lead Member:			

D. Certificate for Sole Proprietor

I, ……....., hereby confirm that I am

the sole owner of the business trading as …….

As witnesses:

1. …….. Sole Owner: ……..
2. …….. Date: ……..

E. Certificate for Close Corporation

We, the undersigned, being the members in the business trading as ……..

……..……..……, hereby authorize Mr/Ms ……..

acting in the capacity of ……., to sign all to sign all documents in connection with this tender for Tender N°: Ugu-07-1631-2023 and any contract resulting from it on our behalf.

Name	Address	Signature	Date

Note: This certificate is to be completed and signed by all members upon whom rests the direction of the affairs of the Close Corporation as a whole

SCHEDULE OF SOURCES OF SUPPLY OF MATERIALS

The Tenderer shall list below the proposed type, source or trade name of the materials he wishes to use.

The acceptance of this tender shall not be construed as approval of all or any of the listed materials. Should any or all of the materials not be approved subsequent to acceptance of tender, this shall in no way invalidate this tender and the tendered unit rates for the various items of work shall remain final and binding.

MATERIAL	TYPE OR TRADE NAME	SOURCE
SAND (Concrete)		
SAND (Bedding)		
STONE		
CEMENT		
STEEL PIPES		
VALVES		
OTHER		

SIGNATURE: .....……..…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

SUB-CONTRACTING FOR LOCAL EME OR QSE

Objective

The objective of Ugu District Municipality's Empowerment ambition is to bring about meaningful transformation in the built environment construction industry through the following:

- Meaningful Economic Participation.
- Local Economic Development.
- Transfer of Technical, Management and Entrepreneurial Skills; and
- Creation of Sustainable Large Black Enterprises

Sub-contracting to Local EME or QSE

Sub-contracting for Local EME or QSE – the value of goods, services and works paid to one or more targeted enterprise(s) exclusive of the following:

- Cost of major strategic materials such as pipes, valves, pump sets, electrical switch gear, instrumentation, generator and gantry crane.
- All allowances, and any Value Added Tax or sales tax which the law requires the Employer to pay to the Contractor.

The Empowerment Target for Sub-contracting to Local EME or QSE works is expressed as a percentage of the contract amount. The special materials are to be defined and agreed upon prior to going out to tender.

Ugu District Municipality requires a minimum of 5% for contracts < R5 Million or a maximum of 30% for all other contracts of the value of goods, services and works paid to one (1) or more targeted enterprises to comply with the Ugu District Municipality's Preferential Procurement Policy Framework Act Policy Number 5/21/P (Date Last Amended: December 2022). pertaining to the Preferential Procurement Policy Framework Act. .

Applicability

The Empowerment Target for Sub-contracting for Local EME or QSE is applicable to all Capital Projects contracts for Contractors with a CIDB grading of 5CE or higher in the Civil Engineering classes of works and may be achieved through any of the following mechanisms/approaches:

- Joint Venture
- Partnership
- Sub-contracting

The requirements of an Empowerment Target for Sub-contracting for Local EME or QSE apply only to:

a) Construction works contracts in the Civil Engineering (CE) class of construction works.

b) construction works contracts of an estimated minimum project duration of six (6) months.

It is envisaged that such mechanisms/approaches will involve two (2) or more entities, one (1) being an established or developed enterprise (or JV) and the other(s) being one (1) or more targeted enterprise(s). These are defined in the table below.

Intention is for skills to be transferred from the developed enterprise to the targeted enterprise hence joint ventures formed by two (2) or more targeted enterprises are not desirable. Engaging Sub-contractors will be a preferred method.

Pre-qualification Criteria for Preferential Procurement
Only targeted enterprise that meet one (1) or more of the following criteria will be considered:

a) a tenderer having a stipulated minimum B-BBEE status level of contributor.

b) an EME or QSE.

c) a tenderer sub-contracting a minimum of 5% for contracts < R5 Million or a maximum of 30% for all other contracts to:

(i) an EME or QSE which is at least 100% owned by black people.
(ii) an EME or QSE which is at least 51% owned by black people.
(iii) an EME or QSE which is at least 25% - 50% owned by black people.
(iv) an EME or QSE which is at least 51% owned by black people who are youth.
(v) an EME or QSE which is at least 51% owned by black people who are women.
(vi) an EME or QSE which is at least 51% owned by black people with disabilities.
(vii) an EME or QSE which is 51% owned by black people living in rural or underdeveloped areas or townships.
(viii) a cooperative which is at least 51% owned by black people.
(ix) an EME or QSE which is at least 51% owned by black people who are military veterans.
(x) an EME or QSE.

Reporting
For each monthly invoice submitted by the main Contractor, on a Contract where the Empowerment Target for Sub-contracting for Local EME or QSE is applicable, the split between the Developed Enterprise(s) and the Targeted Enterprise(s) claim must be clearly articulated to enable the Empowerment Target for Sub-contracting for Local EME or QSE targets to be easily and regularly monitored.

Eligibility Criteria

- For tenders where the Empowerment Target for Sub-contracting for Local EME or QSE is applicable, those that do not offer the minimum percentage to be specified that is set by Ugu District Municipality, according to the requirements mentioned above, will be deemed ineligible.
- CIDB registration requirement for both main and targeted partner where applicable.
- Eligibility criteria for the developed and targeted enterprises shall be separated; and
- The onus is on the developed enterprise to ensure that their targeted partner meets the criteria for targeted enterprises.

Eligibility Criteria for Targeted Enterprise

1. Developed enterprise must not have equity holding exceeding 20%, either directly or through a flow-through principle.
2. CIDB registration >1 (GB, CE, ME and EB).
3. SARS registration and tax clearance.
4. CIPC registration; and
5. Must be at least 51% Black-owned.

Monitoring of Contractual Obligations

- Agreement between developed and target partner to be submitted within fourteen (14) days from date of award clearly providing detailed work packages to be performed by the targeted enterprise.
- Payment Certificates from the targeted partner indicating work packages performed CIDB document
- Site visits.
- Interviews with targeted partner's staff to cover:.
    - Confirmation that targeted partner has been paid for services rendered,
    - Confirmation of skills transfer,
- Performance management,

Penalties for not Achieving the Minimum Empowerment Target for Sub-contracting for Local EME or QSE or Finishing Late

In the case where the minimum Empowerment Target for Sub-contracting for Local EME or QSE value of 30% is not achieved, the Contractor will be penalized as follows:

- The Empowerment Target for Sub-contracting for Local EME or QSE amount not achieved in Rand will be multiplied by a factor of 0.7. The factored amount in Rand will be deducted from the Contractor's final certificate.
- The Contractor is to support and mentor the Targeted Enterprise(s) to achieve the project milestones as part of the objectives to transfer technical, management and entrepreneurial skills.

Annexes:

a) Declaration by Targeted Enterprise

b) Targeted Enterprise Company Profile

SIGNATURE: .....……..…….. **DATE: …….....**
(of person authorised to sign on behalf of the Tenderer)

SCHEDULE OF PROPOSED SUB-CONTRACTORS

The Tenderer shall list below any Sub-Contractors he wishes to employ to carry out part(s) of the Work.

The acceptance of his tender shall not be construed as approval of all or any of the listed Sub-Contractors. Should any or all of the Sub-Contractors not be approved subsequent to acceptance of the tender, this shall in no way invalidate this tender. Furthermore, the tendered unit rates for the various items of work shall remain final and binding.

N°	Proposed Sub-Contractors	Part or Type of Work	Address of Proposed Subcontractor	Contact Details	Value of Work (R)
1					
2					
3					
4					
5					
6					
7					
TOTAL VALUE OF WORKS TO BE SUB-CONTRACTED					R

Bidders are requested to furnish certified copies of the proposed subcontractor's Company Registration Documents, BEE Rating Certificate as well as certified copies of the owners' Identity Documents along with this tender.

SIGNATURE: .....…….....…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

SCHEDULE OF CONSTRUCTION EQUIPMENT

The Tenderer must state below what Construction Equipment will be available for the work should he be awarded the contract.

DESCRIPTION, SIZE, CAPACITY	YEAR OF MANUFACTURE	NUMBER

NB : After the award of the contract, the Contractor must satisfy the Engineer that all the above equipment or equivalent equipment will be on the site at all times when required. The Contractor shall maintain all equipment in a good working order for the duration of the contract.

The Contractor also undertakes to bring onto the site, without additional costs to the Employer, any additional equipment which, in the opinion of the Engineer, is necessary for completing the contract within the tendered contract period.

SIGNATURE: .....……..…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

AMENDMENTS, QUALIFICATIONS AND ALTERNATIVES

(This is not an invitation for amendments, deviations or alternatives but should the Tenderer desire to make any departures from the provisions of this contract he shall set out his proposals clearly hereunder. The Employer will not consider any amendment, alternative offers or discounts unless forms (a), (b) and (c) have been completed to the satisfaction of the Employer).

I / We herewith propose the amendments, alternatives and discounts as set out in the tables below :

(a) AMENDMENTS

Page, Clause or Item Nº	Proposed Amendment

(1) Amendments to the General and Special Conditions of Contract are not permitted.

(2) The Tenderer must give full details of all the financial implications of the amendments and qualifications in a covering letter attached to his tender.

(b) ALTERNATIVES

Proposed Alternative	Description of Alternative

(1) Individual alternative items that do not justify an alternative tender, and an alternative offer for time for completion should be listed here.

(2) In the case of a major alternative to any part of the work, a separate Bill of Quantities, programme, etc., and a detailed statement setting out the salient features of the proposed alternatives must accompany the tender.

(3) Alternative tenders involving technical modifications to the design of the works and methods of construction shall be treated separately from the main tender offer.

(c) DISCOUNTS

Item on which Discount is Offered	Description of Discount Offered

(1) The Tenderer must give full details of the discounts offered in a covering letter attached to his tender, failing which, the offer will be prejudiced.

SIGNATURE: .....…….....…….. DATE: …….....
(of person authorised to sign on behalf of the Tenderer)

RECORD OF ADDENDA TO TENDER DOCUMENT

We confirm that the following communications received from the Employer's Agent before the submission of this tender offer, amending the tender documents, have been taken into account in the tender offer

Addendum N°	DATE	TITLE OR DETAILS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

*Attach additional pages if more space is required.

SIGNATURE: .....…… DATE: ……..……..
(of person authorised to sign on behalf of the Tenderer) V

Ugu District Municipality

UMZIMKHULU BULK WATER AUGMENTATION SCHEME: PHASE 2

TENDER N°: UGU-07-1631-2023

CONSTRUCTION OF THE BACKWASH WATER RECOVERY FACILITY AT BHOBHOYI WATER TREATMENT WORKS

CIDB CLASSIFICATION: 7ME OR HIGHER

CONTRACT AND PRICING DATA
VOLUME 2 OF 4

ISSUED BY:

Ugu District Municipality

P O Box 33
Port Shepstone
4240

Contact Name : Ms Noncedo Gidimisani

Telephone : 039 688 5700

Email Address : Noncedo.Gidimisani@ugu.gov.za

PREPARED BY:

Royal HaskoningDHV (Pty) Ltd

P O Box 1066
Pietermaritzburg
3200

Contact Name : Mr Selemo Sefehle

Telephone : 087 350 6776

Email Address : Selemo.Sefehle@rhdhv.com

APRIL 2023

CLOSING DATE & TIME:	**12:00 on Friday, 19 May 2023**
COMPULSORY TENDER MEETING:	**10:00 on Wednesday, 26 April 2023**

PROCUREMENT DOCUMENT
(Based on the CIDB Standard for Uniformity in Engineering and Construction Works Contracts August 2019 as published by CIDB and the General Conditions of Contract for Construction Works (Third Edition 2015) as published by the South African Institution of Civil Engineering)

NAME OF TENDERER : .....

CHECK-LIST FOR TENDER SUBMISSION

The Tenderer is to indicate in the check-boxes provided that he/she has completed the required section of the tender document. Completion of this check-list will assist the Tenderer in ensuring that he/she has attended to all the required items for submission with this tender.

		Yes	No	Yes	No	Comments
Cover	Name of Tenderer					
TP.5	MBD1: Invitation to Bid					
RD.5	Compulsory Site Inspection Certificate and Declaration					
RD.7	MBD2: Tax Clearance Certificate Requirements					
RD.8	MBD4: Bidder's Disclosure					
RD.11	MBD5 : Declaration For Procurement Above R10 Million					
RD.14	MBD6.1 : Preference Points Claim Form ITO the Preferential Regulations					
RD.18	Sworn Affidavit – B-BBEE Exempted Micro Enterprise - General					
RD.20	Sworn Affidavit – B-BBEE Qualifying Small Enterprise – General MBD8					
RD.22	Compulsory Enterprise Questionnaire					
RD.24	Company Registration Certificate and Shareholding Details					
RD.25	Contractor's Certificate of Registration with CIDB					
RD.26	Contractor's COID Registration Details					
RD.27	Form of Intent to Provide a Performance Guarantee					
RD.28	Joint Venture Agreement					
RD.29	Good Standing with Municipal Accounts					
RD.30	Experience of Tenderer and Current Projects					
RD.34	Proposed Organization and Staffing					
RD.35	Experience of Key Personnel					
RD.41	Construction Methodology and Preliminary Programme					
RD.42	Financial Resources					
RD.43	Quality Control and Environmental Management					
RD.44	Contractor's Health and Safety Declaration					
RD.46	Construction Health and Safety Plan					
RD.48	Certificate of Authority					
RD.50	Schedule of Sources of Supply of Materials					
RD.51	Sub-Contracting for Local EME or QSE					
RD.54	Schedule of Proposed Sub-Contractors					
RD.55	Schedule of Construction Equipment					
RD.56	Amendments, Qualifications and Alternatives					
RD.57	Record of Addenda to Tender Document					

Page	Description	Completed		For office use		
		Yes	No	Yes	No	Comments
C.3	Form of Offer					
C.8	Contract Data					
PD.7	Bill of Quantities					

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C1.1: FORM OF OFFER AND ACCEPTANCE

IMPORTANT NOTE:

<u>ALL Tenderers MUST</u> complete and sign Form A: OFFER (the first page hereafter).

Form B: ACCEPTANCE will be signed by the <u>Employer</u> and then only in the case of the successful Tenderer.

Form C: SCHEDULE OF DEVIATIONS must be signed by the <u>Employer</u> as well as the <u>successful Tenderer</u> at the time of the award of the Contract.

A tender in which Form A: OFFER has not been completed and signed by the Tenderer, will invalidate the OFFER and will be disqualified.

C1.1 FORM OF OFFER AND ACCEPTANCE

(Agreement)

OFFER

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a Contract in respect of the following works:

Tender N°: Ugu-07-1631-2023: uMzimkhulu Bulk Water Augmentation Scheme: Phase 2 Construction of the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works

The Tenderer, identified in the Offer signature block below, has examined the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the Tenderer, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance, the Tenderer offers to perform all of the obligations and liabilities of the Contractor under the Contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the Conditions of Contract identified in the Contract Data.

THE OFFERED TOTAL OF THE PRICES INCLUSIVE OF VALUE ADDED TAX IS

……

……...…Rand (in words); R ……...(in figures).

This Offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document to the Tenderer before the end of the period of validity stated in the Tender Data, whereupon the Tenderer becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

For the Tenderer:

*** Name of Tenderer** *(Organisation)* **:** .....

*** Signature** *(of person authorized to sign the tender)* **:** .....

*** Name** *(of signatory in capitals)* **:** .....

Capacity *(of Signatory)* **:** .....

Address : .....

: .....

Witness:

Signature : ..... **Date** : .....

Name*(in capitals)* **:**: .....

Notes :
*** Indicates what information is mandatory. Failure to complete the mandatory information and sign this form will invalidate the tender.**

ACCEPTANCE

By signing this part of the Form of Offer and Acceptance, the Employer identified below accepts the Tenderer's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the Conditions of Contract identified in the Contract Data. Acceptance of the Tenderer's Offer shall form an agreement between the Employer and the Tenderer upon the terms and conditions contained in this Agreement and in the Contract that is the subject of this Agreement.

The terms of the Contract are contained in
Part 1 Agreement, and Contract Data, (which include this Agreement)
Part 2 Pricing Data
Part 3 Scope of Work
Part 4 Site Information

and the schedules, forms, drawings and documents or parts thereof, which may be incorporated by reference into Parts 1 to 4 above.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules as well as any changes to the terms of the Offer agreed by the Tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said documents are valid unless contained in this Schedule, which must be duly signed by the authorised representatives of both parties.

The Tenderer shall within two weeks after receiving a completed copy of this Agreement, including the Schedule of Deviations (if any), contact the Employer's Agent (whose details are given in the Contract Data) to arrange the delivery of any other bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data at, or just after, the date this Agreement comes into effect.. Failure to fulfill any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

Notwithstanding anything contained herein, this Agreement comes into effect on the date when the Tenderer receives one fully completed original copy of this document, including the Schedule of Deviations (if any). Unless the Tenderer (now Contractor) within five days of the date of such receipt notifies the Employer in writing of any reason why he / she cannot accept the contents of this Agreement, this Agreement shall constitute a binding Contract between the parties.

Signature *(person authorized to sign the acceptance)* : .....

Name *(of signatory in capitals)* : .....

Capacity *(of Signatory)* : .....

Name of Employer *(Organisation)* : .....

Address : .....

:.....

Witness:

Signature : ..... **Date** : .....

Name*(in capitals)* **::** .....

SCHEDULE OF DEVIATIONS

Notes:

The extent of deviations from the tender documents issued by the Employer prior to the tender closing date is limited to those permitted in terms of the Conditions of Tender. A Tenderer's covering letter shall not be included in the final contract document. Any change or addition to the tender documents arising from the above agreements and recorded here, shall also be incorporated into the final draft of the Contract,

1. **Subject** : ……..

   Details : ……..

   : ……..

2. **Subject** : ……..

   Details : ……..

   : ……..

3. **Subject** : ……..

   Details : ……..

   : ……..

By the duly authorised representatives signing this Schedule of Deviations, the Employer and the Tenderer agree to and accept the foregoing Schedule of Deviations as the only deviations from and amendments to the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, as well as any confirmation, clarification or change to the terms of the offer agreed by the Tenderer and the Employer during this process of offer and acceptance.

FOR THE TENDERER		**FOR THE EMPLOYER**
……..……..	Signature	……..……..
……..……..	Name (in capitals)	……..……..
……..……..	Capacity	……..……..
……..……	Name and Address of	……..……
……..	Organisation	……..
……..		……..
……..		……..
……	Witness Signature	……
……..	Witness Name	……..
……..	Date	……..

CONFIRMATION OF RECEIPT

Note: This Form must not be completed at tender stage. It will only form part of a future Contract between the Employer and the successful Tenderer (now Contractor)

The Tenderer, (now Contractor), identified in the Offer part of this Agreement hereby confirms receipt from the Employer, identified in the Acceptance part of this Agreement, of one fully completed original copy of this Agreement, including the Schedule of Deviations on this

the ..... (day) of (month) 20..... (year)

at ..... (place)

FOR THE CONTRACTOR:

Signature: .....

Name: .....

Capacity: .....

Signature and Name of Witness:

Signature: .....

Name: .....

C1.2: CONTRACT DATA

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C.1.2 CONTRACT DATA

C1.2.1 PART 1: DATA PROVIDED BY THE EMPLOYER

C1.2.1.1 GENERAL CONDITIONS OF CONTRACT

1. GENERAL

These Particular Conditions of Contract (PCC) form an integral part of the Contract. They shall amplify, modify or supersede, as the case may be, the General Conditions of Contract 2015 to the extent specified below, and shall take precedence and shall govern.

The Clauses of the Particular Conditions affected hereafter are numbered "PCC" followed in each case by the number of the applicable Clause or Sub-Clause in the General Conditions of Contract 2015, and if applicable, the heading, or (where a new condition that has no relation to the existing clauses is introduced) by a number that follows after the last Clause number in the General Conditions.

PCC 1.1 Definitions

PCC 1.1 Definitions

PCC 1.1.1.1 *Re-word this Sub-clause as follows:*

"agreed" means agreed by the Employer, or the Employer's Agent acting on behalf of the Employer, and the Contractor.

PCC 1.1.1.35 *Add the following new Sub-clause:*

"Construction Work Permit" means a document issued in terms of Regulation 3 of the Construction Regulations 2014.

PCC 1.1.1.36 *Add the following new Sub-clause:*

"Client" used in the Occupational Health and Safety Act and its Construction Regulations, means Employer.

PCC 1.1.1.37 *Add the following new Sub-clause:*

"Principal Contractor" used in the Occupational Health and Safety Act and its Construction Regulations, means Contractor.

PCC 1.2 Interpretations

Add the following Sub-clauses:

PCC 1.2.1.3 Sent by facsimile or e-mail or any like electronic form of communication, and a receipt notification is obtainable by the sender

PCC 1.2.1.4 Posted to the addressee and delivered by Postal Authorities

PCC 1.2.1.5 Delivered by a courier

PCC 3.2.4 Employer's Agent for Health and Safety

Replace Clause 3.2.4 with the following:

'In terms of Clause 1.3.2, all parties to the Contract shall be subject to the relevant requirements of the Construction Regulations 2014 (as amended) of the Occupational Health and Safety Act, Act 85 of 1993 (as amended).

Add the following at the end of the above new replacement Clause 3.2.4:

'Where the Employer is obliged to appoint an Employer's Agent for Health and Safety in terms of the Construction Regulations 2014 (as amended) of the Occupational Health and Safety Act (Act 85 of 1993 as amended), and where such Employer's Agent for Health and Safety has complied with the registration requirements of a Construction Health and Safety Agent as a specified category in terms of section 18 (1) (c) of the Project and Construction Management Professions Act (Act 48 of 2000), the applicable clauses of the latest edition of the "Standard Scope Of Services for Construction Health and Safety Agents registered In terms of Section 18(1)(c) of the Project And Construction Management Professions Act (Act No. 48 Of 2000)", including Clauses:

2.2.5 "STAGE 5 - CONSTRUCTION DOCUMENTATION AND MANAGEMENT", and

2.2.6 "STAGE 6 - PROJECT CLOSE – OUT", and

2.2.7 "ADDITIONAL RELATED SERVICES

as published in "Registration Rules for Construction Health and Safety Agents in Terms of Section 18 (1) (c) of the Project and Construction Management Professions Act, 2000 (Act No. 48 of 2000)" by the South African Council for Construction and Project Management Professionals in terms of the Project and Construction Management Professions Act (Act 48 of 2000 as amended), shall be subject to all communication and other protocols as stipulated by the Employer's Agent, unless otherwise accorded by law.

PCC 3.3.5 Limitation on Delegation of the Employer's Agent's Powers

Add to the end of the Sub-clause:

"or Clause 10.3"

PCC 4.4 Sub-contracting

PCC 4.4.1 *Insert the following after the existing wording:*

Re-word this Sub-clause as follows:

"The Contractor is mandated to sub-contract a minimum of 30 % of the work to Emerging Micro-enterprises or small business enterprises that are 51 % owned by either black people, black youth, black women, black people with disabilities, black persons living in rural or underdeveloped areas and black military veterans, but it shall not sub-contract the whole contract. The Contractor shall not sub-contract any Works to Sub-contractors who are not appropriately registered and graded by the Construction Industry Development Board. Proof of registration and grading shall be submitted to the Employer's Agent prior to the award of any such work to a Sub-Contractor."

PCC 4.10.1 Engagement of Employees

Add the following to this clause:

The Contractor shall be required to obtain consent for the provision of labour. The Contractor shall through the services of Community Liaison Officer obtain local labour in consultation with the Project Steering Committee.

PCC 4.10.3 Contractor's Default in Payment to Labourers and Employees

Add the following Clause:

Any dispute between the Contractor and labourers regarding delayed payment or default in payment of fair wages if not resolved immediately may compel the Employer to intervene.

Should the Contractor default in making timeous payments of wages due to labour, the Employer may pay these moneys directly to the labour, from any moneys due or which may become due to the Contractor under the Contract.

PCC 4.10.4 Provision of Hand Tools:

Add the following Clause:

The Contractor shall throughout the project duration provide his/her labour force with hand tools of adequate quality, sufficient in numbers and shall make the necessary provisions to maintain the tools in good and safe working conditions.

PCC 5.7.2 Night Work

Amend Clause 5.7.2 as follows:

Delete the second paragraph and substitute with the following :

'In such an event, the additional costs incurred, by acceding to the Contractor's request, shall be deducted from the amount payable to the Contractor.'

PCC 5.12 Extension of Time for Completion

Add the following to the end of Sub-clause 5.12.3:

"but shall only be granted where it is also shown that a delay has occurred to the critical path of the programme referred to in Sub-clause 5.6.1"

PCC 5.12.2.2 Rain Delays

The number of days per month on which work is expected not to be possible as a result of normal rainfall for which the Contractor shall make provision, is given in the table of Section C4.2 "Conditions on Site." In his/her tendered rates and programme, the Contractor shall allow at least for the number of lost working days listed for each month. Only the number of days lost as a result of adverse weather conditions per month exceeding the number of days listed in the table will qualify for consideration of extension time.

During the execution of the Works, the Employer's Agent's Representative will certify a day lost due to abnormal rainfall and adverse weather conditions only:

- If no work was possible on the relevant working day on any item which is on the critical path according to the latest approval construction programme : or
- if at least 50 % of the work force and plant on site could not work during the specific working day

An extension of time as a result of abnormal rainfall and adverse weather conditions shall be calculated monthly being equal to the number of working days certified by the Employer's Agent's Representative as lost due to abnormal rainfall and adverse weather conditions, less the number of days allowed for as in the table of Section C4.2 "Conditions on Site", which could result in a negative figure for certain months.

The extension of time, as a result of abnormal climatic conditions for which the Contractor may apply, shall be the cumulative algebraic sum of the monthly extensions. Should the sum thus obtained be negative, the extension of time shall be taken as Nil**.**

PCC 5.14.5.1 Consequences of Completion

Amend Clause 5.14.5.1 as follows:

In the second line, replace the word “Guarantor” with the words “Contractor, who shall then be responsible for returning it to the Guarantor”

PCC 6.2.1 Security

Amend Clause 6.2.1 as follows:

In the fourth line, delete the word “selected” and replace it with “stated”.

PCC 6.2.3 Security

Performance Guarantee “expiry date” means the date of Issue of the Certificate of Completion

PCC 6.4 Valuation of Variations

Add the following to the end of this Sub-clause:

"If the Employer’s Agent requests prices or rates for extra or additional work the Contractor shall supply the prices or rates for the work within fourteen (14) days of the request. If the Employer’s Agent considers the prices or rates unreasonable he shall request the Contractor to revise these prices or rates immediately. Delays that arise as a result of the Contractor's failure to supply reasonable rates within the fourteen (14) day period shall be the responsibility of the Contractor.

The prices or rates shall be accompanied by a fully detailed, complete break-down indicating mark-ups throughout and copies of suppliers/sub-contractors’ quotations shall be attached.

On completion of the extra or additional work, and when the Contractor has made payment to his/her suppliers/sub-contractors, the Contractor shall supply the Employer’s Agent with copies of all his/her, and his/her suppliers/sub-contractors, invoices and receipts.

PCC 6.8.4 Subsequent changes in legislation

Amend Clause 6.8.4 as follows;

In lines 7 and 8, delete the words “after due consultation between the Employer and the Contractor,”

and replace them with the following: “after first consulting with the Employer and the Contractor in terms of Clause 3.2.2,”

PCC 6.8.5 Rates of Exchange

Add a new Sub-Clause 6.8.5 as follows:

Where the goods are imported, the Contractor shall within fourteen (14) days of the notification of acceptance of his/her tender arrange through his/her bankers for the foreign commitment to be covered forward down to the Rand in order to fix the rate of exchange, exercising due care in consultation with the said bankers to ensure that the forward exchange is taken out on such terms as will provide the best possible exchange rate. The Contractor shall notify the Employer as soon as possible regarding the rate which has been fixed on such forward exchange.

An increase or decrease between the basic rate of exchange as at a date seven (7) days prior to the date of closing of tenders and that existing at the date of establishment of the forward exchange cover within the period stipulated above shall be paid or deducted by the Employer. Upon the failure of the Contractor to arrange cover aforesaid, the Contractor shall be liable for any such increase or decrease in the basic rate of exchange occurring after the last-mentioned date.

The bank charges incurred in obtaining the forward exchange cover shall be for the Employer's account.

PCC 6.9.3 Identification of Plant and Materials

Add the following at the end of Sub-Clause 6.9.3:

Storage of Plant

In consideration of receiving, from the Employer, payment on account, after the deduction of retention monies, in respect of items of Plant stored at the Contractor's workshop or his/her suppliers' premises or his/her other storage facilities, the Contractor shall complete the standard Employer Certificate of Indemnity. In so doing the Contractor:

(a) acknowledges that the items of Plant are the sole property of, and are held on behalf of, the Employer;

(b) indemnifies the Employer against any loss or damage whatsoever of or to the said items of Plant whilst in the Contractor's possession or in transit and undertakes to effect adequate insurance against these risks in the name of the Employer and to produce of such insurance to the Employer’s Agent;

(c) undertakes to deliver and install, at the site, the said Plant when required by the Employer;

(d) undertakes that no payment has been received, in respect of the said items of Plant, from any other of his/her clients or employers and that the Employer has prior claim to the value of payments so received for same, prior to all others, from any assets of the Contractor's company; and

(e) undertakes to act in accordance with such instructions as received from the Employer, through its officers, to protect the interests of the Employer.

Payment for Plant stored at the Contractor's workshop or his/her suppliers' premises or his/her other storage facilities, shall be at the sole discretion of the Employer’s Agent and the Employer’s Agent reserves the right to amend the requirements of the standard Certificate of Indemnity.

PCC 6.10.3 Retention Money

Add the following paragraph to this Clause:

"No interest shall be paid on retention money held by the Employer, irrespective of for how long it is held."

PCC 6.10.5 Payment of Retention Money

Amend Clause 6.10.5 as follows:

In the first line, add the words ', if any,' after the words 'Defects Liability Period'

PCC 6.10.6 Set-off and Delayed Payments

Amend Clause 6.10.6.2 as follows:

Delete the words 'Contractor's Bank' and substitute with the words 'Employer's Bank'

PCC 7.6.3 Removal of Improper Work and Materials

Add new Sub-clause 7.6.3.3:

"Where the Employer's Agent considers that either or both Sub-clauses 7.6.3.1 and 7.6.3.2 above apply to an event of a serious nature, he/she shall have the right to involve the Employer in the matter, in which case he/she will arrange a joint meeting **between the** Employer, the Employer's Agent and the Contractor before giving any instructions to the Contractor"

PCC 8.3.1 Excepted Risks

Amend Clause 8.3.1.7 as follows:

Delete the words 'Epidemic famine or plague' *and substitute with* 'Epidemic, pandemic, famine of plague'.

Amend Clause 8.3.1.12 as follows:

In the second line, delete the words 'Employer or any of their' and substitute with 'or any of his/her'.

PCC 8.6 INSURANCES

Add the following to Clause 8.6 - Insurances to be affected

The insurance cover affected by the Contractor in terms of this Clause shall not carry a first loss amount greater than those set out in the schedule below:

Contract Price	**The Amount of First Loss**
Up to and including R 100 000.00	R 5 000.00
Exceeding R 100 000.00 up to and including R 500 000.00	R 10 000.00
Exceeding R 500 000.00 up to and including R 1 000 000.00	R 20 000.00
Exceeding R 1 000 000.00 up to and including R 2 000 000.00	R 30 000.00
Exceeding R 2 000 000.00 up to and including R 4 000 000.00	R 40 000.00
Exceeding R 4 000 000.00 and over	R 50 000.00

The insurance policy shall contain a specific provision whereby cancellation of the policy prior to the end of the period referred to in Clause 8.2.1 cannot take place without the prior written approval of the Employer's Agent.

Furthermore, the insurance cover effected by the Contractor shall meet the following requirements:

(a)	Third Party Insurance (Public Liability)		
	i)	Minimum amount for any one occurrence, unlimited as to the number of occurrences for the period of the contract, inclusive of the maintenance period	**R 10 000 000**
	ii)	Consequential loss to be covered by policy	**R 5 000 000**
	iii)	Liability section of policy to be extended to cover blasting	**Yes**
	iv)	Maximum excess per claim or series of claims arising out of one occurrence	**R 100 000**
(b)	Third Party Insurance (Public Liability resulting from vibration and/or removal of lateral support)		
	i)	Minimum amount for any one occurrence, unlimited as to the number of occurrences against any claim for damages or loss caused by vibration and/or removal of lateral support	**R 1 000 000**
	ii)	Maximum excess per claim	**R 150 000**
(c)	Principal's own surrounding Property Insurance		
	i)	Minimum amount for any one occurrence, unlimited as to the number of occurrences against any claim for damage which may occur to the Council's own surrounding property	**R 1 000 000**
	ii)	Maximum excess per claim	**R 150 000**
(d)	Insurance of Works		
	i)	Minimum amount for additional removal of debris (no damage)	**R 200 000**
	ii)	Minimum amount for temporary storage of materials off site, excluding Contractor's own premises	**R 50 000**
	iii)	Minimum amount for transit of materials to site	**R 100 000**
	iv)	SASRA Certificate to be issued in joint names of the Council and the Contractor for the full value of the works (including VAT)	**Yes**
(e)	Joint Insured/Cross Liability Clause		
	i)	Contract Works and Public Liability Policy taken out by the Contactor shall be in the joint names of the Contractor and the Employer	
	iii)	Third Party/Public Liability section of Policy shall include cross liability clause	

PCC 8.6.1.3 Insurances to be Affected

Add the following paragraphs to this Sub-clause:

"Provided that the insurance shall not be required to cover any liability arising out of any of the matters referred to in the provisos of Sub-clause 8.4"

PCC 8.6.8 Manufacturing and/or Fabrication at Premises Other than the Site

Add the following new Sub-clause 8.6.8:

"Where the Contract involves manufacturing and/or fabrication of the Works or part thereof at premises other than the Site, the Contractor shall satisfy the Employer that all materials and equipment for incorporation in the Works are adequately insured during manufacture and/or fabrication. In the event of the Employer having an insurable interest in such Works during manufacture or fabrication then such interest shall be noted by endorsement to the Contractor's policies of insurance."

C1.2.2 CONTRACT DATA (Applicable to this Contract)

CONTRACT DATA FOR Ugu-07-1631-2023

PART 1: DATA PROVIDED BY THE EMPLOYER

CONTRACT SPECIFIC DATA

The following Contract Specific Data, referring to the General Conditions of Contract for Construction Works, Third Edition, 2015, 3rd Print version, are applicable to this Contract:

Compulsory Data	
Clause No.	
1.1.1.13	The Defects Liability Period is **365 calendar days** which period includes the special non-working days.
1.1.1.14	The time for achieving Practical Completion is **15 months** including all special non-working days.
1.1.1.15	**Name of Employer:** Ugu District Municipality.
1.1.1.26/27	The Pricing Strategy of a Re-measurement Contract shall apply (Refer to Clauses 1.1.1.27 and 6.7.1).
1.2.1.2	**The address of the Employer is:** Physical address: 28 Connor Street, PORT SHEPSTONE 4240 Postal address: P O Box 33 PORT SHEPSTONE 4240 Contact numbers: Tel. : 039 682 5700 Fax : 039 682 4280
1.1.1.16	**Name of the Employer's Agent** Royal HaskoningDHV (Pty) Ltd, represented by: Selemo Sefehle
1.2.1.2	**Address of Employer's Agent:** Physical Address: 460 Town Bush Road 3rd Floor Block C Town Bush Office Park Pietermaritzburg 3201 Postal Address: P O Box 1066 Pietermaritzburg 3200 E-mail Address: selemo.sefehle@rhdhv.com Contact Numbers: Corporate: 087 350 6776

<table>
<tr><th colspan="2">Compulsory Data</th></tr>
<tr><th>Clause No.</th><th></th></tr>
<tr><td>3.1.1</td><td>In terms of the Council for the Built Environment Act, Act 43 of 2000, the full name of all relevant statutory councils where the Employer's Agent is registered as a professional person, and the relevant category:
Engineering Council of South Africa (ECSA), established by the Engineering Profession Act, 2000;

Name of Employer's Agent's Representative: Selemo Sefehle
Category of professional registration of the Employer's Agent: Professional Technologist.</td></tr>
<tr><td>3.2.3</td><td>The Employer's Agent shall obtain the specific approval of the Employer before executing any of his functions or duties according to the following table:
<table>
<tr><th>GCC Clause N°</th><th>Description</th></tr>
<tr><td>4.10.1</td><td>Use of Site for Contractor's Employees</td></tr>
<tr><td>5.7.3</td><td>Payment for Acceleration</td></tr>
<tr><td>5.11.3</td><td>Proceeding with Works after Suspension</td></tr>
<tr><td>5.12.4</td><td>Acceleration Instead of Extension of Time</td></tr>
<tr><td>5.13.2</td><td>Reduction in Penalty</td></tr>
<tr><td>6.3.2</td><td>Issuing of a Variation Order</td></tr>
<tr><td>6.8.4</td><td>Determination of additional or reduced costs arising from changes in legislation</td></tr>
<tr><td>6.11.1</td><td>Agreeing of the adjustment of the sums for general items</td></tr>
<tr><td>8.2.2.2</td><td>Authorizing the Contractor to repair and make good damage caused by excepted risks</td></tr>
<tr><td>9.1.5</td><td>Termination of Contract</td></tr>
<tr><td>10.1.5.1</td><td>Agreeing of an extension to the twenty-eight (28) day period</td></tr>
</table></td></tr>
<tr><td>4.10.1</td><td>The contractor shall employ a Community Liaison Officer (CLO), who will be identified by the Employer and on terms specified in this document. The contractor shall recruit local labour only through the services of the CLO in consultation with the Project Steering Committee.

Contractor's default in Payment to Labourers and Employees:

Any dispute between the Contractor and labourers, regarding delayed payment or default in payment of fair wages, if not resolved immediately may compel the Employer to intervene.

The Employer may, upon the Contractor defaulting payment, pay the moneys due to the workers not honoured in time, out of any moneys due or which may become due to the Contractor under the Contract.</td></tr>
<tr><td>5.3</td><td>Commencement of the Works</td></tr>
<tr><td>5.3.1</td><td>The documentation required to be submitted by the Contractor to the Employer's Agent before commencing with the Works are:
• Health and Safety Plan (Refer to Clause 4.3), including:

A signed Agreement between the Employer and the Contractor for the Works to be completed by the Contractor in terms of the provisions of Section 37(2) of the Occupational Health and Safety Act (Act No.85 of 1993) and the Construction Regulations promulgated thereunder (Refer to Clause 4.3)</td></tr>
</table>

Compulsory Data	
Clause No.	
	Proof to the Employer, of payment, that the Contractor has paid all contributions required in terms of the Compensation for Occupational Injuries and Diseases Act, No. 130 of 1993 (Refer to Clause 4.3). • Initial Programme (Refer to Clause 5.6.1) • Security (Refer to Clause 6.2) • Insurances (Refer to Clause 8.6) • Scope of Work (duties), for the design of Temporary Works, as contained in the Professional Services Agreement between the Contractor, and a professionally registered Professional Services Provider, plus proof of the Professional Services Provider's professional registration • Bill of Quantities as evidence that adequate provision has been made for the cost of H&S in the Contract • Certificates of Competence, Schedule of Activities and Relevant Appointments as evidence that the Contractor has necessary competencies for construction work safety • Valid Letter(s) of Good Standing • Signed Form of Offer and Acceptance of this Contract and the signed Confirmation of Receipt as the written appointment of the Contractor by the Employer.
	The documentation required to be submitted by the Employer's Agent to the Contractor before commencing with the works are: Statutory Construction Work Permit (Refer to Clause 1.3.2, in accordance with Regulation 3(1) and 3(2) of the Construction Regulations 2014, as amended).
5.3.2	The time to submit the documentation required before commencement with Works execution is **56** Days. 1. For documentation to be submitted by the Contractor to the Employer: **21** days 2. For a statutory Construction Work Permit to be submitted by the Employer to the Contractor after submission of documentation by the Contractor to the Employer: **35** days
5.4.2	The access and possession of Site shall not be exclusive to the Contractor but shall be as set out elsewhere in the Contract.
5.5.1/ 1.1.1.14	**Time for Practical Completion** The time for achieving Practical Completion, as stated in Clause 1.1.1.14 above, shall include all non-working and special non-working days. Tenderers may state a different alternative time in Item 1.1.14 in Part C1.2.2 Part 2: Data Provided by the Contractor.

Compulsory Data	
Clause No.	
5.8.1 & 5.1.1.1	**Non-working Times and Special Non-working Days** The non-working days are Sundays. The special non-working days are: (1) Statutory public holidays as declared by the National Government, including: New Year's Day, Human Rights Day, Good Friday, Family Day, Freedom Day, Workers' Day, Youth Day, National Women's Day, Heritage Day, Day of Reconciliation, Christmas Day and the Day of Goodwill. (2) Any proclaimed statutory day of mourning which is proclaimed as a statutory public holiday. (3) Any proclaimed statutory election day which is proclaimed as a statutory public holiday. (4) The year-end break, as recommended by the South African Federation of Civil Engineering Contractors (SAFCEC), commencing at the close of business on or close to 15 December and ending with the start of business on the 1st working day after 1 January of the next year, which commences after the Commencement Date and before the Completion Date.
5.12.2.2	**Extension of Time for Abnormal Rainfall** Extensions of time to be considered for abnormal rainfall in terms of Clause 5.12.2.2 shall be calculated as per section C4.2. For the purpose of applying the formula, accurate rain gauging shall be taken at suitable points on the Site and the Contractor shall at his own expense, take all necessary precautions to ensure that rain gauges cannot be interfered with by unauthorized persons.
5.13.1	**Penalty for Delay** The penalty for failing to complete the Works by the Due Completion Date shall be **0.05 % of the Contract Price (exclusive of VAT) per calendar day**. The limit of penalties is 10 % of the Contract Price.
5.16.3	**Latent Defect Period** The latent defect period is **ten (10) years,** commencing on the Day after the date of certification of Final Approval.
6.2.1	**Security** The security to be provided by the Contractor shall be a Performance Guarantee of 10 % of the Contract Sum plus retention of 5 % of the value of the Works.
6.5	**Dayworks**
6.5.1.2.3	The percentage allowances to cover overhead charges for daywork which has not been included in the Daywork Schedule, are as follows: 50 % of the gross remuneration of workmen and foremen actually engaged in the daywork; and 15 % on the net cost of materials actually used No allowance will be made for work done, or for materials and equipment for which daywork rates have been quoted at tender stage.

Compulsory Data	
Clause No.	
6.8	**Adjustment in Rates and/or Prices**
6.8.2	**<u>Civil works</u>** **Contract Price Adjustment Factor** The value of the certificates issued shall be adjusted in accordance with the Contract Price Adjustment Schedule with the following values: The value of “x” is 0.1. The values of the coefficients are: a = 0.30 (Labour) b = 0.15 (Construction Equipment) c = 0.50 (Material) d = 0.05 (Fuel – Wholesale Coast)
	“ "L" is the "Labour Index" and shall be the Consumer Price Index (CPI) for the urban area nearest to the Site, as stated in the Contract Data, and as published in the Statistical News Release P0141 Table A "Consumer Price Index: Main indices; Geographic indices" of Statistics South Africa, or as otherwise amended after the Commencement Date by Statistics South Africa to another suitable equivalent index to be applied to the contract and which takes effect on a specific date, subject to written agreement between the Contractor and Employer. "P" is the "Construction Equipment Index" and shall be the Producer Price Index (PPI) applicable to Civil engineering plant and as published in the Statistical Release P0151.1, Table 4 “Mining and construction plant and equipment price index” of Statistics South Africa, or as otherwise amended after the Commencement Date by Statistics South Africa to another suitable equivalent index to be applied to the contract and which takes effect on a specific date, subject to written agreement between the Contractor and Employer. "M" is the "Materials Index" and shall be the Producer Price Index (PPI) applicable to the Civil engineering industry and as published in the Statistical Release P0151.1, “Civil engineering material price indices” of Statistics South Africa, or as otherwise amended after the Commencement Date by Statistics South Africa to another suitable equivalent index to be applied to the contract and which takes effect on a specific date, subject to written agreement between the Contractor and Employer. "F" is the "Fuel Index" and shall be the Producer Price Index (PPI) for Diesel at wholesale level for the Coast and as published in the Statistical News Release P0142.1, Table 1 of Statistics South Africa, or as otherwise amended after the Commencement Date by Statistics South Africa to another suitable equivalent index to be applied to the contract and which takes effect on a specific date, subject to written agreement between the Contractor and Employer.” The base month is the month prior to the closing date of the tender. The Site or largest part thereof shall be deemed to be located in the national province of KwaZulu-Natal. The urban area nearest the site is uMzimkhulu.

Compulsory Data	
Clause No.	
6.8.2	**Mechanical and Electrical Works** **Contract Price Adjustment Factor** The contract price for mechanical and electrical work shall be subject to escalation in accordance with the following SEIFSA Formula: Only equipment manufactured in South Africa will be subject to escalation. No escalation claims will be considered for an extension of the escalation period due to extension by the Contractor of the contract beyond the contractual completion date. Prices shall be subject to escalation in accordance with SEIFSA standard contract price adjustment formulae for manufacturing and erection contracts as follows: **1. ELECTRICAL EQUIPMENT (SUPPLY)** Formula PO = PI x 0.9 ((a x L1/L0) + (b x E1/E0) - 1) where: PO = Price Adjustment Value PI = Contract Value subject to escalation L0 = SEIFSA index of actual labour cost (all hourly paid employees) (Table C3) for the month prior to tenders closing L1 = SEIFSA index of actual labour cost (all hourly paid employees) (Table C3) for the month one month prior to date of delivery E0 = SEIFSA index for electrical engineering materials (Table G) for the month prior to tenders closing E1 = SEIFSA index for electrical engineering materials (Table G) for the month one month prior to date of delivery a = Labour content = 0.35 b = Material content = 0.65

Compulsory Data	
Clause No.	
	2. ELECTRICAL EQUIPMENT (ERECTION) Formula PO = PI x 0.9 ((L2/L0) - 1) where: PO = Price Adjustment Value PI = Contract Value subject to escalation L0 = SEIFSA index of actual labour cost (all hourly paid employees) Table C3 for the month prior to tenders closing L2 = SEIFSA index of actual labour cost (all hourly paid employees) Table C3 for the month in which erection was carried out **3. MECHANICAL EQUIPMENT (SUPPLY)** Formula PO = PI x 0.9 ((c x L3/L0) + (d x M1/M0) - 1) where: PO = Price Adjustment Value PI = Contract Value subject to escalation L0 = SEIFSA index of actual labour cost (all hourly paid employees) (Table C3) for the month prior to tenders closing L3 = SEIFSA index of actual labour cost (all hourly paid employees) (Table C3) for the month one month prior to date of delivery M0 = SEIFSA index for mechanical materials (Table G) for the month prior to tenders closing M1 = SEIFSA index for mechanical materials (Table G) for the month one month prior to date of delivery c = Labour content = 0.50 d = Material content = 0.50

Compulsory Data	
Clause No.	
	4. MECHANICAL EQUIPMENT (ERECTION) Formula PO = PI x 0.9 ((L4/L0) - 1) where: PO = Price Adjustment Value PI = Contract Value subject to escalation L0 = SEIFSA index of actual labour cost (all hourly paid employees) (Table C3) for the month prior to tenders closing L4 = SEIFSA index of actual labour cost (all hourly paid employees) (Table C3) for the month in which erection was carried out In the case of uncertainties regarding application of the formula, the principles laid out in the latest edition of the booklet, "SEIFSA Formula Principles" shall be followed. In particular, this defines calculation of escalation on any payments made in advance of completion of the contract.
6.8.3	**Variation in Costs of Special Materials** Price adjustments for variations in the costs of special materials are not allowed.
6.10	**Payments**
6.10.1.5	The percentage advance on materials not yet built into the Permanent Works is: **80 %.** Proof of ownership is required.
6.10.3	**Retention Money** The percentage retention on the amounts due to the Contractor is **10%** of the value of the Works. There is no limit of retention money. A guarantee in lieu of retention money is permitted on condition that the expiry date of the guarantee shall be the date that the Final Approval Certificate is signed.
8.6.1	**Insurances (8.6.1.2; 8.6.1.3; 8.6.1.4)** Refer to Particular Condition of Contract PCC 8.6 Insurances
8.6.1.1.2	The Value of Plant and Materials supplied by the Employer to be included in the insurance sum is **Nil.**
8.6.1.1.3	The amount to cover professional fees for repairing damage and loss to be included in the insurance sum is a maximum of **4 %** of the Contract Sum.
8.6.1.3	The limit of indemnity for liability insurance is **R 10 000 000,00** for any single claim. The number of claims during the construction and Defects Liability Periods shall be unlimited.
10.5.2	Dispute resolution shall be by ad-hoc adjudication
10.5.3	The number of Adjudication Board Members to be appointed is **1**.
10.7.1	**Arbitration** If a dispute is, after adjudication, still unresolved, the dispute shall be resolved by arbitration.

VARIATION TO THE GENERAL CONDITIONS OF CONTRACT APPLICABLE TO THIS CONTRACT	
Clause No.	
5.7.2	**Night Work** *Amend Clause 5.7.2 as follows:* Delete the second paragraph and substitute with the following: 'In such an event, the additional costs incurred, by acceding to the Contractor's request, shall be deducted from the amount payable to the Contractor'.
5.14.5.1	**Consequences of Completion** *Amend Clause 5.14.5.1 as follows:* In the second line, substitute the word 'Guarantor' with 'Contractor'.
6.9.2	**Definition of "materials"** *Amend Clause 6.9.2, as follows:* Substitute the word 'plant' with 'Plant'.
6.9.3	**Identification of Plant and materials** *Add the following at the end of Sub-Clause 6.9.3:* **Storage of Plant** In consideration of receiving, from the Employer, payment on account, after the deduction of retention monies, in respect of items of Plant stored at the Contractor's workshop or his suppliers' premises or his other storage facilities, the Contractor shall complete the standard Employer Certificate of Indemnity. In so doing the Contractor: (a) acknowledges that the items of Plant are the sole property of, and are held on behalf of, the Employer; (b) indemnifies the Employer against any loss or damage whatsoever of or to the said items of Plant whilst in the Contractor's possession or in transit and undertakes to effect adequate insurance against these risks in the name of the Employer and to produce of such insurance to the Engineer; (c) undertakes to deliver and install, at the site, the said Plant when required by the Employer; (d) undertakes that no payment has been received, in respect of the said items of Plant, from any other of his clients or employers and that the Employer has prior claim to the value of payments so received for same, prior to all others, from any assets of the Contractor's company; and (e) undertakes to act in accordance with such instructions as received from the Employer, through its officers, to protect the interests of the Employer. Payment for Plant stored at the Contractor's workshop or his suppliers' premises or his other storage facilities, shall be at the sole discretion of the Engineer and the Engineer reserves the right to amend the requirements of the standard Certificate of Indemnity.
6.10.1	**Interim Payments** Amend Clause 6.10.1.5 as follows: In the third line, add the words 'not yet' before the words 'built into'

Clause No.	
6.10.5	**Payment of retention money** Amend Clause 6.10.5 as follows: In the second line, add the words ‘, if any,’ after the words ‘Defects Liability Period’
6.10.6	**Set-off and delayed payments** Amend Clause 6.10.6.2 as follows: Delete the words ‘simple interest’ and substitute with the words ‘interest compounded daily’. Delete the words ‘Contractor’s Bank’ and substitute with the words ‘Employer’s Bank’
7.4.4	**Cost of test specimens and tests** Amend Clause 7.4.4.2 as follows: In the third line of paragraph two, add the words ‘the requirements of’ before the words ‘the Contract’
7.8.2	**Cost of making good of defects** Amend Clause 7.8.2.1 as follows: In the first line, correct the spelling of ‘therefore’.
8.1.3	**Excessive loads and traffic** In the third line, add punctuation ‘…. in the vicinity of the Site, from …..’.
8.3.1	**Excepted risks** Amend Clause 8.3.1.10 as follows: In the second line, delete the words ‘Employer or any of their’ and substitute with ‘or any of his’.
8.6.2	**Liability of deductibles** Add to this Sub-Clause: The insurance cover effected by the Contractor in terms of this Clause shall not carry a first loss amount greater than R50 000,00.

ADDITIONAL CLAUSES TO THE GENERAL CONDITIONS OF CONTRACT APPLICABLE TO THIS CONTRACT	
Clause No.	
1.1	**Definition** *Add the following at the end of Sub-Clause 1.1.1:*
1.1.1.35	"Client", as used in the Occupational Health and Safety Act - Construction Regulations, means Employer.
1.1.1.36	"Principal Contractor", as used in the Occupational Health and Safety Act - Construction Regulations, means Contractor.
1.1.1.37	"Designer", as used in the Occupational Health and Safety Act - Construction Regulations, means the member of the Employer's Agent personnel nominated as Designer.
3.2.3	**Specific Approval of the Employer Required** In addition to Clause 3.2.3 above, the Employer's Agent is required to obtain the specific approval of the Employer for the following: (1) Significant changes to the Specifications related to Plant and materials which may have an impact on the operation and maintenance of the Works; and. (2) Any expenditure beyond the approved Contract Sum.
8.6	**Insurances**
8.6.8	**Manufacturing and/or fabrication at premises other than the Site** *Add the following new Sub-Clause 8.6.8:* "Where the contract involves manufacturing and/or fabrication of the Works or part thereof at premises other than the Site, the Contractor shall satisfy the Employer that all materials and equipment for incorporation in the Works are adequately insured during manufacture and/or fabrication. In the event of the Employer having an insurable interest in such Works during manufacture or fabrication then such interest shall be noted by endorsement to the Contractor's policies of insurance."

PART 2: DATA PROVIDED BY THE CONTRACTOR

The Contractor is advised to read the General Conditions of Contract, as specified in Part 1, in order to understand the implications of this Data which is required to be completed.

Each item of data given below is cross-referenced to the clause in the Conditions of Contract to which it mainly applies.

<table>
<tr><th>GCC REF. CLAUSE No</th><th></th></tr>
<tr><td>1.1.1.9</td><td>Name of Contractor: .....

[Enter the full legal name of the Contractor]</td></tr>
<tr><td>1.2.1.2</td><td>Address of Contractor:

Physical:..... Postal: .....

....

....

E-mail: _____

Contact numbers:

Corporate: _____

Direct: _____

Mobile: _____

Fax: _____</td></tr>
<tr><td>6.2.1</td><td>Security
The security to be provided by the Contractor shall be one of the following:

<table>
<tr><th>Type of security
(with Value Added Tax excluded from the Contract Sum and from the value of the Works for calculating the percentages)</th><th>Indicate "Yes" or "No"</th></tr>
<tr><td>Retention of 10 % of the value of the Works. (5 % held for defects liability period)</td><td></td></tr>
<tr><td>Fixed Performance guarantee of 10 % of the Contract Sum</td><td></td></tr>
<tr><td>Variable Performance Guarantee</td><td></td></tr>
</table></td></tr>
<tr><td>6.5.1.2.3</td><td>The percentage allowances to cover overhead charges are as stated in Part 1: Data provided by the Employer in Sub-clause 6.5.1.2.3</td></tr>
</table>

Signature..…….. Date…….……

(of person authorised to sign on behalf of the Tenderer)

C1.2.3 PART 3: ERRATA TO GCC 2015 BY SAICE

All updates, errata or other amendments to GCC 2015 published by SAICE prior to the Base Month of this Contract shall be deemed to form part of GCC 2015.

Corrections 2017-06-09 published by SAICE and all further updates, errata or other amendments to GCC 2015 published by SAICE prior to the Base Month of this Contract shall be deemed to form part of GCC 2015.

Each party to the Contract shall purchase its own copy of such updates, errata, corrections and other amendments to GCC 2015.

C1.2.4 PART 4: ERRATA TO GCC 2015 BY THE EMPLOYER

The items in this Part 4 shall be deemed to be supplementary corrigenda by the Employer to the GCC 2015 and shall be deemed to form part of GCC 2015. In the event of conflict between any item in this Part 4 and an item in the above Part 3, the relevant item in Part 3 shall take precedence.

C1.2.5 Payment for Labour-Intensive Work

Payment for the labour-intensive Component of the Works

Payment for works identified in the Scope of Work as being labour-intensive shall only be made in accordance with the provisions of the Contract if the works are constructed strictly in accordance with the provisions of the Scope of Work. Any non-payment for such works shall not relieve the Contractor in any way from his obligations either in contract or in delict.

Linkage of Payment for Labour-intensive Component of Works to Submission of Project Data

The Contractor’s payment invoices shall be accompanied by labour information for the corresponding period in a format specified by the Employer. The Contractor’s invoices shall not be paid until all pending labour information has been submitted.

Applicable Labour Laws

“The current Ministerial Determination (also downloadable at www.epwp.gov.za), Expanded Public Works Programmes, issued in terms of the Basic Conditions of Employment Act of 1997 by the Minister of Labour in Government Notice, shall apply to works described in the scope of work as being labour-intensive and which are undertaken by unskilled or semi-skilled workers.

The Conditions of Employment for Expanded Public Works Programmes

1. INTRODUCTION

1.1 This document contains the standard terms and conditions for workers employed in elementary occupations on an Expanded Public Works Programme (EPWP). These terms and conditions do NOT apply to persons employed in the supervision and management of a SPWP.

1.2 In this document –

a) "department" means any department of the State, implementing agent or contractor;

b) "employer" means any department, implementing agency or contractor that hires workers to work in elementary occupations on an EPWP;

c) "worker" means any person working in an elementary occupation on an EPWP;

d) "elementary occupation" means any occupation involving unskilled or semi-skilled work;

e) "management" means any person employed by a department or implementing agency to administer or execute an EPWP;

f) "task" means a fixed quantity of work;

g) "task-based work" means work in which a worker is paid a fixed rate for performing a task;

h) "task-rated worker" means a worker paid on the basis of the number of tasks completed;

i) "time-rated worker" means a worker paid on the basis of the length of time worked.

2. TERMS OF WORK

2.1 Workers on an EPWP are employed on a temporary basis or contract basis.

3. NORMAL HOURS OF WORK

3.1 An employer may not set tasks or hours of work that require a worker to work–

a) more than forty hours in any week

b) on more than five days in any week; and

c) for more than eight hours on any day.

3.2 An employer and worker may agree that a worker will work four days per week. The worker may then work up to ten hours per day.

3.3 A task-rated worker may not work more than a total of 55 hours in any week to complete the tasks allocated (based on a 40-hour week) to that worker.

4. MEAL BREAKS

4.1 A worker may not work for more than five hours without taking a meal break of at least thirty minutes duration.

4.2 An employer and worker may agree on longer meal breaks.

4.3 A worker may not work during a meal break. However, an employer may require a worker to perform duties during a meal break if those duties cannot be left unattended and cannot be performed by another worker. An employer must take reasonable steps to ensure that a worker is relieved of his or her duties during the meal break.

4.4 A worker is not entitled to payment for the period of a meal break. However, a worker who is paid on the basis of time worked must be paid if the worker is required to work or to be available for work during the meal break.

5. SPECIAL CONDITIONS FOR SECURITY GUARDS

5.1 A security guard may work up to 55 hours

5.2 s per week and up to eleven hours per day.

5.3 A security guard who works more than ten hours per day must have a meal break of at least one hour or two breaks of at least 30 minutes each.

6. DAILY REST PERIOD

Every worker is entitled to a daily rest period of at least twelve consecutive hours. The daily rest period is measured from the time the worker ends work on one day until the time the worker starts work on the next day.

7. WEEKLY REST PERIOD

Every worker must have two days off every week. A worker may only work on their day off to perform work which must be done without delay and cannot be performed by workers during their ordinary hours of work ("emergency work").

8. SICK LEAVE

8.1 Only workers who work more than 24 hours per month have the right to claim sick-pay in terms of this clause.

8.2 A worker who is unable to work on account of illness or injury is entitled to claim one day’s paid sick leave for every full month that the worker has worked in terms of a contract.

8.3 A worker may accumulate a maximum of twelve days’ sick leave in a year.

8.4 Accumulated sick-leave may not be transferred from one contract to another contract.

8.5 An employer must pay a task-rated worker the worker’s daily task rate for a day’s sick leave.

8.6 An employer must pay a time-rated worker the worker’s daily rate of pay for a day’s sick leave.

8.7 An employer must pay a worker sick pay on the worker’s usual payday.

8.8 Before paying sick-pay, an employer may require a worker to produce a certificate stating that the worker was unable to work on account of sickness or injury if the worker is –

a) absent from work for more than two consecutive days; or

b) absent from work on more than two occasions in any eight-week period.

8.9 A medical certificate must be issued and signed by a medical practitioner, a qualified nurse or a clinic staff member authorised to issue medical certificates indicating the duration and reason for incapacity.

8.10 A worker is not entitled to paid sick-leave for a work-related injury or occupational disease for which the worker can claim compensation under the Compensation for Occupational Injuries and Diseases Act.

9. MATERNITY LEAVE

9.1 A worker may take up to four consecutive months' unpaid maternity leave.

9.2 A worker is not entitled to any payment or employment-related benefits during maternity leave.

9.3 A worker must give her employer reasonable notice of when she will start maternity leave and when she will return to work.

9.4 A worker is not required to take the full period of maternity leave. However, a worker may not work for four weeks before the expected date of birth of her child or for six weeks after the birth of her child, unless a medical practitioner, midwife or qualified nurse certifies that she is fit to do so.

9.5 A worker may begin maternity leave –

a) four weeks before the expected date of birth; or

b) on an earlier date –

(i) if a medical practitioner, midwife or certified nurse certifies that it is necessary for the health of the worker or that of her unborn child; or

(ii) if agreed to between employer and worker; or

a) on a later date, if a medical practitioner, midwife or certified nurse has certified that the worker is able to continue to work without endangering her health.

9.6 A worker who has a miscarriage during the third trimester of pregnancy or bears a stillborn child may take maternity leave for up to six weeks after the miscarriage or stillbirth.

10. FAMILY RESPONSIBILITY LEAVE

10.1 Workers, who work for at least four days per week, are entitled to three days paid family responsibility leave each year in the following circumstances –

a) when the employee's child is born;

b) when the employee's child is sick;

c) in the event of a death of –

(i) the employee's spouse or life partner;

(ii) the employee's parent, adoptive parent, grandparent, child, adopted child, grandchild or sibling.

11. STATEMENT OF CONDITIONS

11.1 An employer must give a worker a statement containing the following details at the start of employment –

a) the employer's name and address and the name of the EPWP;

b) the tasks or job that the worker is to perform; and

c) the period for which the worker is hired or, if this is not certain, the expected duration of the contract;

d) the worker's rate of pay and how this is to be calculated;

e) the training that the worker will receive during the EPWP.

11.2 An employer must ensure that these terms are explained in a suitable language to any employee who is unable to read the statement.

11.3 An employer must supply each worker with a copy of these conditions of employment.

12. KEEPING RECORDS

12.1 Every employer must keep a written record of at least the following –

a) the worker's name and position;

b) copy of an acceptable worker identification;

c) in the case of a task-rated worker, the number of tasks completed by the worker;

d) in the case of a time-rated worker, the time worked by the worker;

e) payments made to each worker.

12.2 The employer must keep this record for a period of at least three years after the completion of the EPWP.

13. PAYMENT

13.1 An employer must pay all wages at least monthly in cash or by cheque or into a bank account.

13.2 A worker may not be paid less than the minimum EPWP wage rate of **R200/ day** or per task. This will be adjusted annually on the 1st of November in-line with inflation (available CPI as provided by StatSA six (6) weeks before implementation).

13.3 A task-rated worker will only be paid for tasks that have been completed.

13.4 An employer must pay a task-rated worker within five weeks of the work being completed and the work having been approved by the manager or the contractor having submitted an invoice to the employer.

13.5 A time-rated worker will be paid at the end of each month.

13.6 Payment must be made in cash, by cheque or by direct deposit into a bank account designated by the worker.

13.7 Payment in cash or by cheque must take place –

a) at the workplace or at a place agreed to by the worker;

b) during the worker's working hours or within fifteen minutes of the start or finish of work;

c) in a sealed envelope which becomes the property of the worker.

13.8 An employer must give a worker the following information in writing –

a) the period for which payment is made;

b) the numbers of tasks completed, or hours worked;

c) the worker's earnings;

d) any money deducted from the payment;

e) the actual amount paid to the worker.

13.9 If the worker is paid in cash or by cheque, this information must be recorded on the envelope and the worker must acknowledge receipt of payment by signing for it

13.10 If a worker's employment is terminated, the employer must pay all monies owing to that worker within one month of the termination of employment.

14. DEDUCTIONS

14.1 An employer may not deduct money from a worker's payment unless the deduction is required in terms of a law.

14.2 An employer must deduct and pay to the SA Revenue Services any income tax that the worker is required to pay.

14.3 An employer who deducts money from a worker's pay for payment to another person must pay the money to that person within the time period and other requirements specified in the agreement law, court order or arbitration award concerned.

14.4 An employer may not require or allow a worker to –

a) repay any payment except an overpayment previously made by the employer by mistake;

b) state that the worker received a greater amount of money than the employer actually paid to the worker; or

c) pay the employer or any other person for having been employed.

15. HEALTH AND SAFETY

15.1 Employers must take all reasonable steps to ensure that the working environment is healthy and safe.

15.2 A worker must –

a) work in a way that does not endanger his/her health and safety or that of any other person;

b) obey any health and safety instruction;

c) obey all health and safety rules of the EPWP;

d) use any personal protective equipment or clothing issued by the employer;

e) report any accident, near-miss incident or dangerous behavior by another person to their employer or manager.

16. COMPENSATION FOR INJURIES AND DISEASES

16.1 It is the responsibility of the employers (other than a contractor) to arrange for all persons employed on an EPWP to be covered in terms of the Compensation for Occupational Injuries and Diseases Act, 130 of 1993.

16.2 A worker must report any work-related injury or occupational disease to their employer or manager.

16.3 The employer must report the accident or disease to the Compensation Commissioner.

16.4 An employer must pay a worker who is unable to work because of an injury caused by an accident at work 75 % of their earnings for up to three months. The employer will be refunded this amount by the Compensation Commissioner. This does NOT apply to injuries caused by accidents outside the workplace such as road accidents or accidents at home.

17. TERMINATION

17.1 The employer may terminate the employment of a worker for good cause after following a fair procedure.

17.2 A worker will not receive severance pay on termination.

17.3 A worker is not required to give notice to terminate employment. However, a worker who wishes to resign should advise the employer in advance to allow the employer to find a replacement.

17.4 A worker who is absent for more than three consecutive days without informing the employer of an intention to return to work will have terminated the contract. However, the worker may be re-engaged if a position becomes available.

17.5 A worker who does not attend required training events, without good reason, will have terminated the contract. However, the worker may be re-engaged if a position becomes available.

18. CERTIFICATE OF SERVICE

18.1 On termination of employment, a worker is entitled to a certificate stating –

a) the worker's full name;

b) the name and address of the employer;

c) the EPWP on which the worker worked;

d) the work performed by the worker;

e) any training received by the worker as part of the EPWP;

f) the period for which the worker worked on the EPWP;

g) any other information agreed on by the employer and worker.

C1.3: FORMS TO BE COMPLETED BY SUCCESSFUL TENDERER

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C1.3.1 PERFORMANCE GUARANTEE

PRO FORMA

For use with General Conditions of Contract for Construction Works, Third Edition, 2015 3rd Print version.

GUARANTOR DETAILS AND DEFINITIONS

"Guarantor" means: .....

Physical address: .....

"Employer" means: Ugu District Municipality

"Contractor" means: .....

"Employer's Agent" means: Royal HaskoningDHV (Pty) Ltd

"Works" means: Contract N°: Ugu-07-1631-2023: uMzimkhulu Bulk Water Augmentation Scheme: Phase 2: Construction the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works

"Site" means: uMzimkhulu Bulk Water Augmentation Scheme: Phase 2.

"Contract" means: The Agreement made in terms of the Form of Offer and Acceptance and such amendments or additions to the Contract as may be agreed in writing between the parties.

"Contract Sum" means: The accepted amount inclusive of tax of R .....

Amount in words: .....

"Guaranteed Sum" means: The maximum aggregate amount of R .....

Amount in words: .....

"Expiry Date" means: Date of issue of the Certificate of Completion of the Works

CONTRACT DETAILS

The Employer's Agent issues: Interim Payment Certificates, Final Payment Certificate and the Certificate Completion of the Works as defined in the Contract.

PERFORMANCE GUARANTEE

1. The Guarantor's liability shall be limited to the amount of the Guaranteed Sum.

2. The Guarantor's period of liability shall be from and including the date of issue of this Performance Guarantee and up to and including the date of issue by the Employer's Agent of the Certificate of Completion of the Works. The Employer and/or the Employer's Agent shall advise the Guarantor in writing of the date on which the Certificate of Completion of the Works has been issued.

3. The Guarantor hereby acknowledges that:

3.1 any reference in this Performance Guarantee to the Contract is made for the purpose of convenience and shall not be construed as any intention whatsoever to create an accessory obligation or any intention whatsoever to create a suretyship;

3.2 its obligation under this Performance Guarantee is restricted to the payment of money.

4. Subject to the Guarantor's maximum liability referred to in 1, the Guarantor hereby undertakes to pay the Employer the sum certified upon receipt of the documents identified in 4.1 to 4.3:

4.1 A copy of a first written demand issued by the Employer to the Contractor stating that payment of a sum certified by the Employer's Agent in an Interim or Final Payment Certificate has not been made in terms of the Contract and failing such payment within seven (7) calendar days, the Employer intends to call upon the Guarantor to make payment in terms of 4.2;

4.2 A first written demand issued by the Employer to the Guarantor at the Guarantor's physical address with a copy to the Contractor stating that a period of seven (7) days has elapsed since the first written demand in terms of 4.1 and the sum certified has still not been paid;

4.3 A copy of the aforesaid payment certificate which entitles the Employer to receive payment in terms of the Contract of the sum certified in 4.

5. Subject to the Guarantor's maximum liability referred to in 1, the Guarantor undertakes to pay to the Employer the Guaranteed Sum or the full outstanding balance upon receipt of a first written demand from the Employer to the Guarantor at the Guarantor's physical address calling up this Performance Guarantee, such demand stating that:

5.1 The Contract has been terminated due to the Contractor's default and that this Performance Guarantee is called up in terms of 5; or

5.2 A provisional or final sequestration or liquidation court order has been granted against the Contractor and that the Performance Guarantee is called up in terms of 5; and

5.3 The aforesaid written demand is accompanied by a copy of the notice of termination and/or the provisional/final sequestration and/or the provisional liquidation court order.

6. It is recorded that the aggregate amount of payments required to be made by the Guarantor in terms of 4 and 5 shall not exceed the Guarantor's maximum liability in terms of 1.

7. Where the Guarantor has made payment in terms of 5, the Employer shall upon the date of issue of the Final Payment Certificate submit an expense account to the Guarantor showing how all monies received in terms of this Performance Guarantee have been expended and shall refund to the Guarantor any resulting surplus. All monies refunded to the Guarantor in terms of this Performance Guarantee shall bear interest at the prime overdraft rate of the Employer's bank compounded monthly and calculated from the date payment was made by the Guarantor to the Employer until the date of refund.

8. Payment by the Guarantor in terms of 4 or 5 shall be made within seven (7) calendar days upon receipt of the first written demand to the Guarantor.

9. Payment by the Guarantor in terms of 5 will only be made against the return of the original Performance Guarantee by the Employer.

10. The Employer shall have the absolute right to arrange his affairs with the Contractor in any manner which the Employer may deem fit and the Guarantor shall not have the right to claim his release from this Performance Guarantee on account of any conduct alleged to be prejudicial to the Guarantor.

11. The Guarantor chooses the physical address as stated above for the service of all notices for all purposes in connection herewith.

12. This Performance Guarantee is neither negotiable nor transferable and shall expire in terms of 2, where after no claims will be considered by the Guarantor. The original of this Guarantee shall be returned to the Guarantor, by the Contractor, after it has expired.

13. This Performance Guarantee, with the required demand notices in terms of 4 or 5, shall be regarded as a liquid document for the purposes of obtaining a court order.

14. Where this Performance Guarantee is issued in the Republic of South Africa the Guarantor hereby consents in terms of Section 45 of the Magistrate's Courts Act No 32 of 1944, as amended, to the jurisdiction of the Magistrate's Court of any district having jurisdiction in terms of Section 28 of the said Act, notwithstanding that the amount of the claim may exceed the jurisdiction of the Magistrate's Court.

Signed at .....

Date .....

Guarantor's signatory (1) .....

Capacity .....

Guarantor's signatory (2) .....

Capacity .....

Witness signatory (1) .....

Witness signatory (2) .....

C1.3.2 NON-DISCLOSURE UNDERTAKING

NON-DISCLOSURE OF INFORMATION

AGREEMENT

Throughout this TENDER process and thereafter, prospective service providers must secure from Employer written approval PRIOR to the release of any information that pertains to the potential work or activities covered by this TENDER or the subsequent process. Failure to adhere to this requirement may result in disqualification from the TENDER process or civil action.

The Employer will keep responses confidential until a contract is awarded, or the process is terminated. At that time, TENDER documents and related documents may be made available for inspection at the Employer's discretion, except for material that is proprietary or confidential. The Employer will not disclose or make public any pages of a response, which the vendor has marked "proprietary" of Confidential.

We acknowledge that the TENDERING process is subject to the abovementioned non-disclosure Clause together with the Employer policies and procedures with regard to non-disclosure.

We further acknowledge that competitiveness is a requirement of your process and that collusive tendering is prohibited by law. We confirm that we have not engaged in price fixing with any other tenderer or person, or in any way colluded with any other tenderer or person in connection with this TENDER.

For and on behalf of

Name of Signatory: _____

Date: _____

Capacity: _____

Authority: _____

C1.3.3 PROFORMA DISCLOSURE STATEMENT

General Conditions of Contract for Construction Works, Third Edition, 2015

PRO FORMA

Date: .....

Contract: Contract N°: Ugu-07-1631-2023: Construction of the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works

Employer: .....

Employer's Agent: .....

Dear Sir(s)/Madam(s)

I am willing and available to serve as ad-hoc Adjudication Board Member in the above-mentioned Contract.

In accordance with the General Conditions of Contract for Construction Works Adjudication Board Rules relating to disclosure statements by selected or nominated persons to the adjudication, I hereby state that:

- I shall act with complete impartiality and know of nothing at this time, which could affect my impartiality.
- I have had no previous involvement with this project.
- I do not have any financial interest in this project.
- I am not currently employed by the Contractor, Employer or Employer's Agent.
- I do not have any financial connections with the Contractor, Employer or Employer's Agent.
- I do not have or have not had a personal relationship with any authoritative member of the Contractor, Employer or the Employer's Agent which could affect my impartiality.
- I undertake to immediately disclose to the parties any changes in the above position which could affect my impartiality or be perceived to affect same.

Should there be any deviation from the foregoing statements, details shall be given.

I further declare that I am experienced in the work which is carried out under the Contract and in interpreting contract documentation.

Name in full: .....

Signature: .....

C1.3.4 DISPUTE ADJUDICATION AGREEMENT

PRO FORMA

[Note to Tenderer: This form should not be completed for the tender but will be completed by the appointed Contractor.]

This Agreement is entered into between:

Adjudication Board Member:

Name : .....

Physical address : .....

.....

.....

Postal address : .....

E-mail address : .....

Fax number : .....

Telephone number : .....

Mobile number : .....

Contractor:

Name : .....

Physical address : .....

.....

.....

Postal address : .....

E-mail address : .....

Fax number : .....

Telephone number : .....

Mobile number : .....

Employer:

Name : .....

Physical address : .....

.....

.....

Postal address : .....

E-mail address : .....

Fax number : .....

Telephone number : .....

Mobile number : .....

The Contractor and the Employer will hereinafter be collectively referred to as the Parties.

The Parties entered into a Contract for the Construction of the Contract N°: Ugu-07-1631-2023: Construction of the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works, which provides that a dispute under or in connection with the General Conditions of Contract for Construction Works, Third Edition, 2015, must be referred to ad-hoc adjudication.

The undersigned natural person has been appointed to serve as Adjudication Board Member and together with the undersigned Parties agree as follows:

1. The Adjudication Board Member accepts to perform his duties in accordance with the terms of the Contract, the General Conditions of Contract for Construction Works Adjudication Board Rules and this Agreement.

2. The Adjudicator undertakes to remain independent and impartial of the Contractor, Employer and Employer's Agent for the duration of the Adjudication Board proceedings.

3. The Adjudication Board Member agrees to serve for the duration of the Adjudication Board proceedings.

4. The Parties may at any time, without cause and with immediate effect, jointly terminate this Agreement.

5. Unless the Parties agree, the Adjudication Board Member shall not act as arbitrator or representative of either Party in any subsequent proceedings between the Parties under the Contract.

   No Party may call the Adjudication Board Member as a witness in any such subsequent proceedings.

6. The standing Adjudication Board's duties shall end upon the Adjudication Board Member(s) receiving notice from the Parties of their joint decision to disband the Adjudication Board.

7. The Adjudication Board Member shall be paid in respect of time spent upon or in connection with the adjudication including time spent traveling:
   a. A monthly retainer of *(amount)* for *(number)* of months, and/or
   b. A daily fee of *(amount)* based on a *(number)* hour day, and/or
   c. An hourly fee of *(amount)*, and/or
   d. A non-recurrent appointment fee of *(amount)* which shall be accounted for in the final sums payable.

8. The Adjudication Board Member's expenses incurred in adjudication work shall be reimbursed at cost.

Upon submission of an invoice for fees and expenses to the Parties, the Contractor shall pay the full amount within 28 days of receipt of the invoice and he shall be reimbursed by the other party by half the amount so that the fees and expenses are borne equally by the Parties. Late payment of such invoice shall attract interest at prime plus 3 % points compounded monthly at the prime rate charged by the Adjudication Board Member's bank.

This Agreement is entered into by:

Contractor's signature: .....

Contractor's name: .....

Place: ..... Date: .....

Employer's signature: .....

Employer's name: .....

Place: ..... Date: .....

Adjudication Board Member's signature: .....

Adjudication Board Member's name: .....

Place: ..... Date: .....

C1.3.5 DECLARATION OF INSURANCES

I/We hereby declare that the insurance policies enumerated below have been affected by me/us in accordance with the Contract Data.

Cover effected	Clause	Insurer	Policy	Expiry date
The Works				
Construction Equipment				
Provisions of the COID Act				
Common Law Liability				
Motor Vehicle Liability				
Other deemed necessary				
Professional Indemnity	as applicable			

Copies of the abovementioned policies are attached

NOTE : In respect of COID, a copy of the current receipt and letter of good standing is attached

For and on behalf of the Contractor : .....

Official Capacity : .....

Date : .....

NOTE : This schedule shall be completed and submitted to Ugu District Municipality within 14 days from the Commencement Date of the contract and will serve as a condition precedent. The Contractor shall ensure that all policies are in place for the full period under contract, and were policies need to be renewed and or any changes effected, Ugu District Municipality is to be provided with the renewal confirmation and/or details of changes within 14 days of such renewal or changes.

C1.3.6 AGREEMENT IN TERMS OF SECTION 37(2) OF THE OCCUPATIONAL HEALTH AND SAFETY ACT No 85 OF 1993

Whereas Ugu District Municipality under Contract No.: Ugu-07-1631-2023 Construction of the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works

And Whereas the Contractor .....

.....

HAS AGREED TO REGULATE AS PROVIDED FOR IN TERMS OF SECTION 37(2) OF THE OCCUPATIONAL HEALTH AND SAFETY ACT, 85 OF 1993, ("THE ACT") PROCEDURES AND ARRANGEMENTS AS REQUIRED BY THE ACT FOR THE EXECUTION OF THE WORK:

NOW THEREFORE THE PARTIES AGREE AS FOLLOWS:

1 The Contractor warrants that all his and his Sub-contractors' workmen are covered in terms of the provisions of the Compensation for Occupational Injuries and Diseases Act, 130 of 1993, which cover shall remain in force whilst any such workmen is present on Ugu District Municipality premises.

2 The Contractor undertakes to ensure that he/she and/or his/her Sub-contractors and/or their respective employees will at all times comply with all the requirements of the Act and without derogating from this general undertaking, also comply with the following conditions:

2.1 All work performed on Ugu District Municipality premises must be performed under the close supervision of the Contractor's employees who are trained to understand the hazards associated with any work that the Contractor performs on the stated premises.

2.2 The Contractor shall assume the responsibility in terms of Section 16(1) of the Act. If the Contractor delegates any duty in terms of Section 16(2), a copy of such written delegation shall immediately be forwarded to Ugu District Municipality.

2.3 The Contractor shall ensure that he/she familiarizes himself/herself with all the requirements of the Act, and that he/she, his/her employees and any Sub-contractor comply with them.

2.4 The Contractor shall appoint competent employees who shall be trained on any occupational health and safety aspect pertinent to them or to the work that is to be performed.

2.5 Discipline regarding occupational health and safety shall be strictly enforced.

2.6 Personal protective equipment shall be issued as required and worn at all material times.

2.7 Safe work practices shall be enforced, and all employees shall be made conversant with the contents of these practices.

2.8 No unsafe equipment/machinery and/or articles shall be used on the site.

2.9 All incidents referred to in Section 24 of the Act shall be reported by the Contractor to the Department of Labour as well as to Ugu District Municipality. Ugu District Municipality shall further be provided with copies of any written documentation relating to any incident.

2.10 Ugu District Municipality hereby obtains an interest in the issue of any formal inquiry conducted in terms of Section 32 of the Act into any incident involving a Contractor and/or his/her employees and/or his/her Sub-contractor.

2.11 No use shall be made of any Ugu District Municipality machinery/article/substance/personal protective equipment without written approval.

2.12 Work for which the issuing of a permit is required shall not be performed prior to the obtaining of a duly completed and approved permit.

2.13 No alcohol or other intoxicating substance shall be allowed on the site. Anyone suspected to be under the influence of alcohol, or any other intoxicating substance shall not be allowed on the site.

2.14 Full participation shall be given if and when Ugu District Municipality employees inquire into Occupational Health and Safety issues.

2.15 The Contractor expressly agrees to comply with the procedures and arrangements as required by the Act in the execution of the work.

3 The Contractor confirms that he/she will report to the Employer's Agent anything that he/she deems to be unhealthy and/or unsafe, and that he/she has versed his/her employees and/or Sub-contractor in this regard.

4 The Contractor warrants that he/she shall not endanger the health and safety of Ugu District Municipality employees in any way whilst performing any work on the site.

5 The Contractor confirms that he/she will acknowledge and adhere to Ugu District Municipality's Environmental Management requirements, as well as co-operate in the following areas :

5.1 Full compliance with existing approved standards for performing work, for example, SANS and Ugu District Municipality site written safe working procedures.

5.2 The Contractor agrees to comply with emergency response procedures.

SIGNED BY UGU DISTRICT MUNICIPALITY:.....

(Section 16(2) assignee)

DATE:.....

SIGNED BY CONTRACTOR OR
HIS AUTHORISED
REPRESENTATIVE.....

DATE:.....

C1.3.7 BLASTING INDEMNITY

Contract Nº. Contract N°: Ugu-07-1631-2023: uMzimkhulu Bulk Water Augmentation Scheme: Phase 2: Construction of the Backwash Water Recovery Facility at Bhobhoyi Water Treatment Works

Given by .....

*Company Registration No.: .....

Address: .....

A *Company incorporated with limited liability according to the company laws of the Republic of South Africa, *Partnership, *Close Corporation, *Public Company (hereinafter called the Contractor), represented herein by …….. in his capacity as the

Contractor's …… duly authorized.

Hereto by a resolution of the Contractor dated…… a certified copy of which resolution is attached to this indemnity.

WHEREAS the Contractor has entered into a Contract with Ugu District Municipality (hereinafter called the Employer) for, …….. and the Employer required this Indemnity from the Contractor.

NOW THEREFORE THIS DEED WITNESSETH that the Contractor does hereby indemnify and hold harmless the Employer in respect of all loss or damage that may be incurred or sustained by the Employer by reason of or in any way arising out of or caused by blasting operations that may be carried out by the Contractor in connection with the aforementioned Contract and also in respect of all claims that may be made against the Employer in consequence of such blasting operations, by reason of or in any way arising out of any accidents or damage to persons, life or property or any other cause whatsoever, and also in respect of all legal or other expenses that may be incurred by the Employer in examining, resisting or settling any such claims; for the due performance of which the Contractor binds itself according to law.

THUS, DONE AND SIGNED for and on behalf of the Contractor at: .....

on the …… day of ……. 20….. in the presence of the subscribing witnesses.

AS WITNESSES

1. **.....** **.....**
SIGNATURE **DESIGNATION OF SIGNATORY**

2. **.....** **.....**
SIGNATURE **DESIGNATION OF SIGNATORY**

*** Delete where not applicable**

C1.3.8 TRANSFER OF RIGHTS AND INDEMNITY

(To be completed during construction by successful Tenderer only when claiming for materials on site)

Claim for materials on site, Payment Certificate N°. .... Date:

Contract N°: ..... For (contract title) .....

.....

I, the undersigned (name of signatory) ..... in my capacity as

..... of (name of Contractor)

.....

duly authorised hereto on behalf of the Contractor hereby transfer, cede and assign all the Contractor's rights, title and interest in and to the materials and goods, for which evidence of bona fide ownership is attached hereto, unto and in favour of (name of Employer):

.....

Insofar as the Contractor retains actual control of the materials and goods, the right of ownership thereof passes to the Employer by constitutum possessorium.

I herewith indemnify the Employer against any claim to and in respect of said materials by reason of the Contractor's sequestration or liquidation or of any defect in the Contractor's title to the materials and agree that no payment for materials on site will be made by the Employer until such time as I have submitted documentary proof of bona fide ownership of the said materials and goods.

This transfer shall become effective upon conclusion of the Contractor receiving payment from the Employer or from any other person on behalf of the Employer for the materials and goods as Materials on Site, payment of retention money thereon excluded.

I further confirm that I am fully responsible for all materials and goods listed under this Transfer of Rights and that they have been insured adequately against all risks and will remain insured until they are built into or used in the permanent works and taken over by the Employer.

This certificate of Transfer of Rights applies only to the materials and goods as listed in the following table.

Description of item	Unit	Quantity	Rate	Amount	Supplier
TOTAL VALUE OF MATERIALS AND GOODS					

Signed by: …… Date: ……..……..……
for and on behalf of the Contractor.

Witnessed by: ……. Date: ……..……..……

NOTE: This form, together with the documentary proof of ownership or proof of payment by the Contractor to the supplier, shall accompany the Contractor's claim for payment for materials on site in terms of Clause 6.10.1.5 of the General Conditions of Contract, Third Edition, 2015.

C2: PRICING DATA

C2.1: PRICING INSTRUCTIONS

C2.2: BILL OF QUANTITIES

C2: PRICING DATA

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C2.1 PRICING INSTRUCTIONS

C2.1.1 GENERAL

All prices shall be quoted in the currency of the Republic of South Africa and shall not be subject to adjustment except in terms of the conditions stated by the Tenderer in Amendments, Qualifications and Alternatives, included as part of section T2. In the event of the tenderer not stating his conditions for price adjustment his/her prices will be held to be firm and holding throughout the duration of the Contract, subject to CPA adjustment in terms of Clause 6.8.2 of GCC 2015.

Value Added Tax is not to be included in the rates but is to be included in the appropriate item in the Summary Sheet of the Bill of Quantities.

C2.1.2 SANS SPECIFICATIONS MEASUREMENT AND PAYMENT CLAUSES

Measurement and payment shall be in accordance with the relevant provisions of Clause 8 of each of the Standard Engineering Specifications referred to in the Scope of Work. The Preliminary and General items shall be measured in accordance with the provisions of C2.1.8.

Clause 8 of each Standard Engineering Specification, read together with the relevant clauses of the Scope of the Works, set out what ancillary or associated work and activities are included in the rates for the operations specified. Should any requirements of the measurement and payment clause of the applicable Standard Engineering Specification, or the Scope of the Works, conflict with the Bill of Quantities, the requirements of the Standard Engineering Specification or Scope of the work, as applicable, shall prevail.

C2.1.3 QUANTITIES GIVEN IN THE BILL OF QUANTITIES

The Bill of Quantities has been drawn up generally in accordance with Civil Engineering Quantities 1990 issued by the SA Institution of Civil Engineers, but more specifically with the SANS 1200 method. The short descriptions and payment reference clauses of the items in the Bill of Quantities are for identification purposes only and comply in general with the measurement and payment clauses of the Standardized Specifications, the Project Specifications and the Particular Specifications. They must be read together with the relevant clauses of the Scope of Work and directives on the drawings, set out what ancillary or associated work and activities are included in the rates for the operations specified.

The quantities given in the Bill of Quantities are the estimated quantities of work to be done and will be subject to re-measurement during the execution of the work. The Contractor shall obtain the Employer's Agent's detailed instructions for all work before ordering any materials or executing work or making any arrangements for it. The Works as finally completed in accordance with the Contract shall be measured and paid for as specified in the Bill of Quantities, and the contract price for the completed Contract shall be computed at the relevant unit rates and prices, all in accordance with the General and Special Conditions of Contract, the Specifications and Project Specifications and the drawings. Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance has been made for waste. The validity of the Contract will in no way be affected by differences between the quantities in the Bill of Quantities and the quantities finally certified for payment.

C2.1.4 DISCREPANCIES BETWEEN BILLED AND FINAL QUANTITIES

The work scheduled hereunder is generally more fully described in the Specification or shown on the drawings, and in pricing his/her tender the tenderer is referred to the whole of the Conditions of Contract, Specification, drawings and Schedule of Quantities, in order to fully comprehend the scope, extent and meaning of each item scheduled. The validity of the Contract will in no way be affected by differences between the quantities in the Bill of Quantities and the quantities finally certified for payment.

Any costs involved in meeting the obligations and liabilities imposed by the Conditions of Contract and in complying generally with the requirements of the Contract shall be deemed to be apportioned to and included under the various items, and the prices quoted against each item must cover the full inclusive cost of all work to be completed under the item plus such apportionment of the general costs.

C2.1.5 GOVERNING LAWS

If a Bill of Quantities (or schedule of rates) applies and there is an error in the line item total resulting from the product of the unit rate and the quantity, the line item total shall govern, and the rate shall be corrected. Where there is an obviously gross misplacement of the decimal point in the unit rate, the line item total as quoted shall govern, and the unit rate will be corrected.

Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern, and the tenderer will be asked to revise selected item prices (and their rates if a Bill of Quantities applies) to achieve the tendered total of the prices.

Where there is a discrepancy between the amounts in figures and in words, the amount in words shall govern.

C2.1.6 PRICING RULES

The prices and rates to be inserted by the tenderer in the Bill of Quantities shall be the full inclusive prices to be paid by the Employer for the work described under the several items, and shall include full compensation for all costs and expenses that may be required in and for the completion and maintenance during the defects liability period of all the work described and as shown on the drawings as well as all overheads, profits, incidentals and the cost of all general risks, liabilities and obligations set forth or implied in the documents on which the tender is based.

Each item shall be priced and extended to the "Total" column by the tenderer, with the exception of the items for which only rates are required (Rate Only), or items which already have Prime Cost or Provisional Sums affixed thereto. If the Contractor omits to price any items in the Bill of Quantities, then these items will be considered to have a nil rate or price.

All items for which terminology such as "inclusive" or "not applicable" have been added by the tenderer will be regarded as having a nil rate which shall be valid irrespective of any change in quantities during the execution of the Contract.

All rates and amounts quoted in the Bill of Quantities shall include all levies and taxes (other than VAT).

The use of correction fluid is not permitted. Incorrect entries shall not be erased or obliterated with correction fluid but must be crossed out neatly. The correct figures must be entered above or adjacent to the deleted entry, and the alteration must be initialed by the tenderer.

C2.1.7 PRELIMINARY AND GENERAL ITEMS

The Preliminary and General Section (Section 1) is provided to cover the Contractor's expenses incurred in complying with the requirements of the tender documents.

(a) Fixed Charge Items

Each item should be priced separately and, subject to the Employer's Agent certifying in terms of Clause 6.7 of the General Conditions of Contract that the work has been done, payment will be made as follows:

(i) the total amount due when the certified value fixed charge items in this section is less than 5 % of the net contract price;
(ii) when the certified value of fixed charge items in this section is greater than 5 % of the net contract price, payment will be limited to 5% of the net contract price. The remainder will be paid when the value of the work done under the contract, excluding the value of fixed charge items in this section, is greater than 50 % of the net contract price, excluding the value of fixed charge items in this section.

(b) Time-Related Items

Any Time-Related items not priced shall be deemed to be covered by the prices of other items in the section.

Payment of Time-Related items in this section will be made throughout the contract period, the amount per month being the value of the item divided by the completion in months or, if specified in weeks, the equivalent number of months, in terms of Clause 5.5 of the General Conditions of Contract. The final monthly increment will only be paid upon the issue of a Completion Certificate.

C2.1.8 PROVISIONAL SUMS / PRIME COST SUMS

Where Provisional Sums or Prime Cost Sums are provided for items in the Bill of Quantities, payment for the work done under such items will be made in accordance with Clause 6.6 of the General Conditions of Contract 2015. The Employer reserves the right, during the execution of the Works, to adjust the stated amounts upwards or downwards according to the work actually done under the item, or the item may be omitted altogether, without affecting the validity of the Contract. The tenderer shall not under any circumstances whatsoever delete or amend any of the sums inserted in the "Amount" column of the Bill of Quantities and in the Summary of the Bill of Quantities unless ordered or authorized in writing by the Employer before closure of tenders.

C2.1.9 "RATE ONLY" ITEMS

The tenderer shall fill in rates for all items where the words "Rate Only" appear in the "Total" column. "Rate Only" items have been included where:

(a) an alternative item or material is contemplated;
(b) variations of specified components in the make-up of a pay item may be expected; and
(c) no work under the item is foreseen at tender stage but the possibility that such work may be required is not excluded.

For "Rate Only" items no quantities are given in the "Quantity" column, but the quoted rate shall apply in the event of work under this item being required. The tenderer shall however note that in terms of the Tender Data the Tenderer may be asked to reconsider any such rates which the Employer may regard as unbalanced.

C2.1.10 MONTHLY PAYMENTS

Unless otherwise specified in the Specifications and Project Specifications, progress payments in Interim Certificates, referred to in Clause 6.10 of the General Conditions of Contract, in respect of "sum" items in the Bill of Quantities shall be by means of interim progress instalments assessed by the Engineer and based on the measure in which the work actually carried out relates to the extent of the work to be done by the Contractor.

C2.1.11 WORDS AND ABBREVIATIONS

1. For the purposes of this Bill of Quantities, the following words shall have the meanings hereby assigned to them:

   Unit : The unit of measurement for each item of work as defined in the Standardized, Project or Particular Specifications

   Quantity : The number of units of work for each item

   Rate : The payment per unit of work at which the Tenderer tenders to do the work

   Amount : The quantity of an item multiplied by the tendered rate of the (same) item

   Sum : An amount tendered for an item, the extent of which is described in the Bill of Quantities, the Specifications or elsewhere, but of which the quantity of work is not measured in units

2. The units of measurement indicated in the Bill of Quantities are metric units. The following abbreviations may appear in the Bill of Quantities:

mm	=	millimetre
m	=	metre
km	=	kilometre
km-pass	=	kilometre-pass
m²	=	square metre
m²-pass	=	square metre-pass
ha	=	hectare
m³	=	cubic metre
m³-km	=	cubic metre-kilometre
kW	=	kilowatt
kN	=	kilonewton
kg	=	kilogram
t	=	ton (1 000 kg)
%	=	per cent
PC Sum	=	Prime Cost Sum
Prov Sum	=	Provisional Sum

C2.2 BILL OF QUANTITIES

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		PART 1: PRELIMINARY AND GENERAL				
1	**SANS 1200A**	**SECTION 1: PRELIMINARY & GENERAL**				
1.1	PSA 8.2.1	**FIXED-CHARGE ITEMS**				
1.1.1	8.3.1	Contractual requirements	Sum	1		
	8.3.2	**Establish Facilities on the Site:**				
1.1.2	8.3.2.1	Facilities for Employer's Agent (SANS 1200 AB):				
1.1.2.1	8.3.2.1	a) Two contract nameboards, one furnished office, one furnished meeting room, a toilet with handwash facilities and two covered carports as per PSAB 3.1, 3.2, 4.1 and 5.2.	Sum	1		
1.1.2.2	PSAB 4.2 & 5.5	b) Survey equipment and two assistants as per PSAB 4.2.	Sum	1		
1.1.3	8.3.2.2	Facilities for Contractor:				
1.1.3.1		Offices, storage sheds, workshops, laboratories, ablution and latrine facilities, tools, equipment and plant, etc. at designated sites and elsewhere on site as required and including all requisite water and electric power supplies and communications	Sum	1		
1.1.4	8.3.3	General Responsibilities and Other Fixed Charge Obligations	Sum	1		
1.1.5	PSA 8.3.4	Remove Employer's Agent's and Contractor's site establishment on completion of the Works	Sum	1		
1.1.6	PSA 8.3.4 (a)	Provision of hard copy and electronic copy of As-Built Drawings (refer to Clause C3.2.3 of Section C3.2 Engineering)	Sum	1		
1.1.7	PSA 8.3.4 (b)	Provision of Other Documentation (refer to Clause C3.2.4.3 of Section C3.2 Engineering)	Sum	1		
1.1.8	PSA 8.4.2.2 & Part Spec PTC	Dealing with water, inclusive of Stormwater Management Plan for construction purposes in terms of C3.5.5.1.	Sum	1		
1.1.9	C3.5.7 & Part Spec PTC	The preparation and establishment of all procedures required to achieve and ensure compliance with the requirements of the Environmental Management Plan in terms of SANS 1921-1 Clause 4.19.	Sum	1		
1.1.10.1	C3.5.12 & Part Spec TH Revised OHS Spec	The preparation and establishment of all procedures required to achieve and ensure compliance with the requirements of Construction Regulations 2014 and the related Construction Health and Safety Plan in terms of C3.5.122 & SANS 1921-1 Clause 3.5.	Sum	1		
1.1.10.2	C3.5.12 & Part Spec TH Revised OHS Spec	The completion and checking of the Project Health and Safety file upon completion of the Works and handing it over to the Employer in terms of C3.5.22 & SANS 1921-1 Clause 4.15.	Sum	1		
1.1.11	C3.5.6 & C3.6.3	The preparation and establishment of the Contractor's Quality Assurance Plan and structures, including the construction record and dossier keeping documentation in terms of SANS 1921-1 Clause 4.4.	Sum	1		
1.1.12	SANS 1921-1 Clause 4.9.5	The preparation and establishment of the Security Management Plan including ID cards for all workers on site, identification system for vehicles on site and for working within wildlife enclosures and including Sub-contractors in terms of SANS 1921-1 Clause 4.9.5.	Sum	1		
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
1.2	PSA 8.2.2 & 8.4	**TIME-RELATED ITEMS**				
1.2.1	8.4.1	Contractual Requirements	Sum	1		
1.2.2	PSA 8.4.2.3	Operate and maintain facilities on Site for the duration of construction	Sum	1		
1.2.3	8.4.2.1	Facilities for Employer's Agent for the duration of construction (SANS 1200 AB)	Sum	1		
1.2.3.1	8.4.2.1, PSA 8.2.2 & PSAB 8.2.1	a) Two contract nameboards, one furnished office, one furnished meeting room, a toilet with handwashing facilities and two covered carports as per PSAB 3.1, 3.2, 4.1 and 5.2.	Sum	1		
1.2.3.2	PSAB 4.2 & 5.5	b) Survey equipment and two assistants as per PSAB 4.2.	Sum	1		
1.2.3.3	PSAB 8.2.1	c) Allowance of R800.00 per week for the Employer' Agent's Representative's cellular phone and data usage	Sum	1		
1.2.4	8.4.2.2	Facilities for Contractor for the duration of construction	Sum	1		
1.2.4.1		Offices, storage sheds, workshops, laboratories, living accommodation, ablution and latrine facilities, tools and equipment, water supplies, electric power, communications, access and plant.	Sum	1		
1.2.4.2	PSA 8.4.2.2 & PTC	l) Dealing with water, inclusive of Stormwater Management Plan for construction purposes in terms of C3.5.5.1.	Sum	1		
1.2.4.3	84.2.2(i) & SANS 1921-1: 4.5.1.	Access to and on the Works including construction of all temporary roads, tracks, and ramps, etc. in terms of SANS 1921-1 Clause 4.5.1.	Sum	1		
1.2.5	SANS1200 8.4.3	Supervision for the duration of construction	Sum	1		
1.2.6	8.4.4	Company and head office over head costs for the duration of construction	Sum	1		
1.2.7	8.4.5	General responsibilities and other time-related obligations for the duration of construction	Sum	1		
1.2.8	8.4.5	General responsibilities and other time-related obligations for the duration of construction for all CPG scope of works	Sum	1		
1.2.9	PSA 8.4.7 & C3.5.22	The management and supervision of all procedures and documentation required to ensure compliance with the HIV/AIDS Awareness Programme for the duration of construction in terms of SANS 1921 Part 6.	Sum	1		
1.2.10	C3.5.7 & Part Spec PTC	The management and supervision of all procedures and documentation required for the duration of the Contract to ensure compliance with the requirements of the Environmental Management Plan for the duration of construction in terms of SANS 1921-1 Clause 4.19.	Sum	1		
1.2.11	C3.5.12 & Part Spec TH Revised OHS Spec	The management and supervision of all procedures and documentation required to ensure compliance with the Project Health and Safety Plan for the duration of construction in terms of C3.5.12 & SANS 1921-1 Clause 4.15.	Sum	1		
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
1.2.12	C3.5.6 & C3.6.3	The management and supervision of all procedures and documentation required to ensure compliance with the Contractor's Quality Assurance Plan for the duration of construction in terms of SANS 1921-1 Clause 4.4.	Sum	1		
1.2.13		**Other time-related obligations which the Tenderer requires to be priced separately**				
1.2.13.1		(a)	Sum	1		
1.2.13.2		(b)	Sum	1		
1.2.13.3		(c)	Sum	1		
1.3		**PROVISIONAL SUMS**				
1.3.1	PSA 8.5(a)	Laboratory Testing (Required by the Employer's Agent (refer to PSAB 8.2.2 (a) and C3.5.10.2.	Prov Sum	1	100 000,00	100 000,00
1.3.2		Contractor's commission on Item 1.3.1	%	100 000.00		
1.3.3	PSA 8.5(b) & C3.5.13	Allowance of R3000.00 per week for Community Liaison Officer in terms of C3.5.13.	Prov Sum	1	350 000,00	R 350 000,00
1.3.4		Contractor's commission on Item 1.3.3	%		350 000,00	
1.3.5	SANS 1921-1 Clause 4.5	Detailed surveys and investigations for location of all interconnecting pipework, valve and ancillaries	Prov Sum	1	100 000,00	100 000,00
1.3.6		Contractor's commission on Item 1.3.5	%	100 000.00		
1.3.7	C3.4.6	An allowance to deal with permits and wayleaves in terms of C3.5.19	Prov Sum	1	50 000,00	50 000,00
1.3.8		Contractor's commission on Item 1.3.7	%	50 000.00		
1.3.9	PSA 8.5(c)	Accredited Skills Training of Employer selected local community members	Prov Sum	1	600 000,00	600 000,00
1.3.10		Contractor's commission on Item 1.3.9	%		600 000,00	
1.3.11	PSA 8.5(d)	Allow a provisional sum for dealing with all social and Community matters including relocation of households affected by extension of waterworks boundary as and when ordered by Employer's Agent	Prov Sum	1	3 000 000,00	R 3 000 000,00
1.3.12		Contractor's commission on Item 1.3.11	%		3 000 000,00	
1.3.13	PSA 8.5 (e)	Stationary and other consumables for the Employer's Agent's Representative	Prov Sum	1	25 000,00	R 25 000,00
1.3.14		Contractor's commission on Item 1.3.13	%		25 000,00	
1.3.15	PSA 8.5 (f)	An allowance for Council visit lunches and any Council Sod-turning ceremonies or similar	Prov Sum	1	50 000,00	R 50 000,00
1.3.16		Contractor's commission on Item 1.3.15	%		50 000,00	
1.3.17	PSA 8.5 (g)	HAZOP, hazardous classification, MHI reports and commissioning planning where ordered by the Employer's Agent.	Prov Sum		800 000,00	R 800 000,00
1.3.18		Contractor's commission on Item 1.3.17	%		800 000,00	
1.3.19	PSA 8.5 (h) & C3.13.5	Training of Employer's Operating and Maintenance Team as specified in C3.13.5: Drawings and Other Documents	Prov Sum	1	300 000,00	R 300 000,00
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
1.3.20		Contractor's commission on Item 1.3.19	%		300 000,00	
1.3.21		In-service Training for 1Nº Student	Prov Sum	1	200 000,00	R 200 000,00
1.3.22		Contractor's commission on Item 1.3.21	%		200 000,00	
1.3.23	PSA 8.4.6	Fixed Preliminary and General Costs for all CPG scope of works	Prov Sum	1		R 950 000,00
1.3.24		Contractor's Mark-Up for Company and head office over head costs for item 1.3.24	%			
1.4	8,6	**Prime cost items**				
1.4.1		(a) Prime cost of goods and materials to be supplied to the site of the Works in terms of the Contract	Sum	1		
1.4.2		(b) Contractor's commission on Item 1.4.1	%	1		
1.4.3		(c) Transport and labour to handle and install materials in item 1.4.1 above as specified or ordered by the Engineer	Sum	1		
1.5		**Allow the following additional items which the Tenderer requires to be priced separately:**				
1.5.1		(a)	Sum	1.00		
1.5.2		(b)	Sum	1.00		
1.5.3		(c)	Sum	1.00		
1.6	PSA 8.7 & Part Spec PTA	**DAYWORKS:**				
1.6.1	Part Spec PTA 5.1	**Labour:**				
1.6.1.1		a) Unskilled	Hr	500,00		
1.6.1.2		b) Semi-skilled : pipelayer, section leader survey assistant	Hr	100,00		
1.6.1.3		c) Skilled : artisan	Hr	50,00		
1.6.1.4		d) Surveyor including assistants and equipment	Hr	50.00		
1.6.1.5		e) Construction Assistant	Hr	20.00		
1.6.1.6		f) Construction Supervisor	Hr	10.00		
1.7	Part Spec PTA 5.2	**Plant:**				
1.7.1		a) Lowbed with trailer of sufficient capacity and axles to transport any of the heavy machinery listed below.	t.km	2 500.00		
1.7.2		b) Front end loader (min 60 kW)	Hr	50.00		
1.7.3		c) Track type excavator (Cat 225 or similar	Hr	50.00		
1.7.4		d) Tractor loader backhoe (min 45 kW)	Hr	50.00		
1.7.5		e) Smooth drum vibratory compactor (min 12 tonnes)	Hr	50.00		
1.7.6		f) Compressor with hoses, breakers and bits (min air output 7 m3/min)	day	5.00		
1.7.7		g) Tip truck (12m³)	Hr	50.00		
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
1.7.8		h) Grader (min 112 kW)	Hr	50.00		
1.7.9		i) Water tanker (min 10 000 litre)	Hr	50.00		
1.7.10		j) Bulldozer with ripper (min 100 kw)	Hr	50.00		
1.7.11		k) Self propelled crane (min 20 ton)	Hr	50.00		
1.7.12		l) Pneumatic tyred roller (min 20 tons)	Hr	50.00		
1.7.13		m) Heavy duty self powered welding machine	Hr	50.00		
1.7.14		n) Pedestrian roller (Bomag 90 or similar)	Hr	50.00		
1.7.15		o) Plate compactor	hr			
1.7.16		p) Generator and breaker (5 KVA)	day	5.00		
1.7.17		q) Dewatering pumps complete with pipework and accessories (80 mm)	hr			
1.7.18		r) Mobile electric welding set complete with generator and accessories (220 V)	hr			
1.7.19		Standing time costs, all inclusive of plant and labour costs per day, (working days only) to be paid only if Contractor can substantiate a claim for Employer's Agent's Representative to adjudicate.	day	5,0		
1.8	PSA 8.8.2	**Dealing with Traffic**				
1.8.1	SANS 1921 - Parts 1 & 2	Dealing with traffic for the duration of construction (refer to SANS 1921 - Parts 1 & 2)	Sum	1.00		
TOTAL PART 1: PRELIMINARY AND GENERAL CARRIED FORWARD TO SUMMARY						

SUMMARY OF PART 1: PRELIMINARY AND GENERAL

PART 1:	DESCRIPTION	AMOUNT
SECTION 1:	PRELIMINARY AND GENERAL	
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES ON PAGE PD.99		

ITEM NO	FOR CPG	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			PART 2: CIVIL				
1.0			**SECTION 1: VORTEX DEGRITTER**				
1,1		SANS 1200D, PSD	**EARTHWORKS**				
1.1.1		8.3.1	**Site preparation**				
1.1.1.1		8.3.1.1	Clear and grub as directed by the Engineer	m²	57		
1.1.1.2		8.3.1.2	Clear site / remove topsoil to a depth of 150mm and stockpile and maintain for reuse and/or disposal	m²	57		
1.1.2		8.3.2	**Bulk excavation:**				
1.1.1.1		8.3.2 (a)	Excavate in all materials and use for embankment or backfill or dispose, as ordered	m³	119		
1.1.1.2		8.3.2 (b)	Extra over for:				
1.1.1.2.1		8.3.2 (b) (1)	Intermediate excavation	m³	12		
1.1.1.2.2		8.3.2 (b) (2)	Hard rock excavation	m³	6		
1.1.1.2.3		8.3.2 (b) (3)	Boulder excavation, Class A	m³	5		
1.1.1.2.4			Boulder excavation, Class B	m³	5		
1.1.3		8.3.3	**Restricted excavation (see Drawing D-2):**				
1.1.3.1			(a) Excavate for restricted foundations,footings and pipe trenches in allmaterials and use for backfill or embankment or dispose	m³	44		
1.1.3.2		8.3.3 (b)	Extra over for:				
1.1.3.2.1		8.3.3 (b) (1)	Intermediate excavation	m³	5		
1.1.3.2.2		8.3.3 (b) (2)	Hard rock excavation	m³	5		
1.1.3.2.3		8.3.3 (b) (3)	Boulder excavation, Class A	m³			
1.1.3.2.4		8.3.3 (b) (4)	Boulder excavation, Class B	m³			
1.1.4		8.3.4	**Importing of materials:**				
1.1.4.1		PSD 8.3.14	(a) Extra-over for 5% cement stabilisation of backfill (by mass), compacted in layers not exceeding 175mm to minimum 98% Mod AASHTO maximum dry density, incl for the supply of cement, G4/G5 crushed stone, mixing, adding water	m³	15		
1.1.5		8.3.5	Extra excavation in all materials to provide working space around structure	m²	34		
1.1.6		8.3.10	Topsoiling	m²	34		
1.1.7		8.3.11	Grassing or other vegetation cover	m²	34		
1.1.8		PSD 8.3.15	Trimming and rolling of sidewalks, verges, medians and islands	m²	34		
1.1.9		PSD 8.3.16	Final finishing and clearing up	Sum	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
1,2		SANS 1200G, PSG	**CONCRETE (STRUCTURAL)**				
1.2.1		8,2	**Scheduled Formwork Items**				
1.2.1.1		8.2.1	**Rough, Straight, Vertical**				
1.2.1.2.1			(a) External faces of Channel and splitter box (Below ground level)	m²	48		
1.2.1.2		8.2.1	**Rough, Straight, Circular**				
1.2.1.2.1			(a) External faces of Vortex degritter Tanks and Channels	m²	83		
1.2.1.3		8.2.2	**Smooth, Straight, Vertical**				
1.2.1.3.1			(a) External faces of Channel and splitter box (above ground level)	m²	8		
1.2.1.3.2			(b) Internal faces of Channel and splitter box	m²	70		
1.2.1.4		8.2.2	**Smooth, Straight, Circular**				
1.2.1.4.1			(a) Internal faces of Vortex degritter Tanks and Channels	m²	80		
1.2.1.5		8.2.2	**Smooth, Straight, Horizontal at a maximum prop height of 4m to soffit of**				
1.2.1.5.1			(a) Walkway slab	m²	80		
1.2.1.6		8.2.5	**Narrow widths (up to 250mm wide) straight edge of**				
1.2.1.6.1			(a) Channel Floor Slabs	m	32		
1.2.1.7		8.2.5	**Narrow width <=300mm curved edge of**				
1.2.1.7.1			(a) Circular Tank and Channel	m	14		
1.2.2		8.2.6	**Box out holes/form voids:**				
1.2.2.1		8.2.6 (a)	Small, circular of diameter up to and including 0,35 m:				
1.2.2.1.1		8.2.6 (a) (3)	Over 1,5 m and up to 2,0 m deep	No	1		
1.2.2.2		8.2.6 (c)	Large, circular, of diameter over 0,35 m up to and including 0,7 m:				
1.2.2.2.1		8.2.6 (c) (2)	Over 0,5 m and up to 1,0 m deep	No	3		
1.2.3		8,3	**Scheduled Reinforcement Items**				
		8.3.1	**Steel bars:**				
1.2.3.1		8.3.1	(a) Mild Steel (R), all sizes	t	0,8		
1.2.3.2		8.3.1	(b) High Tensile Steel (Y), all sizes	t	7		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
1.2.4		8,4	**Scheduled Concrete Items**				
1.2.4.1		8.4.1	**Prescribed mix concrete Grade 25/19 mass concrete**				
1.2.4.1.1			(a) All concrete benching including formwork, laying, shaping and finishing to line and level	m³	1		
1.2.4.2		8.4.2	**Blinding layer with 15/19 concrete grade:**				
1.2.4.2.1			(a) 50mm thick blinding	m³	2		
1.2.4.3		8.4.3	**Strength concrete, grade 35/19**				
1.2.4.3.1			(a) Complete structure Including channels	m³	33		
1.2.4.3.2			(b) Splitter box complete	m³	3		
		8.4.4	**Unformed surface finishes:**				
1.2.4.4		8.4.4 (b)	**Steel-floated finish**				
1.2.4.4.1			(a) Top of Walls	m²	13		
1.2.4.4.2			(b) Floor slab	m²	13		
1.2.4.5		8,5	**Joints (as detailed on Drawings)**				
1.2.4.5.1			(a) Contraction joints	m	10		
1.2.4.5.2			(b) Expansion joints	m	10		
1.2.4.6		8,7	**Grouting:**				
1.2.4.6.1		8.7 (a)	Under base (or beds)	m³	1		
1.2.4.6.2		8.7 (b)	Grout pockets for H.D. bolts	m³	1		
1.2.4.7		PSG 8.9	Grouting of pipes/specials through walls or slabs	m³	1		
1.2.4.8		PSG 8.10	Casting of pipes/specials through walls or slabs	m³	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
1.3		SABS 1200 HA, PSHA	**STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
1.3.1		8.3.2	Handrails:				
1.3.1.1			Supply and install tubular galvanised steel handrailing including bends and for all galvanised steel holding down bolts and setting same into concrete as per Drawing MD5775-RHD-BR-VD-DR-C-1101	m	32		
1.3.2		8.3.4 (a)	**Open Grid Flooring**				
1.3.2.1			Supply and install open grid flooring RS80 'GMS Rectagrid' or similar approved, 1480 x 1200mm with 40x40x4.5mm M.S. angle frames built in to splitter box to cut and suit as per Drawing MD5775-RHD-BR-VD-DR-C-1101	No	1		
1.4			**MISCELLANEOUS ITEMS**				
1.4.1		SABS 1200 G, PSG	**Pipe specials**				
			All mild steel to have 4.5mm wall thicknesss and to be API 5L Grade X 42 unless indicated differently, Steel flanges to SANS 1123 Table 1000/3				
1.4.1.1		PSG 8.10	DN350 pe/fl 500mm long steel pipe with puddle flange 125mm from pe	No	1		
1.4.2		SANS 1200 LE	Supply and lay reinforced concrete pipes with ogee joints of diameters and class indicated:				
1.4.2.1		8.2.1	DN450 concrete pipe class 50D	m	2		
1.4.3		PSG 8.11	Cleaning, disinfecting and sterilising of structure in accordance with the specification	Sum	1		
1.4.4		PSG 8.12	Testing of structures in accordance with the Specification for water tightness	Sum	1		
1.4.5		SANS1200 LC 8.2.6	Supply and install cable duct sand	m³	1		
TOTAL SECTION 1: VORTEX DEGRITTER CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
2.0			**SECTION 2: BALANCING TANK**				
2.1		SANS 1200D, PSD	**EARTHWORKS**				
		8.3.1	**Site preparation**				
2.1.1.1		8.3.1.1	Clear and grub as directed by the Engineer	m²	370		
2.1.1.2		8.3.1.2	Clear site / remove topsoil to a depth of 150mm and stockpile and maintain for reuse and/or disposal	m²	370		
2.1.2		8.3.2	**Bulk excavation:**				
2.1.2.1		8.3.2 (a)	(a) Excavate in all materials and use for embankment or backfill or dispose, as ordered	m³	940		
2.1.2.2		8.3.2 (b)	Extra over for:				
2.1.2.2.1		8.3.2 (b) (1)	Intermediate excavation	m³	569		
2.1.2.2.2		8.3.2 (b) (2)	Hard rock excavation	m³	60		
2.1.2.2.3		8.3.2 (b) (3)	Boulder excavation, Class A	m³	10		
2.1.2.2.4		8.3.2 (b) (4)	Boulder excavation, Class B	m³	6		
2.1.3		8.3.3	**Restricted excavation**				
2.1.3.1			(a) Excavate for restricted foundations, footings and pipe trenches in all materials and use for backfill or embankment or dispose	m³	951		
2.1.3.2		8.3.3 (b)	(b)Extra over for:				
2.1.3.2.1		8.3.3 (b) (1)	Intermediate excavation	m³	578		
2.1.3.2.2		8.3.3 (b) (2)	Hard rock excavation	m³	19		
2.1.3.2.3		8.3.3 (b) (3)	Boulder excavation, Class A	m³	10		
2.1.3.2.4		8.3.3 (b) (4)	Boulder excavation, Class B	m³	10		
2.1.4		8.3.4	**Importing of materials:**				
2.1.4.1		PSD 8.3.14	(a) Extra-over for 5% cement stabilisation of backfill (by mass), compacted in layers not exceeding 175mm to minimum 98% Mod AASHTO maximum dry density, incl for the supply of cement, G4/G5 crashed stone, mixing, adding water	m³	187		
2.1.5		8.3.5	Extra excavation in all materials to provide working space around structure	m²	83		
2.1.6		8.3.8	**Existing services (see 5.1.2.2):**				
2.1.6.1		8.3.8.1	Location:				
2.1.6.1.1		8.3.8.1 (a)	(a) Supply (unless hired under item (b) below) of specialist equipment for detection	Sum	1		
2.1.6.1.2		8.3.8.1 (b)	(b)The use or hire of specialist equipmentfor detection	hr	100		
2.1.6.1.3		8.3.8.1 (c)	(c) Excavate by hand in soft material to expose Water, Sewer and Electrical services	m³	50		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
2.1.7		8.3.9	Extra over for backfill or for fill material against existing storage building	m³	10		
2.1.8		8.3.10	Topsoiling	m²	83		
2.1.9		8.3.11	Grassing or other vegetation cover	m²	83		
2.1.10		PSD 8.3.16	Final finishing and clearing up	Sum	1		
2.2		**SANS 1200G**	**CONCRETE (STRUCTURAL)**				
2.2.1		8,2	**Scheduled Formwork Items**				
2.2.1.1		8.2.1	**Rough, straight, battered**				
2.2.1.1.1			(a) external faces of main tank walls (measured to 150mm below Finished Ground Level)	m²	76		
2.2.1.2		8.2.1	**Rough, straight, Vertical**				
2.2.1.2.1			(a) External faces of all control chambers walls (150mm below ground level)	m²	72		
2.2.1.3		8.2.2	**Smooth, straight, Vertical**				
2.2.1.3.1			(a) External and internal faces of all control chambers walls	m²	452		
2.2.1.3.2			(b) Internal faces of Main Tank Walls and dividing Walls	m²	482		
2.2.1.4		8.2.2	**Smooth, straight, battered**				
2.2.1.4.1			(a) External faces of all control chambers walls (above ground level)	m²	243		
2.2.1.5		8.2.2	**Smooth, straight and circular**				
2.2.1.5.1			(a) Columns	m²	87		
2.2.1.6		8.2.5	**Narrow widths (up to 250mm wide) straight edge of**				
2.2.1.6.1			(a) Walkways Slabs	m	60		
2.2.1.7		8.2.5	**Narrow widths (up to 400mm wide) straight edge of**				
2.2.1.7.1			(b) Foundations main tank and Control chambers	m	140		
		8.2.6	**Box out holes/form voids:**				
2.2.1.8			(a) Small, circular of diameter up to and including 0,35 m:				
2.2.1.8.1		8.2.6 (a) (1)	Up to 0,5 m deep	No	1		
2.2.1.8.2		8.2.6 (a) (2)	Over 0,5 m and up to 1,0 m deep	No	1		
2.2.1.8.3		8.2.6 (a) (3)	Over 1,0 m and up to 1,5 m deep	No	1		
2.2.1.8.4		8.2.6 (a) (4)	Over 1,5 m and up to 2,0 m deep	No	1		
2.2.1.8.5		8.2.6 (a) (5)	Over 2,0 m deep	No	25		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
2.2.2		8,3	**Scheduled Reinforcement Items**				
		8.3.1	**Steel bars:**				
2.2.2.1		8.3.1	(a) Mild Steel (R), all sizes	t	7		
2.2.2.2		8.3.1	(b) High Tensile Steel (Y), all sizes	t	61		
2.2.3		8,4	**Scheduled Concrete Items**				
2.2.3.1		8.4.1	**Prescribed mix concrete Grade 25/19 mass concrete**				
2.2.3.1.1			(a) All concrete benching including formwork, laying, shaping and finishing to line and level	m³	3		
2.2.3.2		8.4.2	**Blinding layer with 15/19 concrete grade:**				
2.2.2.2.1			(a) 50mm thick blinding	m²	373		
2.2.3.3		8.4.3	**Strength concrete, grade 35/19**				
2.2.3.3.1			(a) 400mm concrete main tank floor	m³	88		
2.2.3.3.2			(b) 400mm concrete control chambers floors	m³	42		
2.2.3.3.3			(c) 400mm narrowing to 170mm Main Tank concrete wall	m³	90		
2.2.3.3.4			(d) 200mm internal concrete wall	m³	19		
2.2.3.3.5			(e) 250mm Control chambers concrete wall	m³	53		
2.2.3.3.6			(f) 400 diamater concrete columns	m³	9		
2.2.3.3.7			(g) 200mm concrete walkway	m³	10		
2.2.3.4		PSG 8.1.3.2	No fines concrete including finishing and sealing as specified for underdrainage system				
2.2.3.4.1			(a) in 75mm thick horizontal layer	m³	28		
		8.4.4	**Unformed surface finishes:**				
2.2.3.5		8.4.4 (a)	**Wood-floated finish**				
2.2.3.5.1			(a) all benching and screed	m²	11		
2.2.3.6		8.4.4 (b)	**Steel-floated finish**				
2.2.3.6.1			(a) Upper surfaces of walkways slabs	m²	35		
2.2.3.6.2			(b) Top of all walls including Inlet and Outlet Control chambers	m²	21		
2.2.3.7		8.4.4 (c)	**Power-floated finish**				
2.2.3.7.1			(a) Main floor Tank	m²	195		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
2.2.3.8		8,5	**Joints:**				
2.2.3.8.1			Floor Contraction joints 400mm high as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	40		
2.2.3.8.2			Wall Contraction joints 400mm to 170mm wide as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	35		
2.2.3.8.3			Floor Expansion joints 400mm high as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	195		
2.2.3.8.4			Wall Expansion joints 400mm to 170mm wide as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	195		
2.2.3.9		8,7	**Grouting:**				
2.2.3.9.1		8.7 (a)	Under base (or beds)	m^3	2		
2.2.3.9.2		8.7 (b)	Grout pockets for H.D. bolts	m^3	2		
2.2.3.9.3		PSG 8.9	(c) Grouting of pipes/specials through walls or slabs	m^3	5		
2.2.3.9.4		PSG 8.10	(d) Casting of pipes/specials through walls or slabs	m^3	5		
2.3		SABS 1200 HA	**STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
2.3.1		8.3.2	**Handrails:**				
2.3.1.1			Supply and install tubular galvanised steel handrailing including bends and for all galvanised steel holding down bolts and setting same into concrete as per Drawing MD5775-RHD-BR-BT-DR-C-1201	m	90		
2.3.2		8.3.3	**Ladders, complete and installed including all galvanised steel holding down bolts and setting same into concrete**				
2.3.2.1			Galvanised steel external ladder 4.0 m high as per Drawing MD5775-RHD-BR-BT-DR-C-1201	No	1		
2.3.2.2			Galvanised steel internal ladder 5.0 m high at inlet chambers as per Drawing MD5775-RHD-BR-BT-DR-C-1201	No	3		
2.3.2.3			Galvanised steel internal ladder 2.8 m high at outlet Chambers as per Drawing MD5775-RHD-BR-BT-DR-C-1201	No	3		
2.3.2.4			Galvanised steel internal ladder 2.8 m high at overflow Chamber as per Drawing MD5775-RHD-BR-BT-DR-C-1201	No	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
2.3.3		8.3.4 (a)	**Flooring, complete and installed with**				
2.3.3.1			Supply and install open grid flooring RS80 'GMS Rectagrid' or similar approved, 2475x2350 mm with 40x40x4.5mm M.S. angle frames built in to Inlet chambers as per Drawing MD5775-RHD-BR-BT-DR-C-1201	No	3		
2.3.3.2			Supply and install open grid flooring RS80 'GMS Rectagrid' or similar approved, 2030x1700 mm with 40x40x4.5mm M.S. angle frames built in to Outlet chambers as per Drawing MD5775-RHD-BR-BT-DR-C-1201	No	3		
2.3.3.3			Supply and install open grid flooring RS80 'GMS Rectagrid' or similar approved, 2275x1830mm with 40x40x4.5mm M.S. angle frames built in to Overflow chamber as per Drawing MD5775-RHD-BR-BT-DR-C-1201	No	1		
2.4			**MISCELLANEOUS ITEMS**				
2.4.1		SABS1200G, PSG	**Pipe Specials**				
			All mild steel to have 4.5mm wall thicknesss and to be API 5L Grade X 42 unless indicated differently, Steel flanges to sans 1123 Table 1000/3				
2.4.1.1			DN150 d/fl wedge gate valve	No	6		
2.4.1.2			DN250 d/fl wedge gate valve	No	5		
2.4.1.3			DN350 d/fl wedge gate valve	No	2		
2.4.1.4			DN150 dismantling joint, 194mm f/f	No	6		
2.4.1.5			DN250 dismantling joint, 194mm f/f	No	5		
2.4.1.6			DN350 dismantling joint, 194mm f/f	No	2		
2.4.1.7		PSG8.10	DN250 x DN150 d/fl 205mm long reducer	No	1		
2.4.1.8		PSG8.10	DN350 x DN250 d/fl 255mm long reducer	No	1		
2.4.1.9			DN250 flange adaptor to suit DN250 PVC-U pipe	No	1		
2.4.1.10		PSG8.10	DN150 d/fl x 90 degree 3 segments bend, 230mm c/f	No	2		
2.4.1.11		PSG8.10	DN250 d/fl x 90 degree 3 segments bend, 355mm c/f	No	1		
2.4.1.12		PSG8.10	DN400 pe/fl x 90 degree 3 segments bend, 405mm c/f	No	1		
2.4.1.13		PSG8.10	DN400 d/fl x 90 degree 3 segments bend, 405mm c/f	No	1		
2.4.1.14		PSG8.10	DN150 x DN150 d/fl equal tee with 460mm long barrel and 230mm long c/fl central branch	No	1		
2.4.1.15		PSG8.10	DN250 x DN150 d/fl unequal tee with 560mm long barrel and 280mm long c/fl central branch	No	2		
2.4.1.16		PSG8.10	DN350 x DN250 d/fl unequal tee with 710mm long barrel and 280mm long c/fl central branch	No	2		
2.4.1.17		PSG8.10	DN150 pe/fl 720mm long steel pipe with puddle flange 150mm from pe	No	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
2.4.1.18		PSG8.10	DN250 pe/fl 795mm long steel pipe with puddle flange 150mm from pe	No	2		
2.4.1.19		PSG8.10	DN250 pe/fl 720mm long steel pipe with puddle flange 150mm from pe	No	1		
2.4.1.20		PSG8.10	DN250 d/fl 757mm long steel pipe with puddle flange 325mm from one end	No	3		
2.4.1.21		PSG8.10	DN250 d/fl 750mm long steel pipe with central puddle flange	No	2		
2.4.1.22		PSG8.10	DN250 d/fl 3400mm long steel pipe	No	1		
2.4.1.23		PSG8.10	DN250 d/fl 3490mm long steel pipe	No	1		
2.4.1.24		PSG8.10	DN350 d/fl 1130mm long steel pipe with puddle flange 350mm from one end	No	1		
2.4.1.25		PSG8.10	DN350 d/fl 750mm long steel pipe with puddle flange 350mm from one end	No	1		
2.4.1.26		PSG8.10	DN350 d/fl 1060mm long steel pipe with puddle flange 370mm from one end	No	1		
2.4.1.27		PSG8.10	DN350 d/fl 810mm long steel pipe with puddle flange 375mm from one end	No	1		
2.4.1.28		PSG8.10	DN350 d/fl 710mm long steel pipe with puddle flange 3705mm from one end	No	1		
2.4.1.29		PSG8.10	DN350 d/fl 3125mm long steel pipe	No	1		
2.4.1.30		PSG8.10	DN350 d/fl 2830mm long steel pipe	No	1		
2.4.1.31		PSG8.10	DN400 pe/fl 600mm long steel pipe with puddle flange 150mm from pe	No	1		
2.4.1.32		PSG8.10	DN400 d/fl 2720mm long steel pipe	No	1		
2.4.1.33		PSG8.10	DN150 pe/fl 670 mm long steel pipe with puddle flange 150mm from pe	No	2		
2.4.1.34		PSG8.10	DN150 pe/fl 550 mm long steel pipe with puddle flange 150mm from pe	No	1		
2.4.1.35		PSG8.10	DN150 pe/fl 580 mm long steel pipe with puddle flange 150mm from pe	No	2		
2.4.1.36		PSG8.10	DN150 d/fl 3125 mm long steel pipe	No	1		
2.4.1.37		PSG8.10	DN150 d/fl 1210 mm long steel pipe with puddle flange 355 mm from one end	No	1		
2.4.1.38		PSG8.10	DN150 d/fl 1565 mm long steel pipe with puddle flange 370 mm from one end	No	2		
2.4.1.39		PSG8.10	DN150 d/fl 2825 mm long steel pipe	No	1		
2.4.1.40		PSG8.10	DN150 d/fl 1135 mm long steel pipe with puddle flange 370 mm from one end	No	2		
2.4.1.41		PSG8.10	DN150 pe/fl 1170 mm long steel pipe with puddle flange 150mm from pe	No	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
2.4.2			**Supply and install PVC-U scour/drain pipe**				
2.4.2.1			DN160 class 34 PVC-U pipe, to be cut and install as per Drawing MD5775-RHD-BR-BT-DR-C-1201	m	26		
2.4.3		SANS1200 LC	**Supply and install uPVC cable ducts**				
2.4.3.1		8.2.5	DN75 PVC-U cable ducts	m	20		
2.4.4		PSG 8.11	Cleaning, disinfecting and sterilising of structure in accordance with the specification	Sum	1		
2.4.5		PSG 8.12	Testing of structures in accordance with the Specification for water tightness	Sum	1		
2.4.6		SANS1200 LC 8.2.6	Supply and install cable duct sand	m^3	1		
TOTAL SECTION SECTION SECTION 2: BALANCING TANK CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
3.0			**SECTION 3: FACILITIES BUILDING: CONCRETE WORKS**				
3.1		SANS 1200D, PSD	**EARTHWORKS**				
3.1.1		8.3.1	**Site preparation**				
3.1.1.1		8.3.1.1	Clear and grub as directed by the Engineer	m²	304		
3.1.1.2		8.3.1.2	Clear site / remove topsoil to a depth of 150mm and stockpile and maintain for reuse and/or disposal	m²	304		
3.1.2		8.3.2	**Bulk excavation:**				
3.1.2.1		8.3.2 (a)	(a) Excavate in all materials and use for embankment or backfill or dispose, as ordered	m³	831		
3.1.2.2		8.3.2 (b)	Extra over for:				
3.1.2.2.1		8.3.2 (b) (1)	Intermediate excavation	m³	455		
3.1.2.2.2		8.3.2 (b) (2)	Hard rock excavation	m³	73		
3.1.2.2.3		8.3.2 (b) (3)	Boulder excavation, Class A	m³	8		
3.1.2.2.4		8.3.2 (b) (4)	Boulder excavation, Class B	m³	8		
3.1.3		8.3.3	**Restricted excavation**				
3.1.3.1		8.3.3 (a)	(a) Excavate for restricted foundations, footings and pipe trenches in all materials and use for backfill or embankment or dispose	m³	250		
3.1.3.1		8.3.2 (b)	Extra over for:				
3.1.3.1.1		8.3.3 (b) (1)	Intermediate excavation	m³	100		
3.1.3.1.2		8.3.3 (b) (2)	Hard rock excavation	m³			
3.1.3.1.3		8.3.3 (b) (3)	Boulder excavation, Class A	m³			
3.1.3.1.4		8.3.3 (b) (4)	Boulder excavation, Class B	m³			
3.1.4		8.3.4	**Importing of materials:**				
3.1.4.1		PSD 8.3.14	(a) Extra-over for 5% cement stabilisation of backfill (by mass), compacted in layers not exceeding 175mm to minimum 98% Mod AASHTO maximum dry density, incl for the supply of cement, G4/G5 crushed stone, mixing, adding water	m³	123		
3.1.4.2		8.3.5	Extra excavation in all materials to provide working space around structure	m²	77		
3.1.4.3		8.3.7	Additional lateral support if ordered (provisional)	Sum	1		
3.1.5		8.3.8	**Existing services (see 5.1.2.2):**				
3.1.5.1		8.3.8.1	**Location of Services:**				
3.1.5.1.1		8.3.8.1 (a)	Supply (unless hired under item (b) below) of specialist equipment for detection	Sum	1		
3.1.5.1.2		8.3.8.1 (b)	The use or hire of specialist equipment for detection	hr	40		
3.1.5.1.3		8.3.8.1 (c)	Excavate by hand in soft material to expose existing service	m³	84		
3.1.5.2		8.3.8.2	**Dealing with services that are at risk because of the construction of earthworks:**				
3.1.1.2.1		8.3.8.2 (a)	Cables	Sum	1		
3.1.1.2.2		8.3.8.2 (b)	Permanent protection of existing services	Sum	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
3.1.1.2.3		8.3.8.2 (c)	(c) Temporary protection of existing services	Sum	1		
3.1.1.3		8.3.9	Extra over for backfill or for fill material against structures	m³	10		
3.1.1.4		8.3.10	Topsoiling	m²	70		
3.1.1.5		8.3.11	Grassing or other vegetation cover	m²	70		
3.1.1.6		PSD 8.3.16	Final finishing and clearing up	Sum	1		
3.2		SANS 1200G, PSG	**CONCRETE (STRUCTURAL)**				
3.2.1		8,2	**Scheduled Formwork Items**				
3.2.1.1		8.2.1	**Rough, straight, vertical**				
3.2.1.1			(a) external faces of pump well walls and Sumps (measured to 150mm below Finished Ground Level)	m²	114		
3.2.2		8.2.2	**Smooth, straight, Vertical**				
3.2.2.1			(a) External and internal faces of all pump well walls	m²	422		
3.2.2.2			(b) Columns	m²	125		
			(b) External faces of roof slab and ring beam	m²	125		
3.2.3		8.2.2	**Smooth, straight, horizontal at a maximum prop height of 4m to soffit of**				
3.2.3.1			(a) All Floor Slabs including Walkways	m²	220		
3.2.3.2			(b) Ring Beam	m²	100		
3.2.3.2			(c) Stairs Landing	m²	3		
3.2.4		8.2.5	**Narrow widths (up to 400mm wide) straight edges of**				
3.2.4.1			(a) Ring Beam upstand internal faces	m	226		
3.2.4.2			(b) All floor Slabs Including Drains, Cable ducts and Column Bases	m	67		
3.2.4.3			(c) Stairs and Stairs Landings	m	51		
3.2.5		8.2.6	**Box out holes/form voids:**				
3.2.5.1			(a) Small, circular of diameter up to andincluding 0,35 m:				
3.2.5.1.1		8.2.6 (a) (1)	Up to 0,5 m deep	No	1		
3.2.5.1.2		8.2.6 (a) (2)	Over 0,5 m and up to 1,0 m deep	No	1		
3.2.5.1.3		8.2.6 (a) (3)	Over 1,0 m and up to 1,5 m deep	No	1		
3.2.5.1.4		8.2.6 (a) (4)	Over 1,5 m and up to 2,0 m deep	No	1		
3.2.5.1.5		8.2.6 (a) (5)	Over 2,0 m deep	No	3		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
3.2.5.2		8.2.6 (c)	Large, circular, of diameter over 0,35 m up to and including 0,7 m:				
3.2.5.2.1		8.2.6 (c) (5)	(1) Over 2,0 m deep	No	3		
3.2.6		8,3	**Scheduled Reinforcement Items**				
		8.3.1	**Steel bars:**				
3.2.6.1		8.3.1	(a) Mild Steel (R), all sizes	t	6		
3.2.6.2		8.3.1	(b) High Tensile Steel (Y), all sizes	t	55		
3.2.7		8,4	**Scheduled Concrete Items**				
3.2.7.1		8.4.1	**Prescribed mix concrete Grade 25/19 mass concrete**				
			(a) All concrete benching including formwork, laying, shaping and finishing to line and level	m³	1		
		8.4.2	**Blinding layer with 15/19 concrete grade:**				
3.2.7.1.1			(a) Minimum 50mm thick blinding	m²	172		
3.2.7.2		8.4.3	**Strength concrete, grade 15/19**				
3.2.7.2.1			False floor	m³	7		
3.2.7.3		8.4.3	**Strength concrete, grade 35/19**				
3.2.7.3.1			(a) Concrete floors	m³	101		
3.2.7.3.2			(b) Roof Slabs including upstand	m³	55		
3.2.7.3.2			(c) Ring Beams	m³	50		
3.2.7.3.4			(d) Sumps and Pump well Walls	m³	81		
3.2.7.3.5			(e) All Concrete columns including column bases	m³	19		
3.2.7.3.6			(f) Stairs and stairs landings	m³	4		
3.2.8		8.4.4	**Unformed surface finishes:**				
3.2.8.1		8.4.4 (b)	Steel-floated finish				
3.2.8.1.1			(a) Upper surfaces of Walls and stairs	m²	14		
3.2.8.2		8.4.4 (c)	Power-floated finish				
3.2.8.2.1			(a) All floors slabs including roofs	m²	369		
3.2.9		8,5	**Joints:**				
3.2.9.1			(a) Contraction joints	m	15		
3.2.9.2			(b) Expansion joints	m	10		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
3.2.10		8,7	**Grouting:**				
3.2.10.1		8.7 (a)	Under bases (or beds)	m³	2		
3.2.10.2		8.8	HD bolts and miscellaneous metal work	m³	1		
3.2.10.3		PSG 8.9	Grouting of pipes/specials through walls or slabs	m³	5		
3.2.10.4		PSG 8.10	Casting of pipes/specials through walls or slabs	m³	5		
3,7			**MISCELLANEOUS ITEMS**				
3.7.1		SABS1200G, PSG	**Pipe Specials**				
			All mild steel to have 4.5mm wall thicknesss and to be API 5L Grade X 42 unless indicated differently, Steel flanges to sans 1123 Table 1000/3				
3.7.1.1			DN100 d/fl wedge gate valve	No	1		
3.7.1.2			DN200 d/fl wedge gate valve	No	1		
3.7.1.3			DN250 d/fl wedge gate valve	No	6		
3.7.1.4			DN200 d/fl air valve	No	1		
3.7.1.5			DN250 d/fl air valve	No	1		
3.7.1.6			DN250 d/fl non-return valve	No	2		
3.7.1.7			DN200 dismantling joint, 194mm f/f	No	1		
3.7.1.8			DN250 x DN100 d/fl 205mm long reducer	No	1		
3.7.1.9			DN250 x DN200 fl/pe 180mm long reducer	No	1		
3.7.1.10			DN100 flange adaptor to suit DN100 PVC_U pipe	No	1		
3.7.1.11			DN200 flange adaptor to suit DN200 PVC-U pipe	No	1		
3.7.1.12			DN250 flange adaptor to suit DN250 PVC-U pipe	No	1		
3.7.1.13			DN100 d/fl x 90 degree 3 segments bend, 230mm c/f	No	3		
3.7.1.14			DN150 d/fl x 90 degree 3 segments bend, 230mm c/f	No	5		
3.7.1.15			DN200 d/fl x 90 degree 3 segments bend, 230mm c/f	No	2		
3.7.1.16			DN250 d/fl x 90 degree 3 segments bend, 280mm c/f	No	6		
3.7.1.17			DN150 d/fl x 90 degree reducing bend	No	1		
3.7.1.18		PSG8.10	DN250 x DN250 d/fl equal tee with 460mm long barrel and 230mm long c/fl central branch	No	1		
3.7.1.19		PSG8.10	DN200 x DN100 d/fl unequal tee with 463mm long barrel and 230mm long c/fl central branch	No	1		
3.7.1.20		PSG8.10	DN100 pe/fl 820mm long steel pipe with central puddle flange	No	2		
3.7.1.21		PSG8.10	DN250 pe/fl 1975mm long steel pipe with puddle flange 320mm from pe	No	2		
3.7.1.22			DN100 d/fl 3400mm long steel pipe	No	2		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
3.7.1.23			DN250 d/fl 500mm long steel pipe	No	1		
3.7.1.24			DN250 d/fl 560mm long steel pipe	No	2		
3.7.1.25			DN250 d/fl 1350mm long steel pipe	No	1		
3.7.1.26			DN250 d/fl 4930mm long steel pipe	No	1		
3.7.1.27		PSG8.10	DN250 d/fl 1500mm long steel pipe with puddle flange 850mm from one end	No	1		
3.7.1.28			DN100 fl/pe 400mm long steel pipe	No	1		
3.7.1.29			DN200 fl/pe 300mm long steel pipe	No	2		
3.7.1.30			DN250 fl/pe 300mm long steel pipe	No	1		
3.7.1.31		PSG8.10	DN150 pe/fl 780 mm long steel pipe with puddle flange 150mm from pe	No	1		
3.7.1.32		PSG8.10	DN150 pe/fl 530 mm long steel pipe with puddle flange 150mm from pe	No	1		
3.7.1.33		PSG8.10	DN150 pe/fl 445 mm long steel pipe with puddle flange 150mm from pe	No	1		
3.7.1.34			DN150 d/fl 1550 mm long steel pipe	No	1		
3.7.1.35		PSG8.10	DN150 d/fl 2080 mm long steel pipe with puddle flange 355 mm from one end	No	1		
3.7.1.36			DN150 d/fl Wedge Gate valve	No	2		
3.7.1.37		PSG8.10	DN150 d/fl Wedge Gate valve with extension spindle	No	1		
3.7.1.38		PSG8.10	DN150 d/fl Wedge Gate valve complete with actuator	No	1		
3.7.1.39		PSG8.10	DN150 d/fl 705mm long steel pipe with central flange	No	1		
3.7.1.40		PSG8.10	DN150 pe/fl 2016mm long steel pipe with puddle flange 375mm from flange ended	No	1		
3.7.1.41			DN150 d/fl dismantling joint	No	1		
3.7.2		PSLE	**Supply and install PVC-U scour/drain pipe**				
3.7.2.1		PSLE 8.2.14 (i)	DN100 slotted uPVC pipe, to be cut and install as per Drawing MD5775-RHD-BR-FB-DR-C-1301	m	50		
3.7.2.2		PSLE 8.2.14(iii)	Geofabric material (BIDIM Grade A4 or similar approved) installed around stone. and shall include for a 300 mm overlap	m²	19		
3.7.2.3		PSLE 8.2.14(iv)	19mm stone in peripheral drain wrapped in Grade A4 Bidim or similar approved	m³	19		
TOTAL SECTION SECTION SECTION 43: FACILITIES BUILDING: CONCRETE WORKS CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
	CPG		**SECTION 4: FACILITIES BUILDING: BUILDING WORKS**				
4		PQA 15	**BRICKWORK, BLOCKWORK AND PLASTERING**				
		PQA 15.1	**BRICKWORK**				
4,1			**Brickwork of NFX bricks (14 Mpa nominal compressive strength)**				
4.1.1			Brickwork in class II mortar				
4.1.1.1		PQA 15.1	Brick wall 230mm thick	m²	230		Rate Only
4.1.1.2			Brick wall 110mm thick	m²	50		Rate Only
4.1.1.3			Allow for cutting toothing and bonding	m²	40		Rate Only
			Brickwork Sundries				
4.1.2		PQA15.9	Galvanised Brickwork reinforcement				
4.1.2.1			"Brickforce" or similar approved wire mesh reinforcement, 150mm wide, built into walls and lintels.	m	550		Rate Only
4.1.2.2		PQA15.5	110 x 70mm Precast concrete lintels fixed to brickwork over all openings suitbale for double brick wall.	m	25		Rate Only
4.1.3		PQA 15.2	**Louvre vents**				
4.1.3.1			1250mm wide x 750mm deep trox NL aluminium louvre or similar approved	No	6		Rate Only
4.1.3.2			1800mm wide x 2250mm deep trox NL aluminium louvre or similar approved	No	1		Rate Only
4.1.4		PQA 15.3	**Building in window frames, door frames, pipes, steelwork, etc**				
4.1.4.1			(a) Internal Doors	No	4		Rate Only
4.1.4.2			(a) External Doors with security gate	No	1		Rate Only
4.1.4.3		PQA 15.4	Damp proof course	m²	220		Rate Only
4.1.4.4		PQA 15.6	Extraction fans	No	9		Rate Only
4.1.4.5		PQA 15.7	Chases in brickwork	m	100		Rate Only
4.1.4.6		PQA 15.8	Hoop iron ties complete	No	10		Rate Only
4.1.4.7		PQA 16.4	Waterproof coating of external faces	m²	250		Rate Only
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
4.1.5		PQA 17	**Plastering**				
4.1.5.1		PQA 17.1	Supply and apply 3:1 cement plaster with waterproofing agent (or similar approved) minimum 10 mm thick in one coat to internal face of the building including for a smooth and even steel float finish	m²	250		Rate Only
4.1.6		PQH	**Painting**				
4.1.6.1			Degrease and remove all contamination and apply one coat primer and two coats high gloss enamel (Plascon velvaglo polyurethane velvet non drip enamel or similar approved) to all internal walls	m²	250		Rate Only
4.1.7		PQB	**FLOOR FINISHES**				
4.1.7.1		PQB7.1.1	25mm thick granolithic screed steel float finish	m²	175		Rate Only
4.2		PQD	**STEEL DOORS AND WINDOWS**				
4.2.1		PQD 3.1	**Galvanised Pressed Steel Door Frames**				
			1,2mm Rebated frames suitable for one brick thick walls				
4.2.1.1			Frame for door 832 x 2032mm high	No	5		Rate Only
4.2.1.2			Galvanised louvred transformer double door and frame size 2000 x 3000 mm as manufactured by "Bitcon" or similar approved including pointing in mastic cement after setting in position. Frames to have metal priming coat to concealed edges prior to building in and to be painted as specified. Door to have cut out for crawl beam at top edge of meeting styles	No	2		Rate Only
4.2.1.3		PQD3.2	Aluminium window glazed with opaque glass PT69	No	1		Rate Only
4.2.1.4		PQD3.2	Aluminium window glazed with opaque glass PT99	No	1		Rate Only
4.2.1.5		PQD3.2	Aluminium window glazed with opaque glass PT1512	No	1		Rate Only
4.2.2		PQF 5	**Bathroom Sanitary and fittings**				
4.2.2.1			WC - consul close-coupled toilet suite as supplied by ceramic tile market or similar approved. toilet brush and holder is to be provided to the approval of the engineer.	No	1		Rate Only
4.2.2.2			WHB - consul wash hand basin and universal full pedestal as supplied by ceramic tile market or similar approved.	No	1		Rate Only
4.2.2.3			TRH - spindle toilet roll holder (code TVCH6225) as supplied by ceramic tile market or similar approved to each toilet.	No	1		Rate Only
4.2.2.4			500 x 600mm framed mirrors each to be fixed to the wall of male and female change rooms.	No	1		Rate Only
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
4,3		SABS 1200 HA, PSHA	**STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
4.3.1		8.3.1	**Lifting Mechanism and Beam**				
4.3.1.1			Supply and install 2 tonne rated crawl beam 305 x 165 x 41kg x 11m long complete with support beams and all fittings including chain block c/w 5m lift and geared trolley with hook block as shown on Drawing	No	1		Rate Only
4.3.1.2			Supply and install 2 tonne rated crawl beam 305 x 165 x 41kg x 11.3m long complete with support beams and all fittings including chain block c/w 5m lift and geared trolley with hook block as shown on Drawing	No	1		Rate Only
4.3.1.3			Load Testing	sum	2		Rate Only
4.3.2		8.3.2	**Handrails:**				
4.3.2.1			Supply and install tubular galvanised steel handrailing including bends and for all galvanised steel holding down bolts and setting same into concrete as per Drawing MD5775-RHD-BR-FB-DR-C-1303	m	35		Rate Only
4.3.3		8.3.4 (a)	**Flooring, complete and installed with**				
4.3.3.1			Supply and install open grid flooring RS80 'GMS Rectagrid' or similar approved, 8450x1100 mm with 40x40x4.5mm M.S. angle frames built in to drainage channel as per Drawing MD5775-RHD-BR-FB-DR-C-1303	No	1		Rate Only
4.3.3.2			Supply and install open grid flooring RS80 'GMS Rectagrid' or similar approved, 9825x1100 mm with 40x40x4.5mm M.S. angle frames built in to drainage channel as per Drawing MD5775-RHD-BR-FB-DR-C-1302	No	2		Rate Only
4.4		SANS 1200MJ, PSMJ	**SEGMENTED PAVING**				
4.4.1		8.2.1	Provision of edge restraints				
4.4.1.1			Beam edging complete with 15PMa mass concrete	m	90		Rate Only
4.4.2		PSMJ 8.2.2	Construction of paving complete				
4.4.2.1			500mm x 500mm x 50mm thick precast concrete paving slab	m²	90		Rate Only
4.4.2.2		PSMJ 8.2.3	Cutting units to fit edge restraints	m	30		Rate Only
4.4.2.3		PSA 8.4.6	Construction of the Facilities Building complete	Prov Sum	1		960 000,00
4.4.2.4			Contractor's Mark Up for Management, Development and Supervision of the CPG sub-	%			
TOTAL SECTION SECTION SECTION 4: FACILITIES BUILDING - BUILDING WORKS CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
5.0			**SECTION 5: RESERVOIR**				
5,1		SANS 1200D, PSD	**EARTHWORKS**				
5.1.1		8.3.1	**Site preparation**				
5.1.1.1		8.3.1.1	Clear and grub as directed by the Engineer	m²	833		
5.1.1.2		8.3.1.2	Clear site / remove topsoil to a depth of 150mm and stockpile and maintain for reuse and/or	m²	833		
5.1.2		8.3.2	**Bulk excavation:**				
5.1.2.1		8.3.2 (a)	Excavate in all materials and use for embankment or backfill or dispose,as ordered	m³	4014		
5.1.2.2		8.3.2 (b)	Extra over for:				
5.1.2.2.1		8.3.2 (b) (1)	Intermediate excavation	m³	1249		
5.1.2.2.2		8.3.2 (b) (2)	Hard rock excavation	m³	1933		
5.1.2.2.3		8.3.2 (b) (3)	Boulder excavation, Class A	m³	194		
5.1.2.2.4		8.3.2 (b) (4)	Boulder excavation, Class B	m³	5		
5.1.3		8.3.3	**Restricted excavation (see Drawing D-2):**				
5.1.3.1			(a) Excavate for restricted foundations,footings and pipe trenches in allmaterials and use for backfill or embankment or dispose	m³	1062		
5.1.3.2		8.3.3 (b)	Extra over for:				
5.1.3.2.1		8.3.3 (b) (1)	Intermediate excavation	m³	229		
5.1.3.2.2		8.3.3 (b) (2)	Hard rock excavation	m³	20		
5.1.3.2.3		8.3.3 (b) (3)	Boulder excavation, Class A	m³	20		
5.1.3.2.4		8.3.3 (b) (4)	Boulder excavation, Class B	m³	5		
5.1.4		8.3.4	**Importing of materials:**				
5.1.4.1		PSD 8.3.14	(a) Extra-over for 5% cement stabilisation of backfill (by mass), compacted in layers not exceeding 175mm to minimum 98% Mod AASHTO maximum dry density, incl for the supply of cement, G4/G5 crashed stone, mixing, adding water	m³	357		
5.1.4.1		8.3.5	Extra excavation in all materials to provide working space around structure	m²	125		
5.1.5		8.3.7	Additional lateral support between chlorine House and Proposed reservoir, if ordered (provisional)	Sum	1		Rate only
5.1.6		8.3.8	**Existing services (see 5.1.2.2):**				
5.1.6.1		8.3.8.1	**Location of Existing Services:**				
5.1.4.1.1		8.3.8.1 (a)	(a) Supply (unless hired under item (b) below) of specialist equipment for detection	Sum	1		Rate only
5.1.4.1.2		8.3.8.1 (b)	(b) The use or hire of specialist equipment for detection	hr	40		
5.1.6.2		8.3.8.1 (c)	Excavate by hand in soft material to expose Water, Sewer and Electrical services	m³	50		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
5.1.7		8.3.8.2	**Dealing with services that are at risk because of the construction of earthworks:**				
5.1.7.1		8.3.8.2 (a)	Cables (PS…)	No	5		
5.1.7.2		8.3.8.2 (b)	Permanent protection of Water and Stormwater Service (PS…)	Sum	1		Rate only
5.1.7.3		8.3.8.2 (c)	Temporary protection of Water and Stormwater Service (PS...)	Sum	1		Rate only
5.1.8		8.3.9	Extra over for backfill or for fill material against structures (PS. . .)	m³	125		
5.1.9		8.3.10	Topsoiling	m²	125		
5.1.10		8.3.11	Grassing or other vegetation cover	m²	125		
5.1.11		PSD 8.3.16	Final finishing and clearing up	Sum	1		
5,2		SANS 1200G, PSG	**CONCRETE (STRUCTURAL)**				
5.2.1		8,2	**Scheduled Formwork Items**				
5.2.1.1		8.2.1	**Rough, straight, battered**				
5.2.1.1.1			(a) External faces of reservoir Walls (measured to 150mm below Finished Ground Level)	m²	407		
5.2.1.2			**Rough, straight, Vertical**				
5.2.1.2.1			(a) External faces of Control chamber (measured to 150mm below Finished Ground Level)	m²	41		
5.2.1.2.2			(b) External faces of wall 600mm deep wall footing	m²	70		
5.2.1.3		8.2.2	**Smooth, straight, buttered**				
5.2.1.3.1			(a) External faces of Main Tank walls (above ground level)	m²	473		
5.2.1.4		8.2.2	**Smooth, straight, Vertical**				
5.2.1.4.1			(a) Internal faces and External faces of Control chamber (above Ground Level)	m²	177		
5.2.1.4.2			(b) Internal faces of main tank walls	m²	835		
5.2.1.4.3			(c) Overflow and rainwater outlet	m²	11		
5.2.1.5		8.2.2	**Smooth, straight and circular**				
5.2.1.5.1			(a) Columns	m²	164		
5.2.1.6		8.2.2	**Smooth, straight, sloping**				
5.2.1.6.1			(a) columns heads	m²	20		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
5.2.1.7		8.2.2	**Smooth, straight, horizontal to soffit of**				
5.2.1.7.1			(a) Main roof slab	m²	540		
5.2.1.7.2			(b) control chamber roof slab	m²	12		
5.2.1.7.3			(c) Overflow and Rainwater outlet slab	m²	6		
5.2.1.8		8.2.5	**Narrow widths (up to 300mm wide) straight edge of**				
5.2.1.8.1			(a) Column base and roof slab (Internal)	m	168		
5.2.1.9		8.2.5	**Narrow widths (up to 500mm wide) straight edge of**				
5.2.1.9.1			(b) Roof slab (External)	m	104		
		8.2.6	**Box out holes/form voids:**				
5.2.1.10			(a) Small, circular of diameter up to and including 0,35 m:				
5.2.1.10.1			(1) Over 2,0 m deep	No	2		
5.2.1.11			(b) Large, circular, of diameter over 0,35 m up to and including 0,7 m:				
5.2.1.11.1			(1) Over 1,0 m and up to 1,5 m deep	No	1		
5.2.1.11.2			(2) Over 2,0 m deep	No	2		
5.2.2		8,3	**Scheduled Reinforcement Items**				
		8.3.1	**Steel bars:**				
5.2.2.1		8.3.1	(a) Mild Steel (R), all sizes	t	18		
5.2.2.2		8.3.1	(b) High Tensile Steel (Y), all sizes	t	159		
5.2.3		8,4	**Scheduled Concrete Items**				
5.2.3.1		8.4.1	**Prescribed mix concrete Grade 25/19 mass concrete**				
5.2.3.1.1			(a) All concrete benching/screed including shaping and laying to line and level	m³	0,5		
5.2.3.1.2			(b) Mass concrete of control chamber for outlet pipe	m³	30		
5.2.3.2		8.4.2	**Grade 15/19 concrete Blinding layer**				
5.2.3.2.1			(a) 50mm thick blinding	m³	32		
5.2.3.3		8.4.3	**Strength concrete, grade 35/19**				
5.2.3.3.1			(a) Main Tank concrete floor Slab	m³	269		
5.2.3.3.2			(b) Roof slab including ring beam	m³	122		
5.2.3.3.3			(c) Control chamber roof and Floor Slab	m³	8		
5.2.3.3.4			(d) Overflow and rainwater outlet slab	m³	2		
5.2.3.3.5			(e) Reservoir Main walls	m³	418		
5.2.3.3.6			(f) Control Chamber Walls	m³	30		
5.2.3.3.8			(h) Concrete Column including base and head	m³	29		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
5.2.3.4		PSG 8.1.3.2	No fines concrete including finishing and sealing as specified for underdrainage system				
5.2.3.4.1			(a) in 75mm thick horizontal layer	m³	54		
		8.4.4	**Unformed surface finishes:**				
5.2.3.5		8.4.4 (a)	**Wood-floated finish**				
5.2.3.5.1			(a) all benching and screed	m²	8		
5.2.3.6		8.4.4 (b)	**Steel-floated finish**				
5.2.3.6.1			(a) Upper surfaces of roof slabs and ring beam	m²	576		
5.2.3.6.2			(b) Control chambers roof slab	m²	13		
5.2.3.7		8.4.4 (c)	**Power-floated finish**				
5.2.3.7.1			(a) Main floor Tank including control chamber	m²	713		
5.2.3.4		8,5	**Joints:**				
5.2.3.4.1			Floor Contraction joints 600mm to 200mm high, as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	160		
5.2.3.4.2			Wall Contraction joints 600mm to 400mm wide, as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	182		
5.2.3.4.3			Floor Expansion joints 600mm to 200mm high, as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	160		
5.2.3.4.4			Wall Expansion joints 600mm to 400mm wide, as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	182		
5.2.3.5		8,7	**Grouting:**				
5.2.3.5.1		8.7 (b)	Grout pockets for H.D. bolts	m³	2		
5.2.3.5.2		PSG 8.9	Grouting of pipes/specials through walls or slabs	m³	2		
5.2.3.5.3		PSG 8.10	Casting of pipes/specials through walls or slabs	m³	2		
5.2.3.5.4			Joints	m³	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
5.3		SABS 1200 HA	**STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
5.3.1		8.3.2	**Handrails:**				
5.3.1.1			Supply and install tubular galvanised steel handrailing including bends and for all galvanised steel holding down bolts and setting same into concrete as per Drawing MD5775-RHD-BR-RV-DR-C-1501	m	10		
5.3.2		8.3.3	**Ladders, complete and installed including all galvanised steel holding down bolts and setting same into concrete**				
5.3.2.1			Galvanised steel external ladder 5.0 m high including safety cage as per Drawing MD5775-RHD-BR-ZZ-DR-C-1801	No	1		
5.3.2.2			Galvanised steel internal ladder 8.25 m high (SS Grade 316) including safety cage as per Drawing MD5775-RHD-BR-ZZ-DR-C-1801	No	1		
5.3.2.3			Supply and install stainless steel 1700 x 400 woven mesh complete as shown on Drawing MD5775-RHD-BR-ZZ-DR-C-1801	No	1		
5.3.2.4			Supply and install stainless steel 500 x 500 woven mesh complete as shown on Drawing MD5775-RHD-BR-ZZ-DR-C-1801	No	1		
5.3.2.5			Supply and set in roof ND200 Grade 316 stainless steel ventilator as detailed on Drawing MD5775-RHD-BR-ZZ-DR-C-1801	No	4		
5.4			**MISCELLANEOUS ITEMS**				
5.4.1		SABS1200G, PSG	**Pipe Specials**				
			All mild steel to have 4.5mm wall thicknesss and to be API 5L Grade X 42 unless indicated differently, Steel flanges to sans 1123 Table 1000/3				
5.4.1.1			DN500 d/fl butterfly valve	No	1		
5.4.1.2			DN100 d/fl wedge gate valve	No	1		
5.4.1.3			DN100 d/fl air valve	No	1		
5.4.1.4			DN200 d/fl wedge gate valve	No	1		
5.4.1.5		PSG8.10	DN500 d/fl 750mm long steel pipe with central puddle flange	No	1		
5.4.1.6		PSG8.10	DN500 x DN100 d/fl unequal tee with 700mm long barrel and 450mm long c/fl central branch	No	1		
5.4.1.7			DN500 dismantling joint, 302 f/f	No	1		
5.4.1.8			DN500 pe/fl 90 degree bellmouth bend, radius 510mm, 3970mm c/f to flanged end and 880mm c/f to bellmouth end with 700mm diameter bellmouth inlet trimmed to match concrete floor	No	1		
5.4.1.9			DN200 d/fl x 90 degree 3 segments bend, 280mm c/f	No	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
5.4.1.10			DN200 pe/fl 90 degree bellmouth bend, radius 510mm, 4350mm c/f to flanged end and 880mm c/f to bellmouth end with 300mm diameter bellmouth inlet trimmed to match concrete floor	No	1		
5.4.1.11		PSG8.10	DN200 pe/fl 500mm long steel pipe with puddle flange 125mm from pe	No	1		
5.4.1.12			DN700 d/fl x 16 degree 2 segments bend, 355mm c/f	No	1		
5.4.1.13		PSG8.10	DN700 pe/fl 1300mm long steel pipe with central puddle flange	No	1		
5.4.2		PSLE	**Supply, handle, lay, joint and test including jointing material for Underfloor PVC-U pipe drainage system**				
5.4.2.1		PSLE 8.2.14 (i)	DN160 slotted uPVC class 16 with open joints to suit	m	48		
5.4.2.2			DN160 PVC-U class 16 with open joints to suit	m	12		
5.4.2.3		PSLE 8.2.14 (i)	DN160 uPVC class 16 peripheral drainage pipe including bends and fittings	m	110		
5.4.3		PSG 5.5.19	**Manhole Cover**				
5.4.3.1			Supply and install manhole cover and frame 1100 x 1200 as detailed on Drawing MD5775-RHD-BR-ZZ-DR-C-1800	No	1		
5.4.3.2			Supply and install manhole cover and frame 1640 x 1000 as detailed on Drawing MD5775-RHD-BR-ZZ-DR-C-1800	No	1		
5.5		PSG 8.11	Cleaning, disinfecting and sterilising of structure in accordance with the specification	Sum	1		
5.6		PSG 8.12	Testing of structure in accordance with the Specification for water tightness	Sum	1		
5.7			**Supply and place single sized washed, crushed igneous stone to required lines and levels:**				
5.7.1			25mm stone in peripheral drain	m³	54		
5.7.2			40 mm stone on reservoir roof	m³	56		
TOTAL SECTION SECTION SECTION 6: RESERVOIR CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
6.0			**SECTION 6: GRAVITY THICKENER**				
6.1		SANS 1200D, PSD	**EARTHWORKS**				
6.1.1		8.3.1	**Site preparation**				
6.1.1.1		8.3.1.1	Clear and grub as directed by the Engineer	m²	339		
6.2.1.1		8.3.1.2	Clear site / remove topsoil to a depth of 150mm and stockpile and maintain for reuse and/or disposal	m²	339		
6.1.2		8.3.2	**Bulk excavation:**				
6.1.2.1			(a) Excavate in all materials and use for embankment or backfill or dispose, as ordered	m³	1384		
6.1.2.2		8.3.2 (b)	Extra over for:				
6.1.2.2.1		8.3.2 (b) (1)	Intermediate excavation	m³	536		
6.1.2.2.2		8.3.2 (b) (2)	Hard rock excavation	m³	180		
6.1.2.2.3		8.3.2 (b) (3)	Boulder excavation, Class A	m³	46		
6.1.2.2.4		8.3.2 (b) (4)	Boulder excavation, Class B	m³			
6.1.3		8.3.3	**Restricted excavation :**				
6.1.3.1			(a) Excavate for restricted foundations, footings and pipe trenches in all materials and use for backfill or embankment or dispose	m³	536		
6.1.3.2		8.3.3(b)	Extra over for:				
6.1.3.2.1		8.3.3 (b) (1)	Intermediate excavation	m³	536		
6.1.3.2.2		8.3.3 (b) (2)	Hard rock excavation	m³	54		
6.1.3.2.3		8.3.3 (b) (3)	Boulder excavation, Class A	m³	54		
6.1.3.2.4		8.3.3 (b) (4)	Boulder excavation, Class B	m³	47		
6.1.4		8.3.4	**Importing of materials:**				
6.1.4.1		PSD 8.3.14	(a) Extra-over for 5% cement stabilisation of backfill (by mass), compacted in layers not exceeding 175mm to minimum 98% Mod AASHTO maximum dry density, incl for the supply of cement, G4/G5 crashed stone, mixing, adding water	m³	150		
6.1.5		8.3.5	Extra excavation in all materials to provide working space around structure	m²	69		
6.1.6		8.3.8	**Existing services (see 5.1.2.2):**				
6.1.7		8.3.8.1	**Location of Existing Services:**				
6.1.7.1		8.3.8.1 (a)	Supply (unless hired under item (b) below) of specialist equipment fordetection	Sum	1		
6.1.7.2		8.3.8.1 (b)	The use or hire of specialist equipmentfor detection	hr	40		
6.1.7.3		8.3.8.1 (c)	Excavate by hand in soft material to expose existing service	m³	142		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
6.1.8		8.3.8.2	**Dealing with services that are at risk because of the construction of earthworks:**				6 342,00
6.1.8.1		8.3.8.2 (b)	(a) Permanent protection of existing service	Sum	1		
6.1.8.2		8.3.8.2 (c)	(b) Temporary protection of existing service	Sum	1		
6.1.9		8.3.10	Topsoiling	m²	69		
6.1.10		8.3.11	Grassing or other vegetation cover	m²	69		
6.1.11		PSD 8.3.16	Final finishing and clearing up	Sum	1		
6.2		SANS 1200G, PSG	**CONCRETE (STRUCTURAL)**				
6.2.1		8,2	**Scheduled Formwork Items**				
6.2.1.1		8.2.1	**Rough, straight, Vertical**				
6.2.1.1.1			(a) External faces of Scour Chamber (measured to 150mm below Finished Ground Level)	m²	30		
6.2.1.2		8.2.1	**Rough, straight, Circular**				
6.2.1.2.1			(a) External faces of main tank walls (measured to 150mm below Finished Ground Level)	m²	138		
6.2.1.3		8.2.2	**Smooth, straight, Vertical**				
6.2.1.3.1			(a) Internal and External faces of Scour chamber and Outlet chamber	m²	51		
6.2.1.4		8.2.2	**Smooth, straight, Circular**				
6.2.1.4.1			(a) External faces and Internal faces of main tank wall and Overflow Launder	m²	54		
6.2.1.5		8.2.2	**Smooth, straight, horizontal to soffit of**				
6.2.1.5.1			(a) Overflow Launder Slab	m²	34		
6.2.1.6		8.2.5	**Narrow width <=300mm curved edge of**				
6.2.1.6.1			(a) Circular Tank Base	m	58		
		8.2.6	**Box out holes/form voids:**				
6.2.1.7			(a) Small, circular of diameter up to and including 0,35 m:				
6.2.1.7.1			(1) Over 1,0 m and up to 1,5 m deep	No	1		
6.2.1.7.2			(2) Over 2,0 m deep	No	3		
6.2.2		8,3	**Scheduled Reinforcement Items**				
		8.3.1	**Steel bars:**				
6.2.2.1		8.3.1	(a) Mild Steel (R), all sizes	t	4		
6.2.2.2		8.3.1	(b) High Tensile Steel (Y), all sizes	t	34		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
6.2.3		8,4	**Scheduled Concrete Items**				
6.2.3.1		8.4.1	**Prescribed mix concrete Grade 25/19 mass concrete**				
6.2.3.1.1			(a) All concrete benching/screed including shaping and laying to line and level	m³	13		
6.2.3.1.2			(b) Mass concrete of control chamber for outlet pipe	m³	9		
6.2.3.2		8.4.2	**Blinding layer with 15/19 concrete grade:**				
6.2.3.2.1			(a) 50mm thick blinding	m³	23		
6.2.3.3		8.4.3	**Strength concrete, grade 35/19**				
6.2.3.3.1			(a) Main Tank concrete floor Slab including Sump and overflow launder	m³	64		
6.2.3.3.2			(b) Main Tank concrete walls including Sump and overflow launder	m³	62		
6.2.3.3.3			(c) Scour chamber complete	m³	57		
6.2.3.3.4			(d) Outlet chamber complete	m³	3		
6.2.3.4		PSG 8.1.3.2	No fines concrete including finishing and sealing as specified for underdrainage system				
6.2.3.4.1			(a) 75mm floor with no fines	m³	10		
		8.4.4	**Unformed surface finishes:**				
6.2.3.4		8.4.4 (b)	**Steel-floated finish**				
6.2.3.4.1			(a) Top of all walls including Scour and Outlet Control chambers	m²	111		
6.2.3.4.2			(b) Top of Launder slab	m²	25		
6.2.3.5		8.4.4 (c)	**Power-floated finish**				
6.2.3.5.1			(a) Reservoir Floor Slab	m²	171		
6.2.3.6		8,5	**Joints:**				
6.2.3.6.1			Floor Contraction joints 380mm to 200mm high, as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	80		
6.2.3.6.2			Wall Contraction joints 300mm wide as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	47		
6.2.3.6.3			Floor Expansion joints 380mm to 200mm high, as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	54		
6.2.3.6.4			Wall Expansion joints 300mm wide as per Drawing MD5775-RHD-BR-ZZ-DR-C-1800	m	35		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
6.2.3.7		8,7	**Grouting:**				
6.2.3.7.1		8.7 (a)	Under bases (or beds)	m³	2		
6.2.3.7.2		PSG 8.9	Grouting of pipes/specials through walls or slabs	m³	2		
6.2.3.7.3		PSG 8.10	Casting of pipes/specials through walls or slabs	m³	2		
6.2.3.7.4			Joints	m³	2		
6.3		SANS 1200HA	**STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
6.3.1		8.3.2	**Handrails:**				
6.3.1.1			(a) Supply and install tubular galvanised steel handrailing including bends and for all galvanised steel holding down bolts and setting same into concrete as per Drawing MD5775-RHD-BR-GT-DR-C-1401	m	5		
6.3.2		8.3.3	**Ladders, complete and installed including all galvanised steel holding down bolts and setting same into concrete**				
6.3.2.1			Galvanised steel internal ladder 4.0 m high at scour chamber as per Drawing MD5775-RHD-BR-GT-DR-C-1401	No	1		
6.3.3		8.3.4	**Flooring, complete and installed with frames**				
6.3.3.1			Supply and install open grid flooring RS80 'GMS Rectagrid' or similar approved, 1800x1350 mm with 40x40x4.5mm M.S. angle frames built in to scour chambers as per Drawing MD5775-RHD-BR-GT-DR-C-1401	No	1		
6.3.3.2			Supply and install open grid flooring RS80 'GMS Rectagrid' or similar approved, 1100x1100 mm with 40x40x4.5mm M.S. angle frames built in to Outlet chambers as per Drawing MD5775-RHD-BR-GT-DR-C-1401	No	1		
6.4			**MISCELLANEOUS ITEMS**				
6.4.1		SABS1200G, PSG	**Pipe Specials**				
			All mild steel to have 4.5mm wall thicknesss and to be API 5L Grade X 42 unless indicated differently, Steel flanges to sans 1123 Table 1000/3				
6.4.1.1		PSG8.10	DN150 d/fl wedge gate valve with 4300mm extension spindle	No	1		
6.4.1.2		PSG8.10	DN150 pe/fl 4540mm long steel pipe with puddle flange 540mm from pe	No	1		
6.4.1.3		PSG8.10	DN150 pe/fl 3825mm long steel pipe with puddle flange 325mm from pe	No	1		
6.4.1.4		PSG8.10	DN150 pe/fl 4430mm long steel pipe with puddle flange 540mm from pe	No	1		
6.4.1.5			DN150 d/fl 4430mm long steel pipe	No	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
6.4.1.6			DN150 d/fl x 45 degree 2 segments bend, 135mm c/f	No	1		
6.4.1.7		PSG8.10	DN250 pe/fl 500mm long steel pipe with puddle flange 125mm from pe	No	1		
6.4.2		PSLE	**Underfloor and Pheripheral drainage**				
6.4.2.1		PSLE 8.2.14 (i)	DN160 HDPE slotted peripheral drainage pipe including bends and fittings	m	65		
6.4.2.2		PSLE 8.2.14 (iv)	25mm stone in peripheral drain	m³	11		
6.4.3		PSLC 8.2.5	**Supply and install uPVC cable ducts**				
6.4.3.1			DN75 PVC-U cable ducts	m	20		
6.5		PSG 8.11	Cleaning, disinfecting and sterilising of structure in accordance with the specification	Sum	1		
6.6		PSG 8.12	Testing of structure in accordance with the Specification for water tightness	Sum	1		
TOTAL SECTION SECTION SECTION 6: GRAVITY THICKENER CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
7.0	**CPG**		**SECTION 7: INTERLINKING PIPELINES**				
7.1		SABS 1200 DB, PSDB	**EARTHWORKS (PIPE TRENCHES)**				
7.1.1		8.3.1	**Site clearance and (if specified) removal of topsoil:**				
7.1.1.1		8.3.1 (a)	Clear vegetation and trees of girth up to 1,0 m for a width of 1200mm along pipeline route	m	952		
7.1.1.2		8.3.1 (b)	Clear trees of girth over 1,0 m and designated obstacles	No	16		
7.1.1.3		8.3.1 (c)	Remove topsoil to a nominal depth of 150mm	m²	903		
7.1.2		8.3.2	**Excavation:**				
			Pipe Trenches				
7.1.2.1		8.3.2(a)	Selected excavation in all materials for trenches, backfill and dispose of surplus/unsuitable material for: (Rate to include where required shoring or other suitable lateral support):				
			Pipes up to DN350 for depths:				
7.1.2.1.1			0,0 m - 1,0 m	m	157		
7.1.2.1.2			1,0 m - 1,5 m	m	102		
7.1.2.1.3			1,5m - 2,0 m	m	235		
7.1.2.1.4			2,0 m - 2,5 m	m	38		
			Pipes DN400 up to DN750 for depths:				
7.1.2.1.5			0,0 m - 1,0 m	m	67		
7.1.2.1.6			1,0 m - 1,5 m	m	25		
7.1.2.1.7			1,5m - 2,0 m	m	144		
7.1.2.1.8			2,0 m - 2,5 m	m	34		
7.1.2.1.9			2,5 m - 3,0 m	m	33		
7.1.2.1.10			3,0 m - 3,5 m	m	5		
7.1.2.1.11			3,5 m - 4,0 m	m	116		
			Exceeding 4,0m	m	50		
7.1.2.2		8.3.2a 8.3.4a	Restricted trench excavation in all materials for 900 mm nom dia pipe 1,5 m to 2 m deep below bulk excavation and supply and install close shoring (to be designed and supervised by suitably experienced PrEng) and stockpile or dispose of excavated material	m	30		
7.1.2.3			Extra-over Item 7.1.2.2 for lateral support left permanently in the trench only if ordered (Prov)	m	20		
7.1.2.4		PSDB 8.3.5 (c)	Excavate by hand in confined areas for pipe trenches or to locate and expose existing services where ordered by the Engineer	m³	27		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
7.1.2.5		8.3.2(b)	Extra over item 7.1.2.4 above for:				
7.1.2.5.1		8.3.2 (1)	Intermediate excavation (Prov)	m³	1073		
7.1.2.5.2		8.3.2 (2)	Hard rock excavation (Prov)	m³	110		
7.1.2.5.3		PSDB 8.3.2	Backfill stabilised with 5% cement where directed by the Engineer	m³	13		
7.1.2.6		8.3.2 (c)	Excavate and dispose of unsuitable material from trench bottom (provisional)	m³	50		
7.1.2.7		8.3.2	Electrical cable trench approx 0,5 m wide 1,0 m deep incl for backfilling after cables are laid by others	m	200		
7.1.3		8.3.3	**Excavation ancillaries:**				
7.1.3.1		8.3.3.1	**Make up deficiency in backfill material (provisional)**				
7.1.3.1.1		8.3.3 (a)	From other necessary excavation on site	m³	50		
7.1.3.1.2		8.3.3 (b)	By importation from designated borrow pits	m³	50		
7.1.3.1.3		8.3.3 (c)	By importation from commercial or off-site sources selected by the Contractor	m³	50		
7.1.4		8.3.3.3	**Compacting in road reserves**	m³	20		
7.1.5		8.3.5	**Existing services that intersect or adjoin a pipe trench:**				
7.1.5.1		8.5.2 (a)	Services that intersect a trench (angles between centre-lines in plan of 45 - 90°)	No	10		
7.1.5.2		8.5.2 (b)	Services that adjoin a trench (parallel to or at a angle between centre-lines in plan of less than 45°)	m	60		
7.1.6		8.3.6	**Finishing:**				
7.1.6.1		8.3.6.1	**Reinstate road surfaces complete with all courses:**				
7.1.6.1.1		8.3.6.1 (a)	Gravel on shoulders	m²	18		
7.1.6.1.2		8.3.6.1 (c)	Asphalt of thickness 80mm in roadway	m²	18		
7.2		SANS 1200LB, PSLB	**BEDDING (PIPES)**				
7.2.1		8.2.1	**Provision of bedding from trench excavations and/or other excavations without the need for screening or other treatment for:**				
7.2.1.1		8.2.1 (a)	Selected granular material	m³	265		
7.2.1.2		8.2.1 (b)	Selected fill material	m³	276		
7.2.2		8.2.2	**Supply only of bedding by importatlon:**				
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
7.2.2.1		8.2.2.1	**From other necessary excavations (provisional):**				
7.2.2.1.1		8.2.2.1 (a)	Selected granular material	m³	30		
7.2.2.1.2		8.2.2.1 (b)	Selected fill material	m³	35		
7.2.2.2		8.2.2.3	**From commercial sources (provisional):**				
7.2.2.2.1		8.2.2.3 (a)	Selected granular material	m³	100		
7.2.2.2.2		8.2.2.3 (b)	Selected fill material	m³	140		
7.2.2.3		8.2.3	Supply and install Grade 15/19 Concrete bedding cradle under pipe	m³	5		
7.2.2.4		8.2.4	Encasing of pipes in concrete	m³	10		
7.3		SANS 1200 LD, PSLD	**SEWER AND DRAIN PIPES**				
7.3.1		8.2.1	**Supply, handle, lay, bed, joint and test the following uPVC Sewer Pipes (Class 34) with integral rubber ring joints on one end of each length to SABS 791 complete with couplings**				
7.3.1.1			DN160	m	70		
7.3.1.2			DN110	m	160		
7.3.2		8.2.3	**Sewer Manholes**				
7.3.2.1			Supply all materials, excavate and construct 1.0m diameter circular manholes complete with medium duty covers and frames, Type 2A as shown on relevant drawing for depths:				
7.3.2.1.1			0 - 2 m depth	No	7		
7.3.3		SANS 1200LE 8.2.10	**Accessories:**				
7.3.3.1		8.2.10 (c)	Supply and Install complete set for Step irons for all Manholes	No	7		
7.4.3		PSL 8.2.1(b) & 8.2.3	Resilient Seal Gate Valves PN12 (supply and install, including testing etc. and all fittings like bolts, nuts, washers, etc.)				
7.4.3.1			DN250	No	1		
7.4.4		8.2.1	**Supply, handle, lay, test and disinfect HDPE pipes Class 9 including all joining materials, bends and fittings:**				
7.4.4.1			63mm dia	m	180		
7.4.5		8.2.13	Precast concrete gate valve chambers complete, including grade 25/13 precast concrete spacer ring manhole, 1100mm x 1050mm cover and lid as per Drawing for depth of 1m - 2m	No	1		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
7.4.6		SANS 1200L	**Mild Steel pipes**				
			All steel pipes, fittings and specials are to have 6mm wall thickness and to be API 5L Grade X42 steel with belled and plain ends, fillet welded and to have factory applied solvent free epoxy lining and coating				
		8.2.1	Supply, handle, lay, bed, joint, test, flush steel pipes and fittings and check for holidays for both internal and external linings. (Rates are to include for all fillet welding and for the making good of both internal lining and external coating)				
7.4.6.1			DN600 x 4.5mm wall thickness	m	150		
7.4.6.2			DN350 x 4.5mm wall thickness	m	6		
7.4.6.3			DN250 x 4.5mm wall thickness	m	140		
7.4.6.4		8.2.4	Extra over Item 6.4.6.1 to 6.4.6.3 for cutting pipes to length to suit site requirements	No	5		
7.4.6.5		8.2.4	Extra-over item 6.4.6.1 to 6.4.6.3 for supply and welding of flange	No	5		
7.4.6.6		8.2.2	**Steel Bends**				
7.4.6.6.1			Extra over Item 6.4.6.1 for fabrication , installation and jointing of the following specials: DN600 x 22.5° 2 Segment bend 850 mm C/F	No	2		
7.4.6.6.2			Extra over Item 6.4.6.1 for fabrication , installation and jointing of the following specials: DN600 x 45° 3 Segment bend 850 mm C/F	No	3		
7.4.6.6.2			Extra over Item 6.4.6.2 for fabrication , installation and jointing of the following specials: DN350 x 90° 3 Segment bend 355 mm C/F	No	2		
7.4.6.6.3			Extra over Item 6.4.6.3 for fabrication , installation and jointing of the following specials: DN250 x 90° 3 Segment bend 355 mm C/F	No	4		
7.4.6.6.4			Extra over Item 6.4.6.3 for fabrication , installation and jointing of the following specials: DN350 x 45° 3 Segment bend 355 mm C/F	No	3		
7.4.6.6.5			Extra over Item 6.4.6.3 for fabrication , installation and jointing of the following specials: DN350 x 22.5° 3 Segment bend 355 mm C/F	No	10		
7.4.6.6			DN50 GMS roll grooved Pipe PN 16 w/t 3.9mm complete with bends and fittings	m	30		
7.5		SANS 1200 LE, PSLE	**CONCRETE PIPES**				
7.5.1		8.2.1	Supply, handle, lay, bed and test concrete pipes, Class 100D with spigot and socket ends and complying to SANS 667				
7.5.1.1			DN450	m	257		
	CPG		DN450	m	115		
7.5.1.2	CPG		DN500	m	22		
7.5.1.3	CPG		DN600	m	34		
7.5.1.4	CPG		DN750	m	20		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
7.5.2		8.2.4	Extra-over Item 6.5.1 for cutting pipes:				
7.5.2.1			DN450	No	2		
7.5.2.2			DN500	No	2		
7.5.2.3			DN600	No	2		
7.5.2.4			DN750	No	2		
7.5.3			Extra over Item 6.5.1 for supplying and installing joints with machined collars and special couplings	No	15		
7.5.4			Extra over Item 7.5.1 for encasing joints	No	5		
7.5.5		SANS LE 8.2.11	Anchor/thrust blocks as pe Drawing MD5775-RHD-BR-ZZ-DR-C-1801				
7.5.5.1			(1) Concrete	m^3	4		
7.5.5.2			(2) Formwork	m^2	24		
7.5.5.3			(3) Reinforcement	t	0,7		
7.5.6		8.2.8	**Manholes**				
7.5.6.1			Supply all materials, excavate and construct 1.5m diameter circular manholes complete with medium duty covers and frames, Type 2A as shown on relevant drawing for depths:				
7.5.6.1.1			0 - 2 m depth	No	23		
7.5.6.1.2			2 - 3 m depth	No	6		
7.5.6.1.3			3 - 4 m depth	No	2		
7.5.6.2			Supply all materials, excavate and construct brick manholes complete with medium duty covers and frames, Type 2A as shown on drawing MD5775-RHD-BR-ZZ-DR-C-1800:	No	6		
7.5.7		8.2.10	**Accessories:**				
7.5.7.1			Supply and Install complete set for Step irons for all Manholes	No	31		
7.5.7.2			Supply and Install grid inlets including frames as per drawing MD5775-RHD-BR-ZZ-DR-C-1800	No	5		
7.5.8		8.2.13	Raising or lowering of existing manholes	No	5		
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
7.6			**MISCELLANEOUS ITEMS**				
7.6.1		PSL 8.2.15	Corrosion protection for all steel pipe including bends and fittings	m	40		
7.6.2		PSL 8.2.20	Marker posts				
7.6.2.1			Supply and install pipeline marker at all horizontal bends and where ordered by the Engineer. To be as shown on Drawing MD5775-RHD-BR-ZZ-DR-C-1801 and rate to include painting twice with "white" road marking paint	No	24		
7.6.3		SANS1200LD 8.2.10	Permanent plug stoppers (provisional)	No	2		
7.6.4		PSLE 8.2.17	Connection to existing manhole	No	5		
7.6.5		PSLE 8.2.18	Breaking into existing stormwater pipe	No	5		
7.7		SABS 1200 DK	**GABIONS AND STONE PITCHING**				
7.7.1		8.2.1	Supply all materials, construct and place gabions and mattresses where ordered:				
7.6.1.1		8.2.1 a	Surface preparation (Cavities filled with approved excavated rock or material)	m²	75		
7.7.2		8.2.2	Gabions (Rate to include costs for complete supply of all materials, filling of the cages and construction of the gabions/ mattresses) for:				
7.6.2.1			2 x 1 x 1 m galvanised wire boxes	m³	75		
7.6.2.2			2 x1 x 0,3 m galvanised Reno mattresses	m³	25		
7.6.2.3			Geotextile where ordered (Kaymat U24 or similar approved)	m²	75		
7.7.3		8.2.5	Ordinary stone pitching (grouted)	m²	75		
7.7.4			Extra over Item 6.7.2 for grade 15/19 concrete screed, 50 mm thick to top of mattresses where ordered	m³	12		
TOTAL SECTION SECTION SECTION 7: INTERLINKING PIPELINES CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
8.0	**CPG**		**SECTION 8: SITEWORKS & ROADS**				
8.1		SANS 1200C, PSC	**SITE CLEARANCE**				
8.1.1		8.2.1	Clear and grub	m²	1904		Rate Only
8.1.2		8.2.2	**Remove and grub large trees and tree stumps of girth**				
8.1.2.1			(a) Over 1,0 m and up to and including 2,0 m	No	5		Rate Only
8.1.2.2			(b) Over 2,0 m and up to and including 3,0 m	No	1		Rate Only
8.1.2.3			(c) Over 3,0 m in steps of 1,0 m	No	1		Rate Only
8.1.3		8.2.4	Reclear surfaces (only on instructions from the Engineer)	m²	10		Rate Only
8.1.4		8.2.5	Take down and dispose of existing fences and gate				
8.1.4.1			1,8 m high diamond mesh fence with four strand barbed wire (fence posts at approx 4m centres)	m	1000		Rate Only
8.1.4.2			2,4 m high electrified fence (fence posts at approx 4 m centres)	m	500		Rate Only
8.1.4.3			Double gates 4 m wide (incl. posts)	No	1		Rate Only
8.1.5		8.2.6	**Clear hedge or fence or both where not scheduled separately**				
8.1.5.1			Electrical cables, cable containment & equipment	Sum	1		Rate Only
8.1.5.2		8.2.8	Demolish and remove structures/buildings and dismantle steelwork as ordered by Employer's Agent	Sum	1		Rate Only
8.1.5.3		8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	43		Rate Only
8.1.6		PSMK 8.2.14	**Remove existing precast kerbing and/or channelling:**				
8.1.6.1			(a) To spoil in approved spoil site within wastewater works				
8.1.6.1.1			(i) Barrier kerbs	m	15		Rate Only
8.1.6.1.2			(ii) Combination mountable kerb and channel	m	20		Rate Only
8.1.6.2			(b) To temporary stock pile for reuse				
8.1.6.2.1			(i) Barrier kerbs	m	10		Rate Only
8.1.6.2.2			(ii) Combination mountable kerb and channel	m	15		Rate Only
8.1.7		PSC 8.2.15	**Reinstatement of fences**				
8.1.7.1			Wire/barbed wire fences up to 1.8 m high above ground level	m	50		Rate Only
8.1.7.2			Wire/barbed wire fences between 1.8 m high and 3.0 m high above ground level	m	50		Rate Only
8.1.8			Childproof barrier	m	350		Rate Only
8.1.9		PSC 8.2.13	Temporary protection with demarcation fencing as required or as indicated by the Employer's Agent for the existing services	m	100		Rate Only
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
8.2		**SANS1200DM, PSDM**	**EARTHWORKS (ROADS, SUBGRADE)**				
8.2.1	CPG	8.3.4	Cut to fill and compact to minimum 93% modified AASHTO density and compacted in layers not exceeding 200mm	m³	6500		Rate Only
8.2.2	CPG	8.3.4	Borrow to fill and compact to minimum 93% modified AASHTO density and compacted in layers not exceeding 200mm	m³	4500		Rate Only
8.2.3	CPG	8.3.3	Rip, form and compact insitu material (G10) in cut and fill areas to depth 150mm and compact to 93% Mod AASHTO (provisional)	m³	188		Rate Only
8.2.4	CPG	8.3.5 & PSDM 3.4	Construct 150mm thick layer with G9 material from commercial source or stockpile, compacted to 95% mod AASHTO max density	m³	188		Rate Only
8.2.5	CPG	8.3.5 & PSDM 3.4	Construct 150mm thick layer with G7 material from commercial source or stockpile, compacted to 95% mod AASHTO max density	m³	188		Rate Only
8.3		**SANS1200 ME, PSME**	**SUBBASE**				
8.3.1	CPG	8.3.3	Construct 150mm thick subbase with cemented natural gravel (C4) material from commercial source, compacted to 95% mod AASHTO max density	m³	188		Rate Only
8.4		**SANS1200 MF, PSMF**	**BASE**				
8.4.1	CPG	PSMF 8.3.3	Construct 125mm thick base with G5 material from commercial source, compacted to 86% of Apparent Relative Density	m³	157		Rate Only
8.4.2		**SANS1200 MH, PSMH**	**Bituminous Surface Treatment**				
8.4.2.1	CPG		Establish premix team	Sum	1		Rate Only
8.4.2.2	CPG	8.5.1	Prime Coat using MSP 1 at 0.7 litres/m²	m²	1250		Rate Only
8.4.2.3	CPG	8.5.3	Tack Coat	m²	1250		Rate Only
8.4.2.4	CPG	8.5.4	30mm continuously graded medium asphalt 50/70 pen grade bitumen	m²	1250		Rate Only
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
8.4.3		SANS 1200 MM	**ROAD LINES**				
		8.4.1	Road markings in reflective paint applied at a nominal rate of 0.42l/m² (refer to road traffic signs manual)				
8.4.3.1	CPG		White lines width 100mm broken or unbroken (WM3)	m	2000		Rate Only
8.5		SANS 1200 MK, PSMK	**KERBING AND CHANNELLING**				
8.5.1		8.2.1	**Concrete kerbing**				
			New Precast Concrete Kerbs				
8.5.1.1			(a) Figure 6 , complete including concrete haunching as specified:				
8.5.1.2	CPG		(i) On straights and radii exceeding 20m	m	100		Rate Only
8.5.1.3	CPG		(ii) On radii exceeding 4m up to 20m	m	100		Rate Only
8.5.1.4	CPG		(iii) On radii up to 4m	m	50		Rate Only
8.5.2			**Cut-off Drains**				
8.5.2.1	CPG	SANS 1200 DM 8.3.15	Excavate average 600 mm wide and 300 mm deep to form sloping cut off drain with splayed sides	m	40		Rate Only
8.6			Supply and install galvanised road protection barrier / bollards around the site platform complete with base plate.	m	100		Rate Only
8.7		PSA 8.4.6	Construction of the guard house complete	Prov Sum	1		1 200 000,00
8.8			Contractor's Mark Up for Management, Development and Supervision of the CPG sub-contractor	%			
TOTAL SECTION SECTION SECTION 8: SITEWORKS & ROADS CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
9.0	**CPG**		**SECTION 9: WATERWORKS BOUNDARY FENCING**				
9.1		**SANS 1200D**	**EARTHWORKS**				
9.1.1		PYA 3.2	(a) Excavate in all materials and use for embankment or backfill or dispose, as ordered	m³	441		Rate Only
9.1.2			(b) Extra over for:				
9.1.2.1			(1) Intermediate excavation	m³	22		Rate Only
9.1.2.2			(2) Hard rock excavation	m³	22		Rate Only
9.1.3		PYA 2.6 & 3.3	25Mpa Concrete foundation footing	m³	161		Rate Only
9.1.4		PYA 5.2	Blockwork for walls	m	1000		Rate Only
9.1.5			Extra over Brickckwork for walls	m²	11		Rate Only
9.1.6			Plaster for walls	m²	4400		Rate Only
9.1.7			110mm diameter slotted HDPE drainage pipes in 250x235x25 Stone surround all wrapped in Grade A4 Geotextile Bidim	m	1000		Rate Only
9.1.8		PYA 5.3	Extra Over 1.17.2 for motorized sliding gate, 5000mm long; including gate guide, motor and remote controls	No	1		Rate Only
9.1.9			Extra over 1.17.3 for the laying and installation of the electrical cable in conduit from the gate motor to the offices and staff facilities, including all electrical connections	Sum	1		Rate Only
9.1.10		PYA 5.4	Extra over for corner piers and bends	No	400		Rate Only
9.1.11		PSA 8.4.6	Construction of the Waterworks Boundary Fencing complete	Prov Sum	1		1 390 000,00
9.1.12			Contractor's Mark Up for Management, Development and Supervision of the CPG sub-contractor	%			
TOTAL SECTION SECTION SECTION 9: WATERWORKS BOUNDARY FENCING CARRIED FORWARD TO SUMMARY							

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
10.0	**CPG**		**SECTION 10: GUARD HOUSE**				
10.1		**SANS 1200D**	**EARTHWORKS**				
10.1.1		PSD 8.3.3	Restricted Excavation				
10.1.1.1		8.3.3 a)	(a)Excavate for restricted foundations,footings and pipe trenches in allmaterials and use for backfill or embankment or dispose	m³	55		Rate Only
10.1.2		8.3.3 b)	(b) Extra over for				
10.1.2.1		8.3.3 b)1)	(1) Intermediate excavation	m³	10		Rate Only
10.1.3		8.3.4	Importing of materials				
10.1.3.1		PSD 8.3.14	(a) Extra-over for 5% cement stabilisation of backfill (by mass), compacted in layers not exceeding 175mm to minimum 98% Mod AASHTO maximum dry density, incl for the supply of cement, G4/G5 crushed stone, mixing, adding water	m³	24		Rate Only
10.1.4			**Soil Poisoning**				
			Soil insecticide in accordance with SANS 5859				
10.1.5			250 Micron PVC Damp proof membrane treated with poison for termites	m²	10		Rate Only
10.2		SANS 1200G, PSG	**CONCRETE (STRUCTURAL)**				
10.2.1		8,2	**Scheduled Formwork Items**				
10.2.1.1		8.2.1	Rough straight vertical				
10.2.1.1.1			(a) to both sides of ground wall	m²	2		Rate Only
10.2.1.2		8.2.2	Smooth straight horizontal to				
10.2.1.2.1			(a) Soffit of ring beams	m²	18		Rate Only
10.2.3		8,3	**Scheduled Reinforcement Items**				
10.2.3.1		8.3.2	High tensile welded mesh reinforcement reference 617	m²	20		Rate Only
10.2.4		8,4	**Scheduled Concrete Items**				
10.2.4.1		8.4.3	**Strength concrete, grade 35/19**				
10.2.4.1.1			Column bases	m³	24		Rate Only
10.2.4.2		8.4.4	**Unformed surface finishes:**				
		8.4.4 b)	Steel Floated				
10.2.4.2.1			Upper surface of floor slab	m²	16		Rate Only
10.2.5		8,6	**Precast Concrete**				
10.2.5.1		PQA15.5	Precast concrete lintels	m	10		Rate Only
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
10.3		PQA	**BRICKWORK, BLOCKWORK AND PLASTERING**				
			Sizes in descriptions				
			Where sizes in descriptions are given in brick units, ""one brick"" shall represent the length and ""half brick"" the width of				
			Face bricks				
			Bricks shall be ordered timeously to obtain uniformity in size and colour				
		PQA 15.1	**Brickwork**				
			Foundations (Provisional)				
10.3.1			Brickwork of NFX bricks (7 MPa nominal compressive strength) in class II mortar				
10.3.1.1			One brick walls	m²	50		Rate Only
			Superstructure				
10.3.2			Brickwork of NFP bricks in class II mortar				
10.3.2.1			Half brick walls (internal walls)	m²	9		Rate Only
10.3.2.2			One brick walls	m²	72		Rate Only
10.3.3			**Face Brickwork**				
		PQA 15.1	Approved face bricks pointed with recessed horizontal and vertical joints				
10.3.3.1			Extra over brickwork for face brickwork	m²	72		Rate Only
10.3.4			**Waterproofing**				
10.3.4.1		PQA 16.4	Waterproof coating of external faces	m²	72		Rate Only
10.3.5			**Dampproofing of Walls and Floors**				
10.3.5.1		PQA 15.4	One layer 375 micron embossed polyethylene damp proof course (SANS 952-1985 type B) in window sills	m²	10		Rate Only
10.3.5.2		PQA 15.4	One layer 250 micron Damp Proof Coarse (SANS 952-1985 type D) or USB plastic sheeting under floor slab	m²	20		Rate Only
10.3.6		PQI 5	**Roof Coverings**				
10.3.6.1		PQI 5.1	0,8mm Hulamin aluminuim sheet IBR profile in single lengths and accessories Roof covering with pitches not exceeding 25 degrees, fixed to steel purlins or rails	m²	35		Rate Only
10.3.7		PQF 5	**Rainwater goods**				
10.3.7.1			Aluminium 100 x 76 mm U shaped gutters complete with fixing brackets	m	12		Rate Only
10.3.7.2			Supply and fit 76mm x 82mm uPVC downpipe inclusive of all necessary holder bats, shoe ends and bends. 3.6m high overall	No	9		Rate Only
10.3.7.3			Precast concrete channel at the base of each gutter downpipe	No	4		Rate Only
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
10.3.8			**Roof and Wall Insulation**				
10.3.8.1			Multi-layered reinforced double-sided aluminium foil sheeting in accordance with SANS 1381-4 with a mass of not less than 293g/m and a Class I fire rating in accordance with SANS 0177-3				
10.3.8.1.1		PQC 10.2.8	Type H2 "Sisalation" or similar approved polyethylene bubble fold aluminium foil faced both sides sheeting	m²	35		Rate Only
10.3.8.1.2		PQC 10.2.8	Insulation sheeting laid taut over purlins and fixed concurrent with roof covering with minimum 150mm stapled laps including galvanised steel straining wires at not exceeding 400mm centres and double-sided tape at edges where required	m²	35		Rate Only
10.3.9			**Carpentry and Joinery Doors etc.**				
10.3.9.1		PQC 10.2.2	Supply and install complete factory made (prefabricated) roof trusses as designed by specialist	Sum	1		Rate Only
10.3.9.2		PQC 10.2.1	Supply, deliver and install single door 800mm wide x 2400mm high complete with frame panels details as per Drawing MD5775-RHD-BR-GH-DR-C-1701	No	2		Rate Only
10.3.10			**Ceilings, Partitions and Access Flooring**				
10.3.10.1		PQC 10.2.4	Fascia board	m	25		Rate Only
10.3.10.2		PQC 10.2.9	75mm rhino cornice	m	20		Rate Only
10.3.10.3		PQC 10.2.9	75 mm Gypsum plaster cornice and cover strips	m	20		Rate Only
10.3.11			**Supplementary Preambles**				
			Floor coverings, wall linings, etc shall, where applicable, be fixed with adhesive as recommended by the manufacturers of the flooring, linings, etc				
10.3.11.1		PQB 7.2.1	Vinyl floor tiling/sheeting	m²	20		Rate Only
10.3.11.2		PQB 7.3.2	75mm high skirting to match vinyl floor	m	25		Rate Only
10.3.11.3		PQB 7.1.1	25 mm screed (Provisional)	m²	20		Rate Only
10.3.11.4		PQB 7.1.1	steel trowelled rendering to floor and tiled with ceramic tiles	m²	35		Rate Only
10.3.12			**Ironmongery**				
10.3.12.1		**PQC10.2.12**	**""En-Suite"" Locks**				
			The following locks are to be suitable for master and grand master key operation. Manufactured by ""Union"" or similar approved				
10.3.12.1.1			3 lever mortice lock to external door, include two set of keys as specified per lock	No	1		Rate Only
10.3.12.1.2			Approved clotted lock to toilet with engaged or red external sign, include two set of keys as specified per lock	No	1		Rate Only
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
10.3.13			**Sundries**				
10.3.13.1		PQC 10.2.11	38mm Diameter rubber door stop, plugged	N°	1		Rate Only
10.3.14		PQF 5	**Bathroom Sanitary and fittings**				
10.3.14.1			WC - consul close-coupled toilet suite as supplied by ceramic tile market or similar approved. toilet brush and holder is to be provided to the approval of the engineer.	No	1		Rate Only
10.3.14.2			WHB - consul wash hand basin and universal full pedestal as supplied by ceramic tile market or similar approved.	No	1		Rate Only
10.3.14.3			TRH - spindle toilet roll holder (code TVCH6225) as supplied by ceramic tile market or similar approved to each toilet.	No	1		Rate Only
10.3.14.4			500 x 600mm framed mirrors each to be fixed to the wall of male and female change rooms.	No	1		Rate Only
10.4			**METAL WORK**				
10.4.1		**PQD3.1.1**	**Galvanised Pressed Steel Door Frames**				
			1,2mm Rebated frames suitable for half brick walls				
10.4.1.1			Frame for door 762 x 2032mm high	No	1		Rate Only
10.4.1.2			Frame for door 832 x 2032mm high	No	1		Rate Only
10.4.2		**PQD3.1.2**	**Galvanised Steel Windows, Doors, etc.**				
			Standard industrial windows				
10.4.2.1			590mm X 1000mm Aluminium window glazed with opaque glass	No	1		Rate Only
10.4.2.2			890mm X 1000mm Aluminium window glazed with opaque glass	No	1		Rate Only
10.4.2.3			2400m x 1300m aluminium window frame with oneway slide panel with glass	No	2		Rate Only
10.4.2.4			1500m x 1300m aluminium window frame with oneway slide panel with glass	No	1		Rate Only
10.5			**MISCELLANEOUS ITEMS**				Rate Only
10.5.1		PQA 17.1	Supply and apply 3:1 cement plaster with waterproofing agent (or similar approved) minimum 10 mm thick in one coat to internal face of the building including for a smooth and even steel float finish	m²	60		Rate Only
		PQH 4.1	Degrease and remove all contamination and apply one coat primer and two coats high gloss enamel (Plascon velvaglo polyurethane velvet non drip enamel or similar approved) to all internal walls	m²	72		Rate Only
10.5.2		PQH 4.1	Approved 150 x 150 x 5mm white glazed porcelain tiles fixed with adhesive to plaster (plaster elsewhere) On walls in kitchen in sink area	m²	4		Rate Only
			Subtotal Carried Forward to Next Page				

ITEM NO		PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
			Subtotal Brought Forward from Previous Page				
10.5.3			Supply and install gate valves for each toilet and connect to water supply	No	2		Rate Only
10.5.4			Connect to existing services at nearest point with less number of fittings and bends using fittings described in drawing No MD5775-RHD-BR-SL-1000	Sum	3		Rate Only
10.5.5		SANS 1200LD	**Sewer pipes**				
10.5.5.1		8.2.1	Supply Class 34 uPVC sewer pipes, lay at minimum fall of 1:90 and install cast iron Rodding eyes	m	30		Rate Only
10.5.6			Drill holes through walls and punch	Sum	1		Rate Only
10.5.7			Supply and install work tops furniture and toilet as per Drawing MD5775-RHD-BR-GH-DR-C-1701	Sum	1		
10.6		**SANS 1200MJ**	**SEGMENTED PAVING**				
10.6.1		8.2.1	Provision of edge restraints				
10.6.1.1			Beam edging complete with 15PMa mass concrete	m	26		Rate Only
10.6.2		8.2.2	Construction of paving complete				Rate Only
10.6.2.1			500mm x 500mm x50mm thick precast concrete paving slab	m²	26		Rate Only
10.6.3		PSMJ 8.2.3	Cutting units to fit edge restraints		30		Rate Only
10.6.4		PSA 8.4.6	Construction of the guard house complete	Prov Sum	1		1 200 000,00
10.6.5			Contractor's Mark Up for Management, Development and Supervision of the CPG sub-contractor	%			
TOTAL SECTION SECTION SECTION 10: GUARD HOUSE CARRIED FORWARD TO SUMMARY							

SUMMARY OF PART 2: CIVIL & BUILDING

PART 2:	DESCRIPTION	AMOUNT
SECTION 1:	VORTEX DEGRITTER	
SECTION 2:	BALANCING TANK	
SECTION 3:	FACILITIES BUILDING:CONCRETE WORKS	
SECTION 4:	FACILITIES BUILDING:BUILDING WORKS	
SECTION 5:	RESERVOIR	
SECTION 6:	GRAVITY THICKENER	
SECTION 7:	INTERLINKING PIPELINES	
SECTION 8:	SITEWORKS & ROADS	
SECTION 9:	WATERWORKS BOUNDARY FENCING	
SECTION 10:	GUARD HOUSE	
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES ON PAGE PD.99		

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		PART 3: ELECTRICAL WORKS				
		Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation, taking delivery, handling, erection and installation of the following plant and equipment:				
1		**SECTION 1: LV DISTRIBUTION BOARDS**				
1.1		Supply DB GH complete	Sum	1		
1.2		Install DB GH complete	Sum	1		

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
2		**SECTION 2: MOTOR CONTROL CENTRES (MCCs)**				
2.1		Supply MCC 3 Complete	Sum	1		
		MCC 3 Install, test and Commissioning of all electrical plant and equipment in accordance with the Commissioning Plan Standard Specification including all documentatioN				
2.2		Stage 1	Sum	1		
2.3		Stage 2	Sum	1		
2.4		Stage 3	Sum	1		
2.5		Stage 4	Sum	1		
2.6		Stage 5	Sum	1		
2.7		Stage 6	Sum	1		
TOTAL SECTION SECTION 2: MOTOR CONTROL CENTRES (MCCs) CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
3		**SECTION 3: LOW VOLTAGE POWER CABLING AND TERMINATIONS**				
3.1		**600 / 1000 V copper conductor PVC/PVC/SWA/PVC cables**				
3.1.1		185mm² x 4 core	m	400		
3.1.2		150mm² x 4 core	m	0		Rate Only
3.1.3		120mm² x 4 core	m	0		Rate Only
3.1.4		95mm² x 4 core	m	0		Rate Only
3.1.5		70mm² x 4 core	m	120		
3.1.6		50mm² x 4 core	m	0		Rate Only
3.1.7		35mm² x 4 core	m	0		Rate Only
3.1.8		25mm² x 4 core	m	0		Rate Only
3.1.9		16mm² x 4 core	m	0		Rate Only
3.1.10		10mm² x 4 core	m	0		Rate Only
3.1.11		6mm² x 4 core	m	0		Rate Only
3.1.12		4mm² x 4 core	m	0		Rate Only
3.1.13		2.5mm² x 4 core	m	0		Rate Only
3.1.14		185mm² x 3 core	m	0		Rate Only
3.1.15		150mm² x 3 core	m	0		Rate Only
3.1.16		120mm² x 3 core	m	0		Rate Only
3.1.17		95mm² x 3 core	m	0		Rate Only
3.1.18		70mm² x 3 core	m	250		
3.1.19		50mm² x 3 core	m	0		Rate Only
3.1.20		35mm² x 3 core	m	0		Rate Only
3.1.21		25mm² x 3 core	m	0		Rate Only
3.1.22		16mm² x 3 core	m	280		
3.1.23		10mm² x 3 core	m	0		Rate Only
3.1.24		6mm² x 3 core	m	550		
3.1.25		4mm² x 3 core	m	80		
3.1.26		2.5mm² x 3 core	m	650		
3.1.27		16mm² x 2 core	m	0		Rate Only
3.1.28		10mm² x 2 core	m	0		Rate Only
3.1.29		4mm² x 2 core	m	0		Rate Only
3.1.30		4mm² x 2 core	m	0		Rate Only
3.1.31		2.5mm² x 2 core	m	0		Rate Only
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
3.2		**Terminations of 600 / 1000 V copper conductor PVC/PVC/SWA/PVC cables**				
3.2.1		185mm² x 4 core	No	4		
3.2.2		150mm² x 4 core	No	0		Rate Only
3.2.3		120mm² x 4 core	No	0		Rate Only
3.2.4		95mm² x 4 core	No	0		Rate Only
3.2.5		70mm² x 4 core	No	4		
3.2.6		50mm² x 4 core	No	0		Rate Only
3.2.7		35mm² x 4 core	No	0		Rate Only
3.2.8		25mm² x 4 core	No	0		Rate Only
3.2.9		16mm² x 4 core	No	0		Rate Only
3.2.10		10mm² x 4 core	No	0		Rate Only
3.2.11		6mm² x 4 core	No	0		Rate Only
3.2.12		4mm² x 4 core	No	0		Rate Only
3.2.13		2.5mm² x 4 core	No	0		Rate Only
3.2.14		185mm² x 3 core	No	0		Rate Only
3.2.15		150mm² x 3 core	No	0		Rate Only
3.2.16		120mm² x 3 core	No	0		Rate Only
3.2.17		95mm² x 3 core	No	0		Rate Only
3.2.18		70mm² x 3 core	No	4		
3.2.19		50mm² x 3 core	No	0		Rate Only
3.2.20		35mm² x 3 core	No	0		Rate Only
3.2.21		25mm² x 3 core	No	0		Rate Only
3.2.22		16mm² x 3 core	No	8		
3.2.23		10mm² x 3 core	No	0		Rate Only
3.2.24		6mm² x 3 core	No	2		
3.2.25		4mm² x 3 core	No	4		
3.2.26		2.5mm² x 3 core	No	30		
3.2.27		16mm² x 2 core	No	0		Rate Only
3.2.28		10mm² x 2 core	No	0		Rate Only
3.2.29		6mm² x 2 core	No	0		Rate Only
3.2.30		4mm² x 2 core	No	0		Rate Only
3.2.31		2.5mm² x 2 core	No	0		Rate Only
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
3.3		**Cable Supports:**				
		Hot dipped galvanised cable ladders wire mesh and perforated cable trays				
3.3.1		**Medium Duty perforated Cable tray (hot dipped galvanised) including all accessories**				
3.3.1.1		305 mm straight	m	60		
3.3.1.2		305 mm horizontal bend	No	4		
3.3.1.3		305 mm riser/dropper/external bend	No	4		
3.3.1.4		305 mm T-piece	No	3		
3.3.1.5		152 mm straight	m	60		
3.3.1.6		152 mm horizontal bend	No	4		
3.3.1.7		152 mm riser/dropper/external bend	No	4		
3.3.1.8		152 mm T-piece	No	3		
3.3.1.9		114 mm straight	m	60		
3.3.1.10		114 mm horizontal bend	No	4		
3.3.1.11		114 mm riser/dropper/external bend	No	4		
3.3.1.12		114 mm T-piece	No	3		
3.3.2		**Medium Duty perforated Cable tray (316 Stainless Steel) including all accessories**				
3.3.2.1		114 mm straight	m	40		
3.3.2.2		114 mm horizontal bend	No	2		
3.3.2.3		114 mm riser/dropper/external bend	No	2		
3.3.3		**Angle iron runners (hot dipped galvanised) including all accessories**				
		Supply and install				
3.3.3.1		20 mm x 20 mm x 5mm	m	20		
3.3.3.2		40 mm x 40 mm x 5mm	m	5		
TOTAL SECTION SECTION 3: LOW VOLTAGE POWER CABLING AND TERMINATIONS CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
4		**SECTION 4: FIELD CONTROL STATIONS**				
4.1		IP65, 3CR12, powder coated field control station as per drawing MD5775-E02 consisting of Emergency stop, including mounting stand, outer sheath sealing Stainless Steel 316 cable glands and all required accessories and fasteners. All anchors, screws, bolts and nuts shall be stainless steel.	No	1		
4.2		IP65, 3CR12, powder coated field control station as per drawing MD5775-E02 consisting of start, stop, Emergency stop, including mounting stand, outer sheath sealing Stainless Steel 316 cable glands and all required accessories and fasteners. All anchors, screws, bolts and nuts shall be stainless steel.	No	8		
TOTAL SECTION SECTION 4: FIELD CONTROL STATIONS CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
5		**SECTION 5: EARTHING & LIGHTNING PROTECTION**				
5.1		Supply and Install under foundation earth mat for MCC Room LV earth and electronic earth consisting of a grid of 4m x 6m with 2m intervals and 2m 250 micron copper plated earth rods x12, 70mm2 bare copper earth wire and termoweld joints x12	No	1		
5.2		50mm2 round aluminium air termination conductor including joints, aluminium air termination conductor supports 700mm apart, mounting and accessories.	m	387		
5.3		Supply and Install 50mm2 green PVC insulated copper down conductor.	m	60		
5.4		Earth Bar 250mm x 50mm x 6mm with 6x pre drilled 6mm holes manufactured from HC red copper bar, mounted on dumpy insulators	No	1		
5.5		Earth Bar 500mm x 50mm x 6mm with 10 x pre drilled 10mm holes manufactured from HC red copper bar, mounted on dumpy insulators including single test clamp	No	1		
5.6		Supply and Install flush mounted lightning protection test box including 25 x 5mm electroplated test clamp, stainless steel bolts with washers, including all accessories.	No	8		
5.7		Excavate, backfill and compaction 500mm deep x 300mm wide trench in intermediate material.	m	95		
5.8		Earhting and bonding of all metalic parts according to SANS 10142-1	Sum	1		
5.9		70mm Bare stranded copper earth conductor installed around the Backwash Water Building	m	160		
5.1		2m, 250 micron copper plated non-threaded earth rod to SANS 1063 including, driving cap, incl. accessories. Including drilling 50mm diameter hole for earth rod and filling with conductive 0.2 Ohm/m concrete concrete.	No	8		
5.11		Exothermic connection for earth cables or rods as required	No	8		
5.12		Testing and issuing of earhting and lighting protection certificate for each building	Sum	1		
5.13		25 mm Galvanised Conduit: Supply and install surface mounted including galvanised saddles and accessories.	m	50		
5.14		20mm PVC conduit inserted into Galvanised Conduit	m	50		
5.15		Testing and issuing of test lightning protection test certificate for a level IV LPS for the entire site including any adjustments required to achieve the required certification.	Sum	1		
TOTAL SECTION SECTION 5: EARTHING AND LIGHTNING PROTECTION CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
6		**SECTION 6: ELECTRICAL BUILDING SERVICES**				
		Supply, installation, testing, commissioning and handover documentation.				
6.1		**Light Switches**				
6.1.1		Light switches in 100 x 50mm boxes, complete with conduit boxes, White PVC covers and chromium fixing screws where applicable (15 Amp minimum rating) and labelling as specified.				
6.1.2		Light Switch: 16A 1 way, 1 lever, Supply & Install	No	1		
6.1.3		Light Switch: 16A 1 way, 2 lever, Supply & Install	No	1		
6.2		**Switched Socket Outlets**				
		Socket outlets of various configurations mountings, complete with conduit boxes, appropriate covers etc. and labelling as specified.				
6.2.1		16A Single and SANS 164-2 euro combination Switch Socket Outlet-Supply & Install	No	2		
6.2.2		IP44, 32 Amp 3 Phase, 5 pin, 400V, Welding plug point - Supply & Install	No	1		
6.3		**Conduit (25 mm PVC): Supply and install PVC Conduit cast in concrete, chased in brickwork or installed in ceiling void including joints, bends, glands, HDG saddles and all accessories.**				
6.3.1		Fire - Supply	m	15		
6.3.2		Fire - Install	m	15		
6.4		**Conduit (20 mm PVC): Supply and install PVC Conduit cast in concrete, chased in brickwork or installed in ceiling void including joints, bends, glands, HDG saddles and all accessories.**				
6.4.1		Lighting - Supply	m	40		
6.4.2		Lighting - Install	m	40		
6.4.3		Power - Supply	m	12		
6.4.4		Power - Install	m	12		
6.5		**Conduit (20 mm Galv): Supply and install Galvanised Conduit to SANS 61386 specification, in Z275 pre Galv, surface mounted including joints, bends, glands, HDG saddles and all accessories.**				
6.5.1		Lighting - Supply	m	148		
6.5.2		Lighting - Install	m	148		
6.6		**Galvanised Junction or Outlet Boxes chased in brickwork or cast on concrete**				
6.6.1		Lighting 50 x 100 mm - Supply	No	1		
6.6.2		Lighting 50 x 100 mm - Install	No	1		
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
6.6.3		Lighting 60 mm round - Supply	No	53		
6.6.4		Lighting 60 mm round - Install	No	53		
6.6.5		Power 100 x 100 mm - Supply	No	15		
6.6.6		Power 100 x 100 mm - Install	No	15		
6.6.7		Fire 60 mm round - Supply	No	1		
6.6.8		Fire 60 mm round – Install	No	1		
6.7		**Galvanised Outlet Boxes surface mounted to SANS 61386 specification, in Z275 pre**				
6.7.1		Lighting 50 x 100 mm - Supply	No	1		
6.7.2		Lighting 50 x 100 mm - Install	No	1		
6.7.3		Lighting 60 mm round - Supply	No	34		
6.7.4		Lighting 60 mm round - Install	No	34		
6.7.5		Power 100 x 100 mm - Supply	No	1		
6.7.6		Power 100 x 100 mm - Install	No	1		
6.8		**Isolators and Connections**				
		Isolators installed in boxes, recessed and connections to equipment supplied by others:				
6.8.1		32A TP IP65	No	1		
6.8.2		32A DP IP65	No	1		
6.9		**Wiring**				
6.9.1		600/1000Volt grade PVC insulated wire (incl. insulated copper earthwire), of various colours, drawn into conduit, trunking or power skirting including wastage, tools & equipment.				
6.9.2		2.5mm2 (Lighting) - Supply& Install	m	500		
6.9.3		4mm2 (Switched Socket Outlets) - Supply& Install	m	100		
6.9.4		2.5mm2 (BCEW) - Supply& Install	m	300		
6.9.5		Daylight Switch				
6.9.6		15 Amp rated IP65 daylight switch	No	2		
6.10		**Luminaires**				
		Luminaires, complete with conduit boxes, 5Aunswitched socket outlet where required and all fixings and accessories.				
6.10.1		TypeC1- 65W LED vapour proof fitting with robust corrosion resistant housing and diffuser, stainless steel latches, hinged prismatic diffuser for ease of lamp replacement, IP65 ingress protection and complete with mounting kits and glands.	No	8		
6.10.2		TypeC1E- Same as C1 with 30 min battery backup	No	20		
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
6.10.3		Type G2 - 15W LED bulkhead fitting. The luminaire shall consist of a high pressure die cast aluminium base and trim ring casting and an opal high impact acrylic shallow dome shaped diffuser. Base and trim ring are to be black epoxy powder coated. When installed, the trim ring and diffuser shall cover the entire base casting.	No	20		
6.10.4		Type F - 104W, 12580 LM floodlight with IP66 ingress protection, 10kV surge protection. The luminaire shall consist of marine grade high pressure die-cast aluminium with PMMA optic and high impact IK10 acrylic diffuser.	No	20		
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
6.11		**Trenching**				
		Trenching as per typical LV trench detail on drawing MD2005-E07 Electrical Typicals				
6.11.1		Trenching for Intermediate excavation	m³	150		
6.11.2		Trenching for Hard rock excavtion	m³	20		
6.11.3		Cable Warning Tape	m	365		
6.11.4		Concrete Cable Markers	No	20		
6.12		**Bonding**				
6.12.1		Bonding of the entire Electrical installation to SANS10142-1	Sum	1		
6.13		**Electrical and Electronic Sleeves including long radius bends**				
6.13.1		Supply and install 50mm HDPE Sleeves	m	60		
6.13.2		Supply and install 75mm HDPE Sleeves	m	120		
6.13.3		Supply and install 110mm HDPE Sleeves	m	50		
6.13.4		Supply and install 160mm HDPE Sleeves	m	60		
TOTAL SECTION SECTION 6: ELECTRICAL BUILDING SERVICES CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
7		**SECTION 7: PV SOLAR POWER SYSTEM**				
7.1	C3.12.37.1	Supply and install 100kW Solar Inverter	Sum	1		
7.2	C3.12.37.2	Supply and install 545kWp PV Solar Panels.	No	528		
7.3		Hot dipped galvanised steel structures for the PV soalr panels designed to suit the load and wind conditions of the site location, including conrete bases and all mounting accessories.	Sum	1		
7.4	C3.12.37.3	Supply and install all cabling and accessories associated with the PV solar installation and inverter to tie to the new MCC	Sum	1		
	C3.12.37.3	Earthing and Lightning protection complete for Solar PV Panels	Sum	1		
TOTAL SECTION 7: GENERAL CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
8		**SECTION 8: GENERAL**				
8.1		Final cleaning and painting of all plant and equipment	Sum	1		
8.2		Energy Logging of the existing Bobhoyi WTW Main incomer for 7 days	Sum	1		
8.3		Supply and install all other items not included above but which are nevertheless necessary to meet the Scope of Work and/or are required for the proper, safe and effective operation of the plant (Tenderer to specify below):				
		a)				
		b)				
		c)				
		d)				
		e)				
TOTAL SECTION 8: GENERAL CARRIED FORWARD TO SUMMARY						

SUMMARY OF PART 3: ELECTRICAL

PART 3:	DESCRIPTION	AMOUNT
SECTION 1:	LV DISTRIBUTION BOARDS	
SECTION 2:	MOTOR CONTROL CENTRES (MCCs)	
SECTION 3:	LOW VOLTAGE POWER CABLING AND TERMINATIONS	
SECTION 4:	FIELD CONTROL STATIONS	
SECTION 5:	EARTHING & LIGHTNING PROTECTION	
SECTION 6:	ELECTRICAL BUILDING SERVICES	
SECTION 7:	PV SOLAR POWER SYSTEM	
SECTION 8:	GENERAL	
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES ON PAGE PD.99		

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		PART 4: CONTROL & INSTRUMENTATION EQUIPMENT				
		Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation, taking delivery, handling, erection and installation of the following plant and equipment:				
1		**SECTION 1: SCADA & TELEMETRY**				
1.1		Provisional Sum for SCADA Server and Work Station Hardware and Software.	Prov Sum	1		R 100 000,00
1.2		Overheads, charges and profit on above Item	%			
1.4		Programming of SCADA	Sum	1		
1.5		Installation and Configuration of server, operator client, engineering station and data historian and all related operating system	Sum	1		
1.6		Factory acceptance testing of SCADA software	Sum	1		
1.7		Site Acceptance Testing	Sum	1		
1.8		(a) Provisional sum for integrating the new scope of work to the existing telemetry equipment using the Ugu specialist	Prov Sum	1		R 100 000,00
1.9		(b) Overheads, charges and profit on Item 1.4.1(a) above	%			
1.10		CAT6 LAN and all cabling and integration into optic fibre network including switch and media converters	Sum	1		
1.11		Supply and install Optic fibre cabling (FOC) 24 core SM, PE sheathed SWA	m	200		
TOTALSECTION 1: SCADA & TELEMETRY CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
2		**SECTION 2: PLC CONTROL SYSTEM**				
2.1		Installation of PLC and all associated components inside PLC panel. (Panel measured elsewhere as part of MCC)	Sum	1		
2.2		Factory acceptance testing of PLC panel wiring	Sum	1		
2.3		Development and Issue of detailed design P&ID Drawings	Sum	1		
2.4		Development and Issue of Functional design specification as specified	Sum	1		
2.5		Programming of PLC	Sum	1		
2.6		Factory acceptance test of PLC and panel PC software	Sum	1		
2.7		Wiring and loop Diagrams	Sum	1		
TOTAL SECTION 2: PLC CONTROL SYSTEM CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
3		**SECTION 3: INSTRUMENT FIELD ENCLOSURES AND MOUNTING**				
3.1	MD5775-RHD-BR-ZZ-D-E-0007	Supply and install Field Enclosure 1 including SS frame complete for mounting enclosure at 1.5m above ground level	No	1		
3.2	MD5775-RHD-BR-ZZ-D-E-0007	Supply and install Field Enclosure 2 including SS frame complete for mounting enclosure at 1.5m above ground level.	No	1		
3.3	MD5775-RHD-BR-ZZ-D-E-0007	Supply and install Field Enclosure 3 including SS frame complete for mounting enclosure at 1.5m above ground level.	No	1		
3.4	MD5775-RHD-BR-ZZ-D-E-0007	Supply and install Field Enclosure 4 including SS frame complete for mounting enclosure at 1.5m above ground level.	No	1		
3.5	MD5775-RHD-BR-ZZ-D-E-0007	Supply and install Field Enclosure 5 including SS frame complete for mounting enclosure at 1.5m above ground level.	No	1		
3.6	MD5775-RHD-BR-ZZ-D-E-0007	Supply and install 20mm IP68 4 way corrosion and UV resistant glass reinforced polyester compound with nitrile rubber seal including all IP68 rated glands, terminations and accessories and installed with stainless steel anchors. Junction box to be sized to take a maximum of 6 x 2.5mm terminations	No	6		
3.7	MD5775-RHD-BR-ZZ-D-E-0007	Supply and install 25mm IP68 4 way corrosion and UV resistant glass reinforced polyester compound with nitrile rubber seal including all IP68 rated glands, terminations and accessories and installed with stainless steel anchors. Junction box to be sized to take a maximum of 12 x 2.5mm terminations	No	8		
TOTAL SECTION 3: INSTRUMENT FIELD ENCLOSURES AND MOUNTING CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
4		**SECTION 4: FIELD INSTRUMENTATION**				
4.1		**Supply of the following:**				
4.1.1	C3.13.20.f	Backwash Recovery Inflow Channel ultrasonic Level (measured as flow) Sensor including remote transmitter - open channel flume LIT-1001	No	1		
4.1.2	C3.13.21.a	Balancing Tank ultrasonic Level Sensor including remote transmitter LIT-1002	No	1		
4.1.3	C3.13.21.a	Gravity Thickener ultrasonic Level Sensor including remote transmitter LIT-1003	No	1		
4.1.4	C3.13.21.a	Gravity Thickener ultrasonic Level Sensor including remote transmitter LIT-1004	No	1		
4.1.5	C3.13.21.a	Gravity Thickener ultrasonic Level Sensor including remote transmitter LIT-1005	No	1		
4.1.6	C3.13.21.a	Return Flow Sump ultrasonic Level Sensor including remote transmitter LIT-1006	No	1		
4.1.7	C3.13.21.a	Sludge Sump ultrasonic Level Sensor including remote transmitter LIT-1007	No	1		
4.1.8	C3.13.21.a	4ML Reservoir compact ultrasonic Level Indicating Transmitter LIT-1008	No	1		
4.1.9	C3.14.20.e	Balancing Tank settling effluent compact Flow Meter between flange contact ultrasonic DN 250 PN 16 SANS flanges complete FIT-1001	No	1		
4.1.10	C3.14.20.e	Return Flow Sump effluent compact Flow Meter between flange contact ultrasonic DN 250 PN 16 SANS flanges complete FIT-1002	No	1		
4.1.11	C3.14.23.a	Total Suspended Solids sensor including remote transmitter	No	1		
4.1.12	C3.14.23.b	Ultrasonic Sludge Blanket Level Detector including remote transmitter	No	1		
4.2		**Testing and commisioning of the following**				
4.2.1	C3.13.20.f	Backwash Recovery Inflow Channel ultrasonic Level (measured as flow) Sensor including remote transmitter - open channel flume LIT-1001	No	1		
4.2.2	C3.13.21.a	Balancing Tank ultrasonic Level Sensor including remote transmitter LIT-1002	No	1		
4.2.3	C3.13.21.a	Gravity Thickener ultrasonic Level Sensor including remote transmitter LIT-1003	No	1		
4.2.4	C3.13.21.a	Gravity Thickener ultrasonic Level Sensor including remote transmitter LIT-1004				
4.2.5	C3.13.21.a	Gravity Thickener ultrasonic Level Sensor including remote transmitter LIT-1005				
4.2.6	C3.13.21.a	Return Flow Sump ultrasonic Level Sensor including remote transmitter LIT-1006	No	1		
4.2.7	C3.14.20.e	Sludge Sump ultrasonic Level Sensor including remote transmitter LIT-1007	No	1		
4.2.8	C3.14.20.e	4ML Reservoir compact ultrasonic Level Indicating Transmitter LIT-1008	No	1		
4.2.9	C3.14.23.a	Balancing Tank settling effluent compact Flow Meter between flange contact ultrasonic DN 250 PN 16 SANS flanges complete FIT-1001	No	1		
4.2.10	C3.14.23.b	Return Flow Sump effluent compact Flow Meter between flange contact ultrasonic DN 250 PN 16 SANS flanges complete FIT-1002	No	1		
4.2.11	C3.14.23.b	Total Suspended Solids sensor including remote transmitter	No	1		
4.2.12	C3.14.23.b	Ultrasonic Sludge Blanket Level Detector including remote transmitter	No	1		
		Vibration transmitters for motors	No	16		
TOTAL SECTION SECTION 4: FIELD INSTRUMENTATION CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
5		**SECTION 5: CONTROL AND INSTRUMENTATION CABLES**				
5.1		**Supply, install & termination PVC PVC APL PVC twisted pair/triad 1mm2, overall screened copper conductor instrumentation cable. Excavation for cable trenches and cable supports are measured separately.**				
5.1.1		Supply and Install				
5.1.1.1		1 pair	m	100		
5.1.1.2		2 pair	m	100		
5.1.1.3		4 pair	m	0		Rate Only
5.1.1.4		8 pair	m	0		Rate Only
5.1.2		Terminations				
5.1.2.1		1 pair	ends	4		
5.1.2.2		2 pair	ends	40		
5.1.2.3		4 pair	ends	0		Rate Only
5.1.2.4		8 pair	ends	0		Rate Only
5.2		**Supply, install & termination PVC PVC SWA PVC twisted pair/triad 1 mm2, overall screened copper conductor instrumentation cable. Excavation for cable trenches and cable supports are measured separately.**				
5.2.1		Supply and Install				
5.2.1.1		2 pair	m	610		
5.2.1.2		4 pair	m	500		
5.2.1.3		8 pair	m	500		
5.2.2		Terminations				
5.2.2.1		2 pair	ends	40		
5.2.2.2		4 pair	ends	40		
5.2.2.3		8 pair	ends	40		
TOTAL SECTION SECTION 5: CONTROL AND INSTRUMENTATION CABLES CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
6		**SECTION 6: HANDOVER & TRAINING**				
6.1		**Tuition and training of Employer's staff in operation and maintenance of the Works as specified including all training resources. The training shall be provided by way of formal training sessions by the Contractor/OEM suppliers who shall certify that the training has been completed satisfactorily.**				
6.1.1		OEM Certified Basic SCADA Course	person	5		
6.1.2		OEM Certified Advanced SCADA Course	person	5		
6.1.3		OEM Certified SCADA Alarm Management & Analysis Course	person	5		
6.1.4		OEM Certified PLC Control System Fundamentals (3 day course)	person	5		
6.1.5		OEM Certified PLC Ladder Logic Programming (3 day course)	person	5		
6.1.6		OEM Certified PLC Control System Maintenance and Troubleshooting (3 day course)	person	5		
6.1.7		Operations and Maintenance Manual as specified	Copy	3		
TOTAL SECTION SECTION 6: HANDOVER & TRAINING CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
7		**SECTION 7: GENERAL**				
7.1		PLC Programming Software package including licenses	No	1		
7.2		Supply and install all other items not included above but which are nevertheless necessary to meet the Scope of Work and/or are required for the proper, safe and effective operation of the plant (Tenderer to specify below):				
		……				
TOTAL SECTION 7: GENERAL CARRIED FORWARD TO SUMMARY						

SUMMARY OF PART 4: CONTROL & INSTRUMENTATION EQUIPMENT

PART 4:	DESCRIPTION	AMOUNT
SECTION 1:	SCADA & TELEMETRY	
SECTION 2:	PLC CONTROL SYSTEM	
SECTION 3:	INSTRUMENT FIELD ENCLOSURES AND MOUNTING	
SECTION 4:	FIELD INSTRUMENTATION	
SECTION 5:	CONTROL AND INSTRUMENTATION CABLES	
SECTION 6:	HANDOVER & TRAINING	
SECTION 7:	GENERAL	
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES ON PAGE PD.99		

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		PART 5: MECHANICAL				
1		**SECTION 1: VORTEX DEGRITTER**				
		Mechanical Project Specification M1 - Vortex Degritter				
1.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Vortex Degritter:				
1.1.1		A Vortex Degritter and all ancillaries in accordance with the Mechanical Project Specification and Datasheet:	No	2		
`		Penstocks	No	6		
		Grit Classifiers	No	2		
		Airl lift pumps complete with interconnecting pipework and all ancillaries	No	2		
1.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Vortex Degritter:				
1.2.1		Supplied under item 1.1.1 , 1.1.2 , 1.1.3 and 1.1.4	No	1		
1.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
1.3.1		All plant and equipment	Sum	1		
1.4		**Commissioning:**				
1.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
1.5		**General:**				
1.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
1.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
1.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M1	Sum	1		
TOTAL SECTION 1: VORTEX DEGRITTER CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
2		**SECTION 2: BALANCING TANK VERTICAL MIXERS**				
		Mechanical Project Specification M2 - Balancing Tank Vertical Mixers				
2.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Balancing Tank Vertical Mixers:				
2.1.1		Balancing Tank vertical Mixers, complete with 2,2 kW motor and all ancillaries in accordance with the Mechanical Project Specification and Datasheet:	No	3		
2.1.2		Penstocks	No	2		
2.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Balancing Tank Vertical Mixers:				
2.2.1		Supplied under item 2.1.1 and 2.1.2	No	1		
2.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
2.3.1		All plant and equipment	Sum	1		
2.4		**Commissioning:**				
2.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
2.5		**General:**				
2.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
2.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
2.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M2	Sum	1		
TOTAL SECTION SECTION 2: BALANCING TANK VERTICAL MIXERS CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
3		**SECTION 3: POLY DOSING SYSTEM**				
		Mechanical Project Specification M3 - Poly Dosing System				
3.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Poly Dosing System:				
3.1.1		A Poly Dosing System complete with a concerntrate day tank, makeup dilution dosing systen, 4 dosing pumps and all ancillaries in accordance with the Mechanical Project Specification and Datasheet:	No	4		
3.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Poly Dosing System:				
3.2.1		Supplied under item 3.1.1	No	1		
3.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
3.3.1		All plant and equipment	Sum	1		
3.4		**Commissioning:**				
3.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
3.5		**General:**				
3.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
3.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
3.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M3	Sum	1		
TOTAL SECTION SECTION 3: POLY DOSING SYSTEM CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
4		**SECTION 4: THICKENER BRIDGE**				
		Mechanical Project Specification M4 - Thickener Bridge				
4.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Thickener Bridge:				
4.1.1		A Thickener Bridge complete with Drive 1,1 KW, platform and walkway, feedwell, rake mechanism and all ancillaries in accordance with the Mechanical Project Specification and Datasheet:	No	1		
4.1.2		Desludge valve: 150NB Pinch valve, actuated	No	1		
4.1.3		Manual Knife Gate Valve 150NB	No	1		
4.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Vortex Degritter:				
4.2.1		Supplied under item 4.1.1 and 4.1.2	No	1		
4.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
4.3.1		All plant and equipment	Sum	1		
4.4		**Commissioning:**				
4.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
4.5		**General:**				
4.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
4.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
4.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M4	Sum	1		
TOTAL SECTION SECTION 4: THICKENER BRIDGE CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
5		**SECTION 5: THICKENED SLUDGE CENTRIFUGE FEED PUMPS**				
		Project Specification M5 - Thickened Sludge Centrifuge Feed Pumps				
5.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Pumps:				
5.1.1		Progressive cavity pumps each equipped with 15 kW motor and duty of 6,55 l/s x 18 m complete with all ancillaries.	No	2		
5.1.2		Base frame, couplings, bolts, instrumentation	Set	2		
		Factory Testing of Pumps:				
5.1.3		Hydraulic pressure testing of pumps	No	2		
5.1.4		Performance testing of pumps	No	1		
		Pipework and Valves:				
5.1.5		All pipework and valves for above, including all pipework from the pumps as shown on the tender drawings.	Sum	1		
5.1.6		All necessary permanent supports for the pipework and valves.	Sum	1		
5.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Pumps and Pipework:				
5.2.1		For pumpsets (supplied under item 5.1.1 and 5.1.2) including for setting up bedplates and HD bolts.	Sum	1		
5.2.2		Pipework and valves (supplied under item 2.1.5 and 2.1.6) including all fixing and securing of supports	Sum	1		
5.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
5.3.1		All plant and equipment	Sum	1		
5.4		**Commissioning:**				
5.4.1		Commissioning all mechanical plant and equipment in accordance with the Commissioning Plan Standard Specification	Sum	1		
5.5		**General:**				
5.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
5.5.2		Final cleaning and painting of all plant and equipment	Sum	1		
		Subtotal Carried Forward to Next Page				R -

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				**R -**
5.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No M5	Sum	1		
5.5.4		Supply and install all other items not included above but which are nevertheless necessary to meet the Scope of Work and/or are required for the proper, safe and effective operation of the plant (Tenderer to specify below):				
TOTAL SECTION SECTION 5: THICKENED SLUDGE CENTRIFUGE FEED PUMPS CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
6		**SECTION 6: CENTRIFUGE**				
		Mechanical Project Specification M6 - Centrifuge				
6.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Centrifuge:				
6.1.1		A Centrifuge with power 165 KW and all ancillaries in accordance with the Mechanical Project Specification and Datasheet:	No	2		
6.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Centrifuge:				
6.2.1		Supplied under item 6.1.1	No	1		
6.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
6.3.1		All plant and equipment	Sum	1		
6.4		**Commissioning:**				
6.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
6.5		**General:**				
6.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
6.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
6.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M6	Sum	1		
TOTAL SECTION SECTION 6: CENTRIFUGE CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
7		**SECTION 7: RETURN FLOW PUMPS**				
		Project Specification M7 - Return Flow Pumps				
7.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Pumps:				
7.1.1		Single Stage Centrifugal Pumps each equipped with a 30 kW motor with a duty of 66,19 l/s x 25,65 m complete with all ancillaries	No	2		
7.1.2		Base frame, couplings, bolts, instrumentation	Set	2		
		Factory Testing of Pumps:				
7.1.3		Hydraulic pressure testing of pumps	No	2		
7.1.4		Performance testing of pumps	No	1		
		Pipework and Valves:				
7.1.5		All pipework and valves for above, including all pipework from the pumps l as shown on the tender drawings.	Sum	1		
7.1.6		All necessary permanent supports for the pipework and valves.	Sum	1		
7.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Pumps and Pipework:				
7.2.1		For pumpsets (supplied under item 7.1.1 and 7.1.2) including for setting up bedplates and HD bolts.	Sum	1		
7.2.2		Pipework and valves (supplied under item 2.1.5 and 2.1.6) including all fixing and securing of supports	Sum	1		
7.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
7.3.1		All plant and equipment	Sum	1		
7.4		**Commissioning:**				
7.4.1		Commissioning all mechanical plant and equipment in accordance with the Commissioning Plan Standard Specification	Sum	1		
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
7.5		**General:**				
7.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
7.5.2		Final cleaning and painting of all plant and equipment	Sum	1		
7.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No M7	Sum	1		
7.5.4		Supply and install all other items not included above but which are nevertheless necessary to meet the Scope of Work and/or are required for the proper, safe and effective operation of the plant (Tenderer to specify below):				
TOTAL SECTION SECTION 7: RETURN FLOW PUMPS CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
8		**SECTION 8: AIR BLOWER**				
		Mechanical Project Specification M8 - Air Blower				
8.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Air Blower:				
8.1.1		1 duty 1 standby ,Air blowers for air lift pumps with power 22KW, all interconnecting pipework and all ancillaries in accordance with the Mechanical Project Specification and Datasheet:	No	2		
8.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Air Blower:				
8.2.1		Supplied under item 8.1.1	No	1		
8.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
8.3.1		All plant and equipment	Sum	1		
8.4		**Commissioning:**				
8.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
8.5		**General:**				
8.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
8.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
8.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M8	Sum	1		
TOTAL SECTION SECTION 8: AIR BLOWER CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
9		**SECTION 9: FLASH MIXER**				
		Mechanical Project Specification M9 - Flash Mixer				
9.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Air Blower:				
9.1.1		A Flash Mixer with power 1,1 KW and all ancillaries in accordance with the Mechanical Project Specification and Datasheet:	No	2		
9.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Flash Mixer:				
9.2.1		Supplied under item 9.1.1	No	1		
9.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
9.3.1		All plant and equipment	Sum	1		
9.4		**Commissioning:**				
9.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
9.5		**General:**				
9.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
9.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
9.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M9	Sum	1		
		……	…….	……	…….	……
		……	…….	……	…….	……
		……	…….	……	…….	……
		……	…….	……	…….	……
TOTAL SECTION SECTION 9: FLASH MIXER CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
10		**SECTION 10: THICKENED SLUDGE MIXER**				
		Mechanical Project Specification M13 - Thickened Sludge Mixer				
10.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Thickened Sludge Mixer:				
10.1.1		A Thickened Sludge Mixer with power 1,1 KW including support structure and all ancillaries in accordance with the Mechanical Project Specification and Datasheet:	No	2		
10.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Thickened Sludge Mixer:				
10.2.1		Supplied under item 9.1.1	No	1		
10.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
10.3.1		All plant and equipment	Sum	1		
10.4		**Commissioning:**				
10.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
10.5		**General:**				
10.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
10.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
10.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M9	Sum	1		
		……	……	……	……	……
		……	……	……	……	……
		……	……	……	……	……
		……	……	……	……	……
TOTAL SECTION SECTION 10: THICKENED SLUDGE MIXER CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
11		**SECTION 11: CENTRIFUGE WASH WATER PUMPS AND TANK**				
		Project Specification M14 - Centrifuge Wash Water Pumps and Tank				
11.1		**Design, supply & delivery to site of the following plant and equipment including quality assurance, factory testing and temporary storage pending installation:**				
		Pumps:				
11.1.1		Wash water pumps equiped with a motor and complete with all ancillaries as specified by supplier.	No	2		
11.1.2		Base frame, couplings, bolts, instrumentation	No	2		
		Factory Testing of Pumps:				
		All pipework and valves for above, including all pipework from the pumps as shown on the tender drawings.	No	2		
		All necessary permanent supports for the pipework and valves.	No	1		
		Pipework and Valves:				
		All pipework and valves for above, including all pipework from the pumps as shown on the tender drawings.	Sum	1		
		All necessary permanent supports for the pipework and valves.	Sum	1		
		Water Tank:				
		Water tank with a capacity of 5000 litres and made of polyethylene material.	Sum	1		
11.2		**Taking delivery, handling, erection and installation of the following plant and equipment:**				
		Pumps and Tank:				
11.2.1		For pumpsets (supplied under item 14.1.1 and 14.1.2) including for setting up bedplates and HD bolts.	Sum	1		
		Pipework and valves (supplied under item 14.1.5 and 14.1.6) including all fixing and securing of supports	Sum	1		
11.3		**Site performance testing and adjusting the plant and equipment supplied and installed under this section of the Contract after completion of erection and installation:**				
11.3.1		All plant and equipment	Sum	1		
		Subtotal Carried Forward to Next Page				

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		Subtotal Brought Forward from Previous Page				
11.4		**Commissioning:**				
11.4.1		Commissioning all plant and equipment in accordance with the Commissioning Plan Standard Specification:	Sum	1		
11.5		**General:**				
11.5.1		Supply and install 100 mm high embossed plastic signs to identify major components of plant and equipment	No	1		
11.5.2		Final cleaning and painting of all plant and equipment in accordance with the Employer's colour coding	Sum	1		
11.5.3		Spares recommended to be kept by the Employer as listed in Returnable Technical Data Sheet No, M14	Sum	1		
		……	……	……	……	……
		……	……	……	……	……
		……	……	……	……	……
		……	……	……	……	……
TOTAL SECTION SECTION SECTION 11: CENTRIFUGE WASH WATER PUMPS AND TANK CARRIED FORWARD TO SUMMARY						

SUMMARY OF PART 5: MECHANICAL

PART 5:	DESCRIPTION	AMOUNT
SECTION 1:	VORTEX DEGRITTER	
SECTION 2:	BALANCING TANK VERTICAL MIXERS	
SECTION 3:	POLY DOSING SYSTEM	
SECTION 4:	THICKENER BRIDGE	
SECTION 5:	THICKENED SLUDGE CENTRIFUGE FEED PUMPS	
SECTION 6:	CENTRIFUGE	
SECTION 7:	RETURN FLOW PUMPS	
SECTION 8:	AIR BLOWER	
SECTION 9:	FLASH MIXER	
SECTION 10:	THICKENED SLUDGE MIXER	
SECTION 11:	CENTRIFUGE WASH WATER PUMPS AND TANK	
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES ON PAGE PD.99		

ITEM NO	PAYMENT REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R-c
		PART 6: OPERATION AND CONTROL				
6.1		Preperation of Operation and Maintenance manual for Works as a whole	Sum	1		
6.2		Employer assisted operation and maintaince of the plant for a minimum fault free continuous period of 72 hours	Sum	1		
6,3		Site inspection and checking that equipment is properly maintained. Site visits at 1, 6 and 12 months after the commissioning date. Report to be compiled and submitted after each inspection	Per Visit	12		

SUMMARY OF PART 6: OPERATION AND CONTROL

PART 6:	DESCRIPTION				AMOUNT
PART 6:	OPERATION AND CONTROL				
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES ON PAGE PD.99					

SUMMARY OF THE BILLS OF QUANTITIES

SECTION	DESCRIPTION	AMOUNT (Rand)
Part 1	Preliminary & General	
Part 2	Civil & Building	
Part 3	Electrical	
Part 4	Control & Instrumentation Equipment	
Part 5	Mechanical	
Part 6	Operation & Control	
TOTAL OF THE BILLS OF QUANTITIES		
Allow: 10% for Contingencies (The provisional sum provided here may only be expended as directed by the Employer's Agent and may be deducted in whole or in part)		
TOTAL		
Allow: 8% for Price Escalation During the Contract Period (The provisional sum provided here may be employed only as necessary in terms of the Contract Price Adjustment Schedule)		
TOTAL		
Add: 15 % VAT		
TOTAL (Carried forward to C1.1 : Form of Offer)		

SIGNED ON BEHALF OF TENDERER: .....

Ugu District Municipality

UMZIMKHULU BULK WATER AUGMENTATION SCHEME: PHASE 2

TENDER N°: UGU-07-1631-2023

CONSTRUCTION OF THE BACKWASH WATER RECOVERY FACILITY AT BHOBHOYI WATER TREATMENT WORKS

CIDB CLASSIFICATION: 7ME OR HIGHER

SCOPE OF WORK, SITE INFORMATION & ANNEXURES
VOLUME 3 OF 4

ISSUED BY:

Ugu District Municipality

P O Box 33
Port Shepstone
4240

Contact Name : Ms Noncedo Gidimisani

Telephone : 039 688 5700

Email Address : Noncedo.Gidimisani@ugu.gov.za

PREPARED BY:

Royal HaskoningDHV (Pty) Ltd

P O Box 1066
Pietermaritzburg
3200

Contact Name : Mr Selemo Sefehle

Telephone : 087 350 6776

Email Address : Selemo.Sefehle@rhdhv.com

APRIL 2023

CLOSING DATE & TIME:	**12:00 on Friday, 19 May 2023**
COMPULSORY TENDER MEETING:	**10:00 on Wednesday, 26 April 2023**

PROCUREMENT DOCUMENT
(Based on the CIDB Standard for Uniformity in Engineering and Construction Works Contracts August 2019 as published by CIDB and the General Conditions of Contract for Construction Works (Third Edition 2015) as published by the South African Institution of Civil Engineering)

NAME OF TENDERER : .....

CHECK-LIST FOR TENDER SUBMISSION

The Tenderer is to indicate in the check-boxes provided that he/she has completed the required section of the tender document. Completion of this check-list will assist the Tenderer in ensuring that he/she has attended to all the required items for submission with this tender.

		Yes	No	Yes	No	Comments
Cover	Name of Tenderer					
TP.5	MBD1: Invitation to Bid					
RD.5	Compulsory Site Inspection Certificate and Declaration					
RD.7	MBD2: Tax Clearance Certificate Requirements					
RD.8	MBD4: Bidder's Disclosure					
RD.11	MBD5 : Declaration For Procurement Above R10 Million					
RD.14	MBD6.1 : Preference Points Claim Form ITO the Preferential Regulations					
RD.18	Sworn Affidavit – B-BBEE Exempted Micro Enterprise - General					
RD.20	Sworn Affidavit – B-BBEE Qualifying Small Enterprise – General MBD8					
RD.22	Compulsory Enterprise Questionnaire					
RD.24	Company Registration Certificate and Shareholding Details					
RD.25	Contractor's Certificate of Registration with CIDB					
RD.26	Contractor's COID Registration Details					
RD.27	Form of Intent to Provide a Performance Guarantee					
RD.28	Joint Venture Agreement					
RD.29	Good Standing with Municipal Accounts					
RD.30	Experience of Tenderer and Current Projects					
RD.34	Proposed Organization and Staffing					
RD.35	Experience of Key Personnel					
RD.41	Construction Methodology and Preliminary Programme					
RD.42	Financial Resources					
RD.43	Quality Control and Environmental Management					
RD.44	Contractor's Health and Safety Declaration					
RD.46	Construction Health and Safety Plan					
RD.48	Certificate of Authority					
RD.50	Schedule of Sources of Supply of Materials					
RD.51	Sub-Contracting for Local EME or QSE					
RD.54	Schedule of Proposed Sub-Contractors					
RD.55	Schedule of Construction Equipment					
RD.56	Amendments, Qualifications and Alternatives					
RD.57	Record of Addenda to Tender Document					

Page	Description	Completed		For office use		
		Yes	No	Yes	No	Comments
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C.8	Contract Data					
PD.7	Bill of Quantities					

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C3.1: DESCRIPTION OF WORK

C3.1 Description of Work

C3.1.1 Employer's Objectives

Ugu District Municipality (the Employer), being the Water Services Authority (WSA) and the Water Services Provider (WSP), is responsible for the provision of adequate, reliable, and safe water supply and sanitation systems that stretches from Scottburgh in the North to Port Edward in the south and inland to Harding. To this end, the Employer owns and operates numerous water abstraction and treatment facilities, one of which is the Bhobhoyi Water Treatment Works located approximately 5 km inland of the Port Shepstone.

Run-off river water is abstracted from the uMmzimkhulu River at St Helen's Rock and was, in the past, pumped direct to the Bhobhoyi Water Treatment Works. The Employer has recently constructed the uMzimkhulu River Off-channel Storage Dam and raw water is pumped from St Helen's Rock Pump Station to the dam. Water from the dam is then fed by gravity to supply the Bhobhoyi Water Treatment Works. The Employer has also augmented the capacity of the St Helen's Rock Pump Station by installing new pumps that have increased its rated capacity from 54 Mℓ/d to 108 Mℓ/d.

The Employer's objective at the existing Bhobhoyi Waterworks is to recover backwash wastewater and clarifier desludge and reduce treatment water losses through the construction of the Backwash Water recovery and sludge treatment facility.

The purpose of the project is to reduce water losses (Water Conservation) at Bhobhoyi Waterworks as part of the response to the sustainable water resources utilization. The project will also enhance the District Municipality's Water Conservation and Water Demand Management initiatives at the waterworks

Under this Tender N°: UGU-07-1631-2023, Ugu District Municipality is inviting tenders for the construction of a 5.8 Mℓ/day backwash water recovery and sludge treatment facility at the existing Bhobhoyi Water Treatment Works.

C3.1.2 Overview of the Works

Ugu District Municipality is the Water Services Authority (WSA) and the Water Services Provider (WSP) for the entire Ugu District Municipal area/region. Bhobhoyi Waterworks treatment capacity was upgraded from 27 Mℓ/day to 81 Mℓ/day as part of uMzimkhulu Bulk Water Augmentation Scheme Phase 1. The ultimate future capacity will be 108 Mℓ/day after Phase 2 has been completed.

uMzimkhulu Bulk Water Augmentation Scheme Phase 2 comprises of the following:

- The Construction of a Water Services Laboratory at the existing Ugu District Municipality Disaster Centre located adjacent to the N2 Coastal/N2 Inland interchange,
- The Construction of the Backwash Water recovery and sludge treatment facility located at the existing Bhobhoyi Waterworks, and
- The upgrade of the Bhobhoyi Waterworks from the existing 81 Mℓ/d treatment capacity to the ultimate 108 Mℓ/d treatment capacity.

Approximately 10 % of the present plant capacity amounting to 8,1 Mℓ/day (and expected to be 10,8 Mℓ/d in the future) is lost via treatment losses. The Backwash Water Recovery Facility is required to recycle the backwash wastewater and the clarifier desludge waste to the inlet works to reduce these water losses. Backwash and clarifier de-sludge waste is currently being discharged to an existing water course near the waterworks.

This document is prepared for the construction of the Backwash Water Recovery and Sludge Treatment Facility. The existing Backwash Water Recovery Facility (BWRF) mainly comprises of the following:

- A Vortex Degritter to separate the grit from the treatment waste streams such as the backwash water and the clarifier underflow,
- A reinforced concrete balancing tank to balance the flows from backwashing and the clarifier under flows,
- A facilities building to house the dosing pumps, flash mixer, recycle pumping station and the centrifuge for dewatering the thickened sludge,
- A gravity thickener,
- Interlinking pipework ranging from 250 to 525 mm diameter pipelines, and
- A 4 Mℓ clear water concrete reservoir.

C3.1.3 Description of the Works

The general description of the Works to be completed as part of this contract includes;

The supply, installation, testing and commissioning of the mechanical, electrical/control and instrumentation works for the following;

1. Vortex Degritters.
   - Construction of 2 Nº Vortex Degritters, one duty and one standby. Construction of a Splitter Box/Manhole to bypass the process system in case of equipment failure.
   - Supply and installation of Grit Classifiers, Air Blowers/ Air Lift Pump, Rotating Turbine and other Mechanical equipment as specified for each Vortex Degritter.

2 Balancing Tank
   - Construction of a Concrete Balancing Tank structure with three different compartments.
   - Installation of 3 Nº Mixers for each compartment of the Balancing Tank.
   - Installation of 2 Nº Penstock to control flow between the compartments.
   - Access Walkway around the structure to allow access to the mixers platform and penstocks.

3 Facility Building

   Construction of a Facility Building to house the MCC, the Centrifuges and Polymer Dosing System. The Facilities Building will also house the return pumps and the pump to the centrifuges. The wet and dry well are both located below ground, as shown on the drawings. Two separate wet wells are to be constructed; one for the clear water and the other for the thickened sludge.

   - Polymer Dosing
     - Supply, Installation of a Polymer Preparation and Dosing Continuous Flow System for both powder and liquid polymers.
     - A Storage Tank subdivided into three (mixing, maturation and storage) for Dosing Chambers.
     - Tank Auxiliary Equipment, including the Dry Material Feeder and Jet Mixer, water and flushing Inlet, 3 Nº x Stirrers, Control Panel/PLC, and an Ultrasonic Level Sensor.
     - Pumps include 4 Nº Smart Digital Polymer Dosing Pumps, 1Nº Concentrate Feed Pump.
     - Piping and instrumentation (Gate Valves, Pressure Relief Valves, Pulsation Dampers, Non-Return Valves, Pressure Loading Valves, Strainers) and Dosage Calibration Cylinders.

- Centrifuge Feed Pumps: Installation of one duty and one standby. This set is located in the dry well and it will pump the thickened sludge to the Centrifuges.
  - Centrifuges: 2 Nº Centrifuges will be installed at the upper floor of the building.
- Return Pumps: Installation of one duty and one standby, this set is located in the dry well and it will pump the clear water back to the inlet work.

4 Gravity Thickener

- Construction of 1 Nº Gravity Thickener.
- Installation of Mechanical Rotating Bridge and other mechanical equipment as specified.
- Access Walkway around the structure.
- 1 Nº Motorised Sludge Desludge Valve.

5 Interlinking pipework ranging from 250 to 750 mm diameter pipelines:

Installation of Concrete Pipe Class 50D varying from DN450 to DN750 for most gravity fed pipework. The Concrete Pipes are from the Collector Manhole to the Splitter Manhole and then to the Headwall and also from the Reservoir Overflow to the Headwall.

- Installation of DN250 uPVC Pipe for the pump main and other pressurised sections of the network.

6 4 Mℓ clear water Reinforced Concrete Reservoir.

- Construction of a Reinforced Concrete Reservoir to increase on-site storage capacity.
- Installation of a DN400 Steel Pipe outlet to connect to the existing DN500 pipework as shown on the drawings.

C3.1.4 Location of the Works and Access

The project area is located within the coastal area of the Ugu District Municipality, some 9 km inland from Port Shepstone, along N2 Freeway to Harding, on the KwaZulu Natal Lower South Coast area as shown on the Locality Plan in Section C4.5. The Global Positioning System (GPS) Co-ordinates of the Bhobhoyi Waterworks site are 30°47'05"S and 30°23'06"E.

The site conditions are as detailed in Section C4.2.

C3.1.5 Temporary Works

The Contractor is to allow for all temporary works required for this Contract. The Contractor shall be required to obtain the use of suitable land and to establish maintain and secure his/her site office, workshop, storage facilities for pipes, plant, equipment, fittings, fuel, lubricants and all other materials required in the performance of this Contract, all in terms of the requirements of the Contract as described in C3 of this document and in the Employer's Environmental Specification, PTC: Construction Environmental Management Plan enclosed in this document.

The Contractor shall design, install and operate an appropriate de-watering system such that the works can be carried out in acceptably dry and safe conditions.

The Contractor shall provide temporary site facilities for his/her own use and for the use of the Employer's Agent and shall remove these at the end of construction. The Contractor will be required to obtain the necessary approval from the relevant roads authority and provide access to the site from existing roads.

The Contractor will be required to design and provide all formwork and scaffolding, as may be required.

C3.1.6 Nature of Ground and Subsoil Conditions

According to the 3030 Port Shepstone cartography, 1:250 000 Geological Map Series, the general area within which the site is located is underlain by the Ecca Group Shale and Sandstone. The sediments that the area is underlain by belongs to the Karoo Supergroup that is estimated to be 180 – 300 million years. This was verified by the presence of Shale in some of the test pits examined.

The area is classified as having a climatic N-value which is below 5. This indicates that the area is a humid climatic region with chemical weathering being the main form of weathering. At the time of the investigation, subsurface water seepage was not encountered in any of the Test Pits.

Soil erosion will be a problem if excavation and topsoil conservation are not managed appropriately, especially in the seasonal rainy months. In addition to the river and streams, natural drainage lines and small eroded gulleys exist along the bulk sewer pipeline route. The water table will be relatively high during the summer months.

The site investigation was carried out on 02 – 07 April 2023, in order to investigate the nature and engineering properties of the underlying soil. In total, thirteen (13) test spots were investigated, as directed by Royal HaskoningDHV. The test pits were profiled to a required maximum permissible depth of 1300mm. The positioning of the test pits were as follows:

- Balancing Tank – TP1 and TP2.
- Centrifuge Building – TP1, TP2 and TP3.
- Grit Removal – TP1 and TP2.
- Guard House – TP1 and TP2.
- Sludge Thickener – TP1, TP2, TP3 and TP4.

The in-situ materials on the site consists mainly of a silty sand, shale and in-situ rock at varying depths. The site is located in the Bhoboyi Water Treatment Plant. The land in the investigated site has a gentle slope from the north to south with steep access roads.
Trees are dispersed around the boundaries of the water treatment plant. The outcrop of rock was not visible. Boulders were seen on site that are suspected to have been excavated to install services for the plant. Rock at a shallow depth of 500mm below the natural ground level was observed during the investigation. This will make excavation in some areas quite difficult.

DCP test results were used as a guide to determine the excavation conditions. The above anticipated / prevalent excavation conditions should be used as estimates only. These test results shows that the anticipated excavation conditions at a particular depth varies from soft to hard rock.

Moist conditions were primarily encountered at the bottom of the proposed Guard House test pits. Slightly moist conditions were encountered at the bottom of the Proposed Balancing Tank, Centrifuge Building and Grit Removal test pits. Dry conditions were found at the proposed Sludge Thickener test pits. Although the conditions encountered in the test pits generally do not require subsurface drainage measures at the depths examined, they should nonetheless be considered due to the water containing structures being constructed where water spillage is anticipated. Surface drainage measures are required as general practice to divert surface runoff from structures. Moderate moisture content was found in the material extracted from most of the test pits.

Material extracted from TP1 and TP2 of the proposed Centrifuge Building area and TP3 of the proposed Sludge Thickener area can possibly be used as selected material. Fill material for pipeline construction was found at TP1 of the proposed Guard House area. It must be mentioned that these materials should be periodically tested during usage in order to verify their class and acceptability.

The unsuitable in-situ materials and/or expensive horizon below the founding depth should be removed and replaced with gravel materials that possess G5 or G6 quality.

There was no evidence of any potential collapse within the sidewalls on most test pits during the logging process. This indicates that the material encountered on most of the test pits was not too coarse. In TP2 of the proposed Grit Removal position, TP2 & TP3 of the proposed Sludge Thickener position, gravel material was encounter. The side walls of the three abovementioned test pits had a potential of collapsing due to the coarse material found.

The above-mentioned Geotechnical Report is included in Section C4.7: Site Information.

The information provided above only serves as a guideline and prospective Tenderers shall acquaint themselves with the nature of materials on site.

C3.2: ENGINEERING

C3.2 Engineering

C3.2.1 Design Services and Activity Matrix

Description	Responsible Party
Final Design of Civil Works	Employer
Basic Engineering and layouts of Mechanical and Electrical Engineering Works	Employer
Final design of mechanical and electrical works for approval by the Employer's Agent	Contractor
Design of alternatives proposed (if any)	Contractor
Temporary works	Contractor
Other documentation (described under (3.2.4.3)	Contractor
Preparation of Record(1) Drawings	Employer's Agent

(1) Based on As-Built information to be provided by the Contractor

C3.2.2 Employer's Design

The conceptual hydraulic analysis of the system has been completed by the Employer.

The drawings for the civil works have been finalised on the basis of the hydraulic and treatment process designs for the works.

The Contractor is responsible for the detailed design and layout of plant and equipment on the site and within/on the proposed new structures should there be any variations from the Employer's proposed layouts/arrangements as shown on the drawings accompanying this document.

Drawings issued to Tenderers as part of the tender documents must be regarded as provisional and preliminary for the Tenderer's benefit to generally assess the Scope of Work. The tender drawings are issued separately to this document.

At commencement of the Contract, the Employer's Agent will deliver to the Contractor, copies of the construction drawings and any instructions required for the commencement of the Works. From time to time thereafter during the progress of the Works, the Employer's Agent may issue further drawings or revisions for construction purposes as may be necessary for adequate construction, completion and defects correction of the Works. The work shall be carried out in accordance with the latest available revision of the drawings approved for construction.

C3.2.3 Drawings

The following drawings are applicable to the Contract and are bound separately:

Drawing Nº	Drawing Title
MD5775-RHD-BR-SL-DR-C-1000	BACKWASH WATER RECOVERY SITE LAYOUT
MD5775-RHD-BR-VD-DR-C-1101	VORTEX DEGRITTER
MD5775-RHD-BR-VD-DR-C-1102	VORTEX DEGRITTER
MD5775-RHD-BR-BT-DR-C-1201	BALANCING TANK
MD5775-RHD-BR-BT-DR-C-1202	BALANCING TANK
MD5775-RHD-BR-FB-DR-C-1302	FACILITIES BUILDING
MD5775-RHD-BR-FB-DR-C-1303	FACILITIES BUILDING
MD5775-RHD-BR-FB-DR-C-1304	FACILITIES BUILDING
MD5775-RHD-BR-FB-DR-C-1305	FACILITIES BUILDING
MD5775-RHD-BR-FB-DR-C-1306	FACILITIES BUILDING
MD5775-RHD-BR-FB-DR-C-1307	FACILITIES BUILDING
MD5775-RHD-BR-GT-DR-C-1401	GRAVITY THICKENER TANK
MD5775-RHD-BR-RV-DR-C-1501	4 ML RESERVOIR
MD5775-RHD-BR-RV-DR-C-1502	4 ML RESERVOIR
MD5775-RHD-BR-GH-DR-C-1701	GUARD HOUSE
MD5775-RHD-BR-ZZ-DR-C-1800	STANDARD DETAILS
MD5775-RHD-BR-GR-DR-C-1801	STRUCTURAL JOINTS
MD5775-RHD-BR-ZZ-D-E-4100	SINGLE LINE DIAGRAM & GENERAL ARRANGEMENT
MD5775-RHD-BR-ZZ-D-E-4200	ELECTRICAL TYPICALS
MD5775-RHD-BR-ZZ-D-E-4300	ELECTRICAL LAYOUT
MD5775-RHD-BR-ZZ-D-E-4400	P&ID DRAWING LEGEND
MD5775-RHD-BR-ZZ-D-E-4500	P&ID DRAWING
MD5775-RHD-BR-ZZ-D-E-4600	CONTROL NETWORK
MD5775-RHD-BR-ZZ-D-E-4700	C&I TYPICAL DRAWING

The Contractor will be required to mark up one complete set of prints of the construction drawings with as-built information and submit these to the Employer's Agent for his/her approval prior to issue of the Certificate of Practical Completion. An item has been included in the Bill of Quantities to cover the costs of the provision of a complete set of marked-up as-built drawings.

C3.2.4 Contractor's Design

The Contractor's responsibilities for design and documentation includes, but are not necessarily limited to, the descriptions below:

C3.2.4.1 Design of Alternatives

Should the Contractor, at tendering stage or following appointment, propose any alternative to the Employer's design, such proposal shall only be deemed valid if it is accompanied by adequate and suitable sketches or drawings detailing the extent of the alternative and the component, sufficient to establish the means of execution of the work, applicable fabrication drawings, etc. and provided that such submission is also accompanied by Method Statements, and specifications where appropriate, detailing how the Contractor proposes to go about the work from the ordering of materials, organizing of equipment, steps in executing the alternative proposal, together with proposed lists of personnel involved, tools, health and safety measures and measures for environmental compliance.

Such alternative shall be provided adequately in advance of the proposed work to allow for sufficient consideration and consultation and shall be subject to the Employer's Agent's approval.

C3.2.4.2 Design of Temporary Works

The Contractor shall be responsible for the layout of his/her site camp, construction areas, design of all material storage areas, temporary works, including construction access, culverts and drainage. The Contractor is also referred to the Employer's Environmental Specification, PTC: Construction Environmental Management Plan in this regard.

C3.2.4.3 Final Design of Mechanical and Electrical Works for Approval by the Employer's Agent

The conceptual design of the mechanical and electrical works for tender purposes is based on generic mechanical equipment, its generic operational efficiencies and footprints. The Contractor is required to produce the detailed designs of the mechanical and electrical works according to the tendered proprietary mechanical and electrical equipment and to produce detailed general arrangement drawings for the installation of the equipment.

The contractor shall indicate the required construction tolerances for the civil works for proper installation and operation of the mechanical equipment. The weights of the tendered mechanical equipment shall be provided by the contractor for the Structural Engineer to finalise the structural design and reinforcement for the civil works.

The Employer's Agent shall update the civil construction drawings to suit the general arrangement drawings and the construction tolerances as required by the mechanical contractor.

C3.2.4.4 Other Documentation required from Contractor

Operation and Maintenance Manual

The Contractor shall be responsible to produce the Operations & Maintenance Manual for the Works. Two draft copies and two electronic copies of the O & M Manual shall be issued to the Employer's Agent prior to commissioning of the Works. Before the Certificate of Practical Completion is issued (after the successful completion of the Trial Operational Period) four final copies of the final approved version of the O & M Manual shall be issued to the Employer's Agent.

Binders with hard plastic covers and four-ring spring clip holders shall be used. Binders shall not be over-filled to allow use without damage to the contents. A spare binder shall be provided for every three used, marked with the contract information. At least one set shall contain original copies.

The manual shall be of a standard acceptable to the Employer's Agent. Title labels which include contract number, title, location, Contractor's name as well as the equipment or fittings used together with volume number and contents shall be fixed on the front as well as the spine of the binders.

Manuals shall be in English only, with sections of equipment arranged by labelled dividing separator sheets. Where standard literature is obtained from suppliers or manufacturers, this shall be neatly photocopied in A4 size, with the applicable sections clearly marked, omitting duplicate sections in languages other than English.

Comprehensive indexes shall be included, with separate sections (with their own index) where required, as follows:

- Record (as-built) drawings referenced to the drawings list in C3.2.3.
- Fittings and Plant supplied
- Name and contact details of all suppliers
- A comprehensive schedule of routine maintenance for the works.
- The index is not exhaustive and may be amended by the Employer's Agent during the construction stage.

C3.3: PROCUREMENT

C3.3 Procurement

C3.3.1 Preferential Procurement Procedures

C3.3.1.1 Requirements

The conditions associated with the granting of preferences, if any, and the sanctions relating to a breach of preferencing conditions are contained below.

C3.3.1.2 Resource Standard Pertaining to Targeted Procurement

The Employer has determined that 100% of the Contractor's unskilled labour force shall be made up from the Ward(s) or Semi-urban Suburb in the Local Municipality area. Local labour employed on the Contract shall be paid in accordance with the Civil Engineering Industry minimum wage rate and all statutory conditions of employment shall be met including registration with the Unemployment Insurance Fund. The rate of pay shall be inclusive of the 1% UIF contribution.

C3.3.1.3 Contracts of Employment

All employees of the Contractor shall be issued with a written contract of employment which shall be signed by the Contractor and the employee. The contracts shall be in isiZulu and in English.

Contracts of employment shall incorporate, inter alia, the following:

- personal particulars,
- job title and job description,
- employment period, including any probation period, which probation period shall not exceed 13 weeks,
- hours of work, statutory holidays, vacation, sick leave,
- remuneration, including wage rates for overtime, and any monetary allowances and deductions applicable to any probationary period and the time after its satisfactory completion,
- method of payment,
- medical and any other social benefits,
- conditions precedent to termination of employment,

and shall be accompanied by a written statement of company procedures covering such matters as training, promotion and redundancy policies, procedures for dealing with grievances, disciplinary procedures, protective clothing and occupational safety, and the like.

C3.3.1.3 Induction Programme

Before starting training or regular working, all employees shall attend an induction programme at which, inter alia, methods of working, site safety procedures, environmental policies, and the employees' role in relation to them shall be addressed. The employees shall be given an introduction to the Contractor's general industrial relations policy and procedures, covering aspects such as selection for promotion and redundancy, any bonus schemes, procedures for dealing with grievances, disciplinary procedures, and the like.

C3.3.1.4 In-task Training

In-task training of the workforce is a general responsibility of the Contractor to ensure that his/her workforce is sufficiently skilled, Health and Safety aware and Environmentally compliant as per the Employer's Environmental Specification, PTC: Construction Environmental Management Plan. The Contractor shall provide in-task training of local labour during the construction of the works and at his/her own cost. In-task training shall consist of training and guidance of Construction Supervisors, Construction Supervisors Assistants and labourers in those construction activities where the labour is engaged. The in-task training shall cover all training and guidance required to ensure that the leaders and labour are able to carry out the project tasks in accordance with the requirements of the project specification. The in-task training shall be carried out by the Contractor's on key and skilled personnel.

C3.3.2 Labour Intensive Construction Methods

The Employer's objectives are to deliver public infrastructure using labour intensive methods where feasible to do so. The Contractor shall plan his/her works in general to make maximum use of labour-intensive methods in preference to the use of plant where appropriate.

Classification of materials for hand excavation shall be as per Annex B of SANS 1921 Part 5 (Tables B.1 & B.2). For excavation by hand, daily task rates shall be as per Table B.3 (Annex B) of SANS 1921 Part 5 ('Typical production per 6-hour task'), where the task rate varies according to classification of soft material (Soft Class 1, Soft Class 2 & Soft Class 3) and depth of excavation (Refer also PSDB 5.4.1.). Cases of disagreement in classification of excavation shall be referred to the Employer's Agent, whose decision is final. A task for placing bedding and backfilling by hand (excluding compaction) may be agreed at 7,0m³/day.

The adherence to the application of Labour-Intensive Construction will be monitored by the Community Liaison Officer (CLO) and will be reported on via the monthly income generation reports. Machine excavation shall be used where the classification of excavation is 'intermediate' or 'hard' and for excavation to founding depth of structures and of pipe trenches beyond 1,5m in depth. Machine excavation may also be used where the community reports that the work is too hard for manual labour. The CLO will be the liaison person in this respect.

<u>Labour-Intensive Works</u>

Labour-intensive works comprise the activities described in SANS 1921-5, Earthworks activities which are to be performed by hand, and its associated specification data. Such works shall be constructed using local workers who are temporarily employed in terms of this Scope of Work.

<u>Labour Intensive Competencies of Supervisory and Management Staff</u>

Contractors having a CIDB contractor grading designation of 5CE or higher shall only engage supervisory and management staff in labour intensive works who have completed the skills programme outlined in Table 1.

Where a Contractor has a contractor grading designation of 4CE and below, the managing principal of the Contractor, namely, a sole proprietor, the senior partner, the managing director or managing member of a close corporation, as relevant, shall have personally completed the NQF level 5. All other site supervisory staff in the employ of such contractors must have completed the NQF Level 2-unit standards or NQF level 4-unit standards.

Table 1: Skills Programme for Supervisory and Management Staff

Personnel	NQF Level	Unit Standard Titles	Skills Programme Description
Assistant Construction Supervisor	***2***	Apply Labour-Intensive Construction Systems and Techniques to Work Activities	This unit standard must be completed, **and**
		Use Labour-Intensive Construction Methods to Construct and Maintain Roads and Stormwater Drainage	any one of these 3 units standards
		Use Labour-Intensive Construction Methods to Construct and Maintain Water and Sanitation Services	
		Use Labour-Intensive Construction Methods to Construct, Repair and Maintain Structures	
Construction Supervisor	***4***	Implement Labour-Intensive Construction Systems and Techniques	This unit standard must be completed, **and**
		Use Labour-Intensive Construction Methods to Construct and Maintain	any one of these 3-unit standards
		Roads and Stormwater Drainage Use Labour-Intensive Construction Methods to Construct and Maintain	
		Water and Sanitation Services Use Labour-Intensive Construction Methods to Construct, Repair and Maintain Structures	
Construction Manager	***5***	Manage Labour-Intensive Construction Processes	Skills Programme against this single unit standard

Employment of Unskilled and Semi-Skilled Workers in Labour-Intensive Works

Requirements for the sourcing and engagement of labour.

- Unskilled and semi-skilled labour required for the execution of all labour-intensive works shall be engaged strictly in accordance with prevailing legislation and SANS 1914-5, Participation of Targeted Labour.
- The rate of pay set shall be in accordance with the Ugu District Municipality minimum wage rate has been determined at **R200.00** per day up to a maximum of 9 hours per day.

The following should be considered when setting rates of pay for workers:

- The rate set should consider wages paid for comparable unskilled work in the industry per local area and sector, if necessary.
- The rate should be an appropriate industry determined wage to offer an incentive for work, to reward effort provided and to ensure a reasonable quality of work. It should not be more than the average local rate to ensure people are not recruited away from other employment and jobs with longer-term prospects.
- Men, women, disabled persons and the aged must receive the same pay for work of equal value.

Tasks established by the Contractor must be such that:

a) the average worker completes 5 tasks per week in 40 hours or less, and
b) the weakest worker completes 5 tasks per week in 55 hours or less.

The Contractor must revise the time taken to complete a task whenever it is established that the time taken to complete a weekly task is not within the requirements of 1.1.4.

The Contractor shall, through all available community structures, inform the local community of the labour-intensive works and the employment opportunities presented thereby. Preference must be given to people with previous practical experience in construction and / or who come from households:

a) where the head of the household has less than a primary school education,
b) that have less than one (1) person earning a full-time income,
c) where subsistence agriculture is the source of income,
d) those who are not in receipt of any social security pension income.

The Contractor shall endeavour to ensure that the expenditure on the employment of temporary workers is in the following proportions:

a) 60% women,
b) 20% youth who are between the ages of 18 and 25, and
c) 2% on persons with disabilities.

C3.3.3 Specific Provisions Pertaining to SANS 1914-5

- **Definitions**

  Targeted Labour: Unemployed persons who are employed as local labour on the Project.

- **Contract Participation Goals**

  - There is no specified labourer's contract participation goal for the Contract. The contract participation goal shall be measured in the performance of the contract to enable the employment provided to targeted labour to be quantified.
  - The wages and allowances used to calculate the contract participation goal shall, with respect to both time-rated and task rated workers, comprise all wages paid, and any training allowance paid in respect of agreed training programmes.

- **Terms and Conditions for the Engagement of Targeted Labour**

  Further to the provisions of clause 3.3.2 of SANS 1914-5, written contracts shall be entered into with targeted labour.

- **Variations to SANS 1914-5**

  The definition for net amount shall be amended as follows:

  - Financial value of the contract upon completion, exclusive of any value added tax or sales tax which the law requires the employer to pay the contractor.
  - The schedule referred to in 5.2 shall in addition reflect the status of targeted labour as women, youth and persons with disabilities and the number of days of formal training provided to targeted labour.

- **Training of Targeted Labour**

  - The Contractor shall provide all the necessary on-the-job training to targeted labour to enable such labour to master the basic work techniques required to undertake the work in accordance with the requirements of the Contract in a manner that does not compromise worker health and safety.
  - The cost of the formal training of targeted labour, will be funded by the provincial office of the Department of Labour. This training should take place as close to the Project site as practically possible. The Contractor must access this training by informing the relevant provincial office of the Department of Labour in writing, within fourteen (14) days of being awarded the Contract, of the likely number of persons that will undergo training and when such training is required. The Employer must be furnished with a copy of this request.
  - A copy of this training request made by the Contractor to the DOL provincial office must also be faxed to the EPWP Training Director in the Department of Public Works– Cinderella Makunike, Fax Number 012 328 6820 or email cinderella.makunike@dpw.gov.za Tel: 083 677 4026.
  - The Contractor shall be responsible for scheduling the training of workers and shall take all reasonable steps to ensure that each beneficiary is provided with a minimum of 6 days of formal training if he/she is employed for 3 months or less and a minimum of 10 days if he/she is employed for 4 months or more.
  - The Contractor shall do nothing to dissuade targeted labour from participating in the above-mentioned training programmes.
  - An allowance equal to 100% of the task rate or daily rate shall be paid by the Contractor to workers who attend formal training, in terms of 1.3.4 above.
  - Proof of compliance with the requirements of 1.3.2 to 1.3.6 must be provided by the Contractor to the Employer prior to submission of the final payment certificate.
  - Upon the completion of their training labourers shall be issued with certificates of confirmation of successfully completing the training.

Generic Labour-Intensive Specification

The Generic Labour-intensive specification below is the same as SANS 1921-5, Construction and management requirement for works contracts - Part 5: Earthworks activities which are to be performed by hand and should be included in the Scope of Works without amendment or modification as set out below.

Scope

This specification establishes general requirements for activities which are to be executed by hand involving the following:

- trenches having a depth of less than 1.5 meters,
- pipelaying and backfilling,
- stormwater drainage,
- low-volume roads and sidewalks,
- minor, low-volume concrete work., excluding water retaining structures,
- topsoiling and grassing, and
- stone pitching and rubble concrete masonry.

Precedence

Where this specification is in conflict with any other standard or specification referred to in the Scope of Works to this Contract, the requirements of this specification shall prevail.

Hand Excavatable material

Hand excavatable material is material:

- **Granular Materials:**
  - whose consistency when profiled may in terms of Table 1 be classified as very loose, loose, medium dense, or dense; or ii) where the material is a gravel having a maximum particle size of 10 mm and contains no cobbles or isolated boulders, and no more than 15 blows of a dynamic cone penetrometer is required to penetrate 100 mm;
- **Cohesive Materials:**
  - whose consistency when profiled may in terms of Table 1 be classified as very soft, soft, firm, stiff and stiff / very stiff; or ii) where the material is a gravel having a maximum particle size of 10 mm and contains no cobbles or isolated boulders, and no more than 8 blows of a dynamic cone penetrometer is required to penetrate 100 mm;

Note:

- A boulder, a cobble and gravel are materials with a particle size between 60 and 200 mm.
- A dynamic cone penetrometer is an instrument used to measure the insitu shear resistance of a soil comprising a drop weight of approximately 10 kg which falls through a height of 400 mm and drives a cone having a maximum diameter of 20 mm (cone angle of 60° with respect to the horizontal) into the material being tested.

Table 2: Consistency of Materials when Profiled

Granular Materials		Cohesive Materials	
Consistency	**Description**	**Consistency**	**Description**
Very loose	Crumbles very easily when scraped with a geological pick.	Very soft	Geological pick head can easily be pushed in as far as the shaft of the handle.
Loose	Small resistance to penetration by sharp end of a geological pick.	Soft	Easily dented by thumb; sharp end of a geological pick can be pushed in 30-40 mm; can be moulded by fingers with some pressure.
Medium dense	Considerable resistance to penetration by sharp end of a geological pick.	Firm	Indented by thumb with effort; sharp end of geological pick can be pushed in up to 10 mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade.
Dense	Very high resistance to penetration by the sharp end of geological pick; requires many blows for excavation.	Stiff	Can be indented by thumb-nail; slight indentation produced by pushing geological pick point into soil; cannot be moulded by fingers.
Very dense	High resistance to repeated blows of a geological pick.	Very stiff	Indented by thumb-nail with difficulty; slight indentation produced by blow of a geological pick point.

Trench excavation

All hand excavatable material in trenches, and areas excavated to founding levels for structures having a depth of less than 1.5 metres shall be excavated by hand.

Compaction of Backfilling to Trenches (areas not subject to traffic)

Backfilling to trenches shall be placed in layers of thickness (before compaction) not exceeding 100 mm. Each layer shall be compacted using hand stampers:

- to 90% Proctor density,
- such that in excess of 5 blows of a dynamic come penetrometer (DCP) is required to penetrate 100 mm of the backfill, provided that backfill does not comprise more than 10% gravel of size less than 10 mm and contains no isolated boulders, or
- such that the density of the compacted trench backfill is not less than that of the surrounding undisturbed soil when tested comparatively with a DCP.

Excavation

All hand excavatable material including topsoil classified as hand excavatable shall be excavated by hand. Harder material may be loosened by mechanical means prior to excavation by hand.

The excavation of any material which presents the possibility of danger or injury to workers shall not be excavated by hand.

Clearing and Grubbing

Grass and small bushes shall be cleared by hand.

Shaping

All shaping shall be undertaken by hand.

Loading

All loading shall be done by hand, regardless of the method of haulage.

Haul

Excavation material shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150 m.

Offloading

All material, however transported, is to be off-loaded by hand, unless tipper-trucks are utilised for haulage

Spreading

All material shall be spread by hand.

Compaction

Small areas may be compacted by hand provided that the specified compaction is achieved.

Grassing

All grassing shall be undertaking by sprigging, sodding, or seeding by hand.

Stone Pitching and Rubble Concrete Masonry

All stone required for stone pitching and rubble concrete masonry, whether grouted or dry, must be collected, loaded, off loaded and placed by hand.

Sand and stone shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150 m.

Grout shall be mixed and placed by hand.

Manufactured Elements

Elements manufactured or designed by the Contractor, such as manhole rings and cover slabs, precast concrete planks and pipes, masonry units and edge beams shall not individually, have a mass of more than 320 kg. In addition, the items shall be large enough so that 4 workers can conveniently and simultaneously acquire a proper hand hold on them.

Community Liaison Officer

The adherence to the application of Labour-Intensive Construction will be monitored by the Community Liaison Officer (CLO) and will be reported on via the monthly income generation reports. Machine excavation shall be used where the classification of excavation is ‘intermediate’ or ‘hard’ and for excavation of pipe trenches beyond 1,5 m in depth. Machine excavation may also be used where the community reports that the work is too hard for manual labour. The CLO will be the liaison person in this respect.

C3.3.4 Sub-contracting

C3.3.4.1 CPG and Specialised Sub-contractors

It is a requirement for this Contract that local Sub-contractors be employed in terms of the Contract Participation Goals (CPG) requirements for the works. The schedule in this document is to be completed to indicate the full names and addresses of all proposed CPG Sub-contractors for which approval of the Employer's Agent is sought, stating the section of the works that each will be handling. 30% in total of the approved Civil works Contract value shall be allocated to CPG Sub-contracting of the work.

Sub-contracting of specialised portions of the work is permitted in principle up to a maximum of 10% in total of the approved Contract value. Construction of the concrete works for the main process units shall be undertaken by a Specialist water retaining concrete Contractor.

The appointment of both CPG and Specialised Sub-contractors shall only be formalised on the basis of the presentation of a suitable and compliant sub-contracting agreement in the SAICE General Conditions of Sub-contracting for Construction Works First Edition 2018 format or other acceptable format.

C3.3.4.2 Value of Works to be Sub-contracted

The work for the CPG Sub-contractors must be sub-contracted proportionately to two different Sub-contractors who reside within Umdoni Municipality's boundaries, preferably within the Wards, or Semi-urban Suburbs within the site. One of those Sub-contractors must be of a level 3GB and the other must be a level 2CE. The main objective is to transfer skills such that each Sub-contractor will complete work of a civil engineering nature to a value that will allow him/her to upgrade to the next level.

C3.3.4.3 Contractor's Commission

The Contractor will be required to provide and appoint one person who will be dedicated to mentoring and managing the CPG Sub-contractors throughout the duration of their Works.

The Contractor shall take full responsibility of the works done by the CPG Sub-contractors. Some of the aspects of mentorship will include:

- Pricing / calculating rates
- Business Management
- Basic contractual matters
- Transfer of some construction skills
- Calculation of quantities
- Preparing payment certificates

The Contractor shall be required to provide all the material required by the CPG Sub-contractors, if so required by the appointed CPG subcontractor, to enable them to successfully complete their work.

An item has been included in the Bill of Quantities to cover the costs of mentoring and managing CPG Sub-contractors. The Contractor will be reimbursed for this function through the commission that he/she will earn based on the completed works by the CPG Sub-contractors and not on a proportioned monthly amount of the priced amount.

C3.4: CONSTRUCTION

C3.4 Construction

C3.4.1 Applicable Specifications

C3.4.1.1 Standard Specifications

The standard specifications on which this Contract is based is the South African Bureau of Standards (SABS) Standardised Specifications for Civil Engineering Construction SANS/SABS 1200. The various SANS/SABS specifications referred to in this document are listed in C3.6 of the Scope of Work and the Contractor is advised to obtain them from the Standards South Africa (a division of the SABS) in Pretoria.

The Standardised Specifications (SANS/SABS 1200) must be read in conjunction with the new SANS 1921 family of standards. In case of any discrepancy or conflict between the two, the SANS/SABS 1200 specification shall take precedence and shall govern.

Refer also to the Preface on interim situation until full suite of SANS 2001 Series of Specifications is available, on the first page of the Project Specification.

The term “project specifications” appearing in any of the SANS/SABS 1200 Standardised Specifications is deemed to be equivalent to the term “scope of work” in other SANS specifications.

The variations and additions to the Standard Specifications are prefixed PS (Particular Specification) and take precedence over the SANS Standardised Specification.

Where a specification is in conflict with either the variations and additions to Standardized Specifications or the SANS Standardised Specifications, the Particular Specifications shall take precedence.

C3.4.1.2 Applicable National and International Standards

Wherever possible items and materials for construction of the works shall comply with the relevant South African Bureau of Standards Specifications and with the British Standards where these are applicable in the absence of local standards.

The Contractor, when using materials conforming to a Standard Specification shall if called upon furnish the Employer’s Agent with certificates of tests showing that the materials do so conform.

C3.4.1.3 Particular / Generic Specifications

The Particular Specifications are included as C3.8 and take precedence over the Standard Specifications, but not over the Project Specifications.

C3.4.1.4 Certification by Recognised Bodies

Wherever possible items and materials for construction of the works shall comply with the relevant South African Bureau of Standards Specifications and with the British Standards where these are applicable in the absence of local standards.

The Contractor, when using materials conforming to a Standard Specification shall if called upon furnish the Employer’s Agent with certificates of tests showing that the materials do so conform.

C3.4.2 Plant and Materials

No Plant and no Materials shall be supplied by the Employer under this Contract. This will be the sole responsibility of the Contractor.

Plant and Materials that are to form part of the permanent Works shall be required to conform to the specifications herein. Prior to acceptance of materials on the site the Contractor shall therefore submit for prior approval details of the proposed product and manufacturer, including brochures and technical information, and typical quality test routines and validation certificates. Rejection and replacement of materials due to failure to obtain prior approval shall be at the Contractor's expense. A delay in being able to place an order due to late submission of information to the Employer's Agent for prior approval shall be deemed to be a delay caused by the Contractor and no claim for any extension of time will be entertained.

Certain Materials are subject to inspection at the site of the manufacturer's works by an Independent Inspection Authority appointed by the Employer's Agent. The Contractor shall be responsible to arrange the timely attendance of the Inspection Authority. Acceptance of Materials on site shall be subject to the Employer's Agent's approval and generally will not be granted should the Quality Assurance information and Material Data Sheets be deemed to be inadequate or are missing.

The storage of Plant and Materials on site is the Contractor's responsibility. The Contractor shall take adequate precautions to safeguard the Plant and Materials and shall be liable to remedy any defects or replace any Plant and Materials damaged in the course of transport, handling and storage and in the process of incorporation in the Works and testing up to the point of acceptance of the Works by the Employer.

C3.4.3 Construction Equipment

No Construction Equipment will be supplied by the Employer under this Contract. All Construction Equipment required for the completion of the Works shall be provided by the Contractor.

Equipment to be used on site shall be well maintained and, if they are to be used on public roads, in possession of valid roadworthy certificates. Leaking of fuel or lubricant, or excessive or objectionable noise or exhaust emissions, shall be adequate grounds for instruction to remove the Plant from the site, which removal shall be done within 24 hours.

The Contractor shall be responsible for determining the load clearance limits existing at the time and ensuring that his/her Construction Equipment does not exceed such limits. Before moving any heavy construction traffic onto highways, roads and bridges, the Contractor shall make suitable arrangements with the appropriate government authorities and obtain their approval for the passage of such traffic.

The Contractor shall not travel tracked vehicles or Plant on any bituminous sealed road surface. Only rubber tyre vehicles conforming to applicable load restrictions will be permitted to use bituminous sealed roads.

The Contractor shall take note of the work activities that are subject to mandatory Labour-Intensive Construction Methods and shall make adequate allowance for hand tools and PPE sufficient to complete these work activities according to programme. Note the contractual requirement for the Contractor to provide and maintain hand-tools in good working order (PCC 4.10.4)

C3.4.4 Existing Services

C3.4.4.1 Known Services

The approximate positions of some of the known underground services which may be affected by the Works, have been shown on the drawings. The Contractor will be required to contact all service owners and ascertain the location and status of all services irrespective of whether they are shown on the drawing or not.

C3.4.4.2 Treatment of Existing Services

The Contractor shall inform the Employer's Agent of all services both temporarily or permanently affected by the Works and services shall not be exposed, re-routed or modified without the written approval of the service owner. Existing services shall be protected as required, including re-routing of traffic, hand excavation in the vicinity of buried services and strutting or otherwise supporting services that cross trenches or excavations.

C3.4.4.3 Use of Detection Equipment

Where the presence of underground cables is suspected the Contractor shall use such methods as necessary, including cable or metal detectors, to prevent unnecessary damage and consequent delay and cost of repair.

C3.4.4.4 Damage to Services

The Contractor will be held responsible for any damage to known existing services caused by or arising out of his/her operations and any damage shall be made good at his/her own expense. Damage to unknown services shall be repaired as soon as possible and liability shall be determined on site should such damage occur. Once an unknown service is found, regardless of the manner in which it is found, it shall be deemed to be a known existing service.

C3.4.5 Site Establishment

C3.4.5.1 Services and Facilities Provided by the Employer

C3.4.5.1.1 Contractor's Site Camp & Depot (Read with SANS 1921 - 1: 2004 Clause 4.14)

The Employer will not provide sites for the Contractor's establishment but will indicate the possible site(s) for the Contractor's site camp and pipe yard(s), if required. It shall be the Contractor's responsibility to obtain permission for the use of the land and to negotiate the terms of use with the landowner(s).

It is required that facilities be established on site for the Employer's Agent's Representative. These include but are not limited to; a fully furnished meeting room, Employer's Agent Representative's fully furnished office and two covered carports for the Employer's Agent Representative and his/her assistant. Items have been included in the Bill of Quantities to cover the costs of the Employer's Agent's on-site facilities.

No housing is available for the Contractor's employees and the Contractor shall make his/her own arrangements to house his/her employees and to provide all necessary transport arrangements. No informal housing or squatting will be allowed.

C3.4.5.1.2 Potable Water Supply

Connection points for water for domestic use will be made available by the Local Authority from selected and pre-arranged point(s). The Contractor shall make his/her own arrangements with the Local Authority concerning the metering, billing and monthly payments for the use of potable water, according to the terms and agreement of the Local Authority. The Contractor will be required to supply, install, operate and maintain at his/her own costs, such temporary pipework and storage facilities as may be necessary to ensure sufficient supply of water. The Contractor shall be solely responsible for all the necessary costs for payments for this facility.

No other un-metered water supply, or water supply points, will be made available by the Local Authority for the supply of potable water for use by the Contractor.

The Employer does not warrant that any water supply that may exist is adequate for the proper execution of the Works. Any extension of time due to delays resulting from any disruptions to the above-mentioned metered water supply facilities will not be granted.

C3.4.5.1.3 Electricity

The Contractor shall make his/her own arrangements with the relevant Electricity Supply Authority regarding the supply of electricity to the site. The Contractor will also be required to make his/her own arrangements and pay all the requisite connection and consumption charges for whatever temporary power supplies he/she may require for his/her use on the site. No direct payment will be made for the provision of power. The cost thereof shall be deemed to be included in the rates and amounts tendered for the various items of work for which this service is required, or in the Contractor's preliminary and general items as the case may be.

C3.4.5.1.4 Telecommunication Services

The Contractor is to provide his/her own telephone facilities on site. No telephone will be required for the use of the Employer's Agent or his/her Representative for the duration of the Contract. An item has been included in the Bill of Quantities to cover the costs of the Employer's Agent's Representative's cellular phone calls and data connectivity.

C3.4.5.2 Facilities Provided by the Contractor

C3.4.5.2.1 Site Establishment

C3.4.5.2.1.1 Buildings

Possible sites for establishment will be indicated at the Clarification Meeting Site Visit. The Contractor shall determine his/her space requirements and shall be responsible to negotiate permission and terms of use of the site(s) in agreement with the respective landowner(s). The Contractor must not cut down or damage any trees nor make any excavation without the written permission of the Employer's Agent's Representative and will be required to restore the site to its original condition on completion of the Works.

It is required that facilities be established on site for the Employer's Agent's Representative. These include but are not limited to; a fully furnished meeting room, Employer's Agent Representative's fully furnished office, two covered carports for the Employer's Agent Representative and his/her assistant. Items have been included in the Bill of Quantities to cover the costs of the Employer's Agent's on-site facilities.

The Contractor must not remove and/or damage any existing services, nor make any excavations on the site without the written permission of the Employer's Agent's Representative and will be required to restore the site to its original condition on completion of the Works.

The Contractor shall provide and maintain at his/her own cost all sheds and housing necessary for the convenience of his/her workmen and for the accommodation and proper protection of his/her site establishment or other equipment from damage or loss. These are to be erected only on sites which shall have been approved by the Employer's Agent's Representative and they shall be removed as soon as they are no longer required for the Works; and the site thereof restored to its original condition and the ground left clean and sanitary.

All buildings and latrines shall be in accordance with the Local Authority and State Health regulations and shall be kept in a clean, sanitary condition to the satisfaction of the Employer's Agent's Representative

The Contractor's Establishment shall not be considered as being complete until such time as the facilities to be provided for the Employer's Agent are fully in place. (Refer PSA & PSAB).

C3.4.5.2.1.2 Sanitary Facilities

The Contractor shall provide the necessary ablution facilities at his/her camp site and the site of the Works for the use of his/her employees. Separate toilet facilities shall be available for the sole use of the Employer's Agent and his/her Representative(s). Buildings and fencing are to be neat and presentable and the surrounding areas must at all times be kept in a neat, clean and orderly condition. All buildings and latrines shall be in accordance with the local and national health regulations and shall be kept in a clean, sanitary condition.

C3.4.5.2.1.3 Security

The Contractor shall provide security watchmen to safeguard the Works, Plant, Construction Equipment, personnel and materials for the duration of the Contract, as he/she deems fit, at no extra cost to the Employer. The Contractor must ensure that all his/her employees as well as the employees of his/her Sub-contractors are able to identify themselves as members of the construction team.

C3.4.5.2.1.4 Disposal of Stormwater

The Contractor shall pay special attention to the management and disposal of all water on site from whatever source. It is essential that all completed works or parts thereof are kept dry and properly drained. Claims for any delay and for repair of damage caused to the Works as a result of the Contractor's failure to properly manage rain and surface water, will not be considered.

C3.4.5.2.1.5 Disposal of Waste

The Contractor shall dispose of solid waste at the approved Municipal dump yard, or spoil site(s) that has (have) been approved for such use by the Local Authority. Buried waste shall be covered up on a daily basis and the Contractor shall rehabilitate the site prior to Practical Completion being reached. The Contractor shall dispose and cover up all surplus and unsuitable material in spoil areas that have been approved by the Local Municipality. He/she shall be responsible for all arrangements necessary to obtain access to such dump yards and spoil sites.

C3.4.5.2.2 Equipment for Determination of Labour-Intensive Excavation (Read with SANS 1921 - 5: 2004)

The Contractor shall provide and maintain in good condition a Dynamic Cone Penetrometer (DCP) and all associated equipment for the determination of areas that are suitable for Labour-Intensive excavation methods as per PSDB 5.4 and for the classification of excavated materials and checking of compacted backfill as per Annex B of SANS1921 Part 5.

C3.4.5.2.3 Accommodation of Employees (Read with SANS 1921 - 1: 2004 Clause 4.14.)

No housing is available for the Contractor's employees and the Contractor shall make his/her own arrangements to house his/her employees and to transport them to and from site. No informal housing or squatting will be allowed.

C3.4.5.2.4 Establishment of materials storage Yard(s)

The Contractor shall be responsible for the logistics of pipes and other materials collections and deliveries for determining his/her storage requirements for all such materials and the points of delivery, whether to the site camp, or along the pipeline route. The Contractor shall secure adequate land for purposes of deliveries of pipes and other materials and storage and shall be responsible for any damages to pipes and other materials during the loading, transport, offloading, storage and further handling of the pipes and other materials.

The location and size(s) of a pipe storage yard(s) is at the Contractor's discretion. However, as a guide for site layout purposes, an average gap of 400 mm should be allowed between parallel pipes, the end-to-end gap between pipe stacks should be 5 m and the gap between pipes and the perimeter fence should be at least 6 m which includes a 5 m wide firebreak.

Steel pipes should be stored off the ground and secured from rolling using suitable dunnage, such as sandbags. Stacking of pipes should only be considered according to the manufacturer's recommendations.

PVC and HDPE pipes must all be protected from exposure to direct sunlight at all times in storage

To lessen the risk of fire damage the whole site where pipes are stored to be cleared of bushes and shrubs, subject to the requirements of the Employer's Environmental Specification, PTC: Construction Environmental Management Plan, and the grass on the site where pipes are stored to be cut to a height of no more than 25 mm and maintained at a height not exceeding 50 mm.

The Contractor shall provide the necessary supply of drinking water and ablution facilities at his/her pipes and other materials yard(s) and storage area(s) for the use of the security guard(s) and also for his/her employees who work therein.

C3.4.5.2.5 Storage and Laboratory Facilities

No storage facilities will be available or provided by the Employer and the Contractor is to make suitable arrangements to deliver materials as and when required for construction purposes and when called for by the Employer's Agent, whether such call be issued on or after the delivery date offered by the Tenderer.

No laboratory facilities will be available or provided by the Employer and the Contractor is to make suitable arrangements for all such laboratory facilities, whether on or off site. The Contractor shall arrange for process control testing to be undertaken by a Laboratory to be approved by the Employer's Agent. All process control testing that the Contractor is required to complete in terms of the Contract specifications shall be deemed to be covered by the relevant items in the tendered rates.

A Provisional Sum has been allocated for in the Bill of Quantities for the Employer's Agent's Acceptance Control Testing.

C3.4.5.2.6 Water for construction purposes

The Contractor shall make his/her own arrangements for the supply of water for all other construction purposes, including for testing and disinfecting of pipes and structures. Depending on the quantity of water required for construction purposes, including for testing and disinfecting purposes, it may be possible for a separate metered connection to be established, according to the terms and agreement of the Local Authority.

Otherwise, the Contractor shall procure water for construction purposes, including for testing and disinfecting purposes from local rivers, streams, dams, etc. No additional payments will be made to procure water for construction purposes, including for testing and disinfecting purposes, and it shall be deemed to be covered by the relevant items in the tendered rates.

C3.4.5.2.7 Electricity

The Contractor shall make his/her own arrangements concerning the supply of electricity. The Contractor will be required to pay all the requisite connection and consumption charges for whatever temporary electricity supplies he/she may require for his/her use on the site. No direct payment will be made for the provision of electricity. The cost thereof shall be deemed to be included in the rates and amounts tendered for the various items of work for which this service is required, or in the Contractor's preliminary and general items as the case may be.

C3.4.5.2.8 Telecommunication Services

The Contractor is to provide his/her own telephone facilities on site. No telephone will be required for the use of the Employer's Agent or his/her representative for the duration of the Contract. An item has been included in the Bill of Quantities to cover the costs of the Employer's Agent's Representative cellular phone calls and data connectivity.

C3.4.5.2.9 Vehicles and Equipment

No vehicles will be required for use by the Employer or his/her Representatives.

C3.4.6 Permits and Wayleaves

The Contractor shall obtain the necessary approvals and shall be required to comply with the authorities, service providers, and landowners' / occupiers' requirements at all times.

The Contractor will be required to take cognisance of, and comply with, the general wayleave and 'permission to occupy' requirements of the authorities, service providers and landowners / occupiers during the construction of the Works.

The Contractor will be required to confirm that permission has been granted and that the authorities, service providers, landowners/ occupiers and all affected parties have been informed of the Contractor's intentions before commencing with work on each property.

The Contractor is to obtain the necessary approvals and wayleave permits from the following authorities likely to be involved with the Project, or have existing services in close proximity to or crossing the proposed pipeline route;

1) Ugu District Municipality;
2) uMdoni Municipality;
3) KZN Department of Transport;
4) Eskom, and
5) Telkom
6) Fibre data service providers.

The Contractor is to obtain all necessary permits and wayleaves and is to confirm that permission has been granted before commencing with the work where their services are located.

Where required, the Contractor shall apply for abnormal load permits for transporting materials to the site.

C3.4.7 Alterations, Additions, Extensions and Modifications to Existing Works

The Contractor must satisfy himself/herself that the layout of the existing services, structures and Plant is compatible with the proposed Works, and must advise the Employer's Agent of any conflicts.

Alterations to existing services will require prior written authorisation by the Service Provider(s).

C3.4.8 Survey Control and Setting Out of the Works

The Contractor will be responsible for the setting out of the Works.

C3.4.9 Survey Beacons (Read with SANS 1921 - 1: 2004 Clause 4.15)

The Contractor shall take special precautions to protect all permanent survey beacons or pegs such as bench-marks, stand boundary pegs and trigonometrical beacons, regardless of whether such beacons or pegs were placed before or during the execution of the Contract. If any such beacons or pegs are disturbed by the Contractor or his/her employees, the Contractor shall have them replaced by a registered land surveyor at his/her own cost.

C3.5: MANAGEMENT

C3.5 Management

C3.5.1 Management of the Works

C3.5.1.1 Applicable SANS 1921 Specifications

The following SANS 1921 Construction and Management requirements for works standards and associated specification data are applicable:

SANS 1921-1	General Engineering and Construction Works
SANS 1921-2	Accommodation of Traffic on Public Roads
SANS 1921-5	Earthworks Activities Which are to be Performed by Hand
SANS 1921-6	HIV/AIDS Awareness

C3.5.1.2 Particular and Generic Specifications

The applicable Particular Specifications and Generic Specifications are included in section C3.8 of this specification.

C3.5.1.3 Specification Data

The specification data applicable to these SANS 1921 standards is as follows:

Standard	Clause	Essential Data
SANS 1921-1	4.1.7	The requirements for drawings, information and calculations for which the Contractor is to be responsible are detailed in the Project Specifications.
	4.1.10	Where reference is made to “SANS 2001”, substitute with “SANS 1200”
	4.2.1	The responsibility strategy assigned to the Contractor for the Civil Works is A. The responsibility strategy assigned to the Contractor the Mechanical, Electrical and Control & Instrumentation works is B. The contractor shall be responsible for the final design and preparation of fabrication and manufacturing drawings for all Mechanical, Electrical and Control & Instrumentation equipment.
	4.2.2	The Structural Engineer for works is Royal HaskoningDHV.
	4.2.3	Fabrication drawings shall be submitted to the Employer’s Agent as indicated in the Mechanical, Electrical and Instrumentation Specifications, Sections C3.9 to C3.14
	4.3.1	The planning, programme and method statements are to comply with the following: 1) The programme shall be prepared in bar (Gantt) chart form, preferably using a project management software tool such as Microsoft Projects/Excel and shall be issued to the Employer’s Agent in both hard copy and electronic format. The programme shall be structured to cover all items of work including all work to be done by Sub-contractors and shall clearly indicate the critical path 2) The programme must clearly show the intermediate milestone dates to be achieved taking the indicative construction sequences into account.

Standard	Clause	Essential Data
		3) In addition to any other constraints the construction sequence and timing shall take into account the requirement to keep the existing plant operational at all times 4) The programme shall be updated whenever the circumstances of the work execution change and whenever instructed by the Employer's Agent. Each revision of the programme shall be marked with a sequential revision number. The Contractor's programme shall be subject to approval by the Employer's Agent. 5) A lead time of two months is to be allowed in the program for the Employer's Agent to finalise Civil and Structural drawings for Construction to suit the Mechanical and Electrical equipment to be supplied by the Contractor following approval of drawings for such equipment. 6) The Contractor shall be required to submit designs, drawings and details timeously to the Employer's Agent so as not to cause any delay to the civil and building construction program and allowing the Employer's Agent a minimum of 14 days to review and approve the documentation submitted in accordance with Cl 5.9.7 of the General Conditions of Contract. 7) Regular meetings must be held with the Employer's Agent. 8) Method statements shall be prepared by the Contractor for any procedures proposed by the Contractor for use in the Contract as well as in accordance with the requirements of the project specifications.
SANS 1921-1	4.4	The Contractor is required to set up and maintain a Quality Management system and Quality Assurance process. The requirements are detailed elsewhere in this document.
		The Contractor will be solely responsible for the production of work that complies with the Specifications to the satisfaction of the Employer's Agent. To this end it will be the full responsibility of the Contractor to institute an appropriate Quality Assurance (QA) system on site. The Contractor's QA system shall be open to audit by the Employer's Agent to verify that adequate independent checks and tests are being carried out and to ensure that the Contractor's own control is sufficient to identify any possible quality problems which could cause a delay or failure.
		The Contractor shall ensure that efficient supervisory staff, the required transport, instruments, equipment and tools are available to control the quality of his/her own workmanship in accordance with his/her QA system. His/her attention is drawn to the fact that it is not the duty of the Employer's Agent or the Employer's Agent's Representative to act as foreman or surveyor.
	4.5	The Contractor is required to submit Method Statements for specific items of work as identified in this specification and wherever the Contractor proposes his/her own approach or method of working. In order to avoid delays to work Method Statements must be submitted well in advance of the proposed work (at least 10 working days or such suitable time as agreed with the Employer's Agent's Representative) and are subject to the approval of the Employer's Agent.

Standard	Clause	Essential Data
	4.5	The Contractor will be required to verify the accuracy of all survey control provided on the drawings or in the form of beacons previously placed on the site. Prior to setting out, the Contractor shall also check the invert levels of all existing tie-in channels, manholes, pipes etc. against those provided on drawings and immediately report any inconsistencies to the Employer's Agent in writing. The Contractor shall be held directly responsible for any errors in setting out of the Works arising from use of the survey control or existing invert levels provided.
	4.5.1	It is important that, during construction, the Contractor checks all levels from time to time and satisfies himself/herself as to their accuracy prior to placing of concrete as no concrete work will be accepted where tolerances have been exceeded, particularly where it interferes with the hydraulics of the flow through the Works. The maintenance of gravelled temporary deviations and existing gravel roads used for construction shall include the watering of roads daily in the dry season for reduction of dust.
SANS 1921-1	4.6	An item has been included in the Bill of Quantities to cover all work associated with dealing with water.
	4.6 (e)	The Contractor is to ensure that stormwater runoff or any groundwater seepage is controlled by means of temporary earthworks, coffer dams, pumping equipment, well-pointing, de-watering equipment etc. to keep the works free of water.
	4.6 (f)	Dealing with all water during construction from whatever source will include for by-pass arrangements for dealing with all possible flows whether or not the existing flow path is being interfered with during installation of pipework.
	4.7.4	No blasting will be permitted within 10 m of any structure, pipeline or service unless the Contractor can satisfy the Employer's Agent that his/her proposed blasting methods and controls are such that no damage will be caused to the adjoining structure, pipeline or service. The Contractor will be required to provide equipment for and take vibro-recordings at no additional cost to the Employer.
	4.8.1	The Contractor shall be responsible for protection from damage to any structures or services that might be affected by the excavations or works.
	4.8.2	Notwithstanding whatsoever special construction methods, equipment or materials are used by the Contractor to protect the structure or service from damage, all work will be measured for payment on the assumption that normal excavation had been carried out and the Contractor shall therefore make allowance for the additional costs in his/her tendered rates.
SANS-1921-1	4.9.5	The provision of security for the Contractor's site establishment, plant and personnel at all times is the sole responsibility of the Contractor and no claims for payment for additional security measures taken during the contract will be entertained.
	4.9.6	The Contractor is to comply with the Employer's Environmental Specification, PTC: Construction Environmental Management Plan included as a Particular Specification in Section C3.8.

Standard	Clause	Essential Data
	4.12.2	The samples of materials, workmanship and finishes that the Contractor is to provide and deliver to the Employer are: 1) Pipes and jointing methods, 2) Pipe coatings and corrosion protection of pipes and fittings, 3) Pipe bedding and blanket materials, 4) Pipe fitting materials, 5) Concrete aggregate, 6) Concrete sand, 7) Mixed concrete, and 8) Reinforcing, 9) Compaction test results. The fabrication drawings that the Contractor is to provide and deliver to the Employer are those for all fabricated equipment, plant, fittings, specials and bends, gratings, plates, handrails, ladders and any prefabricated items that the Contractor proposes to use in the permanent works.
SANS 1921-1	4.14.3	The office accommodation, equipment, accommodation for site meetings and other facilities for use by the Employer and his/her Agents are: 1) Site offices as per SANS 1200 AB (refer PSAB), 2) Meeting room, minimum floor area 30 square meters, 3) Two covered carports, 4) Safety helmets, gumboots and other necessary safety equipment for the sole use of the Employer and his/her Agents, and 5) Survey equipment as per PSAB 4.2. 6) No testing laboratory is required on site for use by the Employer's Agent.
SANS 1921-1	4.14.5	Ablution facilities are required for the Employer and his/her Agents as per SANS 1200 AB (refer PSAB).
	4.14.6	The requirements for the provision and erection of sign boards are: 1) As per SANS 1200 AB and C4.
	4.17.1	The requirements for the termination, diversion, or maintenance of existing services are: 1) Support in-situ of existing water mains crossing pipe trench 2) Deviation and relocation of electrical power cables– . 3) Temporary deviation and accommodation of traffic. Provisional sums are provided for this purpose.
	4.17.2	Where public services must be interrupted on account of the Works, it shall be the Contractor's responsibility, in conjunction with the appropriate Authority to ensure that all users affected by the interruption are given due and sufficient notice of the date, time and duration of the interruption.

Standard	Clause	Essential Data
	4.17.3	Services which are known to exist on the site are: a) Overhead and buried electrical cabling, b) Water and sewer pipelines, c) Stormwater pipes and catchpits, d) Surfaced and unsurfaced roads, with or without kerbing and tracks. The approximate positions of some of the known overhead and underground services, which may be affected by the Works, have been shown on the drawings. The exact location or number or existence of known and unknown services cannot be guaranteed, and the Contractor will be required to confirm the locations and status of all services with all service owners irrespective of whether they are shown on the drawing or not.
	4.17.4	The requirements for detection apparatus are underground cable and pipe detectors during proving for pipe trench excavation. Where services are found, the Employer's Agent must be notified immediately so that a decision can be made regarding re-alignment, relocation or protection of said services. The Contractor shall on no account effect such adjustments without the prior consent of the Employer's Agent.
	4.17.5	If unknown services are found undamaged, they shall then be deemed to be known services with the provisions pertaining to known services becoming applicable.
	4.17.6	Where a service has been located and exposed, the Contractor shall take every care in ensuring that the excavation containing the service is barricaded and protected against collapse and that the service is adequately protected against damage. Should the existing service become damaged by the Contractor or any third party due to negligence on part of the Contractor, then the cost of its repair along with any consequential costs shall be borne by the Contractor.
	4.17.7	Existing known services or services that have been proved by the Contractor, which are damaged by the Contractor, shall be repaired by the service provider and all costs of the repair shall be borne by the Contractor.
	4.17.8	The Contractor shall so carry out all his/her operations as not to encroach on, or interfere with, trespass on, or damage adjoining land, buildings, properties, road structures, pipelines, places and things, in the vicinity of the Works and outside of the site boundary.

Standard	Clause	Essential Data
SANS 1921-1	4.18	The additional health and safety requirements of the Employer are as specified in the Health and Safety Specification included in C3.8 of this document. The Contractor has to comply with all the COVID-19 regulations
	4.18.2	The site office area, pipe yard(s), the road verges, servitude/working strips and all other construction zones shall be fenced off to prevent unauthorized entry to the site. Gates shall be provided by the Contractor as required for construction access purposes. The Contractor shall be held responsible for the control of access at these gates at all times as well as to the work site during removal and re-erection of fencing. No other opening in the fence shall be permitted and the Contractor shall be responsible for monitoring the fencing on a daily basis and repairing any such opening within the same day that it is detected. Notices in two official languages (English and isiZulu) shall be attached to the fence where appropriate to indicate that the site is for personnel employed on the Contract only and that unauthorised entry is forbidden. The temporary fencing shall comprise 2 m high Bonnox 4 x 4 mesh fencing, Bonnox pattern 1972/4, with straining posts and straining wires as required and according to supplier's directions and with mesh spacing not exceeding 100 mm in both the vertical and horizontal directions. Chevron tape shall be interwoven in a zig zag pattern from the top to the bottom of the fence thereby clearly marking off the working area. Within formalised residential areas the Employer's Agent may specify the addition of square plastic mesh to the temporary fencing, or equivalent method, to act as a childproof barrier to prevent child access to pipe trenches.
SANS 1921-2	4.3.2	**Variations** The Contractor shall design all temporary culverts.
		The Contractor shall be responsible for the design of all temporary deviations.
SANS 1921-5	4.2.1	The means of determination of method of excavation (i.e. by hand or machine excavation) shall be as per PSDB 5.4.1. The depth of trenches which are to be excavated by hand is less than or equal to 1,5 m and providing that the ground is stable.
SANS 1921-6	4.2.1 a)	A qualified service provider is one that appears on the list of recommended service providers, which is available from all regional offices of the Department of Public Works.
		The HIV & AIDS awareness programme is to be repeated at six monthly intervals for the duration of the Contract (including the initial one at the start of the Contract).
	4.3.2	The HIV & AIDS Awareness Champion and the Employer's Representative shall certify the report and schedule described in 4.3.1 whenever a claim for payment is issued to the Employer.

Standard	Clause	Essential Data
	4.1 f)	Appointing an HIV & AIDS Awareness Champion within fourteen (14) days of site handover from amongst the workers (which could include the Community Liaison Officer). The champion should be able to speak, read and write both English and Zulu, and speak and understand any other local language(s) spoken by the workers and shall be on site at all stages of the construction period. The Contractor shall ensure that the Awareness Champion has been trained by the Service Provider on basic HIV & AIDS information, the support services available and has the necessary skills to handle questions regarding the HIV & AIDS programme in a sensitive and confidential manner.
		The Awareness Champion shall be responsible for: • Liaising with the Service Provider to assist in organising awareness workshops; • Filling condom dispensers and monitoring condom distribution; • Handing out information booklets; and • Placing and maintaining posters.
	4.1 g)	Provide information about the names of the closest service providers to be displayed on a poster of size not smaller than A2.
	4.2.3 c)	Understand and communicate the purpose of voluntary HIV & AIDS testing and counselling.
	4.2.3 d)	Recognise the importance of caring for people living with HIV & AIDS and be familiar with the various treatments available, including treatment of opportunistic infections.
SANS 1921-6	4.2.3 e)	Understand and communicate the rights and responsibilities of those living with HIV & AIDS in the workplace and the importance of non-discrimination.
	5	**Sanctions** In the event that the Contractor fails to satisfy the requirements of this specification, the Employer may apply sanctions which include the rejection of claims for payment as being incomplete or the withholding of Completion Certificates (interim or final).

C3.5.2 Planning and Programming

C3.5.2.1 Preliminary Programme

The Tenderer shall include with his/her tender a preliminary programme on the prescribed form to be completed by all Tenderers. The programme shall be in the form of a simplified bar chart with sufficient details to show clearly how the Works will be performed within the time for completion as stated in the Contract Data.

The Contractor shall be deemed to have allowed fully in his/her tendered rates and prices as well as in his/her programme for all possible delays due to normal adverse weather conditions and special non-working days as specified in the Special Conditions of Contract, in the Project Specifications and in the Contract Data.

C3.5.2.2 Construction Programme (GCC 2015 Clause 5.6)

For the purpose of this Clause, "construction programme" means the Programme of the Works to be submitted in terms of Clause 5.6 of the Conditions of Contract 2015 and used to plan and organise the Works.

On award of the Contract, the successful Contractor is to prepare a full Construction Programme. The programme is to show all activities and highlight which are critical path activities. With reference to GCC 2015 Clause 5.6.1 the Initial Programme must be provided prior to commencement of the Works. Adjusted Programmes of Works may be required from time to time as stated in GCC 2015 Clause 5.6.1.

In addition to the Construction programme, when directed, the Contractor shall promptly furnish a detailed sub-programme of the Construction Programme for particular sections of the Permanent Works.

C3.5.2.3 Essential elements to be included in the programme

The following items are to be included in the programme:
A lead time of two months is to be allowed in the program for the Employer’s Agent to finalise Civil and Structural drawings for Construction to suit the Mechanical and Electrical equipment to be supplied by the Contractor following approval of drawings for such equipment.

- Construction of the earthworks at the Facility Building,
- Diversion of Existing backwash water.

C.3.5.2.4 Software Application for Programming

The Construction Programme shall be prepared using MS Projects format (*.mpp) and shall show at least the minimum detail as described in Clause C3.5.3.

C3.5.3 Sequence of the Works

The Contractor can choose his/her own sequence of construction, bearing in mind the availability of water for water-tightness testing of the structures and commissioning of the Balancing Tank will have to be pre-arranged with the Employer. However, the Contractor must practice progressive reinstatement and remediation in line with the Particular Specification, Employer's Environmental Specification, PTC: Construction Environmental Management Plan.

On no account will spoil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others or impact on the environment. In the event of this occurring, the Employer shall have the right to withhold payment for as long as may be necessary in respect of the relevant Works in the areas concerned without prejudicing the rights of others to institute claims against the Contractor on the grounds of unnecessary obstruction.

Finishing and tidying must not be deferred to the end of the Contract. All finishing and tidying shall be carried out to the best advantage of the project as a whole, and in close co-operation with other parties and residents.

C3.5.4 Quality Plans and Control

The Contractor will be solely responsible for the production of work that complies with the Specifications to the satisfaction of the Employer's Agent. To this end it will be the full responsibility of the Contractor to institute an appropriate Quality Assurance (QA) system on site. The Employer's Agent will audit the Contractor's Quality Assurance (QA) system on a regular basis to verify that adequate independent checks and tests are being carried out and to ensure that the Contractor's own control is sufficient to identify any possible quality problems which could cause a delay or failure.

The Contractor shall ensure that efficient supervisory staff, the required transport, instruments, equipment and tools are available to control the quality of his/her own workmanship in accordance with his/her QA-system. His/her attention is drawn to the fact that it is not the duty of the Employer's Agent or the Employer's Agent's Representative to act as Construction Supervisor or Surveyor.

C3.5.5 Management of the Environment

(Read with SANS 1921-1: 2004 Clause 4.19, the Environment Particular Specification and the Employer's Environmental Specification, PTC: Construction Environmental Management Plan.

The Contractor shall pay special attention to the following:

- Clearing of Vegetation

  The Contractor shall not destroy, remove or clear trees, timber or shrubs to any extent greater than that approved. The Contractor shall not carry out any activity outside the areas defined for clearing unless otherwise approved by the Environmental Control Officer.

- Soil Erosion

  The quality of topsoil in stockpiles will be maintained by measures including minimising contamination from other materials, minimising stockpiling periods and prevention of soil erosion by surface runoff or wind. Monitoring for erosion and soil erosion risk will be undertaken regularly to ensure that any erosion that occurs is mitigated as soon as possible.

- Risk of Faunal Injury and Death

  The trenches will be kept open for the minimum period necessary to undertake the works. Temporary fencing or barriers will be placed along the trenches in all populated areas and in areas that are likely to be used as crossing points along the corridor.

- Pollution Prevention

  With particular regard to sanitation, solid waste facilities, fuels, hazardous substances and other liquid pollutants as elaborated in the Particular Specification for Environmental Management.

- Rehabilitation

  The Contractor is to ensure that the site and its surrounds are rehabilitated to the condition in which they were prior to commencement of construction activities.

- Working in Watercourses

  The Contractor shall execute the mitigation and control measures as specified in the Environmental Management Plan in order to preserve the natural environment in instances where the proposed pipeline may traverse any wetlands or watercourses. These objectives are as follows:

  - Surface water legislative requirements must be complied with;
  - Manage water quality; prevent sediment load from entering any water course;
  - Concentrated flow must be managed to prevent downstream erosion and the impact on surface water quality; and
  - Implement mitigation measures to minimise potential impacts.

  The Contractor shall ensure that the following Stormwater Management Principles as specified in the Employer's Environmental Specification, PTC: Construction Environmental Management Plan are adhered to at all times on site:

- Rehabilitation (Revegetation) of Exposed Areas

  Site clearance must occur in a planned manner and cleared areas should be stabilised as soon as possible. Clearance of vegetation should be done only if deemed necessary and must be limited to only facilitate the execution of any work necessary. All areas of impact must be rehabilitated once work has been completed. To ensure stability in revegetated steep areas, geotextiles can be used if required.

- Wetland Protection

  The wetland must be barricaded off to avoid potential damage and vehicular movement through the wetland. Any activities exposing the wetland to soil compaction, stormwater erosion and silting must be prevented.

- Entry and Exit Points onto Tarred Roads

  Construction vehicles entering and exiting the construction area from tarred roads could convey and deposit mud on the road, which will be washed into the storm water system during rain events and lead to siltation of wetlands. It is advisable to place gravel on the entry/exit points of the construction site in order to reduce the amount of mud/soil clinging to tyres. Should soil be deposited on the tar road at the entry/exit points, it should be cleaned up on a daily basis.

- Flow of Water Around Excavations

  Cofferdams shall be constructed around trenched areas in watercourses using sealed plastic bags filled with sand and means of conveyance must be provided for the flow of water to bypass the excavation. The flow of rivers is not to be restricted.

C3.5.6 Accommodation of Traffic on Public Roads Occupied by the Contractor (Read with SANS 1921 – 1: 2004 Clause 4.13 and SANS 1921 – 2: 2004)

C3.5.6.1 General

The Contractor will be responsible for the safe and easy passage of public traffic past and on sections of roads of which he/she has occupation or where work has to be done near traffic.

Accommodation of traffic, where applicable shall comply with SANS 1921-2: 2004: Construction and Management Requirements for Works Contracts, Part 2: Accommodation of Traffic on Public Roads occupied by the Contractor. The Contractor shall obtain this specification from Standards South Africa if accommodation of traffic will be involved on any part of the construction Works.

C3.5.6.2 Basic Requirements

The travelling public shall have the right of way on public roads, and the Contractor shall make use of approved methods to control the movement of his/her equipment and vehicles so as not to constitute a hazard on the road.

The Contractor shall ensure that all road signs, barricades, delineators, flagmen and speed controls are effective, and that courtesy is extended to the public at all times.

Failure to maintain road signs, warning signs or flicker lights, etc, in a good condition shall constitute ample reason for the Employer's Agent to suspend the Work until the road signs, etc, have been repaired to his/her satisfaction.

The Contractor may not commence construction activities affecting existing roads before adequate provision has been made to accommodate traffic in accordance with the requirements of this document and the South African Road Traffic Signs Manual.

The Contractor shall design, construct and maintain all temporary access and haul roads to the various working areas. The Contractor shall construct and maintain all temporary drainage works necessary for temporary deviations.

The Contractor shall provide and grant access to persons whose properties fall within or adjoin the area in which he/she is working.

C3.5.6.3 Traffic Safety Officer

Where warranted by traffic conditions on or near the site, the Contractor shall nominate a suitable member of his/her staff as Traffic Safety Officer to be responsible for the arrangement and maintenance of all the measures for the accommodation of traffic for the duration of the Project. Duties of the Traffic Safety Officer shall be as set out in SANS 1921 Part 2 and shall also be in compliance with the Occupational Health and Safety Act No 85 of 1993 and the Construction Regulations 2014, including the Particular Safety Specification.

C3.5.7 Testing, Completion, Commissioning and Correction of Defects

C3.5.7.1 Process Control Testing

The Contractor shall arrange for all tests required for process control to be done by a laboratory acceptable to and approved by the Employer's Agent.

The Contractor may establish his/her own laboratory on site, or he/she may employ the services of an independent commercial laboratory. Whatever method is used, the Contractor must submit the results of tests carried out on materials and workmanship when submitting work for acceptance by the Employer's Agent. The costs for these tests shall be deemed to be included in the relevant rates and no additional payment will be made for testing, or re-testing, as required.

C3.5.7.2 Acceptance Control Testing

The process control test results submitted by the Contractor for approval of materials and workmanship may be used by the Employer's Agent for acceptance control. However, before accepting any work, the Employer's Agent may have further control tests carried out by a laboratory of his/her choice. The cost of such additional tests will be paid for in the Contract, but tests that failed to confirm compliance with the specifications, will be for the account of the Contractor.

C3.5.8 Recording of Weather

The Contractor shall be permitted to take his/her own rainfall measurements on site subject to the Employer's Agent's Representative's approval, but access to the measuring gauge(s) shall be under the Employer's Agent's Representative's control. The Contractor is to provide and install all the necessary equipment for accurately measuring the rainfall as well as to provide, erect and maintain a security fence plus gate, padlock and keys at each measuring station, all at his/her own cost.

C3.5.9 Management Meetings

The Contractor and such other person(s) as may be nominated by the Employer's Agent shall be required to attend periodic site meetings, the date and place for which will be set by the Employer's Agent in consultation with the Employer and Contractor.

The main purpose of the site meetings will be to review and discuss progress and programme, and all persons attending the site meetings must be empowered to act on behalf of the organisations they represent.

C3.5.10 Daily Records

The Contractor is to provide a triplicate site diary book, which is to be kept on site, for the purpose of keeping daily records in respect of work performed on the site and all significant events. The Employer's Agent's Representative will keep the top copy on his/her records and the Contractor will take the middle copy and the third copy will remain in the site diary book which will be kept on site for the duration of the Contract. Standing time details, disruptions, Construction Equipment on site, etc. to be clearly documented. Lack of such information will lead to disqualification of the claims should claims arise.

C3.5.11 Payment Certificates

The Contractor shall submit invoices at monthly intervals in terms of Clause 6.10.1 of GCC 2015 in respect of works completed during the preceding period and materials on site. The work shall be measured according to the format of the Bill of Quantities and measurements should be taken together with the Employer's Agent's Representative and are subject to agreement as to the status of work completed. The Contractor will submit his/her invoice, together with other invoices and other supporting documentation to the Employer's Agent in terms of GCC 2015 Clause 6.10.2. The Employer's Agent will process the Contractor's invoice within seven days of receipt (refer GCC 2015 Clause 6.10.3 & 6.10.4) to produce a Payment Certificate and will deliver this to the Employer.

The Payment Certificate will be scrutinised by the Employer prior to payment within thirty days of receipt of the Certificate from the Employer's Agent, provided that the date of submission is such as to comply with the Employer's payment cycle as notified to the Contractor. The Contractor must ensure that, allowing for the time allowed for processing certificates by the Employer's Agent, his/her invoice is submitted in good time to allow for the payment cycle to be met.

The Contractor's tendered rates for the relevant items in the Bill of Quantities shall include full compensation for all possible additional costs which may arise from this, and no claims for extra payment due to inconvenience as a result of the modus operandi will be considered.

C3.5.12 Health and Safety

C3.5.12.1 Health and Safety Requirements and Procedures

C3.5.12.1.1 General Statement

It is a requirement of this Contract that the Contractor shall provide a safe and healthy working environment and to direct all his/her activities in such a manner that his/her employees and any other persons, who may be directly affected by his/her activities, are not exposed to hazards to their health and safety. To this end the Contractor shall assume full responsibility to conform to all the provisions of the Occupational Health and Safety Act No 85 and Amendment Act No 181 of 1993, and the OHSA 1993 Construction Regulations 2014 issued 07 February 2014 by the Department of Labour.

For the purpose of this Contract the Contractor is required to confirm his/her status as mandatory and Employer in his/her own right for the execution of the Contract by entering into an agreement with the Employer in terms of the Occupational Health and Safety Act by executing the Agreement form C1.5 included in Section C1: Agreements and Contract Data.

C3.5.12.1.2 Health and Safety Specifications and Plans to be Submitted at Tender Stage

- Employer's Health and Safety Specification

  The Employer's Health and Safety Specification, PTH Construction Health and Safety Plan is included in this document as part of the Particular Specifications.

  Contractors are to take note of the aspects identified in the specification requiring attention in the pricing of the tender and in the preparation of the Health and Safety Plan:

- Contractor's Health and Safety Plan

  The successful Tenderer shall, on receipt of notification that he/she has been awarded the Contract, submit without delay his/her own documented Health and Safety Plan for the execution of the Works under the Contract. The Health and Safety Plan must at least cover the following:

  - a proper risk assessment of the Works, risk items, work methods and procedures in terms of Regulations 9 to 30;
  - pro-active identification of potential hazards and unsafe working conditions;
  - provision of a safe working environment and equipment;
  - statements of methods to ensure the health and safety of Sub-contractors, employees and visitors to the site, including safety training in hazards and risk areas (Regulation 7);
  - monitoring health and safety on the site of works on a regular basis, and keeping of records and registers as provided for in the Construction Regulations;
  - details of the Construction Manager, the Construction Safety Officers and other competent persons he/she intends to appoint for the construction works in terms of Regulation 6 and other applicable regulations; and
  - details of methods to ensure that his/her Health and Safety Plan is carried out strictly in accordance with the OHSA and the Construction Regulations 2014.

  The Contractor's Health and Safety Plan must take into account the residential nature of the surrounding area and particularly the possible presence of vehicles, pedestrians, children, pets and livestock.

  The Contractor's Health and Safety Plan will be subject to approval by the Employer, or amendment if necessary, before commencement of construction work. The Contractor will not be allowed to commence work, or his/her work will be suspended if he/she had already commenced work before he/she has obtained the Employer's written approval of his/her Health and Safety Plan.

  Time lost due to delayed commencement or suspension of the work as a result of the Contractor's failure to obtain approval for his/her Safety Plan, shall not be used as a reason to claim for extension of time or standing time and related costs.

C3.5.12.1.3 Cost of Compliance with the OHSA Construction Regulations

The rates and prices tendered by the Contractor shall be deemed to include all costs for conforming to the requirements of the Act, the Construction Regulations 2014 and the Employer's Health and Safety Specification as applicable to this Contract. Should the Contractor fail to comply with the provisions of the Construction Regulations, he/she will be liable for penalties as provided in the Construction Regulations and in the Employer's Health and Safety Specification.

Items that may qualify for remuneration will be specified in the Safety Specifications included or in the Project Specifications.

C3.5.12.2 Protection of the Public

The Contractor is alerted to the fact that the construction site traverses semi-urban residential suburbs and is located parallel to Provincial Road P483. The Contractor in all his/her planning is to take account of the potential hazard to residents, particularly vehicles, pedestrians, children, pets and livestock and is to take every precaution to avoid accidents and injuries.

The site office area, pipe yard, the servitude/working strip and all other construction zones shall be fenced off to prevent unauthorized entry to the site. Gates shall be provided by the Contractor as required for construction access purposes. The Contractor shall be held responsible for the control of access at these gates at all times as well as to the worksite during removal and re-erection of fencing.

In populated areas and where directed by the Employer's Agent the Contractor shall also supply, install and maintain temporary fencing on both sides of the working area (servitude) and around the perimeter of all agreed additional working areas during construction for prevention of unauthorised access and shall remove on completion of the works.

C3.5.12.3 Barricades and Lighting

Requirements for barricading and lighting are stated Clause 4.18.2 of SANS 1921-1 (Section C3.5.1.3, to be read in accordance with SANS 1921-1 Clause 4.18.2) as well as under the applicable Standard Specifications for each construction activity as modified in the Project Specifications (Section C3.7).

C3.5.13 Community Liaison Officer

The Employer will pay for the services of a Community Liaison Officer (CLO) for the duration of the Contract. The primary role of the CLO will be liaison and facilitation of communication which shall include inter alia:

- Assist in all aspects related to the recruitment of local labour, and advise them of their rights;
- Act as liaison between the Contractor and community on the application of Labour Intensive Construction Methods as set out in this document;
- Act as a source of information for the community and the Ward Councillors on issues related to the Contract;
- Liaise with a Project Committee, as anticipated in the EMP, for community representation;
- Keep the Contractor advised on community issues;
- Keep the Contractor advised on any issues pertaining to local security (where applicable);
- Assist in setting up any meetings/negotiations with affected parties;
- Keep a diary and record details of labour/community issues that may arise;
- Monitor and report on general Health and Safety issues on site;
- Assist in HIV/AIDS awareness programmes; and
- Attend Contract site meetings and report on labour/community issues.

The CLO shall have no authority to issue any instructions to the Contractor. The CLO shall be neutral to all parties and must endeavour to remain impartial should any conflict arise.

Responsibility for identifying a pool of suitable labour shall rest with the CLO, although the Contractor shall have the right to choose from the pool. The Contractor (and Sub-contractors) shall have the right to determine the total number of labourers required at any one time, which may vary throughout the Contract.

The Contractor shall have the right to replace labour that is not performing adequately, and the replacement of any labourer shall be done in conjunction with the CLO.

Local labour employed on the Contract shall be paid in accordance with the Ugu District Municipality minimum wage rate for contracts and all statutory conditions of employment shall be met.

A Provisional Sum item has been included in the Bill of Quantities to cover the costs for the employment of the CLO.

C3.5.14 Methods & Procedures

C3.5.14.1 Management & Disposal of Water (Read with SANS 1921 - 1: 2004 Clause 4.6)

The Contractor shall pay special attention to the management and disposal of water and stormwater on the site. It is essential that all completed works or parts thereof are kept dry and properly drained. Claims for delay and for repair of damage caused to the works as a result of the Contractor's failure to properly manage rain and surface water, will not be considered.

C3.5.14.2 Disposal of Spoil or Surplus Material (Read with SANS 1921 - 1: 2004 Clause 4.10)

The Contractor will be responsible for the disposal of material and making all arrangements in connection therewith. The Contractor shall dispose of all surplus and unsuitable excavated material in designated spoil areas.

C3.5.14.3 Length of Trenches not Backfilled and not Rehabilitated

The recommended maximum length of open trenches at any one time is 400 m in residential areas in order to limit the safety risk to surrounding communities.

In areas immediately adjoined by residential properties the Contractor will not be permitted to excavate any new pipe trenches once the maximum limit for open trench in a particular area has been reached, without the permission of the Environmental Control Officer. A maximum of three working fronts for pipelaying will be permitted.

C3.5.14.4 Length of Pipeline not Pressure Tested

The maximum length of pipeline which is not pressure tested that will be allowed at any given time during construction is 2 000 m. The Contractor will not be permitted to excavate any new pipe trenches once the maximum limit for "un-pressure tested" pipeline has been reached unless otherwise authorised by the Employer's Agent.

C3.5.14.5 Determination of Method of Excavation

Trenches for pipelines shall be excavated by either mechanical means or by hand determined as follows:

Trial holes of minimum dimensions 1,0 m x 1,0 m shall be excavated by hand along all pipeline routes at 50 m intervals ahead of the Contractor's programme. The trial holes shall be 1,0 m deep or less if intermediate or hard rock material is encountered. An item has been included in the Bill of Quantities to cover this work.

If intermediate or hard rock material is encountered in the top 1,0 m of excavation at such trial holes, then excavation may be deemed to be carried out by mechanical means, the length of such excavation determined on the basis of other trial hole findings.

If soft material only is encountered at such trial holes, then excavation may be deemed to be carried out by hand up to a maximum depth of 1,5 m, the length of such excavation determined on the basis of other trial hole findings. The consistency of the material shall be determined as per Table 1 of SANS 1921-Part 5 and the Classification of excavated material shall be as per Annex B of SANS 1921-Part 5 (Tables B.1 & B.2).

If intermediate or hard rock material is encountered in those stretches set aside for hand excavation on the basis of the trial hole findings, then the Contractor may be allowed to remove the intermediate or hard rock material by mechanical or whatever means, the rate for which is to include for backfilling and re-excavating (if necessary).

C3.5.14.6 Determination of Haul Distances

The Contractor shall be responsible to plan his/her work and logistics so as to minimise his/her costs of haul of imported materials and spoil. No payment will be made for overhaul on this contract unless provision is made for in specific items.

C3.5.15 Accredited Skills Training

Apart from the Contractor's own in-task training of his/her workforce it is the intention of the Employer that Accredited On-Site Skills Training will also be provided under this Contract. Candidates for On-Site Skills Training will be identified by the community from individuals who are undergoing, or who have undergone, training at an Accredited Training Providers for skills and learnership. This list will be reviewed by the Employer prior to notifying the Contractor in writing of the names of candidates to be accepted for Accredited Skills Training. The Contractor shall employ such candidates according to his/her full and normal conditions of employment for unskilled labour for the duration of training. The ISD service provider (Institutional and Social Development) shall appoint an Accredited Skills Training Facilitator subject to the Employer's approval who will conduct the training, which will take place adjacent to the worksite in a suitable area to be provided by the Contractor for the purpose of training and set aside for that purpose. The Contractor shall be required to provide an office space for theoretical instruction as well as construction materials for practical training.

It is intended that skills training will be provided in any or all of the following disciplines:

- Trench Excavation and Supervision;
- Pipelaying;
- Steel Fixing;
- Formwork and Concreting;
- Basic Construction Hand;
- Finishing Hand;
- Task Based Labour Administration
- Understanding the Scope of Works and Employer's Agent's Specifications;
- Labour Recruitment and Management;
- Contractor's Responsibilities and Requirements;
- Payroll Management and Implementation;
- Basic Tender and Contract Pricing; and
- Community Liaison and Facilitation.

The Contractor shall provide the workspace and office space for training and shall pay the training candidates at the normal rate of pay for unskilled labour for the duration of the training. The Contractor shall also pay the fees and charges of the Accredited Trainer according to the agreed scale. The cost of Accredited On-Site Training is an item in the Bill of Quantities and the cost is to be reclaimed by the Contractor via the Payment Certificate.

Upon completion of the training by the Contractor the employment shall terminate, and the Contractor shall not be obliged to keep the trained personnel in his/her employ. However, he/she may re-employ candidates on an individual basis by mutual agreement.

Apart from the Contractor's own in-task training of his/her workforce it is the intention of the Employer that Accredited On-Site Skills Training will also be provided under this Contract. The Contractor has management responsibilities in this regard and this Accredited On-Site Skills Training is further described in Particular Specification PTJ. A payment item is included in the Bill of Quantities where the costs of providing this training will be recovered by the Contractor. The item shall be deemed to cover all the Contractor's costs in relation to provision of training as outlined in this section and in Particular Specification PTJ.

C3.5.16 Key Personnel

The Contractor's Key Personnel for this Contract shall be the Contracts Director, Contracts Manager, Construction Manager, Health & Safety Officer, Assistant Construction Manager(s), Engineer, Technician(s), Construction Supervisor(s) and Assistant Construction Supervisor(s).

C3.5.17 Forms for Correct Administration

C3.5.17.1 Report on Employment Generation

The Contractor shall provide to the Employer's Agent, monthly, in an Ugu District Municipality's reporting template form approved by the Employer's Agent, a detailed breakdown of his/her personnel (Contractor's staff and labour such as skilled and semi-skilled) days worked, and those of any Sub-contractors currently employed at the Site. This information is to conform to monthly reporting requirements.

The breakdown shall include details of the following:

- employee name and ID number;
- gender and age group;
- job category, with skill classification, or speciality;
- job title;
- number of employees in each job category or with that job title;
- trainees in each job category;
- classification of employees by origin (local/imported);
- Daily register; and
- Proof of Payment.

Payment certificates will not be processed for payment should the Contractor fail to submit monthly report.

C3.5.17.2 Contractual

Payment Certificate must be accompanied by the relevant monthly report as required in the reporting template.

It is a requirement for processing and finalising the Payment Certificate that the project monthly report is included.

C3.5.18 Electronic Payments

Payment of employees by electronic funds transfer will be permitted provided that the bank or financial institution that is proposed for the transfer of funds is adequately represented within the Ugu District Municipality boundaries, including the provision of ATM facilities.

C3.5.19 Permits

The Employer requires no special permits for the Contractor's personnel other than those required by the statutory authorities. This includes, but is not necessarily limited to, Work and Residence permits for non-South African nationals, Blasting Certificate for the use of explosives and permits from the Department of Energy and Mineral Affairs in respect of mining and exploitation of natural resources including sand and aggregates.

C3.5.20 Proof of Compliance with the Law

The Contractor is referred to the Returnable Schedules in Section T.2. The Contractor shall be required to maintain evidence of the continued validity of all aspects to which he has witnessed compliance at the time of submission of his/her tender, as well as any permits required by nature of his/her operation. The Contractor will be deemed to have granted the Employer the right of inspection of such documentation in the possession of the Contractor at any time as well as to make his/her own independent investigations where necessary.

C3.5.21 Insurance Provided by the Employer

The Employer is not providing Principal Controlled Insurance for the Works that are the subject of this Contract.

C3.6: STANDARD SPECIFICATIONS

C3.6 Standard Specifications

C3.6.1 Introduction

The Standard Specification gives a general description of the requirements to be met and sets out the relevant specifications relevant to the Contract as well as other relevant and additional clauses. In certain clauses the Standard Specifications allow a choice to be specified in the Project Specifications between alternative materials or methods of construction and for additional requirements to be specified to suit a particular contract. Details of such alternative or additional requirements applicable to this Contract are contained in the Project Specifications.

C3.6.2 General

All materials, and components used in the manufacture and fabrication of plant to be supplied under this Contract, shall be the best quality and suitable for the purposes for which they are intended.

C3.6.3 Quality Management

C3.6.3.1 Applicable Quality Management Standards

The Tenderer shall provide a co-ordinated and formally documented statement of his/her quality management system, including quality management objectives, policies, organisation and procedures, for the compulsory implementation of SANS 0157 Code of Practice for Quality Management Systems, Part III. The same applies to Part II of the said Code of Practice which must be implemented on certain selected items only. However, although Part II will not be implemented in all instances it will not exempt the Contractor of compliance with the quality requirements laid down in the tender documents. Monitoring and control by the Employer's Agent may be done at any time on any material.

The Contractor shall submit with his/her tender an assessment report on his/her quality management and quality control system issued by an independent Quality Assurance Authority approved by the Employer's Agent. The inspection on which this assessment report is based shall have taken place not more than 12 months prior to the closing date for this tender.

Responsibility for and all associated costs of compliance with this sub-clause shall rest with the Contractor.

C3.6.3.2 Quality Management Enhancement

Should the Contractor or any of the proposed Sub-contractors not comply with Sub-Clause C3.6.3.1 at the time of tender, a Contract may be awarded subject to a written undertaking to enhance his/her own and/or Sub-Contractor's quality Management system to the satisfaction of the Employer's Agent before commencement of the Contract.

C3.6.3.3 Employer's Agent's Quality Assurance Representative/Inspector

The Employer's Agent may elect to appoint an independent quality assurance representative to act in a surveillance capacity on his/her behalf for part of or the whole of the Contract.

The Employer's Agent's Quality Assurance Representative will be a selected Sub-Contractor and will be paid by the Contractor under this Contract for all tests passed by the Inspector and certified by the Employer's Agent. The Inspector will not act as the quality controller for the Contractor or his/her Sub-Contractors and accordingly payment of the inspector for any tests failing inspection will be for the account of the Contractor. Similarly, the costs of all inspections arising following any failed tests will be for the account of the Contractor.

C3.6.3.4 Classification of Material

Part II of the above-mentioned Code of Practice, i.e, a quality system for manufacture and installation, will apply only to certain critical material, products and services if and where indicated hereunder in this document.

C3.6.3.5 Sub-Letting

All enquiries made and contracts placed by the Contractor for critical components shall require that Sub-contractors comply with the requirements of the preceding sub-clauses. Responsibility for and all associated costs of compliance shall rest with the Contractor. In instances where SANS 0157 is not applicable, Tenderers must indicate what equivalent alternative Code of Practice is being implemented.

C3.6.3.6 Disqualification

Tenderers who do not include the formally documented statements called for in Sub-Clause C3.6.3.1 and who do not respond in terms of Sub-Clause C3.6.3.2 above may be disqualified.

C3.6.4 Standard Specifications

C3.6.4.1 Standardised Specifications

The standard specifications on which this contract is based are the South African Bureau of Standards Standardised Specifications for Civil Engineering Construction SABS 1200. Although not bound in nor issued with this Document, the following Sections of the Standardised Specifications of SABS 1200 shall form part of this Contract:

The following standard specifications shall apply:

A	1986	-	GENERAL
AB	1986	-	ENGINEER'S OFFICE
C	1982	-	SITE CLEARANCE
DA	1990	-	EARTHWORKS (Small Works)
DB	1989	-	EARTHWORKS (Pipe Trenches)
DK	1984	-	GABIONS AND PITCHING
DM	1981	-	EARTHWORKS (Roads, Subgrade)
G	1982		CONCRETE (Structural)
GE	1984		PRECAST CONCRETE (Structural)
HA	1990	-	STRUCTURAL STEELWORK (Sundry Items)
HB	1985		CLADDING AND SHEETING
HC	1988	-	CORROSION PROTECTION of STRUCTURAL STEELWORK
L	1983	-	MEDIUM PRESSURE PIPELINE
LB	1983	-	BEDDING (Pipes)
LC	1981	-	CABLE DUCTS
LD	1982		SEWERS
LE	1982	-	STORMWATER DRAINAGE
C3.7.17		PSLF:	ERF CONNECTIONS
M	1996		ROADS (General)
ME	1981		SUBBASE
MF	1981		BASE
MH	1996		ASPHALT BASE AND SURFACING
MJ	1984		SEGMENTED PAVING
MK	1983		KERBING AND CHANNELING
MM	1984	-	ANCILLARY ROADWORKS

(Note 1 - "SABS" has been changed to "SANS, without change to the contents of the specifications).

Preface on Interim Situation until Full Suite of SANS Series Specifications are Available

The Bill of Quantities is based on the SANS 1200 system of specifications and measurement.

Where SANS specifications are available, these have been incorporated into the “Contract” section of this document.

Where overlapping specifications from the SANS 2001 series of specifications occur the appropriate SANS 1200 specifications have been incorporated into the Project Specifications.

In such cases, the requirements of the SANS 1200 specifications shall prevail over the requirements of the SANS 2001 specification(s).

The payment clauses in the Bill of Quantities are based on the SANS 1200 series of specifications for consistency and the Tenderer is required to ensure that he/she has priced all of the requirements pertaining to the SANS specifications.

The variations and additions to the Standardised Specifications (Project Specifications) as well as the Particular Specifications are included as C3.7 and C3.8 respectively. The variations are prefixed PS and take precedence over the SANS Standardised Specification.

Where the Particular Specifications are in conflict with either the variations and additions to standardized specifications or the SANS Standardised Specifications, the Particular Specifications shall take precedence.

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C3.7.1 PSA: GENERAL
(Applicable to SANS 1200 A – 1986)

PSA 3 MATERIALS

PSA 3.1 Quality and Samples

Add to the Sub-Clause:

No used or recycled material may be used in the Works unless expressly authorised by the Employer's Agent.

Materials specified as being to the approval of a Standard Bureau shall bear the official mark of the appropriate standard.

Samples of concrete aggregates are to be delivered to an approved laboratory.

PSA 4 PLANT

PSA 4.2 Contractor's Office, Stores & Services (Refer SANS 1921-1 Clause 4.14)

Add to the Sub-Clause:

Neither housing nor shelters are available for the Contractor's employees, and the Contractor shall make his/her own arrangements to house his/her employees off site and transport them to and from site.

The Contractor shall be responsible for the provision of security personnel / monitoring services (day and night shift) for the protection of the site camp and any necessary temporary housing facilities for their use.

The temporary facilities and ablution facilities shall comply with the requirements of the Local Authority.

On completion of the Works or as soon as the Contractor's facilities are no longer required the Contractor shall remove such facilities and clear away all surface indications of their presence.

PSA 5 CONSTRUCTION

PSA 5.1.2 Preservation and Replacement of Beacons and Pegs subject to the Land Survey Act (Refer SANS 1921 - 1 Clause 4.15)

Add to the Sub-Clause :

The Employer's Agent will arrange for any pegs that are missing to be replaced at the Contractor's expense.

All survey reference marks shall be clearly marked and protected by the erection of three fencing standards.

All plot boundary pegs shall be painted and marked with fencing droppers.

PSA 5.4 Protection of Overhead and Underground Services (Refer SANS 1921-1 Clause 4.17)

Delete title and substitute the following:

PSA 5.5 Dealing with Water on Works (Refer SANS 1921-1 Clause 4.16)

Add to the Sub-Clause :

For this purpose, he/she shall provide, operate and maintain in sufficient quantity such pumping equipment, well points, pipes and other equipment as may be necessary, and he/she shall also provide any sumps, furrows, cross-embankments, coffer-dams and other temporary works as may be necessary to minimise damage

Protection of Visible and Underground Services (Sub-Clause 5.4).

PSA 5.6 Pollution

Add to the Sub-Clause :

The Contractor shall take all reasonable measures to minimise any dust nuisance, noise, pollution of streams and inconvenience to or interference with the public or others arising out of the execution of the Works.

PSA 5.7 Safety (Refer SANS 1921-1 Clause 4.18)

Add to the Sub-Clause :

All work and particularly work carried out in the proximity of buildings, bridges, tanks or other structures shall be carried out in conformance with the regulations framed under the Occupational Health and Safety Act, 1993 and the Minerals Act, Act 50 of 1991, including shoring where necessary, to ensure the safety of structures that are at risk. This clause shall be read in conjunction with the particular specification for health and safety.

The Contractor shall enter into an agreement on Occupational Health and Safety as per the pro forma bound into This document.

The Contractor shall make available for the duration of the Contract safety helmets, gumboots and any other necessary safety equipment for sole use by the Employer's Agent and his/her representative(s).

PSA 5.9 Protection of Structures (New Sub-Clause)

Where work is carried out in the proximity of buildings, bridges, buried services, tanks, wall or other structures, the Contractor shall take all necessary precautions required in terms of the regulations framed under the Occupational Health and Safety Act, (Act Nº 85 of 1993) to ensure the safety of structures and services that are at risk.

PSA 6 TOLERANCES

PSA 6.2 Degrees of Accuracy

Add to the Sub-Clause :

Generally, Degree of Accuracy II shall be applicable to the whole of the Works, unless specified otherwise (refer specifically to PSD 6 and PSG 6).

PSA 8 MEASUREMENT AND PAYMENT

PSA 8.2.1 Fixed-Charge and Value-Related Items (refer to Clause C2.1 of the Pricing Instructions)

Add to the Sub-Clause :

The amount, if any, by which the sum of the fixed-charge and value-related items exceeds three percent of the net total tendered amount (excluding allowances for contingencies and price escalation) shall be regarded for payment purposes as time-related items and will be paid in accordance with Clause 8.2.2. (refer to Clause C2.1 of the Pricing Instructions)

PSA 8.2.2 Time-related Items (refer to Clause C2.1 of the Pricing Instructions)

Add to the Sub-Clause :

Notwithstanding the provisions of Sub-Clause 8.2.2, an approved extension of time will not qualify the Contractor to receive any payment for that portion of fixed charge and value-related items which has become regarded as "time-related" items in terms of PSA 8.2.1 above.

PSA 8.3.4 Removal of Site Establishment

Add the following new Sub-Clauses:

PSA 8.3.4 (a) Provision of As-built Drawings (refer to Clause C3.2.3 of Section C3.2 Engineering)

An item has been included in the Bill of Quantities to cover the costs of the provision of a complete set of marked-up as-built drawings.

PSA 8.3.4 (b) Provision of Other Documentation (refer to Clause C3.2.4.3 of Section C3.2 Engineering)

An item has been included in the Bill of Quantities to cover the costs of the provision of an Operation and Maintenance Manual.

PSA 8.4.2.2 Temporary Works – (h) Dealing with Water on Works

Add to the Sub-Clause :

The sum in PSA 8.4.2.2 (h) shall cover the cost of providing, operating and maintaining the necessary equipment and other temporary works for dealing with groundwater in trenches and excavations.

PSA 8.4.2.3 Operation and Maintenance of Facilities on Site

In the fourth line, insert the words “security,” before the word “access”.

Add the following two (2) new Sub-Clauses:

“PSA 8.4.6 Supervision of CPG Sub-contractors (refer to Clause C3.3.3 of Section C3.3 Procurement)

An item has been included in the Bill of Quantities to cover the costs of mentoring and managing CPG Sub-contractors. The Contractor will be reimbursed for this function through the commission that he/she will earn based on the completed works by the CPG Sub-contractors and not on a proportioned monthly amount of the priced amount.te

PSA 8.4.7 HIV/Aids Awareness Programme (refer to Clause C3.5.1.3 (C4.2.1a) of Section C3.5 Management)

An item has been included in the Bill of Quantities to cover the costs of implementing and managing the HIV/ Aids Awareness Programme as specified in the above-mentioned Clause. The HIV & AIDS Awareness Programme is to be repeated at six monthly intervals for the duration of the Contract (including the initial one at the start of the Contract).

PSA 8.5 Sums Stated Provisionally by the Employer's Agent

Add the following new Sub-clauses to A 8.5:

PSA 8.5(a) Testing by Employer's Agent (refer to Sub-Clause C3.4.5.2.5 of Section C3.4 Construction)

A Provisional Sum has been allocated for in the Bill of Quantities for the Employer's Agent's acceptance control testing. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.5(b) Community Liaison Officer (refer to Clause C3.5.4 of Section C3.5 Management)

In addition to the requirements of Clause 8.4.3 of SANS 1200 A, the Contractor shall allow for a Community Liaison Officer for the duration of the Contract. A provisional sum is included in the Bill of Quantities for the payment of a C.L.O. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.5(c) Accredited Skills Training (refer to Clause C3.5.10 of Section C3.5 Management)

Particular Specification PTJ: Training specification for accredited on-site skills training of Employer selected local community members is included as part of this document.

In addition to the requirements of Clause 8.4.3 of SANS 1200 A the Contractor shall allow for skills training by an accredited trainer to be approved by the Employer's Agent of some of the local labourers who will be employed on site. A provisional sum is included in the Bill of Quantities for the payment for skill training. The item shall be deemed to cover all the Contractor's costs in relation to provision of training as outlined in this section and in Particular Specification PTJ. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.5(d) Stipend Payments to PSC Members

A provisional sum is included in the Bill of Quantities for the stipend monthly payments to the PSC members to attend one PSC meeting per month for the duration of the Contract. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.5(e) Stationery and Other Consumables for Employer's Agent

A provisional sum is included in the Bill of Quantities for the provision of stationery and other consumables for the Employer's Agent's Representative. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.5(f) Council Visit Lunches, Sod-turning Ceremonies or Similar

A provisional sum is included in the Bill of Quantities for the provision of Council visit lunches and any Council Sod-turning ceremonies or similar. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.5(g) HAZOP, Hazardous Classification, MHI Reports and Commissioning Planning

A provisional sum is included in the Bill of Quantities for the provision of HAZOP, hazardous classification, MHI reports and commissioning planning where ordered by the Employer's Agent. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.5(h) Training of Employer's Operating and Maintenance Team

A provisional sum is included in the Bill of Quantities for the training of Employer's Operating and Maintenance team as specified in C3.13.5: Drawings and Other. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.5(i) In-service Training for 1Nº Student

A provisional sum is included in the Bill of Quantities for the in-service training for 1Nº student to be seconded to the site by the Client and he/she shall be under the supervision of the Employer's Agent for his/her training. The Contractor shall provide all PPE, medicals and health and safety training in terms of Construction Regulations pertaining to site staff. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

PSA 8.7 Dayworks

Replace A 8.7 with Particular Specification PTA: Dayworks. Measurement and Payment shall be in accordance with PTA 5.

PSA 8.8.2 Dealing with Traffic (to be read in conjunction with SANS 1921 – Part 2)

Add the following to A 8.8.2:

This item shall include for the supply, erection and maintenance of all temporary road signs and delineators and for flagmen that may be required, in terms of the South African Road Traffic Signs Manual, for any and all road crossings and work within the road reserve for the full duration of the work within the road reserve. All road signs and delineators shall be new.

The tendered sum for the accommodation of traffic shall include full compensation for all items necessary for such accommodation and the construction and maintenance of bypasses including existing roads used as bypasses during the construction period. It shall also include full compensation for traffic control, the provision of traffic signs, (where necessary), communications equipment required to regulate traffic, for the construction of any necessary temporary drainage works, for the maintenance of all drainage works, arranging the moving of services and subsequent reinstatement thereof, attending to traffic problems and complying with the requirements of the Road Traffic Ordinance and the relevant local authorities.

Payments shall be made in equal monthly instalments from the date of commencement of such work to the end of the Contract period.

C3.7.2 PSAB: ENGINEER'S OFFICE
(Applicable to SANS 1200 AB - 1986)

PSAB 2 INTERPRETATIONS

PSAB 2.1(b) Supporting Specifications

Delete the Sub-Clause and substitute the following :

SANS 1200 A

PSAB 2.3 Definitions

Delete the first two lines and substitute the following :

For the purposes of this specification the definitions given in SANS 1200 A shall apply:

PSAB 3 MATERIALS

PSAB 3.1 Nameboards

In the third line delete “South African Institution of Civil Engineers” and substitute with “South African Association of Consulting Engineers”.

In the fourth line add “and the logo and name of the Municipal Infrastructure Grant” before the words “and the names and titles....”

PSAB 3.2 Office Building(s)

Delete the first sentence and substitute the following:

The Contractor shall supply and furnish one air-conditioned office (6 x 3 m) for the use of the Employer’s Agent and his/her staff and one air-conditioned conference facility (12 x 3 m) for conducting meetings.

Add to the Sub-Clause:

In addition to the furnishings listed under sub-items (a) to (j), the following shall be provided and properly maintained:

a) Electrical installation to include a light and two (2) 15A plug points plus an adequately sized air-conditioning unit (for cooling) for each unit,
b) One refrigerator of at least 100 litre capacity
c) One kettle of at least 2 litre capacity
d) One tea set comprising six (6) cups, six (6) teaspoons, one (1) teapot and one (1) sugar bowl
e) Two covered parking for two (2) vehicles.
f) Two “Barhold” or similar wall-mounted racks suitable for hanging A0 sized drawings.
g) One large meeting table
h) Ten additional chairs.

PSAB 4 PLANT

PSAB 4.1 Telephone

The Contractor shall not be required to provide a cellphone for the sole use of the Employer's Agent or his/her Representative.

PSAB 4.2 Survey Equipment (New Sub-Clause)

The Contractor shall provide the following survey equipment on the Site from the commencement to the completion of the Works :

- One theodolite capable of reading to six seconds of arc and tripod
- One automatic level and tripod
- One levelling staff (4 m long, 1 cm gradations)
- One staff angle bubble
- One metal change-point for levelling
- One spirit level (1 m long)
- Two steel-tipped ranging rods each 2,5 m long
- One 30 m Stilon reel measuring tape
- One 5 m steel measuring tape
- One hammer (2 kg)
- Steel pegs in sufficient quantities as required

The above equipment may be shared by arrangement between the Contractor and the Employer's Agent or his/her Representative on Site. The Contractor shall maintain the equipment in good working order and keep it clean until the completion of the Works. The Contractor shall keep the equipment continuously insured against any loss, damage, or breakage and he/she shall indemnify the Employer and the Employer's Agent against any claims in this regard. Upon completion of the Works the survey equipment as listed above shall revert to the Contractor.

PSAB 5 CONSTRUCTION

PSAB 5.2 Engineer's Office (Refer SANS 1921-1 Clause 4.14)

Add to the Sub-Clause:

The toilet facilities provided for the sole use of the Employer's Agent or his/her representative(s) shall include hand washing facilities and shall be maintained in a hygienic and sanitary condition and shall be removed on completion of the Works. The facilities provided shall conform to the local health authority's requirements as applicable and the Contractor shall pay all sanitary fees and charges.

PSAB 5.5 Survey Assistants

Delete the first sentence and substitute the following :

The Contractor shall make available to the Employer's Agent two (2) suitably trained labourers for use on and about the site on survey and other work directed by the Employer's Agent at all reasonable times.

PSAB 8 MEASUREMENT AND PAYMENT

PSAB 8.1 Scheduled Items

Delete the first sentence and substitute the following:

Items will be scheduled in terms of Sub-Clauses 8.3.2 and 8.4.2 of SANS 1200 A.

PSAB 8.2.1 Fixed and Time-related Charges

Delete the first sentence and substitute the following:

The terms of Sub-Clause 8.2 of SANS 1200 A shall apply.

Add to the Sub-Clause:

The tenderer is to include, under the Time-Related Charges, a Prime Cost Sum of R800,00 per week for a period of time equal to the Time for Completion of the Contract to cover the cost of the Employer's Agent's Representative's cellphone calls and internet access.

PSAB 8.2.2 (a) Laboratory Testing

t is not an express condition of this contract that the Contractor need erect a laboratory. A provisional sum is included in the Bill of Quantities for the payment of the acceptance control testing (by a commercial laboratory) solely for use by the Employer's Agent. Provision is also made in the Bill of Quantities for the Contractor to include a mark-up on the amounts paid.

C3.7.3 PSC: SITE CLEARANCE
(Applicable to SANS 1200 C – 1980 As Amended 1982)

Related Specifications: Particular Specification PTC: Construction Environmental Plan; and
Particular Specification PTD: Landscaping and Grassing.

PSC 3 MATERIALS

PSC 3.1 Disposal of Material

Add to the Sub-Clause:

Material obtained from clearing must be disposed of off-site by the Contractor at his/her expense. Disposal of combustible material by burning will not be permitted, except for burning of combustible material that shall be carried out in areas to be covered over by permanent works. The Contractor will be held responsible for observing the by-laws and regulations of the relevant local authority and for any injury to persons and damage to property caused by any fire starting on site, in his/her camp, or a fire started for any reason by his/her employees, regardless of whether such injury or damage is the direct or indirect result of such fire. The Contractor shall indemnify the Employer and the Employer\s Agent against all claims or damages arising from this source.

PSC 5 CONSTRUCTION

PSC 5.2.3.2 Individual Trees

Delete the second sentence of the Sub-Clause and substitute the following:

The amount of the penalty payable by the Contractor for the removal or damage by him/her of a tree designated for preservation shall be as stated in the Employer's Environmental Management Specification, PTC: Construction Environmental Management Plan.

PSC 5.3 Clearing

Add the following new Sub-Clause:

PSC 5.3.1 Fences (New Sub-Clause)

Where the pipeline route, or any other excavation(s) crosses an existing fence, a section of fencing not exceeding 10 m in length may be removed temporarily during construction and thereafter reinstated to a condition not worse than the original as soon as the pipeline has been installed and backfilled in the immediate vicinity of the crossing. For the period while the existing fence is dismantled, the Contractor shall erect, at the end of each day's operations, a temporary fence to close the gap in the existing fence.

PSC 5.3.2 Demarcation Staking of Pipeline Servitudes, Or Any Other Excavation(s) (New Sub-Clause)

Demarcation of the pipeline construction servitude, or any other excavation(s), will be by means of wooden stakes. These stakes will be at least 1 m high, painted white and placed at least every 30 m on either side of the linear feature, in all areas where works are occurring. The stakes shall be moved as required as the works progresses.

PSC 5.3.3 Fencing of Pipeline Servitudes, Or Any Other Excavation(s) in Populated Areas (New Sub-Clause)

In populated areas and where directed by the Employer's Agent the Contractor shall also supply, install and maintain temporary fencing on both sides of the working area (servitude) and around the perimeter of all agreed additional working areas during construction for prevention of unauthorised access. The temporary fencing shall be removed on completion of the works. The fencing shall comprise of 1.83 m high Bonnox 4 x 4 pattern 1972/4 square mesh range, with straining posts and straining wires as required and according to supplier's directions. The mesh spacing shall not exceed 100 mm in both the vertical and horizontal directions. Chevron tape shall be interwoven in a zig zag pattern from the top to the bottom of the fence thereby clearly marking off the working area.

Gates shall be provided by the Contractor at all entry points as required for construction access purposes. The Contractor shall be held responsible for the control of access at these gates at all times as well as to the worksite during removal and re-erection of fencing. No other opening in the fence shall be permitted and the Contractor shall be responsible for monitoring the fencing on a daily basis and repairing any such opening within the same day that it is detected. Notices in two official languages (English and isiZulu) shall be attached to the fences where appropriate to indicate that the site is for personnel employed on the Contract only and that unauthorised entry is forbidden.

PSC 5.4 Grubbing

In the fourth line delete "200 mm" and substitute 300 mm.

PSC 5.6 Conservation of Topsoil

Add to the Sub-Clause:

All topsoil shall be conserved for later use by stockpiling, clear of the working area.

PSC 5.8 Demolition of Structures

Add to the Sub-Clause:

Where the Contractor is directed to demolish structures in the way of construction the Contractor shall provide Method Statements for the approval of the Employer's Agent. The demolition of such structures shall not commence before the Contractor has received a release form, duly authorised by representatives of the Employer, or the Owner, or the Service Provider and the Employer's Agent, in which any special conditions applicable to the proposed demolition are documented. The acceptance of the work by the Employer's Agent and certification for payment shall be subject to the Contractor submitting to the Employer's Agent documentary evidence of the Client's, Owner's or Service Provider's satisfaction that the demolition process of structures has been completed successfully to the agreed lines and levels

The tendered rates shall include for the provision of a detailed photographic and written record of the structures before demolishing commences and following re-construction

Add the following new Sub-Clauses:

PSC 5.8.1 Removal and Re-Erection of Fencing Infrastructure

Where the Contractor is directed to dismantle fencing infrastructure to facilitate construction and thereafter to re-erect the same fencing infrastructure, the fencing infrastructure shall be erected at the same location, or such other location as may be required by the Client, Owner or Service Provider, using the same or similar materials as those set aside when removing the infrastructure. The demolition of such fencing infrastructure shall not commence before the Contractor has received a release form, duly authorised by representatives of the Employer, or the Owner, or the Service Provider and the Employer's Agent, in which any special conditions applicable to the proposed demolition are documented. The acceptance of the work by the Employer's Agent and certification for payment shall be subject to the Contractor submitting to the Employer's Agent documentary evidence of the Client's, Owner's or Service Provider's satisfaction that the re-erected fencing infrastructure, the over-riding consideration being that it shall be in a condition no worse than that pertaining prior to its removal.

The tendered rates shall include for the provision of a detailed photographic and written record of the fencing infrastructures before dismantling commences and following re-erection.

PSC 8 MEASUREMENT AND PAYMENT

PSC 8.2 Scheduled Items

PSC 8.2.9 Transport Materials and Debris to Unspecified Sites and Dump

Delete the Sub-Clause and substitute:

The cost of cartage to the unspecified disposal site(s) shall not be paid separately and shall be deemed to be included in the Contractor's rates for site clearance.

PSC 8.2.10 Remove Topsoil to a Nominal Depth of 150 mm and Stockpile

Delete from the Sub-Clause heading the words: 'to a Nominal Depth of 150 mm'
Add to the Sub-Clause:

The topsoil, where approved by the Employer's Agent, shall be conserved for later use by stockpiling clear of the working area.

PSC 8.2.11 Fences (New Sub-Clause)

Separate payment will be made for dealing with fences in the manner specified in PSC 5.3.1 above as scheduled.

PSC 8.2.12 Demarcation Staking of Pipeline Servitudes, Or Any Other Excavation(s) (New Sub-Clause)

Payment will be made per linear metre in the manner specified in PSC 5.3.2 above and shall include the removal on completion of the works.

PSC 8.2.13 Temporary Fencing of Pipeline Servitudes, Or Any Other Excavation(s) in Populated Areas (New Sub-Clause)

Payment will be made per linear metre of temporary fencing installed in the manner specified in PSC 5.3.3 above, and the rate shall include for maintaining such fencing in good condition, including daily surveillance and repair, throughout the duration of construction and shall include the removal on completion of the works.

PSC 8.2.14 Demolition of Structures (New Sub-Clause)

Separate items have been included for the demolition of different types of structures, complete to specified SABS standards, in the way of construction.

Payment will be for demolishing and removing to spoil of structures that cannot be re-used. The demolition process of structures must be completed successfully to the agreed lines and levels in the manner specified in PSC 5.8.2 above as scheduled and is to include the costs of providing to the Employer's Agent photographic and written records.

PSC 8.2.15 Removal and Re-erection of Fencing Infrastructures(New Sub-Clause)

Separate items have been included for the removal and re-erection of different types of fencing infrastructure in the way of construction.

Payment will be for removing and re-erecting fencing infrastructures in the manner specified in PSC 5.8.1 above as scheduled and is to include the costs of providing to the Employer's Agent photographic and written records.

C3.7.4 PSD : EARTHWORKS
(Applicable to SANS 1200 D – 1988 (as amended 1990))

Related Specifications: Particular Specification PTC: Construction Environmental Plan; and
Particular Specification PTD: Landscaping and Grassing.

PSD 2 INTERPRETATIONS

PSD 2.3 Definitions

Delete the sentence headed "Restricted excavation" and substitute:

Restricted excavation - An excavation so restricted in area or width as to preclude removal of material by excavating machinery used for bulk excavation measured in terms of Sub-Clause 8.3.1(b). Restricted excavation may be carried out by smaller machinery or by hand, as selected by the Contractor. The extent of restricted excavation shall be as scheduled and/or shown on the drawings; all other excavation shall be regarded as bulk excavation.

PSD 3 MATERIALS

PSD 3.2.1 Material Suitable for Embankments and Terraces

Embankment material shall be compacted to 90% modified AASHTO density.

Add the following new Sub-Clause:

PSD 3.4 Backfilling and Embankments

Sufficient material arising from excavations of pipelines and structures and which is suitable for forming embankments and backfilling against finished structures shall be temporarily stockpiled in the vicinity of the structures or at the designated temporary stockpile site. All other material from the excavations shall be disposed of as directed by the Employer's Agent.

PSD 4 PLANT

Add the following new Sub-Clauses:

PSD 4.5 Restriction on Use of Plant (New Sub-Clause)

Where the Contractor finds it impractical to use mechanical plant for excavation or to complete portions of the work due to restrictions caused by difficult access or the presence of existing structures, pipelines or services shown on tender drawings, the Contractor will be deemed to have satisfied himself/herself as to the alternative requirements when entering rates against the appropriate items in the Bill of Quantities as no claim for extra payment based on the inability to use plant in such circumstances will be considered.

PSD 4.6 Vibration Loadings from Use of Plant (New Sub-Clause)

The onus will be on the Contractor, when proposing to use heavy plant or equipment to complete work in close proximity to existing structures, pipelines or services, to determine the effect of the vibration loading from the plant or equipment on the supporting ground or foundation and the structure, pipeline or service and take all necessary steps to ensure that the stability or integrity of the element concerned is not compromised by the particular selection and use of plant or equipment.

Any damages caused to existing elements directly or indirectly arising out of the use of plant and equipment in close proximity to such existing elements shall be made good to the satisfaction of the Employer's Agent by the Contractor at his/her own expense.

PSD 5 CONSTRUCTION

PSD 5.1.1.1 Barricading and Lighting (Refer SANS 1921-1 Clause 4.18.2 and 4.18.3)

Delete the Sub-Clause and substitute :

Without limiting any obligation which the Contractor may have in terms of any Act, Ordinance or other Legislation, the Contractor shall ensure that all excavations which are accessible to the public or which is adjacent to a public road or thoroughfare, or by which the safety of persons or animals may be endangered are protected as set out in Clause 13 of the General Safety Regulations of the Occupational Health and Safety Act, 1993 and he/she shall ensure that watchmen are employed to keep in good order and effective barricades, barriers and lights at all times.

Trench excavations shall be adequately protected by means of fences or barricades so as to enclose the excavations, as approved by the Employer's Agent. Fences shall have at least two horizontal double sided 'red/white' chevron tapes threaded through the fences as approved by the Employer's Agent. The tapes shall be stretched tightly between supports along both sides and ends of the excavation at levels approximately 0,45 m and 1,25 m above the ground. The supports shall consist of wooden poles or iron standards securely planted in solid ground at not more than 10 m centres so as to enclose the excavations.

Bridges for vehicles and/or pedestrians shall be provided along the route of the work as and where may be considered necessary by the Employer's Agent. They shall consist of a number of suitably sized steel plates laid across open excavated trenches. They shall be protected at all times on each side by a stout two rail time fence, at least 1 m high, consisting of 150 x 75 mm verticals set firmly into the ground, 75 x 50 mm rails securely fastened to them. At least four (4) lamps or reflective markers must be provided at each crossing.

Where construction is in, or across public roads, barricades or barriers and temporary road signs shall be erected. All such signs and positioning thereof shall comply with the requirements set out in Road Note 13 read in conjunction with the SA Road Traffic Signs Manual.

PSD 5.1.1.2 Safeguarding of Excavations (Refer SANS 1921-1 Clause 4.18.3)

In Sub-Clause (a) delete the words "Machinery and Occupational Safety Act" in the third and fourth lines and substitute "regulations to the Occupational Health and Safety Act, 1993"

PSD 5.1.1.3 a) Explosives (New Sub-Clause) (Refer SANS 1921-1 Clause 4.7)

Notwithstanding Sub Clause 5.1.1.3 the Employer's Agent shall be notified at least forty-eight hours beforehand of the Contractor's intention to use explosives on site.

It shall be incumbent on the Contractor to make himself/herself aware of the restrictions to blasting imposed by electric transmission or telephonic lines and other similar services. Where the presence and location of electric transmission or telephonic lines etc., are known or are shown on the Employer's Agent's drawing at tender stage the Contractor must make allowance in his/her rates and programmes for restrictions and delays which may result from restrictions imposed by the authorities.

PSD 5.1.1.3b) Use of Explosives (New Sub-Clause) (Refer SANS 1921-1 Clause 4.7)

Generally, the Contractor will be permitted to use explosives for breaking up rock and hard material during excavations, for demolishing existing structures and for such other purposes where it may normally be required, subject to the following conditions:

a) The Employer's Agent or Inspector of Explosives shall have the power to prohibit the use of explosives in cases where in his/her opinion, the risk of injury or damage to persons, property or adjoining structures is too high. Such action by the Employer's Agent or Inspector of Explosives shall not entitle the Contractor to any additional payment for having to resort to other less economical methods of construction unless otherwise provided in the Contract Data or Bill of Quantities.

b) Should blasting be necessary, the Contractor shall take every precaution to protect the Works and persons, animals and property in the vicinity of the site. The Contractor will be held responsible for any injury or damage caused by any blasting operations and shall make good such damage at his/her own expense.

c) The requirements for the Explosives Regulations Act (Act 26 of 1956) and the requirements of the Inspector of Explosives shall be complied with. In addition, where applicable, the requirements of Chapter 9 of the Regulations published in terms of the Mines and Works Act (Act 27 of 1956) and the requirements of the Government Mining Employer's Agent shall be complied with.

d) A copy of each blasting permit issued to workmen, and of each permit issued to the Contractor to cover the purchase, storage and transport of explosives, shall be handed to the Employer's Agent. The Contractor shall grant the Employer's Agent access to all records maintained for the Inspector of Explosives or the Government Mining Employer's Agent, as the case may be.

e) Before any blasting is undertaken, the Contractor, together with the Employer's Agent shall examine and measure up any buildings, houses or structures in the vicinity of the proposed blasting and establish and record together with the owners thereof the extent of cracking or damage that may exist before commencement of blasting operations. The Contractor shall produce a photographic record of neighbouring structures before blasting commences. These structures will be pointed out by the Employer's Agent. It shall be the responsibility of the Contractor to make good at his/her own expense any further damage to such houses, buildings or structures which is a result of the blasting.

f) Where there is reasonable danger of damage to power and/or telephone lines, water and/or sewer pipelines, or any other services and/or properties, the Contractor shall suitably adapt his/her methods of blasting, the size of the charges and use adequate protective measures such as cover blasting in order to limit the risk of damage as far as possible.

g) When blasting to specified profiles, the Contractor shall so arrange the holes and charges that the resulting exposed surfaces are as sound as the nature of the material permits. The Contractor shall make good at his/her own expense any additional excavation necessitated by the shattering of rock in excess of any overbreak allowance specified in the Specification Data or in any other specification or given on a drawing.

PSD 5.1.1.3c) Limitations for Blasting (New Sub-Clause)

a) Approval of methods and keeping of records

No blasting work may be carried out prior to the Employer's Agent's approval being given in writing.

Prior to starting any drilling for the first section of blasting, the Contractor shall submit for approval to the Employer's Agent, details of the proposed overall methods of blasting that will be used on site, including spacing, depth and pattern of holes, charging levels (kg/m³), spacing and positioning of relays, method of blast initiation, precautions to prevent 'fly rock', maximum charge per relay, traffic arrangements during blasting, and any other details he/she may consider relevant. These details shall be submitted in writing and supported with sketches at least seven days before the commencement of drilling and blasting.

The Employer's Agent will evaluate these details in relation to the given limitations and prior to giving his/her approval, will indicated to the Contractor any changes that may possibly be needed to comply with the limitations.

For all subsequent blasts, the Contractor shall, at least twenty-four hours beforehand, notify the Employer's Agent of the intention to blast and at the same time shall note if any changes will be made relative to the approved method.

The Employer's Agent reserves the right to order the Contractor to modify his/her method of drilling and blasting, or to employ reduced blasting, without thereby invalidating the Contract. The Contractor shall have no claim for extra payment, over and above his/her tendered rates, due to his/her being ordered to use such a different method of drilling or blasting or reduced charges, regardless of any prior approval by the Employer's Agent of any previous method.

After every blast, the Contractor shall, within twenty-four hours, submit to the Employer's Agent details of the actual total mass of explosives used, the approximate volume of material loosened, and the maximum simultaneous mass of explosives detonated (maximum charge per relay).

Notwithstanding any approval given by the Employer's Agent, the Contractor shall at all times be responsible for the safety of the Works, persons, animals and property in the vicinity of the Site during blasting operations.

b) Vibrations

Blasting vibrations are caused by the transmission of the shock wave from the explosion charge through the material being blasted. This shock wave could cause damage to structures in the vicinity of the blasting if the vibrations are not limited to acceptable levels. Damage to structures is closely associated with peak particle velocity of the ground vibrations in the vicinity of the structure. Advisable maximum levels for peak particle velocity are given in Table 2.

Table 2 - Maximum Particle Velocities (Vibration)

Maximum peak particle velocity (mm/s)	Effect on people and buildings
0,5	Threshold of human perception unlikely to cause damage of any type
5	Limit for blasting adjacent to his/historical monuments
25	Limit for blasting near private dwellings in order to reduce disturbance to residents to a minimum
50	Limit for blasting adjacent to residential structures on good foundations
84	Limit for property owned by concern doing the blasting (i.e. minor plaster cracks acceptable)
120	Recommended maximum level for blasting adjacent to sturdy reinforced concrete structures

The peak particle velocity V is related to the distance D from the blast and the maximum mass of explosive E instantaneously detonated (maximum charge per relay) by the general equation:

$$V = \left(\frac{k}{D}\right)^m xE^n$$

where k, m and n are constants for a particular set of circumstances. V is in mm/s, D is in metres and E is in kilograms. Experimentation has shown that n = 0,5 but k and m have to be determined for each site by means of vibration measurements. However, blasting can be safely conducted without vibration measurements or expert advice if the following relationship is used:

$$V = \left(\frac{1150}{D}\right)xE^{0.5}$$

which gives the maximum charge levels for V = 50 mm/s listed in Table 3.

Table 3 - Maximum Charge Levels

Minimum distance from nearest blast hole structure (m)	Maximum charge mass per relay (kg)
10	0,19
20	0,76
30	1,7
40	3,0
50	4,7
60	6,8
70	9,3
80	12,1
90	15,3
100	18,9

Only detonating relays of at least 20 milliseconds delay interval shall be used.

The above relationship can be used to calculate charge mass for other velocity limits. However, if higher charge levels have to be used for practical reasons, expert advice and possibly vibration measurements will be required.

Notwithstanding the above blasting limits, the Contractor shall at all times be responsible for the safety of the Works, person, animals and property in the vicinity of the Site during blasting operations.

PSD 5.1.1.3d) Negligence (New Sub-Clause)

The Contractor shall be liable for all damages to services caused as a result of the Contractor's negligence.

PSD 5.1.2.2 Detection, Location and Exposure (Refer SANS 1921-1 Clause 4.17)

Add to the Sub-Clause:

All existing services on the site may not be shown on the drawings or be visible on the site. The Employer's Agent may order excavation by hand in order to search for and expose services. An item has been included in the Bill of Quantities to cover the cost of such work if so ordered by the Employer's Agent.

Where a service is damaged because of the Contractor's negligence, he/she shall be liable for the costs involved in the repair of the service and any other costs consequent upon the interruption of the damaged services.

PSD 5.1.4.3 Excavated Material Not to Endanger or Interfere (Refer SANS 1921-1 Clause 4.10)

Delete the sentence: "If the necessity ……..will be borne by the Employer."

PSD 5.1.6 Road Traffic Control

Delete from the fifth, sixth and seventh lines all words following "stated in the project specification".

An item has been included in the Bill of Quantities to cover the relevant costs.

PSD 5.1.7 Excessive Pollution (New Sub-Clause) (Refer SANS 1921-1 Clause 4.19)

The Contractor shall take all reasonable measures to minimize excessive noise and dust nuisance, pollution of streams and inconvenience to or interference with the public or others because of the execution of the Works.

PSD 5.2.2.1 Excavation for General Earthworks and for Structures (Refer SANS 1921-1 Clause 4.10)

Add to the Sub-Clause :

(f) Where outside shuttering is ordered by the Employer's Agent, the excavations shall be carried out for an extra width of not more than 600 mm all around the structure, measured from the base of the face to be shuttered, to allow for the shuttering to be fixed, this extra excavation and refilling where necessary is to be measured and paid for under quantities allowed for this purpose in the Bill of Quantities. Outside shuttering shall be used for the construction of all major structures unless ordered otherwise by the Employer's Agent.

(g) Where permanent concrete is to be placed against an excavated face, the excavation shall be trimmed to ensure that there is no projection greater than 20 mm protruding into the excavation profile.

PSD 5.2.2.3 Disposal

Delete the second sentence and substitute:

"He/she shall dispose of surplus and unsuitable material in areas approved by the Employer's Agent".

PSD 5.2.3.1 Embankments

In the fourteenth line delete "600 mm" and substitute "300 mm"

In the seventeenth line delete "300 mm" and substitute "150 mm"

In the twentieth line delete the sentence starting 'Each layer shall be .... ' and substitute the following :

Each layer shall be compacted to achieve 90 % modified AASHTO density except where indicated otherwise on the Drawings.

PSD 5.2.4.2 Topsoiling

Delete the Sub-Clause and substitute:

Where scheduled, topsoil shall be placed on all surfaces and on embankments and shall be lightly compacted by wheeled vehicles or by tamping and trimmed neatly to the required lines grades and levels. The final thickness of topsoil after compaction shall be at least 75 mm. Prior to topsoiling, the surfaces to be topsoiled shall be prepared by pulling horizontal ruts into the soil with the tines of a front-end loader or other suitable method to retard erosion of the topsoil.

PSD 5.2.4.3 Grass or Other Vegetation

Add to the Sub-Clause :

The surface of topsoiled embankments, terraces and other areas designated by the Employer's Agent are to be planted with fine sturdy approved grass as specified elsewhere. The grassed areas are to be fertilized and watered until the area is fully covered with grass.

PSD 5.2.5.1 Freehaul

Delete the Sub-Clause and substitute :

All haul will be regarded as freehaul. No overhaul will be paid under this Contract.

PSD 5.5.5.2 Overhaul

Delete the Sub-Clause.

PSD 6 TOLERANCES

PSD 6.3 Excavation by Mechanical Means (New Sub-Clause)

Where bulk excavation is carried out by earthmoving equipment, such excavation will only be allowed to within a level of 300 mm, or less as ordered by the Employer's Agent, above the general level to which the ground has to be reduced, the balance of the bulk excavation being carried out by hand or by other means approved by the Employer's Agent.

PSD 7 TESTING

PSD 7.4 Tests to the Contractors Account (New Sub-Clause)

The Contractor shall make arrangements with a soils testing laboratory to undertake the following tests and to pass on the test results to the Employer's Agent. The costs of such tests shall be included in the rates tendered for the appropriate item in the Bill of Quantities.

- Material Imported from Outside the Contract Site as Working Surfaces, Subgrade Improvement or for Fill Material
- One CBR and indicator test per 200 m³ of compacted material brought on site, (river sand will normally be exempted from this requirement). A sample and one CBR and indicator test of the material proposed for importation shall be submitted to the Employer's Agent for approval prior to the commencement of importation.
- Fill Material in Place
- One density and moisture content per 100 m³ of compacted fill
- Compacted subgrade or finished level
- One density and moisture content per 200 m² of compacted surface area.

Should any of the above density tests fail to comply with the specified requirements, the Contractor shall at his/her own expense remedy the failed area and submit a new test to the Employer's Agent.

PSD 7.5 Determination of Compaction (New Sub-Clause)

Determination of the standard of compaction achieved shall be carried out in accordance with Standard Methods of Testing Road Construction Materials published by the Department of Transport Division of National Roads, Publication TMH.1.

PSD 7.6 Tests at the Employer's Request (New Sub-Clause)

Where CBR, indicator tests and the like are required by the Employer on materials from within the Contract site the Contractor shall also make arrangements with a soils testing laboratory to undertake these tests, the costs of which have been allowed for in the Bill of Quantities as a provisional sum. Payment for such tests will be per sample tested and reported to the Employer's Agent.

PSD 8 MEASUREMENT AND PAYMENT

PSD 8.1.1 Basic Principles

Delete the first sentence and substitute:

"The basic principles of measurement and payment for all earthworks are that the rates tendered for excavation shall cover the cost of excavating and re-use of the excavated material in backfilling, forming embankments, etc., including any necessary additional offloading, stockpiling and reloading and the cost of disposal of any".

In the eighth line delete "Drawing D-2" and substitute "Fig D-2"

PSD 8.1.2 Basic Principles

Delete the first line of the first sentence and substitute :

"Excavations which are required to be backfilled, or partially backfilled, will be measured as if taken out"

Delete the fifth and sixth lines and substitute :

"other such structures, the volume will be measured from the finished outline of the concrete, or the blinding to the concrete (as the case may be), as shown on the Drawings.

PSD 8.3 Scheduled Items

Add the following new Sub-Clause:

"PSD 8.3.1.3 Exploratory Excavation

All existing services may not be shown on the drawings or visible on site. The rates shall cover the cost of excavating by hand where shown on site by the Employer's Agent to search for and expose existing services. The rates shall also include for the backfilling and compacting of these exploratory excavations to 93 % Mod AASHTO dry density."

PSD 8.3.2 Bulk Excavation

Delete the second sentence and substitute :

"The rate shall cover the cost of complying with all precautions required in terms of 5.1 in addition to the cost of excavation, offloading to stockpile, stockpiling and reloading as may be necessary, spreading or backfilling, compacting and watering"

"Drawing D-1" in the fifth line and in the last line to read "Fig D-1"

PSD 8.3.3 Restricted Excavation

"Drawing D-2" in the first line to read "Fig D-2"

PSD 8.3.4 Importing of Materials

Delete Sub-Clauses (b) and (c).

Add the following Sub-Clauses

PSD 8.3.4 (d) For Embankment Construction

The rate shall cover the cost of royalties (if any) and acquiring suitable material, loading, transporting with freehaul distance, unloading, spreading in layers not exceeding 150 mm thick, watering, compacting to 90 % Mod AASHTO density, trimming slopes of embankment to required outline all in accordance with the specifications. The rate shall also include for carrying out density testing and the disposal of any surplus material……..…Unit: m³

PSD 8.3.4 (e) For Backfilling Around Structures

The rate shall cover the cost of royalties (if any) and acquiring suitable material, loading, transporting with freehaul distance, unloading, spreading in layers not exceeding 150 mm thick, watering, compacting to 90 % Mod AASHTO density, trimming upper surfaces to the required outline all in accordance with the specifications……..Unit: m³

PSD 8.3.11 Grassing or Other Vegetation Cover

Add to the following to the Sub-Clause:

Where directed by the Employer's Agent, approved grass shall be planted after topsoiling has been completed. The planted area shall be neatly trimmed, fertilised and watered. The Contractor shall ensure that the planted areas are not permitted to dry out. Any grass that fails to grow shall be replaced by the Contractor, at his/her own expense, with fresh grass until satisfactory cover is obtained. The rate shall cover the supplying, planting and maintenance of grass, all in accordance with this specification. ....
Unit : m2

PSD 8.3.14 Backfill with Soilcrete (1:10 cement/sand mix)

The rate tendered shall include the supply of labour and all materials i.e. sand, cement, mixing the soilcrete, backfilling below and around structures and compaction to 98 % Modified AASHTO, including de-watering required to carry out the work..……..……..... Unit m³

PSD 8.3.15 Trimming and Compacting of Sidewalks, Verges, Medians and Islands

The rate shall include the supply of all labour, plant and materials (including gravel, sand, cement, etc. and shall cover the cost of spreading, trimming, shaping, watering and compacting (where necessary) to 93 % Mod AASHTO density, and shall include for the removal to spoil of all excess material...……..……..... Unit m²

PSD 8.3.16 Final Finishing and Clearing Up

The rate shall include the supply of all labour, plant and materials for the removal of all excess materials to be discarded, loading, transporting with freehaul distance and off-loading at the designated dump site, and for restoring the construction site to a pristine environment that is acceptable to the Client. Unit Sum

PSD 8.3.17 Location of Services (New Clause)

The rates tendered shall include for the SUPPLY (item a), or HIRE (item b) of specialist equipment for the detection of existing services, where directed by the Employer's Agent. The rates tendered shall include the operation of the specialised equipment on site and the proper recording of all discovered services showing type of services, positions and depths of all cincealed services that are discovered: .Unit : hour

C3.7.5 PSDB: EARTHWORKS (PIPE TRENCHES)
(Applicable to SANS 1200 DB - 1989)

Related Specifications: Particular Specification PTC: Construction Environmental Plan; and
Particular Specification PTD: Landscaping and Grassing.

PSDB 2 INTERPRETATIONS

PSDB 2.1 Supporting Specifications

Add the following new Sub-Clause:

PSDB 2.1.3 Specification for Labour Intensive Methods

SANS 1921 Part 5 shall also apply in the case of labour-based excavation.

PSDB 3 MATERIALS

PSDB 3.1 Classes of Excavation

Add to the Sub-Clause :

The classification of materials in respect of areas designated for hand excavation shall be as per Annex B of SANS 1921 Part B (Tables B.1 & B.2).

PSDB 3.3 Selected Granular Material

Delete the Sub-Clause and substitute :

Selected granular material shall be material of a granular, non-cohesive nature that is singularly graded between 0,6 mm and 10 mm, is free-draining and has a compactibility factor (as determined by the test given in Section LB of Part 3 of SANS 0120) not exceeding 0,4.

PSDB 3.4 Selected Fill Material

Delete the Sub-Clause and substitute :

Selected fill material shall be a sandy clay material having a PI not exceeding 6 and that is free from vegetation and from uncrushable lumps and stones of diameter exceeding 20 mm.

PSDB 3.5(a) Backfill Material

In the third line delete "150 mm" and substitute "100 mm".

PSDB 3.5(b) Backfill Material

In the second line delete “PI not exceeding 12” and substitute “PI not exceeding 6”.

PSDB 3.5(c) Cement Stabilised Backfill (New Sub-Clause)

Where scheduled, or directed by the Employer’s Agent, backfill shall be stabilised with 5 % cement by mass. The backfill material shall have a plasticity index not exceeding 10 and all material must pass through a sieve of aperture size not exceeding that specified in SANS 1200 LB, Sub-Clause 3.2, as amended.

The dry materials shall first be mixed in a concrete mixer, where after sufficient water is to be added to produce the stiffest consistency available for placing and compacting with vibrators.

PSDB 3.6 Materials for Reinstatement of Roads and Paved Areas

Delete the Sub-Clause and substitute:

Material used in the reinstatement of roadways shall fall into the following relevant categories:

(a) Foundation material recovered from the excavation of trenches across existing roadways which, if so instructed by the Employer's Agent, shall be set aside and re-used as sub-base material.

(b) New material which shall conform to the requirements of:

- Clause 3.2.1 of SANS 1200 ME for the Subbase
- Clauses 3.2 and 3.3 of SANS 1200 MF for the Basecourse
- Clause 3.2.2 of SANS 1200 ME for the Gravel Wearing Course
- Clause 3 of SANS 1200 MH for the Asphalt Surfacing

PSDB 3.7 Selection

Delete the second sentence and substitute the following :

The Contractor is not required to use selective methods of excavating but shall, if so instructed by the Employer's Agent, screen or otherwise treat excavated material in order to produce material suitable for the bedding cradle or the bedding blanket.

PSDB 4 PLANT

PSDB 4.1 Excavation Equipment

In the first line delete "The Contractor" and substitute : "In sections deemed to be excavated by mechanical means, the Contractor"

Add to the Sub-Clause :

Should any portion of a pipe trench exceed the specified depth, the Contractor will be held responsible for any additional costs which may arise as a result of such over-excavation. Concrete filling or imported compacted fill may be ordered by the Employer's Agent to be placed below the bottom of the trench.

PSDB 4.3 Compaction Equipment

Add to the Sub-Clause :

In sections designated to be compacted by labour-based methods hand stampers shall be used as per requirements of Clause 4.3 of SANS 1921 Part 5.

PSDB 5 CONSTRUCTION

PSDB 5.1.1 General

Add to the Sub-Clause:

The use of labour-intensive methods is an integral component of this Contract. The method of excavation of trenches is subject to determination according to the method described in PSDB 5.4.1.

PSDB 5.1.2.3 Sloping Ground

Delete the Sub-Clause and substitute :

The Contractor shall be responsible throughout the duration of the Contract, inclusive of the Defects Liability Period, for the provision of all soil erosion preventative measures necessary to protect the trenches, pipes and land utilised by the Contractor during the Contract from any adverse effects of soil erosion, settlement, scour, etc., resulting from the construction of the Works.

Cross embankments, generally extending across the full width of the working strip, consisting of low earth mounds shaped to rounded form and so oriented as to have a fall of 1 % along their length, shall be constructed with compacted material having a minimum density of 90 % modified AASHTO density and minimum dimensions and maximum spacings dependent on the slope of the ground along the length of the pipeline, as indicated in the following table :

Slope of Ground	Minimum Height	Minimum Base Width	Maximum Spacing
0 % - 2 %	No cross-embankments required		
2 % - 5 %	300 mm	1,2 m	55 m
5 % - 10 %	300 mm	1,2 m	40 m
10 % - 15 %	375 mm	1,5 m	30 m
Greater than 15 %	450 mm	1,7 m	20 m

The height of the cross-embankments for a distance of 1 m on either side of the trench centreline shall be raised 150 mm above the remainder of the cross-embankment to allow for settlement. In order to form a satisfactory drainage channel upstream of each cross-embankment (at a slope of 1%) the crown over the backfilled trench shall be removed for a distance of 0,5 m upstream of the cross-embankment.

Cross-embankments shall be constructed to the same minimum standards and dimensions indicated above wherever artificial slopes have been formed on the working strip or other areas used during construction and, with the approval of the Employer's Agent, are permitted to be so left.

Payment will be made for the construction of cross-embankments in accordance with Sub-Clause 8.3.4(c), provided construction thereof has been either ordered or approved by the Employer's Agent prior to the commencement of such construction.

PSDB 5.1.2.4 Cross-Walls in Trenches (New Sub-Clause)

Where ordered by the Employer's Agent, the Contractor shall place sacks of earth as sack breakers or cross walls around and above the pipe up to ground level, prior to backfilling, as a soil erosion measure. Such sacks shall be filled with selected material free of stones in excess of 50 mm maximum dimension. One sack breaker shall consist of these sacks packed tightly against the trench bottom, pipe and actual trench sides, and against each other to form a solid cross wall at least 0,5 m thick from the bottom of the trench to the surface.

An item has been included in the Bill of Quantities to cover the cost of the supply, installation and maintenance of sack breakers.

PSDB 5.2 Minimum Base Widths

Add to the Sub-Clause :

Trench sides shall be as near vertical as possible in order to minimise the quantity of backfill material required and to avoid possible difficulties where pipelines have to be installed parallel to existing services, fences, hedges, etc and to minimise the loading on the pipe.

The base width for trenches for cables, ducts and unbedded flexible continuous piping, of external diameter less than 125 mm laid at a depth not exceeding 1,5 m, shall be equal to the external diameter of the cable, duct or pipe, plus a side allowance of 200 mm on either side.

PSDB 5.4 Excavation

Add to the Sub-Clause :

Where a pipe is to be laid in a vertically-sided trench with temporary side support, it is necessary to ensure that the compacted bedding and backfill is hard up against the soil forming the trench side by withdrawing the temporary supports stage by stage as the backfill rises up the trench.

PSDB 5.4.1 Determination of Method of Excavation (New Sub-Clause):

Trenches for pipelines shall be excavated by either mechanical means or by hand, determined as follows:

Trial holes of minimum dimensions 1,0 x 1,0 m shall be excavated by hand along all pipeline routes at 50 m intervals ahead of the Contractor's programme for trench excavation. The trial holes shall be 1 m deep or less if intermediate or hard rock material is encountered.

If intermediate or hard rock material is encountered in the top 1 m of excavation at such trial holes, then excavation may be deemed to be carried out by mechanical means, the length of such excavation determined on the basis of other trial hole findings.

If soft material only is encountered at such trial holes, then excavation may be deemed to be carried out by hand up to a maximum depth of 1,5 m, the length of such excavation determined on the basis of other trial hole findings. The consistency of the material shall be determined as per Table 1 of SANS 1921-Part 5 and the Classification of excavated material shall be as per Annex B of SANS 1921-Part 5 (Tables B.1 & B.2).

If intermediate or hard rock material is encountered in those stretches set aside for hand excavation on the basis of the trial hole findings, then the Contractor may be allowed to remove the intermediate or hard rock material by mechanical or whatever means, the rate for which is to include for backfilling and re-excavating (if necessary).

PSDB 5.5 Trench Bottom

Add to the Sub-Clause :

Where steel pipes are laid in waterlogged conditions and/or where so instructed by the Employer's Agent a 150 mm thick layer (See PSLB 5.2.5) of imported single sized stone (19 mm size unless otherwise instructed by the Employer's Agent) with a geofabric filter surround ("bidim" Grade A4 or similar approved) shall be constructed under the bedding layer specified for the pipes.

PSDB 5.5.1 Jointing Holes (New Sub-Clause)

Jointing holes shall be cut of sufficient length and depth to allow for the proper making or bolting of pipe joints and to ensure that joint collars or sleeves do not rest on the trench bottoms. After the pipework has been inspected, tested and approved by the Employer's Agent, the jointing holes shall be refilled with selected soft material free from stone and then rammed to provide a continuous uniform support for the pipework. No specific payment will be made for forming and refilling holes, the cost of which is deemed to be included in the tendered rates.

PSDB 5.6.1 Backfilling - General

Add to the Sub-Clause:

Notwithstanding the requirements of Sub-Clauses 5.6.1 and 5.6.6, no pipe joint or pipe fitting shall be covered by either blanket or backfill material prior to the successful completion of the visual inspection and pressure testing of the relevant section of the pipeline.
All backfilling shall be carried out by hand and the Contractor must price his/her tender accordingly. No mechanical plant shall be used in backfilling without prior written consent of the Employer's Agent.

PSDB 5.6.2 Material for Backfilling

Delete the fourth, fifth and sixth lines and substitute the following :

Hard rock material shall not be used for, or incorporated into, the backfill above the bedding layers without the Employer's Agent's approval.

PSDB 5.6.3 Disposal of Soft Excavation Material

Add to the Sub-Clause :

Surplus material or unsuitable material shall be disposed of off-site by the Contractor.

PSDB 5.6.4 Disposal of Machine Excavation, Hard Rock and Boulder Material

Delete the Sub-Clause and substitute :

Surplus machine excavation, hard rock and boulder material from trench excavations shall be disposed of off-site by the Contractor.

PSDB 5.6.8 Transport for Earthworks for Trenches

Delete the Sub-Clause and substitute :

The requirements of Sub-Clause 5.2.5 of SANS 1200 D as amended and as applicable shall apply.

(Refer also to PSD 5.2.5.1 & 5.2.5.2)

PSDB 5.7.2 Areas Subject to Traffic Loads

Add to the Sub-Clause:

"for an extent of 2 m on either side of the carriage-way at each crossing."

PSDB 5.9.4 Bitumen Surfaced Roads: Sub-Base and Base

Add to the Sub-Clause:

Each tenderer shall include in his/her tender allowances to cover the costs of reinstating all surfaces and inclusive of all layers to their conditions pertaining before the commencement of construction.

Items have been included in the Bill of Quantities to cover the reinstatement of certain surfaces (concrete and/or asphalted/gravel driveways and/or roads) and for payment purposes, the area of those specific surfaces shall be calculated from the product of the length of the trench and the specified trench width plus 400 mm (refer PSDB 5.4).

PSDB 8 MEASUREMENT AND PAYMENT

PSDB 8.1.4 Basic Principles

Delete the Sub-Clause and substitute :

Except that the volume will be computed as specified in 8.2.3, the requirements of Sub-Clause 5.2.5.1 (Freehaul) of SANS 1200 D as amended and as relevant, shall apply to freehaul.

PSDB 8.3.2 Excavation

Delete the Sub-Clause and substitute:

- Excavation in all materials for trenches and dispose of surplus material. Rate to include for all temporary works including trimming, shoring and dewatering as required.
- Excavate by hand in soft material up to a maximum depth of 1,5 m for trenches and dispose of surplus or unsuitable material. Rate to include for all temporary works including trimming, shoring and dewatering as required.

Hand excavation (measured in place) of SOFT material in following Classes:

(1) SOFT Class 1 ..... Unit : m³

(2) SOFT Class 2 ..... Unit : m³

(3) SOFT Class 3 ..... Unit : m³

Items will be provided for various pipe diameters to trench base widths as specified in 5.2 and various depths in increments of 0,5 m measured to the bottom of the bedding layer (see Drawings DB-2, DB-3 & DB-4).

Where measured volumetrically in terms of 8.1.2(a), the volumes of excavation will be computed in accordance with 8.2.2 & 8.2.3

Extra-over item (a) above for:

(1) Excavation in Hard Rock Material ..... Unit : m³

(2) Excavation in Boulder Class A Material ..... Unit : m³

(3) Excavation in Boulder Class B Material ..... Unit : m³

Separate items will not be provided for depth increments. Volume will be computed from the trench width determined in accordance with 8.2.3 and the depth from the top of the intermediate or hard rock excavation, as the case may be, either to the bottom of the same material or to the bottom of the trench as specified in (a) above, whichever is the lesser (see Drawing DB-5).

The rates shall cover the cost of the excavation and handling of the material as classified and the disposal of rock and other surplus or unsuitable material.

Measurement of Extra Over for (3) and (4) above will not apply to any length of trench in soft material more than 2 m long. Surplus boulder material from trench excavation shall, where applicable, be disposed of to the designated spoil areas except where shown otherwise on the drawings.

Backfill and compact in all trenches for pipes up to DN600 .....Unit : m³

Extra-over item (d) above for backfill stabilised with 5 % cement where directed by the Employer's Agent .....Unit : m³

The tendered rates for (d) & (e) above shall include full compensation for selecting, mixing, backfilling and compacting of the stabilised material to 90 % of modified AASHTO density ..... Unit : m³

PSDB 8.3.3.1 Make up deficiency in Backfill Materials

No payment will be made for additional backfill material in the trenches due to overbreak, etc. The Contractor must allow for such costs in the tendered rates for excavation measured under PSDB 8.3.2

Payment for imported, graded stone laid under pipelines in accordance with PSDB 5.5 shall be paid for under either Sub-Clause 8.3.3.1(a) or (b) or (c) as scheduled.

PSDB 8.3.3.2 Compaction in the Road Reserve

Replace the heading of this Sub-Clause with the following:

"PSDB 8.3.3.3 Compaction in Road Crossings"

Replace the sentence, "The volume will be measured as specified in 8.2.2, 8.2.3 and 8.3.3.1", with the following:

"To determine the volume in the case of gravel roads, the depth will be measured from the underside of the gravel wearing course to the top of the fill blanket, and in the case of bitumen roads, from the underside of the subbase to the top of the fill blanket.

The rest of the trench shall be backfilled as specified in clauses 5.9.3, 5.9.4 and 5.9.5, as applicable, and payment will be made under item 8.3.6.1."

PSDB 8.3.3.4 Overhaul

Delete the Sub-Clause and substitute :

All haul will be regarded as free haul. No overhaul will be paid for under this Contract.

PSDB 8.3.4(c) Cross Embankments (New Sub-Clause)

Payment for cross embankments will be by volume of embankment constructed in accordance with the specification. .....Unit : m³

PSDB 8.3.5 Existing Services that Intersect or Adjoin a Pipe Trench

Add to the end of the Sub-Clause :

(v) all work involved in locating the service by hand excavation;

(vi) notifying and attending upon the proprietor of the service;

(vii) supporting and protecting the service while the pipeline is installed, inspected, tested and backfilled.

PSDB 8.3.5(c) Excavate by Hand to Expose Existing Services (New Sub-clause)

Where existing services are shown on the drawings or where the existence thereof can be reasonably expected, the Contractor shall in conjunction with the relevant authority(ies), determine the exact depth and location of such services before the commencement of construction. (refer to Clause 5.1.4). ..... Unit : m³

The rate shall cover all costs to excavate by hand to locate the service and backfill to original levels.

PSDB 8.3.6.1 Reinstate road surfaces

Add the following to the Sub-Clause::

The rates for the reinstatement of road surfaces shall also cover the cost for the supply and importation of all material for the reinstatement of the different layers and to their conditions pertaining before the commencement of construction and the cost of density testing as specified in PSD 7.4.

PSDB 8.3.6.2 Grassing (New Sub-Clause)

Where directed by the Employer's Agent, approved grass shall be planted after topsoiling has been completed. The planted area shall be neatly trimmed, fertilised and watered. The Contractor shall ensure that the planted areas are not permitted to dry out. Any grass that fails to grow shall be replaced by the Contractor, at his/her own expense, with fresh grass until satisfactory cover is obtained. The rate shall cover the supplying, planting and maintenance of grass, all in accordance with this specification. ....
Unit : m2

PSDB 8.3.8 Sack Breakers (New Sub-Clause)

Where directed by the Employer's Agent, sack breakers shall be installed from the bottom of the bedding to 300 mm below finished ground level. ..... Unit : No

PSDB 8.3.9 Excavate Trial Holes to Determine Method of Excavation (New Clause)

Excavation by hand of trial holes of minimum dimensions 1,0 x 1,0 m to depth of 800 mm, or less if intermediate or hard rock material is encountered, along all pipeline routes at 50 m intervals. Including use of DCP for classification of material. Including backfilling of the trial holes when notified by the Employer's Agent. ..... Unit No

PSDB 8.3.10 Relocation of Services (New Clause)

A Provisional Sum has been included for the relocation of existing services where directed by the Employer's Agent to new positions and/or alignments ..... Unit : No

Erosion Protection

PSDB 8.3.11 Stormwater Deflection Berms / Cross Embankments (New Sub-Clause)

An item has been included in the Bill of Quantities to cover the cost of the construction of stormwater deflection berms / cross embankments, where ordered by the Employer' Agent, in terms of PSDB 5.1.2.3.

PSDB 8.3.12 Cross-Walls in Trenches (New Sub-Clause)

An item has been included in the Bill of Quantities to cover the cost of the supply, installation and maintenance of sack breakers, where ordered by the Employer's Agent, in terms of PSDB 5.1.2.4.

C3.7.6 PSDK: GABIONS AND PITCHING
(Applicable to SANS 1200 DK - 1996 First revision)

PSDK 3 MATERIALS

PSDK 3.1.1 Stone

Add to the Sub-Clause:

Stone that is hard and unweathered may be selected from the earthwork's excavations. Where no suitable stone is available from excavations the supply shall be at the Contractor's option. The transport of the stone shall be included in the rate for supply.

The stone shall be subjected to both the weathering and the durability tests (see Sub-clauses 7.3 and 7.4).

PSDK 3.1.2 Gabion Cages

Add to the Sub-Clause:

The wire used for the fabrication of gabion baskets and mattresses and for lacing and bracing operations shall be to SANS 675 and galvanised for Class A – heavy galvanised mild steel wire. No PVC coating will be required.

The gabion baskets and mattresses shall be as follows:

The above-mentioned gabion cages shall be constructed of double twisted, hexagonal wire mesh gabions of nominal 80 mm mesh, with 3,4 mm o/d frame wire and 2,7 mm o/d mesh wire. complete with partitions at 1 m centres. All wire shall be mild steel to SANS 1580 - 2005, Class A, zinc coated by heavy duty hot dip galvanising to SANS 675 - 2007.

Each basket and mattress shall be complete as described in SANS 1200 DK.

PSDK 3.1.3 Geotextile

Add to the Sub-Clause:

The filter blanket shall consist of "non-woven" spun bound polyester fabric having a mass of 210g/m2, permeability of 0,003 m/s and multi-direction tensile strength of 16 000N/m such as KAYMAT Grade U24.

The filter blanket must be attached to the gabion wall, basket or mattress by an approved method of fastening, which must ensure that the blanket will stay in position during construction of the infilling behind the gabion wall. The material to be used as fill immediately adjacent to the gabion wall must have good drainage properties to ensure that there is no build-up of pore pressure behind the wall and be free of sharp rocks that could damage the filter blanket.

PSDK 3.2.1 Stone

Add to the Sub-Clause:

Medium pitching, as stated in Table 2 of 3.2.1 shall be used in this Contract.

PSDK 3.2.3 Wire Netting

Add to the Sub-Clause:

Wire netting for gabion basket and mattress cages shall be hexagonal steel wire mesh strengthened by selvedges of heavier wire and by mesh diaphragms that divide the cases into 1 m compartments.

Nominal 80 mm mesh shall be used for gabion basket cages with 2,4 mm diameter galvanised steel wires.

Nominal 60 mm mesh shall be used for gabion mattress cages with 2,0 mm diameter galvanised steel wires.

Selvedge wire shall be galvanised, and the diameter shall be in accordance with Table 3 of SANS 1200 DK.

PSDK 5 CONSTRUCTION

PSDK 5.1.2 Lacing of Cages

Add to the Sub-Clause:

Each diaphragm shall be connected in the same manner to the sides and top panels in addition to the bottom panel. All gabion basket and mattress cages shall be connected to adjacent basket and/or mattress cages by lacing the adjacent selvages together with galvanised steel wire.

PSDK 5.1.3 Type of Cage (New Sub-Clause)

The size of cages for gabion baskets and mattresses shall be as shown on the drawings and measured in the Bill of Quantities.

PSDK 5.1.4 Diaphragms (New Sub-Clause)

Each diaphragm shall be connected in the same manner to the sides and top panels in addition to the bottom panel.

PSDK 5.2.2 Geotextile or Geomembrane (New Sub-Clause)

Filter blankets may be required behind the gabion baskets and the bottom of mattresses in order to prevent leaching of the embankment material through the gabion retaining structures and revetments. The Employer's Agent may order, in writing, that the covered faces of the gabion walls and bases shall be lined with a filter blanket.

PSDK 5.2.3 Assembly

Add to the Sub-Clause:

All gabion basket and mattress cages shall be connected to adjacent gabion and/or mattress cages by lacing the adjacent selvedges together with 2,0 mm dia. galvanised steel wire. The lacing shall be in accordance with Sub-Clause 5.1.2.

PSDK 5.2.4 Rock filling

Add to the Sub-Clause:

Particular care shall be taken in the filling of gabion baskets and mattresses so as to ensure that the voids in the rockfill are reduced to the minimum that can be reasonably achieved. In order to minimise the voids in the rock filling, the filling shall proceed in layers not exceeding 300 mm deep and each layer shall be rodded and barred so as to compact the rockfill before filling of the next layer commences. Where appropriate, hand packing of selected rock particles shall be carried out.

PSDK 5.2.4.2 Mattresses Used in Revetments and Aprons

Add to the Sub-Clause:

Where gabion mattresses are placed in exposed positions the rock particles forming the exposed faces shall be specially selected so as to present a fair and even surface.

PSDK 5.3.4 Wired Pitching

Add to the Sub-Clause:

The areas in which wired or grouted wire pitching is to be used will be indicated on site by the Employer's Agent.

PSDK 5.3.6 Rock Bolsters (New Sub-Clause)

Where rock bolsters are specified or directed by the Employer's Agent (in particular below the outlet of stormwater pipe culverts), the rock shall be dumped or pushed into place as indicated by the Employer's Agent. The heap of rock shall conform to the dimensions, i.e. length, width, height ordered by the Employer's Agent, to a tolerance of 300 mm.

PSDK 8 MEASUREMENT AND PAYMENT

PSDK 8.2.3 Extra-over 8.2.2 for Packing Selected Stone for Exposed Face

Add to the Sub-Clause:

The method of selecting and packing stone for exposed faces as scheduled shall be as specified in Sub-Clause 5.2.7 - Special Finish.

C.3.7.7 PSDM : EARTHWORKS (ROADS, SUBGRADE)
(**Applicable to SANS 1200 DM - 1981)**

PSDM 2 INTERPRETATIONS

PSDM 2.1 SUPPORTING SPECIFICATIONS

Add to the Sub-Clause:

"SANS 1200 AA and SANS 1200 DA are applicable to this Contract."

PSDM 3 MATERIALS

PSDM 3.1 Classification for Excavation Purposes

Replace DM 3.1 with the following:

"Classification of excavation of materials for the purpose of measurement and payment will be as follows:

(i) Common Excavation

All material as defined under Clause 3.1.2 (a) – soft excavation and 3.1.2 (b) – intermediate excavation, but excluding the use of pneumatic power tools.

(ii) Hard Rock Excavation

All material as defined under Clause 3.1.2 (c) and including material that requires removal with the use of pneumatic power tools."

PSDM 3.2 Classification for Placing Purposes

PSDM 3.2.1 General

Add to the Subclause:

"The nomenclature used for the classification of various material types to be used in the designated pavement layers is that defined in the NITRR documents TRH4 and TRH14."

PSDM 3 MATERIALS

PSDM 3.3 SELECTION

PSDM 3.2.3 Selected Layers

Replace DM 3.2.3 with the following:

"Material utilised for selected layers shall comply with the specification requirements of TRH 14:1985 "Guidelines for Road Construction Materials" for G7 (upper selected subgrade), for G9 (lower selected subgrade) and for G10 (subgrade) or can be screened borrow pit or commercial quarry material from commercial source. No overhaul will be payable for materials from borrow pit or commercial sources."

PSDM 3.3.1 General

Add to the Subclause:

"Should insufficient materials of a quality acceptable for use in the selected layer be found in the excavations the balance of the material required for the selected layer shall, when instructed by the Employer's Agent, be obtained from the Contractor's own source. Such material must first be approved by the Employer's Agent before it is brought to site for construction purposes."

Add the following new Subclause:

"PSDM 3.4 Road Foundation Layers

"The proposed gravel road foundation specification is:

- Rip / scarify in situ G10 minimum roadbed material to 250 mm depth, water (where necessary) and compact to 90% mod AASHTO density
- 150 mm imported G7 wearing course layer compacted to 93% Mod AASHTO density."

PSDM 5 CONSTRUCTION

PSDM 5.1 Precautions

PSDM 5.1.1 Safety, Existing Services, Stormwater, etc and Nuisance

Add to the Subclause:

"All existing services may not be shown on the drawings or be visible to the Contractor on site. The Employer's Agent may order excavation by hand to expose such sources.

Where a service is damaged because of the Contractor's negligence, he/she shall be liable for the repair of such service and shall bear all costs involved in the repair and other costs or losses due to the interruption of the services."

PSDM 5.1.2 Accommodation of Traffic

Add the following to DM 5.1.2:

"All road traffic signs needed for the construction site shall be in accordance with the specification requirements of the South African Road Traffic Signs Manual".

PSDM 5.2 Methods and Procedures

PSDM 5.2.2 Cut and Borrow

PSDM 5.2.2.3 Use of Material

d) Borrow pits

Add the following to DM 5.2.2.3(d):

"Imported natural gravel will be from commercial sources, but should the Contractor have his own borrow pit source this will be acceptable, provided that test results submitted by the Contractor proves the material to be of acceptable quality."

PSDM 5.2.2.5 Disposal of Surplus or Unsuitable Material

Add to the Subclause:

"Surplus and unsuitable material shall be disposed of as instructed by the Employer's Agent."

PSDM 5.2.3 Treatment of Roadbed

PSDM 5.2.3.2 Removal of Unsuitable Ground

Replace DM 5.2.3.2 with the following:

The in-situ material is at places unsuitable, and does not meet the material specifications for the selected subgrade as set out in Clause M 3.3.3. The Contractor shall where directed by the Employer's Agent, remove the unsuitable material to the depth directed and backfill with approved material from commercial sources, borrow pit, or stockpile.

The perched water table is anticipated to be fairly shallow especially where insitu rock is encountered within or close to the pavement layer and water seepage through the excavated face at the level of the selected subgrade will in many instances be inevitable during the rainfall season. The Contractor will be required to install the permanent subsoil drains to the details shown on the drawings. The timing of the installation of the subsoil drains is critical to avoid saturating the newly placed selected layers.

Depending on the rate of water seepage into the excavation, the Contractor may be required to install the subsoil drains progressively during the construction of the selected layers to ensure that the layers are not saturated. Construction shall commence from the lower end to facilitate drainage."

PSDM 5.2.8 Transport

PSDM 5.2.8.1 Freehaul

Add to the Subclause:

"All movement of materials from/to cuts fills, borrow pits, stockpiles, commercial sources and surplus material will be regarded as freehaul."

PSDM 8 MEASUREMENT AND PAYMENT

PSDM 8.2 Computation of Quantities

PSDM 8.2.1 Volume Measured Only Once

Replace the first and third sentences as follows:

Earthworks will be *measured* by volume in compacted embankment once only as compacted fill from cut or borrow, whichever is applicable.

Uncompacted fill from cut, material placed to stockpile or to spoil will be measured insitu as excavation."

PSDM 8.3 Scheduled Items

PSDM 8.3.4 Cut to Fill, Borrow to Fill

add the words after the words "road prism" *in the second line of the paragraph.*

"and in borrow pits"

Add the following at the end of the paragraph:

"The rate shall also cover the cost of selection of suitable material in the borrow pit.

The rate for borrow to fill does not include the cost of excavating, loading and offloading or anything which is covered by Item 8.3.4 of SANS 1200 D."

PSDM 8.3.14 Borrow Pits

Replace the words: "Subclause 8.3.6 (b) of SANS 1200 D or Subclause 8.3.4 of SANS 1200 DA, as applicable" *with*:

"Subclause 8.3.4(a) of SANS 1200 D."

PSDM 8.3.15 Catchwater Mounds and Channels and Mitre Banks and Channels

Add the following to the Sub-Clause:

The rate tendered for the construction of channels shall include the excavation to an average 600 mm wide and 300 mm deep channel to form sloping cut off drain with splayed sides

PSDM 8.3.16 Gravel Surface Layer

Replace the words, "calculated by the method of average end areas" in the first line with:

"measured as placed and compacted to the dimensions shown on the drawings or specified by the Employer's Agent and verified on site. The tendered rate shall include for any excess width, wastage and any gravel wearing course laid in excess of the specified thickness."

Add the following new Sub-Clauses:

"PSDM 8.3.17 Royalty Payments for Material from Designated Borrow Pits:

(a) Royalties payable on material from designated borrow pits ..... Unit : PC Sum

(b) Percentage Mark-up on PC Sum for royalty payment. .....Unit : %

A Provisional Sum is included in the Schedule of Quantities for Royalty Payments to respective landowner(s) for material from Borrow Pits. The amount actually expended from the PC Sum shall include full compensation for any charges for labour, profit, transport, establishment and other charges the Contractor may have to include for the procurement of the borrow pit material. The amount(s) for royalty payments must be agreed to in writing by the landowner(s), the Contractor and the Employer's Agent before excavation and removal of the borrow pit material is undertaken.

A Provision is also made in the Schedule of Quantities for the Contractor to include a mark-up on the amounts paid.

C3.7.8 PSG : CONCRETE (STRUCTURAL)
(Applicable to SANS 1200 G - 1982)

PSG 2 INTERPRETATIONS

PSG 2.4 Explanation of Terms

PSG 2.4.3 Joints

Delete the 4th sentence and substitute:

The Employer's Agent may order further joints prior to the commencement of casting the relevant concrete wherein they are situated. Such joints will become "designated joints" and will be paid for in terms of Sub-Clause 8.5, or as may be otherwise agreed. However, should the Contractor require further joints to suit his/her own purposes he/she shall first obtain the approval of the Employer's Agent. Such further joints may then be constructed but these will not be "designated joints", nor will they be paid for.

PSG 3 MATERIALS

PSG 3.2 Cement

PSG 3.2.1 Applicable Specifications

Add to the Sub-Clause:

Unless agreed to otherwise by the Employer's Agent, the cement used on the Works shall be Type Cem 1, Ordinary Portland Cement (OPC) and Pulverised Fly Ash (PFA) or Type CEM II/A-V, or Type CEM II/A-W (all of minimum strength Class 32,5).PC15 (or equivalent in terms of SABS ENV 197-1).

The standard cement specifications SABS 471, SABS 626, SABS 831 and SABS 1466 have been withdrawn and are replaced by the new SANS 50197-1 and -2: Common cements, and SANS 50413-1 and -2: Masonry cement. These specifications will be applicable to this Contract, and the descriptions and types of psd 8s specified, will be based on the designations as defined in these specifications.

PSG 3.2.2 Alternative Types of Cement

Add to the Sub-Clause:

Pulverised Fly Ash (PFA) used on the works shall be from an approved source and shall comply with the requirements of SABS 1491 Part II.

PSG 3.2.3 Cement Storage

Add to the Sub-Clause:

Cement and PFA shall be stored in a closed container and shall not be kept in storage for longer than two months without the Employer's Agent's permission.

PSG 3.4.1 Applicable Specification

Add to the Sub-Clause:

Sand from a source selected by the Contractor and approved by the Employer's Agent after testing by the Contractor will be used under this Contract.

PSG 3.4.2 Use of Plums

Add to the Sub-Clause:

The use of plums will be permitted only in mass concrete fill if agreed to by the Employer's Agent.

PSG 4 PLANT

PSG 4.5.1 Design

Add to the Sub-Clause:

The Contractor shall arrange for a Professional Engineer to design and sign the drawings for the formwork (including all supports) to be used for suspended slabs and roofs and for cast in-situ large and/or deep concrete manifolds and/or chambers.

PSG 4.5.2 Finish

Delete the contents of this Sub-Clause and substitute the following:

The quality of the finished surfaces of the concrete shall be as scheduled or as shown on the drawings.

PSG 4.5.3 Ties

Add to the Sub-Clause:

After removal of ties all ferrules are to be drilled out of the concrete to provide an oversized reamed hole free of all remnants of the ferrule and blown out to remove all dust and other loose material.

The surface of the hole is to be primed by wetting well with a cement/SBR latex slurry and the hole filled by caulking with a cementitious mortar consisting of 1 part cement to 2 parts concrete sand by volume, well mixed with sufficient clean water to obtain the required consistency. This grout is to be well rodded into the hole to completely fill same and provide a dense, void-free plug. The surface is to be troweled to finish flush with the surrounding area.

PSG 5 CONSTRUCTION

PSG 5.1 Reinforcement

PSG 5.1.2 Fixing

Delete from the 8th and 9th lines the following:

"or, if permitted by the Employer's Agent, by welding".

PSG 5.1.3 Cover

Add to the Sub-Clause:

The clearance between reinforcing and steel pipes and flanges cast into concrete shall be no less than 75 mm.

PSG 5.2 Formwork

PSG 5.2.5.2 Removal of Formwork

Delete the first two lines. Add the following after the fourth line:

The minimum times for removal of formwork from concrete containing Portland blast furnace cement given in Table 1 of SANS 1200 GA shall apply also to members of concrete made from a blend of equal parts of Ordinary Portland Cement and other cementitious materials.

PSG 5.2.5.5 Removal of Formwork

Add to the Sub-Clause:

Special attention is to be paid to the repair and sealing of shutter-tie positions in water retaining structures to ensure watertightness.

PSG 5.3 Holes, Chases and Fixing Blocks

Add to the Sub-Clause:

Fixing blocks for the attachment of fixtures may be embedded in concrete provided that the strength or any other desirable feature (such as appearance) is not, in the opinion of the Employer's Agent, impaired thereby. The fixing blocks must be properly cured and of comparable strength and density to the water retaining concrete. The geometry of the fixing blocks must be such that they will not impede the flow of concrete around the blocks and between the reinforcing and the shutters.

The Contractor shall be responsible to provide samples of fixing blocks as proposed for use in the contract in good time for the Employer's Agents inspection. The acceptance of such blocks shall be subject to Employer's Agent's approval.

PSG 5.5 Concrete

PSG 5.5.1.2(b) Consistency

Delete the line (b) and substitute:

(b) by the Employer's Agent in respect of prescribed mix and strength concrete, or

PSG 5.5.1.5 Durability

Add to the Sub-Clause:

The exposure conditions at the site of the Works are to be considered as being 'Moderate'.

PSG 5.5.1.6 Prescribed Mix Concrete

Delete the Sub-Clause and substitute the following:

The grades of prescribed mix concrete are designated Grades 20, 15 and 10 and are composed of cement, sand and stone, as specified hereinbefore, proportioned as follows:

Grade	Size of Stone (mm)	Cement (kg)	Sand (m3)	Stone (m^3)
20/19	19	50	0,110	0,140
15/19	19	50	0,130	0,140
10/38	37,5	50	0,160	0,200

While the proportion of cement to the combined quantity of sand and stone must remain constant for each grade of concrete, as set out above, the relative proportions of sand and stone are to be adjusted, if required by the Employer's Agent, so as to obtain the most suitable consistency of concrete, due to allowance being made for the bulking of sand due to moisture.

The addition of water shall be regulated by the use of properly calibrated containers, only sufficient water being added as will, in the opinion of the Employer's Agent, afford a workable mix.

The fine and coarse aggregates approved for use in strength concrete Grades 30 and 25 are to be used for prescribed concrete mixes Grades 20 and 15.

PSG 5.5.1.7 Strength Concrete

Delete the Sub-Clause and substitute the following:

There shall be five grades of strength concrete used on the works designated Grades 35/19, 25/19, 20/19, 15/19 and 10/40, composed of cementitious material, sand and stone as specified hereinbefore.

The use of concrete admixtures (plasticisers, retarders, accelerators, etc) will not be permitted except by written permission from the Employer's Agent, which permission will only be granted on the basis of the timely submission of adequate material data sheets, technical and performance specifications, together with the accompanying Quality Control processes and Quality Assurance measures to be taken.

Grade 35/19 Concrete for Water Retaining Structures

For Grade 35/19 concrete Type CEM I Ordinary Portland Cement (OPC) and Pulverised Fly Ash (PFA) are to be blended together such that the combined cementitious material comprises 70% OPC and 30% PFA by mass.

The minimum content of combined cementitious material shall be not less than 360 kg and not more than 450 kg per cubic metre of concrete and the minimum cement/water ratio shall be 2,0.

The characteristic cube strength at 28 days shall be not less than 35 MPa.

The concrete mixes for the above-mentioned grades of strength concrete are to be designed by an approved laboratory. At least six weeks before placing any concrete on the works, the Contractor shall supply and deliver to the laboratory, at his/her own cost, samples of the aggregates he/she proposed to use in the concrete mixes. The Contractor shall include in his/her tender for all the fees and charges levied by the laboratory and all other costs incurred in designing and adjusting the strength concrete mixes.

PSG 5.5.1.8 No-Fines Concrete (New Sub-Clause)

No-fines concrete shall be composed of Type CEM I Ordinary Portland Cement and coarse aggregate only, the fine aggregate being omitted from the mix. The proportions of the cement and stone shall be one part by volume of cement to eight parts by volume of stone.

The stone shall comply with the grading requirements of 19 mm single-sized crushed stone to Table 7 of SANS 1083.

Only sufficient water shall be added to the mix to produce a smooth grout to completely cover each and every particle of aggregate.

Proportions may be varied on site with the approval (or to the direction) of the Employer's Agent to obtain a more satisfactory result. The upper surface of the no-fines is to be finished off with a wood float to provide a smooth working surface while adding just sufficient dry mix mortar (1 to 8) to close the upper surface of the voids in order to prevent ingress of foreign matter into the interstices.

Mixing shall be carried out in a mechanical batching plant and the hopper shall first be charged with the aggregate to which a small quantity of water has been added to moisten the aggregate particles. The cement shall then be added followed by the remainder of the water.

The no-fines concrete shall be placed within 20 minutes of having been mixed and shall be rodded and hand-tamped into position. The use of vibrators will not be permitted.

No traffic shall be permitted to traverse the surface of the no-fines concrete during the three days following upon placing and then only over planks or boards placed for that purpose.

The thin surface layer shall be pervious, and this is to be demonstrated to the Employer's Agent three days after placing by applying copious quantities of water onto the surface and there shall be no sign of ponding of water i.e, the surface shall be free draining.

PSG 5.5.2.3 Aggregates

Add to the Sub-Clause:

Batching is to be by mass using an approved type of weigh-batching plant.

PSG 5.5.3.2 Ready-mixed Concrete

Delete the 1st sentence and substitute the following:

Concrete produced at a central concrete production facility, other than at the site of the Works, shall only be accepted for use in the Works with the prior and express approval of the Employer's Agent. Such request by the Contractor shall only be accepted on the basis of a Concrete Mix Design accompanied by test results for the concrete as well as all of the concrete constituents, admixtures (if any) and water used for the mix. The submission in support of the use of ready-mixed concrete should include the Quality Control procedures and documentation that shall apply to the production of the concrete and the design time to initial set, with reference to the applicable transit time between the ready-mix facility and the site, considering traffic factors. A suitable format for submission of design mix information is the D2 form as used by the KZN DoT. The information shall be submitted well in advance of the proposed work and any delays due to late submission of all information required to consider such request shall not be considered acceptable cause for a delay of programme.

When such approval has been given, concrete cubes and all other applicable tests shall be made on site and the test results obtained by the facility concerned will be used for reference purposes only. The tests on site shall include, as a minimum, a slump test conducted on each mixer delivery to the site.

The use of concrete from a ready-mixed concrete facility shall thereafter be permitted subject to the following provisos:

- The facility shall be accredited as being compliant with the requirements of the ISO 9001 standard.
- The concrete batching plant shall be inspected by the Employer\s Agent for compliance with SANS specifications and his/her approval must be obtained in writing before commencement of the concrete works.
- Before any ready-mixed concrete is used on the Works, the Contractor shall furnish the Employer's Agent with a copy of his/her letter to the supplier in which was specified:

  (i) the type of cement(s);
  (ii) the nominal maximum sizes of aggregates;
  (iii) the cement / water ratios;
  (iv) the required compressive strengths;
  (v) the required slump at the time and place of delivery; and
  (vi) the type of additive - documentary evidence proving the suitability of the additive for use in the concrete, particularly in the Grade 35/19 water retaining concrete, shall be given to the Employer's Agent for his/her prior approval.

The following shall be specified in the Contractor's contract/order with the ready mixed concrete supplier and a copy of the relevant documentation shall be given to the Employer's Agent's Representative:

- A maximum delivery period of 90 minutes from the time water is added to the concrete mix to the actual completion of the discharge of concrete on site shall be permitted. The discharge period (including placing the concrete) shall not exceed 30 minutes.
- The concrete slump of every truckload shall be measured on delivery to site as soon as discharge commences, and it shall comply with Clause SANS 1200 G 5.4.1.2 prior to any concrete from that truck being placed. No additional water may be added to the mix after it has left the batching plant without the written approval of the Employer's Agent's Representative. Under no circumstances shall the cement/water ratio for concrete in water retaining structures be less than 2,0.
- A detailed computer printout of the constituents of the concrete mix from the batching plant is to be handed over to and retained by the Employer's Agent's Representative on site on arrival (i.e., truck registration, mix proportions and the time water was added to the mix). The masses of the concrete constituents of each truck shall be checked against that of those submitted with the trial mix, subject to the batching accuracy as specified in SANS 0100-2: 1992. The arrival time of each truck on site and the time that the concrete discharge is completed shall also be recorded by the Employer's Agent's Representative. Dedicated truck drivers shall be used, where possible, for the delivery of the concrete to site.
- When required the Contractor shall satisfy the Employer's Agent that acceptable alternative means of supplying concrete have been arranged and can be brought into operation in the event of disruption in the supply of concrete. In this regard, the Employer's Agent may require that the alternative means of supply shall commence if the disruption in the supply of ready-mixed concrete has lasted for a period of 1½ hours.
- The use of ready-mixed concrete will in no way relieve the Contractor of any of his/her obligations
- for providing concrete that complies with the specifications."

PSG 5.5.5 Placing

PSG 5.5.5.5 Dropping of Concrete

Delete the Sub-Clause and substitute the following:

Dropping concrete freely will only be permitted if the Employer's Agent is satisfied that this is the only practical method of placing.

Add the following new Sub-Clauses:

PSG 5.5.5.10 Jointing in Continuous Walls (New Sub-Clause)

In the case of continuous walls (e.g, reservoir walls) these are to be cast in lifts of such height that each lift can be poured uninterruptedly in one continuous operation over the entire perimeter of the wall. No vertical or inclined construction joints of any kind will be permitted in continuous walls unless they have been specifically ordered or authorised by the Employer's Agent. The placing of concrete shall commence at convenient points on the perimeter of the wall and shall proceed both ways simultaneously so that fresh concrete meets fresh concrete. Any rest pauses, such as for meals, shall be avoided as far as possible, and the Contractor may be required by the Employer's Agent to make the operation continuous by working in shifts. A workable arrangement must be made before each concreting operation commences.

PSG 5.5.5.11 Blinding Layer (New Sub-Clause)

Beneath all structural grades of concrete, or elsewhere if so ordered by the Employer's Agent, or shown on drawings, the bottom of the excavation is to be covered by a blinding layer (screed) in Grade 15/19 concrete to a depth of 75 mm (or 50 mm in some instances) to prevent disturbance of the ground and to serve as an even, clean and accurately positioned working floor for setting steel and placing foundation concrete. This blinding layer shall be laid immediately after excavations have been completed, compacted to required density (where specified by the Employer's Agent), trimmed to the required depths and have been inspected and approved by the Employer's Agent.

PSG 5.5.5.12 Under-drainage Layer (New Sub-Clause)

Quantities have been included in the Bill of Quantities for the placing of a 75 mm thick no-fines concrete under-drainage layer between the top of the blinding layer and the underside of certain structural concrete floors.

PSG 5.5.7.3 Construction Joints

Delete Sub-Sub-Clauses (a), (b), (c) and (d) and substitute:

PSG 5.5.7.3.1 Surface Preparation of Joints

All horizontal and vertical construction joints shall be cleaned of all dirt and loose particles and shall be prepared to the satisfaction of the Employer's Agent. Formed keys shall be provided if shown on the drawings or if instructed by the Employer's Agent. All intersections of construction joints with concrete surfaces which will be exposed to view shall be made straight and level or plumb and shall be constructed to the details shown on the drawings.

The Contractor is to provide a compressor with suitable oil traps in the air delivery hoses on site for the whole period during which concreting is in progress, and this must be available for cleaning concrete faces prior to placing fresh concrete or pouring joints.

"Blowing off" may generally be carried out on horizontal surfaces but under special circumstances approved by the Employer's Agent it may also be carried out on vertical surfaces. The surface concrete to be prepared shall be between 4 and 8 hours old after placing of the concrete has been completed and shall be blown off using a mixture of air and water under a pressure of at least 500 kPa or by using a high-pressure water jet until all dirt, laitance, etc is removed and particles of clean coarse aggregate are exposed sufficiently to produce a rough surface. Any loose particles of coarse aggregate shall also be removed. The success of this method of preparation depends on selecting the correct time (dependent on the type of cement, atmospheric conditions, etc.) so that the concrete has set to just the necessary degree of hardness. The operation may therefore require to be undertaken outside of normal working hours, preferably at night. When the surfaces are at least 12 hours old any remaining loose fine aggregate particles shall be washed off.

"Scabbling", which refers to removal of all surface laitance plus roughening the concrete surface with pneumatic picks in order to expose the coarse aggregate in a uniform pattern, may be carried out on both horizontal and vertical surfaces. The surfaces to be prepared in this manner shall be at least 12 hours old after mixing the concrete. At least 35 % of the roughened surface area shall consist of exposed coarse aggregate.

All surfaces prepared either by "blowing-off" or by "scabbling" shall be kept continuously wet until the next lift of fresh concrete is to be placed against them; the minimum time being 12 hours.

The use of approved wet-to-dry epoxy resin concrete adhesive, strictly in accordance with the manufacturer's instructions, will be permitted in the formation of concrete joints at surfaces where the concrete is older than 7 days.

PSG 5.5.7.3.2 Placing Fresh Concrete at Joints

Vertical construction joint surfaces shall be, as instructed by the Employer's Agent:

All surfaces prepared either by "blowing-off" or by "scabbling" shall be kept smooth, clean and kept damp for at least 24 hours before placing fresh concrete against them or, scabbled, clean and damp as specified above.

Horizontal construction joint surfaces shall have been "scabbled" or "blown off", cleaned and kept continuously wet as specified above before fresh concrete is placed over them. Immediately before placing the fresh concrete, the damp surface of the set concrete shall be evenly coated (by brushing or brooming) with a layer of cement mortar between 10 mm and 15 mm thick. The water/cement ratio and the cement/sand ratio of this mortar shall be the same as that of the fresh concrete to be placed and the mortar shall be producing by leaving the coarse aggregate fraction out of a batch of the fresh concrete. Coating with mortar is to be done in stages immediately before areas of set concrete are covered with fresh concrete, so that no mortar is exposed for longer than one hour after mixing, or less if the mortar has become dry or has started to set before being covered with fresh concrete. Any dried-out mortar shall be removed and, after cleaning the surface, shall be replaced with fresh mortar.

No fresh concrete shall be placed on the top surface of concrete which is laterally restrained (e.g. by formwork or by in-situ earth) while the top layer of concrete is between 3 hours and 12 hours old after mixing. No fresh concrete shall be placed on top of the concrete with an unrestrained lateral surface while the top layer of concrete is between 2 hours and 12 hours old after mixing.

PSG 5.5.8 Curing and Protection

Add to the Sub-Clause:

Notwithstanding the methods of curing itemised under (a) to (e) of the Sub-Clause the walls of thin wall reservoirs or other structures shall be cured by method c) continuous spraying or "microjetting" and shall be subject to continuous spray curing for a minimum period of 10 days.

Delete from the Sub-Clause:

All references to the curing periods relating to concrete made with Portland Blast Furnace Cement since the use of the latter is not permitted in terms of the Contract.

PSG 5.5.9.2 Hot Weather Concreting

Delete the first two sentences and substitute with the following:

When concrete operations are being carried out at ambient temperatures in excess of 32°C, the Contractor shall apply the relevant recommendations for hot weather concreting set out in American Concrete Institute publication ACI 305R-77 "Recommended practice for hot weather concreting".

PSG 5.5.10.2 Unformed Concrete Surfaces

Add to the Sub-Clause:

The unformed surfaces that require to be wood-floated or steel-floated or which are to receive other special treatment as well as the degree of accuracy, if this is not Degree of Accuracy II, are as detailed in the Bill of Quantities.

PSG 5.5.11 Watertight Concrete

Add to the end of the second line:

joints and shutter-tie positions,

Add to the Sub-Clause:

Special care shall be taken when concrete for water retaining structures is being cast. The details of the drawings shall be followed meticulously, especially regarding the quality of concrete to be used, construction joints, the making good of holes used for formwork fixing purposes, and the grouting of pipes and other accessories.

The following structures are to be subject to water-tightness tests:

- Potable water reservoirs.
- All concrete chambers/structures below ground shall exclude water and shall be subject to a visual test for watertightness.

No vertical or inclined construction joints of any kind will be permitted in the perimeter walls of water-retaining structures unless these have been specially ordered or authorised by the Employer’s Agent.

In order to minimise the risk of the Works not being watertight, the Contractor shall take the greatest precaution during construction to prevent the occurrences of possible sources of leakage, and in this respect it is emphasised that:

- as far as possible concreting should be carried out in one continuous operation, preferably alternating the direction of pour so that a cold joint does not occur at the end of pouring a lift.
- where such continuous operation is not possible, proper bond of concrete must be secured,
- while setting, concrete shall be suitably protected from the direct heat of the sun and shall be kept moist for at least 10 days.

Add the following new Sub-Clauses:

PSG 5.5.11.1 Concrete for Water Retaining Structures (New Sub-Clause)

Grade 35/19 concrete, as scheduled, shall be used for the construction of all water retaining structures. For purposes of impermeability, durability and the protection of steel, the cement/water ratio shall be more than 2,0.

PSG 5.5.11.2 Pipes and Conduits Embedded in Concrete (New Sub-Clause)

Except with the approval of the Employer's Agent no pipes other than those shown on the drawings shall be embedded in the concrete.

PSG 5.5.12 Concrete in Wet Ground

Delete the Sub-Clause and substitute:

The design for the structures to be built in wet ground makes full allowance for the conditions likely to be encountered on Site. The documents and drawings indicate what is required to be built. However, the Contractor shall be fully responsible for keeping the excavations free from water whilst the construction work is being carried out. The methods by which he/she proposes to achieve this shall be approved by the Employer's Agent before being implemented. The cost of dewatering shall be included in the tendered rates for the construction work and no separate payment shall be made for such dewatering throughout the construction period.

PSG 5.5.13 Grouting

Add to the Sub-Clause:

Grouting shall be done to the instruction of the Employer's Agent using materials of suitable consistency as follows. Unless otherwise directed, grouting mixtures shall consist of 1 part cement to two parts concrete sand by volume, well mixed and with sufficient water added to obtain the required consistency. Where recesses to be filled are of appreciable dimensions, the Employer's Agent may direct the Contractor to replace a proportion of sand with fine stone to reduce shrinkage. The Employer's Agent may also require the Contractor to use non-shrink or other additives in grouting mixtures where these are allowed for in the Bill of Quantities.

Add the following new Sub-Clauses:

PSG 5.5.13.1 Liquid Grout (New Sub-Clause)

Where liquid grout is required for bolt holes, etc, water shall be added in such quantity that, when the material is thoroughly mixed and stirred, it shall flow readily so as to fill all recesses and air spaces in the work to be grouted. Before grouting any section of the work with liquid grout, the surfaces to receive grout shall first be thoroughly cleaned and flushed with water. The grout shall then be introduced in such a manner as to effectively fill all recesses. When the grout has set the surface of the work shall be finished off flush and smooth with cement mortar.

PSG 5.5.13.2 Grouting of Pipes/Specials Through Walls (New Sub-Clause)

Where entry holes for pipes/specials have been provided in the walls, the Contractor shall be responsible for the grouting in of such pipes/specials regardless of whether or not these have been supplied by himself/herself.

Before commencing the positioning in holes of any pipes/specials the Contractor shall:

- Remove all shuttering and boxing remaining in the holes,
- make any alterations required to the position and shape of the holes and reinforcing steel (lacing bars, etc.) in the holes
- thoroughly clean and scabble the sides of the holes so as to obtain satisfactory bond surface for the new concrete (including the post-forming of "frogs" where longitudinal forces are to be restrained by the concrete); and
- free all surfaces of the pipes/specials of all coatings, and thoroughly scrape and clean the pipes/specials.

After accurately positioning the pipes/specials in the respective holes, the Contractor shall fix the pipes/specials in a suitable manner to prevent movement.

Immediately prior to grouting being carried out by the placing of mortar and concrete around the pipes, the surface of the existing concrete shall be saturated with water. All surplus water shall be removed, and the surface covered with a layer, approximately 12 mm thick, of mortar consisting of 3 parts concrete sand and 1 part cement.

The concrete ingredients shall be mixed and placed as dry as possible to obtain a dense, waterproof concrete. Where a watertight seal is required, the concrete shall be carefully worked around the puddle flange, if any, and the pipe barrel or body of the special, and shall be vibrated in layers so as to obviate any falling away from pipe/special surfaces of the concrete already placed.

The grouting of the hole shall, when set, form a dense, homogeneous, and waterproof mass. A spare vibrator with an independent power source shall be kept in readiness to ensure continuity of placing in the event of the breakdown of the duty vibrator.

Smooth formwork that has been suitably strengthened for use with a vibrator shall be provided for facing the concrete around each pipe/special.

PSG 5.5.13.3 Dry-packed Grout (New Sub-Clause)

When dry-packed grout is specified, under baseplates etc, only sufficient water shall be added to make the mixture ball when squeezed in the hand. Before any grouting is done with dry caulking the surfaces between which the caulking is to be placed shall first be thoroughly cleaned and flushed with water. All surplus visible water shall be wiped or blown away and the dry caulking shall be forcefully rammed or hammered into place using suitable tools. Exposed surfaces shall be finished off neatly with a trowel and extensive exposed areas shall be covered with wet sacking and kept damp for at least 24 hours.

Where additives are required for grouting operations, these shall be brought on to site in the manufacturer's unopened containers and used strictly in accordance with the manufacturer's instructions which the Contractor shall not fail to obtain. If necessary, the Employer’s Agent may require the Contractor to undertake preliminary tests to check the behavior of proprietary additives under the conditions pertaining on the site.

PSG 5.5.13.4 Epoxy Grout (Epoxy mortar type only) (New Sub-Clause)

The manufacturer's instructions shall be observed when an epoxy grout is used.

PSG 5.5.16 Cement Mortar (New Sub-Clause)

Where cement mortar is specified for filling around pipes etc. water shall be added to obtain a firm paste which can be worked with a trowel but is not fluid. Surfaces to receive mortar shall be well wetted and excess water allowed to drain or be removed. The mortar shall be worked into place with a trowel or tamping rod, exposed surfaces floated off and covered with wet hessian for 24 hours and allowed to harden without disturbance.

PSG 5.5.17 Joints (New Sub-Clause)

PSG 5.5.17.1 Fibreboard

Fibreboard shall be provided between concrete sections wherever shown on the Drawings. Fibreboard shall be impregnated and treated with a special bituminous compound to protect it from weathering e.g, "Flexcell", as manufactured by Fosroc (Pty) Ltd or a similar approved board of comparable composition, which shall be securely fixed in position to avoid distortion or displacement while concreting operations are in progress.

PSG 5.5.17.2 Joint Former

Joint former for use in joints shall be approved by the Employer's Agent. It shall consist of a highly resilient closed cell polymer foam (the resiliency shall not be less than 90 % recovery after compression to half original thickness), capable of giving effective support to sealing compounds in movement joints, and able to withstand permanent immersion in water without disintegration.

Minimum required specifications:

- Normal density: 100
- Elongation at break point: 98 %
- Tensile strength at 70%: 782 kPa
- Tear strength of width: 5,4 N/mm

PSG 5.5.17.3 Waterstops

Polyvinyl chloride (PVC) and/or rubber waterstops shall be of approved manufacture and shall be provided with lugs and fixing. The minimum elongation at break point shall be 360 % at 25°C. In the case of PVC waterstops, regenerated PVC will not be accepted. The waterstops shall be of the size and shapes shown on the drawings and as scheduled. Prior to use all waterstops shall be carefully stored to avoid damage or contamination by oil, grease, the sun etc.

The jointing of waterstops by any other means than by approved pre-formed joints designed for the appropriate geometry of the joint shall not be permitted.

PSG 5.5.17.4 Polysulphide Sealants

Polysulphide sealants shall comply with SANS 110/1973 with manganese cured base and with a minimum of 40 % polymer and additionally, shall be suitable for sealing watertight joints in the Works to be constructed under this Contract using these materials and they shall impart no taste nor toxicity to the water when used as necessary and in the quantities necessary to meet the requirements of the Contract. The prices tendered for polysulphide sealants shall include for sufficient timeous chemical testing by the supplier or by his/her agent approved by the Employer's Agent, of the water after purification to establish that the water contains no chemical or organism which is likely to cause degeneration of the polysulphide in the joints. Should any such chemical or organism be found by the said testing to be present in the said waters, the Contractor shall at his/her own expense, substitute other approved material for the polysulphide and seal the joints watertight.

The prices tendered for sealing joints with polysulphide sealants shall include for making up on site concrete test blocks and joints in timber cradles and immersing them in the water in existing reservoirs at a depth of not less than 3 m for three weeks. Three such sample joints shall be prepared and so immersed before sealing of the reservoir floor joints commences.

PSG 5.5.17.5 Joints with Waterstops

Where shown on the Drawings, joints shall be formed in concrete work embodying waterstops embedded in the concrete. It is essential that the waterstops are held securely during concreting by using suitable shuttering and a clamping device for holding the waterstop in position, nailing not being permitted except through the lugs provided for the purpose. The concrete adjacent to the waterstop shall be carefully placed and compacted to avoid honeycombing and to ensure full contact between the water-stop and the adjacent concrete.

After one half of the waterstop has been set into concrete and before the concreting of the succeeding section is commenced, the faces of the concrete against which the succeeding section is about to be cast shall be thoroughly cleaned by brushing with a wire brush, care being taken not to damage the waterstop.

PSG 5.5.17.6 Sliding Joints

Sliding joints are to be formed where shown on the Drawings. The upper concrete surfaces forming the sliding joints are to be finished using the "delayed troweling" technique, which is as follows. Wood float surface and allow the bleed water to dissipate. When the bleed water has dissipated, the surface is to be steel floated. When thoroughly set and dry, these surfaces are to receive a “Kilcher” type Teflon sliding bearing with a capacity of 2 ton/metre and the upper concrete being cast thereon.

PSG 5.5.17.7 Movement Joints

Joint recesses to receive sealing compound are to be formed to the dimensions and shapes indicated on the Drawings. These recesses are to be formed with rough sides and so shuttered that the shuttering can be removed without any timber having to be left in the recesses. Shuttering shall be left in the joints until the joints are ready for priming and filling with sealant. After the removal of the shutters, joints shall be cleaned by mechanically operated wire brushes and all dust removed.

PSG 5.5.17.8 Sealing Joints

The sealing of the expansion joints is to be carried out by the Contractor under the supervision of a representative of the specialist firm supplying the sealing compounds and materials. The Contractor is to be responsible for supplying these approved materials, transporting them to site, storing and using them as required, and providing all labour, tools, equipment and everything necessary to prime and fill the joints.

Before priming and sealing, the joints are to be thoroughly cleaned and dried out by a method approved by the Employer’s Agent.

No sealing of joint recesses is to be carried out until at least 21 days after the adjacent concrete has been cast.

Every care shall be exercised by the Contractor to ensure that the work shall be carried out in accordance with the requirements of this Specification and in strict conformity with any special instructions given by the manufacturers for the proper use and treatment of the sealing materials provided by them.

All internal joints in the floors and the external joints in the roof shall be sealed either with an approved sealant or alternatively, if instructed by the Employer’s Agent, with a 190 mm wide butyl rubber strip of 3 mm nominal thickness (Expoband or similar approved) consisting of two laminations, one layer being fully vulcanised rubber and the other layer being unvulcanised rubber.

The concrete surface onto which the butyl rubber strip is to be laid must be sound, dry and dust free and must be fully cured and free from curing compound. The concrete surfaces on either side of joints shall be finished smooth and level and free from all dirt, dust, laitance, loose material and irregularities with no vertical misalignment between each side of the joint to be sealed. Any portions that are not so finished shall be ground down at the Contractor's expense. The butyl rubber strip is to be installed strictly in accordance with the manufacturer's instructions and adhered to the concrete surfaces so as to form a permanently watertight joint.

Payment for the construction joints shall be measured per linear metre for the various types of construction joints. The rate shall include for all shuttering at the joints, scabbling of the concrete surface and the supply and installation of either an approved sealant or a butyl rubber strip, adhesive, and everything necessary to achieve the objective of a watertight joint.

PSG 5.5.18 Anchors to Pipelines (New Sub-Clause)

Concrete pipeline anchors at horizontal bends, vertical bends and on steep slopes shall be constructed where directed by the Employer's Agent in accordance with type drawings to be supplied. Bolts, clamping straps and reinforcement shall be provided as directed.

In general, anchors will be provided at all horizontal bends in flexibly coupled pipelines and at such vertical bends as the Employer's Agent may decide. Details of the anchors will be supplied by the Employer's Agent.

PSG 5.5.19 Manhole Covers and Frames (New Sub-Clause)

The rates are to include for setting the covers into concrete with the upper edge 10 mm above the concrete level to prevent the entry of rainwater where installed in positions exposed to rain; and set into concrete so as to be flush with either the concrete surface or the finished granolithic surface as required where installed within roofed buildings.

PSG 6 TOLERANCES

PSG 6.2.3 Specified Permissible Deviations

Add to the Sub-Clause:

Except for the special smooth finish described in PSG 5 above, where applicable, the Contractor shall work within the limits of the permissible deviations laid down for Degree of Accuracy II with the following modifications:

Foundations (Sub-Clause 6.2.3(c))

Position on plan... ....+ 20 mm
Surface level ....+ 20 mm

Above Foundations (Sub-Clause 6.2.3(d))

Position on plan...+ 10 mm
Surface level ....+ 5 mm

PSG 7 TESTS

PSG 7.2.1 General

Add to the Sub-Clause :

The testing will include a visual inspection by the Employer's Agent of the concrete surface and dimensions of the work after the stripping of formwork. The Contractor shall accord the Employer's Agent's Representative opportunity to perform such visual inspection and shall provide suitable lighting if the ambient light is inadequate. The Contractor shall not touch up or repair the work in any way until the Employer's Agent has informed him/her that the inspection is completed to his/her satisfaction.

PSG 7.2.1.1 General – Core Sampling (New Sub-Clause)

Should signs of reduced cover or exposed reinforcing, excessive honeycombing or porosity or any other visible defect of the water retaining concrete be evident during visual inspection, the Employer's Agent may organize for core sampling, or other form of testing, to be undertaken at locations in the structure identified by the Employer's Agent's Representative. The Contractor shall be required to provide access to, liaise and cooperate with the service provider conducting such testing. Upon instruction to repair the core holes the Contractor shall proceed to procure the approved materials and shall perform any repairs required to fill the core holes and make good the work according to a method approved by the Employer's Agent.

Should the report of the core testing demonstrate that the concrete work is of adequate strength, density and general integrity the Contractor shall be entitled to recover the cost of repairing the core holes and making good the work according to Dayworks rates for plant, labour and materials. Should the core testing reveal unacceptable material deficiencies in the work the Contractor shall be liable to make good the defective work, including the demolition and reconstruction of the work where indicated, as well as the cost of the testing ordered by the Employer's Agent.

PSG 7.2.3 Laboratory Testing

Add to the Sub-Clause :

The Contractor will be liable for all costs incurred in making structural concrete cubes and having these tested.

Add the following new Sub-Clauses:

PSG 7.2.5 Testing Grouting Procedure (New Sub-Clause)

SANS 0120 : Part 2 Section G page 9, Sub-Clause PSG 8.9 shall be applicable where relevant.

PSG 7.2.6 Watertightness Tests (New Sub-Clause)

Unless otherwise ordered by the Employer's Agent, all water containing structures shall be tested for watertightness. This shall take place after completion of construction and when all concrete that will be in contact with water is at least 28 days old.

Before the structure is tested for watertightness it is to be thoroughly cleaned, swept and brushed to remove all dirt, grit and rubbish and washed down with clean water. Channels and pipes are to be cleaned and inspected and, where the Specification or Bill of Quantities demands, flushed or disinfected.

The structure shall be disinfected after cleaning by filling with water to a depth of 200 – 300 mm and chlorinated by adding a predetermined and agreed quantity of calcium hypochlorite, sufficient for a chlorine content of 20 mg/liter, and uniformly mixing into the water on the floor.

This calcium hypochlorite solution is to be used for spraying, washing and thoroughly disinfecting all the internal surfaces, including pipes, fittings and the ladder. After the last person has left the reservoir a quantity of chlorinated water shall be poured over the access ladder.

Should it be necessary after the above procedure has been carried out, for any person to enter any of the sterilized structures, the sterilizing process shall be repeated for that structure.

During all stages the Contractor shall be held responsible for safeguarding the health of his/her employees. Immediately after the initial cleaning and disinfection, calcium hypochlorite is to be thoroughly dissolved in the water whilst the structure is being filled for testing, after which the Contractor will be instructed either to drain and refill or to put into service, depending on the residual chlorine content in the water after testing is complete and on the results of the bacteriological tests which will be carried out by the Employer.

The cost of the water required for cleaning and disinfecting the reservoir will be for the Contractor's account. The Contractor’s tendered rate for watertightness testing will be deemed to include for this expense.

Each structure shall be filled in stages, at a uniform rate to the next 2 m increment in 24 hours, to top water level unless it is obvious that some appreciable leak has developed and that a test is not possible.

After each stage, the water level is to be established and recorded by means of a hook gauge to be provided by the Contractor, and thereafter, is to be measured and recorded by the Employer’s Agent, in relation to a fixed bench-mark, each successive 24 hours for 2 days in the case of the intermediate stages and 7 days at TWL and the results graphed so as to establish the progressive rate of absorption and leakage. Concurrently with this test the Contractor shall carry out an evaporation loss test by providing a steel tank 600 mm x 600 mm x 450 mm deep, filling with 300 mm of water, and accurately measuring the drop in water level for 24 hours. This drop in water level shall be regarded as a measure of the evaporation loss and shall be used to calculate the probable evaporation loss in the structure being tested.

Should the water level in the structure have dropped by not more than 4 mm plus the calculated evaporation loss, with a maximum allowable drop of 10 mm, the structure shall be accepted as watertight.

Should the structure not satisfy the test, then, after the completion of the remedial work, it should be refilled and if necessary, left for a further stabilising period; a further test of 7 days duration should then be undertaken in accordance with the specification.

If the rate of leakage at any stage exceeds the specified amount (plus an allowance for evaporation if the structure is unroofed) at the end of seven days and there is no prospect, in the opinion of the Employer’s Agent, of the rate of leakage becoming as low as that, he/she shall have the right to deem the water containing structure to be not watertight, and to notify the Contractor accordingly, who shall forthwith take such steps, at his/her own expense and to the approval of the Employer’s Agent, as may be considered necessary to achieve watertightness, other than plastering the floor and inside walls.

In the event of the steps taken by the Contractor proving ineffective in reducing the rate of drop in water level over a period of 7 days to less than specified amount (plus an allowance for evaporation if the structure is unroofed) the Employer’s Agent shall have the right, if he/she considers there is no prospect of the leakage taking up in a reasonable period to the rate stated, to order the Contractor to carry out at his/her own expense, approved steps, on completion of which the Contractor shall again clean out and test in the manner specified and at his/her own expense.

Notwithstanding the fact that a structure may have passed the test described in the aforementioned paragraph, it will not be accepted if there are any leaks or damp spots on any exterior surface. Any such defects shall be sealed and repaired in a manner and to a standard acceptable to the Employer’s Agent.

Backfilling around the reservoir may only commence after successful completion of the watertightness testing.

Watertightness of the concrete roof(s) shall be tested by the continuous sprinkling of water over the roof with approved sprinklers so that a film of water is maintained on the surface of the slab for not less than 6 hours. The roof shall be considered watertight if there are no damp patches visible on the underside after 48 hours of sprinkling or ponding. The roof insulation covering shall be completed as soon as possible after satisfactory testing.

In the event of leakage being evident at any time during the Defects Liability Period the Employer's Agent, before issuing his/her Final Certificate may call for further rectification and testing as already described, if he/she considers such to be necessary, and will have the right to withhold this Certificate until he/she considers the work to be satisfactory.

PSG 8 MEASUREMENT AND PAYMENT

PSG 8.1 Measurement and Rates

PSG 8.1.1 Formwork

PSG 8.1.1.6 The Unit Rate Shall Cover

Add to the Sub-Clause:

The unit rate shall also include for all labour, tools and material necessary for the preparation and effective sealing of shutter-tie positions in order to affect watertightness of these areas, as required.

PSG 8.1.2 Reinforcement

PSG 8.1.2.2 (a) Scheduling of Bars in Various Sizes

Delete the second paragraph and substitute:

The quantities (or percentages) of all other sizes of steel bars that are scheduled may be subject to variations and the contract prices for these will be fixed regardless of the magnitude of such variations (if any).

PSG 8.1.3 Concrete

PSG8.1.3.1(b) Concrete Required to Make Up Overbreak

Delete the Sub-Clause and substitute:

In the case of overbreak in hard rock excavation beneath structures the tendered rates will be deemed to include, inter alia, for the excavation of material, cleaning, washing and brushing with grout and for refilling with Grade 10/40 concrete together with all necessary shuttering and including the additional thickness of concrete in lieu of blinding on horizontal floors. The Contractor is to make his/her own estimate of the extent of overbreak.

PSG 8.1.3.2 Concrete

Add to the Sub-Clause:

(e) No fines concrete drainage layers

Add the following new Sub-Clauses:

PSG 8.4.7 Concrete Complete with Formwork (New Sub-Clause)

Separate items, where so required, have been included in the Bill of Quantities for concrete complete with formwork for each particular grade of concrete or for structural units of similar size and shape, or for both. The unit rates shall cover the cost of the provision of concrete (made with Ordinary Portland Cement unless otherwise so scheduled), mixing, testing, placing, compacting, the forming of stop-ends and unforeseen construction joints, striking off or levelling as applicable, and curing and repairing where necessary, together with the cost of all parts of formwork in contact with the concrete and the necessary bearers, struts, and other supports, plus the layout and plant necessary to erect and strike such formwork.....Unit : m^3

PSG 8.9 Grouting of Pipes/Specials Through Walls or Slabs (New Sub-Clause)

Items, where so required, have been included in the Bill of Quantities for the grouting of pipes and specials through box-outs or broken out openings in walls or slabs. The rates shall include for all necessary labour, plant and materials required to carry out the work described in PSG 5.5.13 and for finishing to the required quality. ..... Unit : No

PSG 8.10 Casting of Pipes/Specials through Walls or Slabs (New Sub-Clause)

Items, where so required, have been included in the Bill of Quantities for the casting of pipes or specials through walls or slabs. The rates shall include for all labour, plant and materials to make the necessary modifications to formwork to allow the pipe or special to be cast in, the positioning of the pipe or special and for finishing the concrete surface to the required quality around the pipe or special at the end of the concreting operation. ..... Unit: No

PSG 8.11 Cleaning, Disinfecting and Sterilising Reservoir (New Sub-Clause)

The rate shall be deemed to cover the cost of water and chlorine for the cleaning and disinfecting the reservoir. The rate shall including provision of labour, plant and materials, logistics and management to clean and disinfect the reservoir, as specified in PSG 7.2.6. ..... Unit: Sum

PSG 8.12 Water-Tightness Testing of Water Retaining Structure (New Sub-Clause)

The rate shall be deemed to cover the cost of supply of water and testing the structure, including provision of labour, plant and materials, logistics and management to conduct the water-tightness testing and to repeat the test until a successful water-tightness test is achieved, as described in PSG7.2.6. ..... Unit: Sum

C.3.7.9 PSHA: STRUCTURAL STEELWORK (SUNDRY ITEMS)
(Applicable to SANS 1200 HA 1990)

PSHA 3 MATERIALS

PSHA 3.1 Structural Steel

Delete the Sub-Clause and substitute:

Except where scheduled to the contrary or shown on the drawings, the grade of steel to be used in the manufacture of the following shall be that grade normally supplied by reputable manufacturers approved by the Employer's Agent:

- Roof cladding
- Handrailing systems
- Open grid flooring systems
- Steel plate flooring
- Steel windows, doors and frames
- Stair treads (but excluding supporting steelwork)
- Access ladders and safety cages.

All structural steelwork which shall include ladders, safety cages and platforms, shall be manufactured from 300 W grade steel in conformity with SANS 1431, except where shown to the contrary on the Drawings or in the Schedule of Quantities.

All stainless steel shall be Grade 304, except where shown to the contrary on the Drawings or in the Schedule of Quantities.

Grade 3Cr12 steel shall be used where scheduled or shown on the Drawings and shall be fully pickled and passivated prior to installation.

PSHA 5 CONSTRUCTION

PSHA 5.1 Drawings and Shop Details

PSHA 5.1.2 Contractor to Provide Shop Details

Add to the Sub-Clause:

The Contractor shall prepare his/her own shop details based on the dimensions and details given on the Drawings and will be required to submit his shop details to the Employer's Agent at least 3 weeks prior to fabrication. Written consent must be obtained from the Employer's Agent, prior to commencing fabrication. Notwithstanding the Employer's Agent's approval, the Contractor is still responsible for ensuring that the shop details are dimensionally correct.

PSHA 5.2.6 Handrails

Add to the Sub-Clause:

Handrailing shall be of tubular construction in Grade 304 stainless steel of an approved proprietary make.

Hand and knee rails shall be not less than 32 mm O.D. (wall thickness not less than 1.6 mm) and the height of the handrails (centre) shall be 1 000 mm above walk-way level, with knee rails located approximately midway between.

Stanchions shall be not less than 44 mm O.D. (wall thickness not less than 1.6 mm) and shall have ball type or spun and flared connectors to suit horizontal or angled handrailing as required. The base plates shall not be less than 8 mm thick.

In general, all bends in the hand and knee railing shall be 140 mm radius. Handrails shall be either side or top mounted and shall be fastened with stainless steel nuts, bolts and washers.

Spacing between stanchions shall be determined by site conditions but in no case shall it exceed 1 800 mm c/c. At bends, stanchions shall be provided on either side at a distance of 300 mm from mid-bend.

Finished handrailing shall be true to line and level and connections shall be securely fixed by means of 2 No. stainless steel pins, finished flush on each side of the joints (to the approval of the Employer's Agent).

All ends shall have closures joining the hand and knee railing.

The rate quoted per metre is to include for the supply and installation of the handrail, knee rail, portion of a stanchion, footing, holding down bolts and nuts and is to be inclusive of all cutting, mitring, welding, grinding and waste.

PSHA 5.2.8 Prefabricated Open Grid Floors

Delete the Sub-Clause and substitute :

Open grid steel flooring is to be of "Gripweld" or similar approved pressure locked 3CR12 type with open grid measuring 100 x 40 mm, cut and framed to the required panel shapes and sizes shown on the Drawings.

PSHA 5.2.10 Protective Treatment

Add to the Sub-Clause :

Rolled steel sections shall be painted in accordance with the details given in SANS 1200 HC as amended by PSHC. All other mild steel shall be hot-dip galvanised except where shown to the contrary on the Drawings or in the Schedule of Quantities. Hot-dip galvanising shall conform to SANS 763 for heavy duty coatings or equivalent. Screwed and socketed tubing shall be galvanised in compliance with BS 1387. Galvanised malleable cast iron fittings shall comply with SANS 509.

Stainless steel and 3Cr12 shall be pickled and passivated in accordance with an approved standard practice prior to installation.

Add the following new Sub-Clauses:

PSHA 5.2.11 Pipe Clamps and Brackets (New Sub-Clause)

Clamps and brackets around pipes are to be constructed to the details shown on the Drawings and are to be provided with all necessary bolts for fixing to concrete.

PSHA 5.2.12 Headstocks, Spindles and Handwheels (New Sub-Clause)

Headstocks are to be provided where indicated, assembled from 75 mm ID stainless steel 304L piping and standard fittings. Each headstock shall be provided with the necessary operating spindle, of the required length (to suit the location of the headstock above the valve), any necessary support brackets and bearings for the spindle, all holding down bolts for fastening to concrete and a handwheel. The spindle shall be capable of transmitting a torque of at least 150 Nm without damage and shall be corrosion resistant to suit the in-situ working environment.

PSHA 5.3 Erection and Installation

PSHA 5.3.6 Grouting

Add to the Sub-Clause:

The Contractor will be fully responsible for all grouting work under this Contract.

PSHA 6 TOLERANCES

PSHA 6.1 Fabrication and Assembly Tolerances

PSHA 6.1.3 Other Tolerances

Add to the Sub-Clause:

The accuracy of erection shall be the Degree of Accuracy II as tabulated but amended as follows:

In items d)1) and d)2) of the table the Degree of Accuracy given as "± 5" shall be read as "± 3".

PSHA 7 TESTING

PSHA 7.1 Test Certificates

Delete the part sentence "in terms of the project specification" from the wording of the Sub-Clause and add the words "when so requested by the former" at the end of the sentence.

PSHA 8 MEASUREMENT AND PAYMENT

PSHA 8.3 Scheduled Items

Add the following introduction to the subsequent Sub-Clauses:

The tendered rates shall cover the cost of preparing shop details (where applicable), the supply of all materials, fabrication, process control, loading, transporting to Site, off-loading, erection (unless separately included), setting into concrete or brickwork and grouting in. They shall also include for the supply of all nuts, bolts, holding down bolts, washers, rivets, cutting to waste, all temporary bracing, templates and shuttering necessary for installing, transporting and erecting.

Where the scheduled items for steelwork include corrosion protection, then the price stated shall also include for such protection as specified in SANS 1200 HC as amended by PSHC. Similarly, the materials and corrosion protection for nuts, bolts, washers etc shall match the steelwork ordered.

Where the requirements of the above introduction conflict with the requirements of Sub-Clauses 8.3.1 to 8.3.6 the requirements of the introduction shall take precedence.

Add the following new Sub-Clauses:

PSHA 8.3.7 Pipe Clamps and Brackets (New Sub-Clause)

The rate shall cover the cost of supplying and fixing in place of (a) pipe clamps and (b) brackets to the details shown on the drawings including all necessary fasteners for fixing to concrete. Unit: No.

PSHA 8.3.8 Penstocks, Spindles, Handwheels (New Sub-Clause)

The rate shall cover the cost of supplying and fixing in place of (a) penstocks including frames and (b) brackets to the details shown on the drawings including all necessary fasteners for fixing to concrete. Unit: No.

C3.7.10 PSHB : CLADDING AND SHEETING
(Applicable to SANS 1200 HB – 1985)

PSHB 3 MATERIALS

PSHB 3.2 Steel Sheeting

PSHB 3.2.2 Pre-painted Galvanised Steel Sheeting

Add to the Sub-Clause:

"Where indicated on the Drawings roof sheeting and/or side cladding, with the IBR pattern shall be of approved manufacture and be pre-painted to the specified colour, shall be supplied and installed. The requisite flashings, gable end closures, ridge pieces and other compatible accessories shall be supplied by the same sheeting manufacturer.

The roof sheeting and side cladding shall, unless otherwise specified or scheduled, be 0,58 mm thick Z275 galvanised steel with a 'Chromadek' finish on one side. Roof flashings, gable ends, ridge pieces and other accessories shall also be 0,58 mm thick Z275 galvanised steel with a 'Chromadek' finish on one side.

Installation shall be in accordance with the manufacturer's details and the finished product shall be entirely weatherproof."

PSHB 3.4 FC Sheeting

Delete the Sub-Clause and replace with:

"PSHB 3.4 Translucent Sheeting

Where indicated on the Drawings glass fibre reinforced polyester or polycarbonate translucent roof sheeting, as manufactured by "Modek Fibreglass Sheeting" or similar approved, shall be supplied and installed. All such sheeting material shall comply with SANS 1150 and shall be 85 % translucent. Both sides of the sheeting shall have the gel coat applied."

Add the following new Sub-Clause:

"PSHB 3.11 Shade Cloth/Netting

The nylon cloth/netting shall be UV resistant and shall be manufactured by an approved manufacturer and shall allow 40 % light to pass through.

Joints shall be heat-welded continuously along the full length with a maximum overlap of 20 mm, or machine-stitched if approved by the Employer's Agent. Edges shall be prepared as described below.

Machine-stitching shall be by means of a UV-resistant nylon thread of not less than 200 kg breaking strain at a stitch spacing not exceeding 10 mm. All stitching shall be uniform and regular.

Where the outer edge of a single sheet or a set of multiple jointed sheets is to be fixed to a structural element, it shall be fixed along its entire length as follows:

The free edge of each sheet, before fixing to a structural element, shall be free from burs and loose threads, and shall be trimmed to an exact size permitting a wide enough strip for preparation of edge reinforcing.

Edge reinforcing shall be either factory-manufactured or heat-treated on site to fuse all loose threads in a manner which prevents irregularities and fraying when stretched. Where heat-treated on site, the reinforcing strip shall be equivalent to a factory-manufactured edge reinforcing in all respects."

PSHB 5 CONSTRUCTION

PSHB 5.5 Installation of Sheeting

PSHB 5.5.1 General

Add to the Subclause:

"The roof sheeting shall be supplied and installed in the longest lengths available in order to minimise the number of end laps. Narrow flutes shall be outermost, with single flute side laps laid facing away from the prevailing driving rain. All sheets shall be secured to the purlins set generally at 1 500 mm centres utilising the fasteners and fixing methods recommended by the manufacturer. Main fasteners shall be positioned in the crown of the second and fourth narrow flutes, i.e, two fasteners per sheet per purlin. Sidelaps shall be secured with fasteners spaced equally between purlins and at centres not exceeding 750 mm. Not less than 15 mm of the broad flute of all roof sheets shall be turned up through 45 degrees at the apex to form a dam and turned down through 10 degrees at the eaves to form a drip.

The vertical cladding shall be fixed in long lengths, broad flutes outermost, with single flute sidelaps fixed facing away from the prevailing wind. All sheets shall be secured to the grids set generally at 1500 mm centres utilising the fasteners and fixing methods recommended by the manufacturer. Main fasteners shall be positioned in the bottom of the first and third narrow flutes, i.e, two fasteners per sheet per girder. Sidelaps shall be secured with fasteners spaced equally between girders and at centres not exceeding 750 mm. Every care must be taken during construction to ensure that sheeting is kept clean from plaster droppings and any staining of sheeting by any other means.

Any sheeting that is defective or on which then paint coating has been damaged, shall, at the discretion of the Employer's Agent be removed and replaced by the Contractor at his/her own expense. If by doing so any good work is affected, this work will also have to be replaced at the Contractor's expense."

Add the following new Sub-Clauses:

"PSHB 5.8 Shade Cloth/Netting

PSHB 5.8.1 Fixing to Eyelets

Where eyelets are welded to structural steel members or anchored in concrete with PVC-sheathed threads, to the satisfaction of the Employer's Agent, they shall consist of 20 mm closed circular rings manufactured from a 3 mm mild steel round bar and shall be spaced apart at not more than 250 mm.

The reinforced edge of each sheet shall be tied to the eyelets with a UV-resistant nylon thread of not less than 200 kg breaking strain with double knots that shall be sealed by heat treatment to prevent self-loosening due to the effects of the temperature. Heat treatment of knots shall consist of applying a heated object to the knot long enough to ensure fusion between threads without adversely affecting its strength.

PSHB 5.8.2 Fixing Around Thin Structural Members

Where fixing to a structural member with a circular profile and with a cross-sectional circumference of less than 300 mm, the edge of the sheet shall be wrapped around the member and heat treated to effect bonding along a continuous edge with the rest of the sheet. The strength of the bond as regards strength, quality and finish, shall be as specified for joints in Sub-Clause PSHB 3.11.

PSHB 5.8.3 Fixing of Continuous Sheet over the Top of a Supporting Structural Element

Fixing of a continuous sheet over the top of a supporting structural element shall not be permitted, in order to allow for uniform movement due to temperature expansion and contraction of single sheets or sets of jointed sheets without warping. Only edges of sheets may be fixed to structural members.

Notwithstanding the requirements specified in the above paragraph, the Employer's Agent may require that a supporting structural element be fixed to the top where excessive sagging of shade cloth/netting becomes apparent at high ambient temperatures, and then only at certain points and in a manner which shall not adversely affect the aesthetic appearance.

All shade cloth/netting shall thus be primarily spanned from outer edge to outer edge at a maximum tension which shall not exceed the maximum working tension and other working properties of the shade cloth/netting during periods of maximum contraction."

C3.7.11 PSHC : CORROSION PROTECTION OF STRUCTURAL STEEL
(**Applicable to SANS 1200 HC: 1988)**

PSHC 3 INTERPRETATIONS

PSHC 3.1 Supporting Specifications

Add the following to the Sub-Clause:

Corrosion protection of structural steelworks that are in the SANS 1200 Specification Structural Steel works, and the related project specifications, shall be as per SANS 1200 H and this related project specification.

PSHC 5 CONSTRUCTION

PSHC 5.3 Dressing and Repairs During Fabrication

Add to the Sub-Clause :

Edges shall be ground to a smooth radius of at least 1 mm unless otherwise indicated.

PSHC 5.4 Preparation for Coating

PSHC 5.4.1 General

Add to the Sub-Clause:

The work of surface preparation prior to painting shall be carried out at the manufacturer’s works.

The work of surface preparation prior to galvanising shall be carried out at the galvaniser’s works.

PSHC 5.4.3.1 Abrasive Blast Cleaning

Add to (a) General:

The standard of blast cleaning required, in terms of Swedish Standard SIS-05-59-00, is Sa 2 1/2.

The surface profile after blasting shall be in accordance with the paint manufacturer's requirements for the particular paint system being used.

Add to (b) Dry Abrasive Blast Cleaning

The blast cleaning media shall not be recycled.

PSHC 5.4.3.2 Cleaning by Hand or with Power Tools

Add to the Sub-Clause:

Cleaning by hand or power tools, where permitted or ordered by the Employer’s Agent, shall be to Standard St 3 of SIS-05-59-00.

PSHC 5.7 Coating System

Add to the Sub-Clause:

The coating system to be applied under this Contract shall be carried out strictly in accordance with the manufacturer's instructions which written instructions shall be obtained by the Contractor and a copy handed to the Employer's Agent's Representative prior to commencing painting operations.

The paint system to be used shall be selected by the Contractor from the following alternative systems:

PSHC 5.7.1 Painting System No. 1

For structural steelwork coastal regions - exterior work:

AECI Dulux	**DFT (µm)**	**Plascon**	**DFT (µm)**
Zinc galv 6(2)	75	Zinc rich primer M1 233	70
Zinc galv 1	touch up	Chemcote High Build CHC 101 – light grey	70
Chlorinated Rubber – Kemrist	90 165	Chemcote enamel CHC 3000 series	30 170

PSHC 5.7.2 Painting System No.2

For structural steelwork coastal regions - interior work

AECI Dulux	**DFT (µm)**	**Plascon**	**DFT (µm)**
Zinc galv 6(2)	60	Degrease with Aquasolv GR	-
Zinc galv 1	touch up	Zinc phosphate Primer UC 182	55
Chlorinated Rubber Kemrist	60 120	Alkyd undercoat UC 189	35
		Enamel	30 120

PSHC 5.7.3 Painting System No.3

For overcoating galvanised work

AECI Dulux	**DFT (µm)**	**Plascon**	**DFT (µm)**
Prepare surface Galvkleen	-	Prepare surface cleaner GIC	-
Corrocote 2(2)	10	Galvogrip metal primer	30
Chlorinated Rubber – Kemrist	70 80	Universal undercoat UCI	30
		Supergloss Enamel Code G	25 85

PSHC 5.8 Application of Paint Coatings

Add to the Sub-Clause:

No application of paint shall be carried out before the paint manufacturer has approved the firm of applicators and the plant to be used, except where instructed to the contrary by the Employer's Agent.

Where applicable, the range of temperature, outside the range of +5° to 35°C, within which paint may be applied, shall be that range which the Contractor shall obtain in writing from the manufacturer of the paint.

The embedded lengths of irremovable fasteners which penetrate deeper than 75 mm from the concrete face may be left as base metal. The remaining portion shall comply with the paint system specified for the adjacent steelwork.

Surfaces which will become inaccessible for coating after fabrication or erection shall be given the full paint treatment specified plus one further topcoat prior to the surfaces becoming inaccessible.

PSHC 5.9 Application of Metal Coatings

Add to the Sub-Clause:

The grade of hot dipped galvanising (HDG) required shall be carried out in accordance with SANS 121:2000, and shall be that for heavy duty coatings. This shall be applicable to all metalwork where HDG is called for either on the drawings or in the Schedule of Quantities.

PSHC 7 TESTING

PSHC 7.1 Testing by the Contractor

Replace Sub-Clause PSHC 7.1 (d) as follows:

Tests are not required to be carried out after the application of each intermediate coat.

PSHC 7.3.8 Dry Film Thickness

Add to the Sub-Clause:

The frequency of DFT test readings required is to be in accordance with SANS Method 141.

C3.7.12 PSL : MEDIUM-PRESSURE PIPELINES
(Applicable to SANS 1200 L – 1983)

PSL 2 INTERPRETATIONS

PSL 2.1.2 Supporting Documents

Add the following after item(s) that have reference:

- SANS HA Structural Steelwork (Sundry Items);
- SANS HC Corrosion Protection of Structures;
- C3.8.1 PVH: Wedge Gate, Resilient Seal, Butterfly and Air Valves
- C3.8.2 PVJ: HDPE Pipes and Fittings
- C3.8.3 PVN: Disinfection of Pipes.

PSL 2.3 Definitions

Add to the Sub-Clause:

Flexible pipe:
All Steel, uPVC and HDPE pipes to be installed under his Contract shall be defined as being flexible pipes for bedding purposes.

PSL 2.4 Abbreviations

Add to the Sub-Clause:

CML : Cement Mortar Lined (Steel pipe):
FBMDPE. Fusion Bonded Medium Density Polyethylene.

The pipes are of API 5L Grade X42 Steel with wall thickness of 4.5 mm and lined internally with 12 mm cement mortar and externally with three layers of fusion bonded solvent borne (or free) epoxy.

The pipes are of API 5L Grade X42 Steel with wall thickness of 4.5 mm and lined internally with 12 mm cement mortar and externally with three layers of fusion bonded solvent borne (or free) epoxy.

PSL 3 MATERIALS

PSL 3.1 General

Add to the Sub-Clause:

The types of pipe materials to be supplied and installed by the Contractor under this Contract are Steel, uPVC and HDPE; and
Appurtenant couplings, fittings, bends, valves and specials..

Add the following new Sub-Clauses:

PSL 3.1.1 Quality Control (New Sub-Clause)

The Contractor shall ensure that all materials used in the execution of the Contract comply with the technical requirements specified.

The Contractor shall maintain accurate and up to date records of all materials, processes, process parameters and measurements necessary to ensure compliance with this specification.

PSL 3.1.2 Quality Surveillance (New Sub-Clause)

The Employer may appoint an independent body to carry out Quality Surveillance on its behalf, particularly for any pipework that is purchased by the Contractor. The Contractor shall provide all facilities and access to premises at all reasonable times as may be necessary for the independent inspectorate to carry out its function. The cost of Quality Surveillance will be reimbursed to the Contractor, except for surveillance of pipes, fittings and specials purchased by the Contractor resulting in rejection or a fruitless call when the cost incurred will be deducted from the amount to be reimbursed to the Contractor.

Advance notice of a minimum of 24 hours shall be given by the Contractor to the appointed inspectorate body when requesting inspection(s) of any portion of the goods for acceptance, and a minimum of 3 working days before commencement of the Contract.

The Contractor's quality control records shall be available for inspection at all reasonable times. Copies of these records shall be made available on request.

Notwithstanding any surveillance carried out by the Employer the Contractor shall retain fully responsibility for the quality of the goods taken delivery of and supplied under the Contract.

All pipes, fittings and specials shall be inspected on delivery to site and all defects shall be made good by the Contractor at his/her expense.

No payment shall be made until satisfactory test certificates have been provided. Such certificates shall be delivered by the Contractor to the Employer’s Agent under separate cover and not despatched with the deliveries of pipes, fittings and specials.

PSL 3.2 AC Pipes and Specials

Delete the Sub-Clause in its entirety.

PSL 3.3 Cast Iron Pipes, Fittings and Specials

Delete the first sentence and replace with the following:

All cast iron pipes, pipe fittings and pipe specials are to conform to SANS 546, BS 78, Part 2 and/or BS 2035 (Class “D” pipes or Class “CD” fittings) so far as they may apply and are not amended in the Schedule of Quantities. All cast iron pipes, fittings and specials shall be hydraulically works tested to a pressure of 2700 kPa.

Add the following new Sub-Clauses:

PSL 3.3.1 Puddle Collars (New Sub-Clause)

Puddle collars used as pipe anchorages shall be of the same dimensions as corresponding flanges but are to be undrilled. The collar shall be capable of transmitting a longitudinal force 33% greater than the internal hydraulic pressure to be applied when testing multiplied by the area of the bore; and under that condition the stress in the metal shall not exceed its yield stress.

PSL 3.4 Steel Pipes, Fittings and Specials

PSL 3.4.1 General

Add to the Sub-Clause:

All steel pipes, fittings and specials shall be to the dimensions and details shown on the drawings or Bill of Quantities. All pipes, fittings and specials shall have their relevant item numbers painted onto the exterior surface prior to dispatch from the factory.

Surface preparation for all steel pipes, fittings and specials shall be Grit Blast to SA 2½ in accordance with SIS 055900.

All steel pipework fittings and specials used is to be coated and lined at a minimum with Plascon KSIR88 or similar approved, with minimum thickness of 250 microns internally and 350microns externally, prepared and applied strictly in accordance with the manufacturer’s instructions.

Alternative proposals (other than those scheduled) for jointing, lining and coating may be offered but the Tenderer shall submit detailed specifications with his/her tender. A sample of the alternative type of jointing or corrosion protection system proposed by the Tenderer shall be submitted to the Employer’s Agent's office within one week of the closing date of the tender.

The sides of taper pieces shall diverge at an angle of not more than 11° to each other. The Tenderer shall be responsible for the provision of strengthening webs, crotch plates, gussets etc as may be necessary to prevent excessive deflection or deformation of fittings and specials when subjected to hydraulic tests, and his/her rate for the work will be deemed to include the design and provision of this reinforcing wherever necessary.

The pipe manufacturer shall obtain and make available to the Employer’s Agent a certificate (or certificates) from the steel manufacturer covering all steel used, showing by which process the steel was made and giving the chemical analysis of the steel and its physical properties. A record shall be kept of pipe serial numbers (see PSL 4.6) and the cast numbers of the steel used.

The pipe manufacturer shall supply written confirmation that all hand welding was carried out by coded welders.

PSL 3.4.2 Pipes of Nominal Bore up to 150 mm

Delete the Sub-Clause and substitute:

Steel pipes and fittings of nominal bore up to 150 mm shall be galvanised of Medium or Heavy Class, plain-ended or flanged and complying with SANS 62, or Groove-ended pipes, fittings and couplings complying with SANS 815 Part 2, as specified on the drawings and in the Bill of Quantities. All piping and fittings supplied shall be hot dip galvanised to ISO 1461 and SANS 121.

PSL 3.4.3 Pipes of Nominal Bore over 150 mm

Insert in the second line between “applicable requirements of” and “SABS 719” the words;

“SANS 815 Part 2 for Groove-ended pipes, fittings and couplings or”

PSL 3.4.4 Fittings and Specials

Add to the Sub-Clause

All steel bends, fittings and specials shall be fabricated to the dimensions and details shown on the drawings and/or described in the Bill of Quantities.

The sides of taper pieces shall diverge at an angle of not more than 11° to each other.

The bend, fitting, and special fabricator shall supply written confirmation that all hand welding was carried out by coded welders.

Individual bends, fittings and specials up to and including 250 NB shall be hot-dip galvanised to heavy duty grade in accordance with ISO 1461 and SANS 121:2000 after fabrication. Where a hot-dipped galvanised fitting is to be welded to a coated and lined pipe, the galvanising is to be abraded off prior to welding. The external coating at the welded joint is to be primed and coated with an approved anti-corrosion system.

Bends, fittings and specials shall be manufactured and tested in accordance with the specification for straight pipe and additionally with Section 8 of BS EN 10311: 2005 and BS 10224: 2002. The nominal dimensions of each bend, fitting and special required are itemised in the Bill of Quantities and/or on the drawings and ‘exact length’ tolerances shall be adhered to. All plain ends on bends, fittings and specials shall have the plain ends prepared for butt welding except those plain ends that are to be jointed with adaptor joints.

Bends shall generally be of the segmented type except where otherwise stated or shown on the drawings.

The Contractor will be responsible for the provision of strengthening webs, crotch plates, gussets, etc as may be necessary to prevent excessive deflection or deformation of fittings and specials when subjected to hydraulic pressure tests, and the tendered rates for the work will be deemed to include for the design and provision of this reinforcing wherever necessary. All crotch plates, wrappers, collars and gussets to be provided by the Contractor under this Contract are to be manufactured from API 5L Grade X42 steel.

Bends shall be fabricated in accordance with the Table below.

Deflection of Angle	
Up to and including 3°	One pipe end scarfed on site
Exceeding 3° and up to and including 9°	Mitre cut (two pipe ends scarfed on site)
Exceeding 9º but less than 15º	2 segment bend
15º and larger but less than 45º	3 segment bend
45º and larger but less than 60º	4 segment bend
60º and larger but less than 75º	5 segment bend
75º and larger but less than 90º	6 segment bend

Bends greater than 90º shall be fabricated from combinations of items from the table above.

Shop drawings of bends, fittings and specials shall be submitted to the Engineer for approval prior to manufacture.

All flanged bends, fittings and specials shall be hydraulically tested at the fabricator's premises to the same pressure that they will be subjected to during the hydraulic testing of the completed pipeline. No visible signs of leakage will be permitted."

Add the following new Sub-Clauses:

PSL 3.4.5 Pipe Sizes and Lengths (New Sub-Clause)

The outside diameter, wall thickness and the end preparation of steel pipes to be supplied under this Contract shall be as per the relevant tables in SANS specification. All pipes shall be supplied to exact length, subject to tolerances allowed in the respective specification.

PSL 3.4.6 Welds (New Sub-Clause)

Welding of pipes shall be carried out in accordance with SANS 9956-3 or other applicable SANS or ISO specification.

Pipes shall be manufactured from steel strips or plates continuously welded along the seams and the height of the inner weld reinforcement shall not exceed 1 mm. In the case of pipes to be used with couplings, the external weld reinforcement shall be ground flush with the outer wall of the pipe over a suitable distance from the end of the pipe.

- *SANS 719: Clause 5.2 - Fabrication*

  Electric resistance welding (ERW) may be used for pipes ranging from DN200 to DN500 with wall thicknesses between 3,5 mm and 10 mm.

  Submerged arc welding (SAW) shall be used for manufacturing spirally welded pipes ranging from DN200 to DN2 000 with wall thicknesses ranging from 4,5 mm to 18 mm.

  The fabrication of larger diameters and/or the use of thicker plates using these welding methods shall be agreed with the Employer's Agent.

  All X-Grade steel shall be welded in accordance with the requirements of API 1104: 'Welding of Pipelines and Related Facilities'.

- *SANS 719: Clause 6.1 - Inspection*

  Add at the end of Sub-Clause 6.1.2 'Welds':

  The Contractor shall also include in his/her prices for the manufacture of pipes, the cost of carrying out at the factory, destructive and non-destructive tests of shop production welds on the following basis:

  Bend and Tensile Tests

  One pipe from each one hundred pipes of each pipe diameter and wall thickness combination, that are manufactured shall be selected at random and specimens for two guided cold bend tests and one transverse tensile test shall be cut therefrom and tested in accordance with SANS 719, Clause 6.2.1.

  In the case of the guided cold bend tests, where welding is carried out from one side only, bend specimens shall be tested with the rest of the bend in tension; where welded from both sides the specimens shall be tested with the inner and outer welds in tension alternately.

  Tensile tests shall be carried out as for the qualification tests.

  The pipes from which successfully tested specimens have been taken shall be trimmed to the maximum possible length and shall be accepted by the Employer for payment purposes as full standard pipe lengths.

  In the event of the welds of any pipe failing to reach the standard of acceptance, such pipe shall be rejected. Two further plate coupons shall be prepared from different pipes, selected at random by the Employer's Agent, for each specimen that has failed to reach the required standard. In the event of such additional tests proving to be satisfactory repairs to the pipe originally failing any test will be permitted by the Employer's Agent and such repairs and subsequent re-test shall be at the Contractor's expense. In the event of the additional tests also failing to reach the required standard, the Employer's Agent shall have the right to reject the entire batch of pipes from which the coupon plates were cut.

  - Fluoroscopic Tests

    100 % of the SAW welds on all pipes shall be tested by fluoroscopic means. Where defects are detected they shall be evaluated in accordance with API 5L and, if necessary, repaired in accordance with the requirements of API 1104. All defects that require repairs shall be recorded and the detail given to the Employer's Agent.

  - Ultrasonic Inspection

    100 % of the ERW welds on all pipes shall be tested by ultrasonic means. Where defects are detected in a pipe by means of ultrasonic testing, the defective section of pipe shall be 100% re-tested by means of X-ray and adjudicated in accordance with API 5L and, if necessary, repaired in accordance with the requirements of API 1104. All defects that require repairs shall be recorded and the detail given to the Employer's Agent.

  - Radiographic Inspection and Adjudication and Repairs in Accordance with API 5L

    5% (random) radiographic examination of all welds deposited by an approved automatic process shall be carried out.

    10% (random) radiographic examination of all welds deposited manually or semi-automatically, and repairs to welds done by an automatic process shall be carried out. Should repairs be required in more than 25% of the tests carried out, the percentage of examination shall be increased to 20 %.

- *SANS 719: Clause 6.3 – Hydraulic Test*

  Delete the Sub-Clause and replace with:

  Every pipe is to be subjected to a hydrostatic pressure test of 'P'.

  Where P = The lesser of (2 x 0,90 x Y x t/D) or 7 MPa
  and P = Factory Hydraulic Test Pressure (MPa)
  Y = Minimum Specified Yield Stress (MPa)
  t = Nominal Wall Thickness of pipe (mm)
  D = Diameter of Pipe Wall (mm) i.e. (Pipe OD + Pipe ID)/2

  Pipe end closures shall be restrained during the test to ensure that no longitudinal stresses are induced in the pipe wall.

  The test pressure in the pipe shall be maintained for at least 10 seconds and thereafter shall be inspected for leaks, weeps or deformation.

  The pipe will be deemed defective and may be rejected if any leaks, weeps or deformation are evident.

- *SANS 719: Clause 7 – Marking*

  The pipe manufacturer(s) shall obtain and make available to the Employer's Agent, a certificate (or certificates) from the steel manufacturer covering all steel plate used, showing by which process the steel was made and giving the chemical analysis of the steel and its physical properties. A record shall be kept of pipe serial numbers (see below) and the cast numbers of the steel used and all copies of all of the data shall be given to the Engineer. The pipe manufacturer shall also supply written confirmation that all hand welding was carried out by coded welders.

  For the purpose of checking and record keeping, consecutive individual numbers shall be stamped with a steel stamp into the ends of all straight lengths of steel pipe as they come off the welding line so that each pipe will bear its own individual number in duplicate imprinted in the steel approximately 50 mm from each end and adjacent to the spiral weld (but clear of the seating area if a rubber coupling is to be used). Each off-cut taken from a pipe after hydraulic testing in the factory and used for the manufacture of a fitting shall bear the number of the original pipe similarly imprinted into the steel at both ends. Care shall be taken not to cover the number with coating.

  After coating, each pipe's individual number together with the Contract Number and the Item Number given in the Bill of Quantities and Dispatch Number allocated consecutively by the Manufacturer shall be painted at each end of the pipe in durable weatherproof numerals 150 mm high, on a durable weatherproof white painted background using stencils to provide the equivalent of a 25 mm wide brush. For easy identification of the pipe in the field these large numbers shall not be more than 1,0 m nor less than 300 mm from the ends of the pipe and shall be on opposite ends of the pipe, viz the number at one end set off 180° radially from the number at the other end. To avoid confusion between the 6's and the 9's, each painted number shall be underlined in red.

  Closure pipes (trued for diameter throughout their length) shall carry two longitudinal stripes (of a colour which contrasts with that of the primer), 50 mm wide, diametrically opposite to each other and extending the full length of the pipe in addition to the marking required above.

PSL 3.4.7 Hydraulic Testing at Factory (New Sub-Clause)

Each pipe shall be hydraulically tested in accordance with SANS 719 Clause 7.3 or such specified test in accordance with the relevant SANS specification.

PSL 3.4.8 Fittings and Specials (Pipes over 150 NB) (New Sub-Clause)

PSL 3.4.8.1 General

All fittings and specials shall be manufactured from straight pipe specified elsewhere in this Specification; the pipe so used shall have satisfactorily passed the stipulated hydraulic pressure tests.

Grooved mechanical couplings shall be manufactured according to SANS 815 Part 2. Other fittings and specials shall be manufactured and tested in accordance with the specification for straight pipe and additionally with Section 8 of BS 534. The nominal dimensions of each fitting and special required are itemised in the Schedule of Quantities and 'exact length' tolerances shall be adhered to.

Bends shall generally be of the gusseted type having dimensions as given by Table 8 of BS 534 except where specified to the contrary in the Bill of Quantities or where the Tenderer can offer a price advantage for supplying even curvature bends.

The manufacturer shall be responsible for designing and providing strengthening webs, crotch plates, gussets, etc. as may be necessary to prevent excessive deflection or deformation of fittings and specials when subjected to hydraulic tests.

PSL 3.4.8.2 Closure Pipes

Closure pipes, which are to be cut on site to the exact lengths, required, shall have the diametrical tolerances specified for the pipe ends applied over the full length of the pipe. Closure pipes shall be supplied in standard lengths.

PSL 3.4.8.3 Puddle Collars (New Sub-Clause)

Puddle collars used as pipe anchorages shall be of the same dimensions as corresponding flanges but are to be undrilled. The collar shall be capable of transmitting a longitudinal force 33 % greater than the internal hydraulic pressure to be applied when testing multiplied by the area of the bore; and under that condition the stress in the metal shall not exceed its yield stress.

PSL 3.7 Other Types of Pipes

PSL 3.7.1 uPVC Pipes

Delete the Sub-Clause and substitute the following:

uPVC pipes shall comply with SANS 966-1 and be of the types, classes and fitted with joint systems as scheduled.

PSL 3.8 Jointing Materials

PSL 3.8.2.1 Flexible Couplings

Delete the Sub-Clause and substitute the following :

Grooved mechanical couplings shall be manufactured according to SANS 815 Part 2. Other flexible couplings shall conform generally to Clause 15 of BS 534 for slip-on type couplings and shall be of approved manufacture. They shall be provided without a central register, except where scheduled to the contrary in the Bill of Quantities. They shall be capable of being tightened and released without damaging or improperly distorting the rubber seating rings and shall be designed to prevent the rubber rings being blown out under pressure or sucked in under vacuum.

The steel used shall conform to the appropriate British Standard Specification and each coupling is to be capable of withstanding the test pressure applicable to the pipes with which they are to be used without exceeding a stress in the steel of 67 % of the yield point.

Couplings shall be protected by an approved epoxy coating system within 4 hours of abrasive blast cleaning the metal surfaces of the coupling in accordance with Swedish Standard SIS 05 5900 Grade SA 2,5. Nuts, bolts and washers shall be electro-galvanised. The plain end of the steel pipe shall be properly prepared before corrosion protection so as to accept the flexible coupling. Special anchoring flexible adaptor joints ("Viking Johnson" or similar) for connecting plain ended steel pipes to flanged joints are to be supplied complete with electrogalvanised bolts and nuts for connecting flanged joint to anchoring flange situated approximately 300 mm from plain end of pipe.

PSL 3.8.3 Flanges and Accessories

PSL 3.8.3.1 Bolted Connections (New Sub-Clause)

All flanges, gaskets, bolts, nuts washers and other appurtenances required for the execution of the work under this Contract shall be supplied and installed by the Contractor under this Contract.

The dimensions and drilling of flanges shall be in accordance with the requirements of SANS 1123: Table 1600, 2500 or 4000 as scheduled except that, where low pressure interconnecting pipework for working pressures up to 1 000 kPa is being supplied, the dimensions and drilling may be "SANS 1123, table 1000/3. All flanges shall be truly at right angles to the axis of the pipe or fitting and shall be drilled with bolt holes off centre.

Puddle flanges shall be of the same diameter and thickness as the end flanges and shall be undrilled.

Flanges cut from steel plate shall be machined flat on the front face, i.e, without a raised joint. No machining need be carried out on the back face (except where insulating flanges are to be installed) provided that face is sufficiently flat to ensure square bedding of the bolt heads and nuts and provided that all weld reinforcement is removed.

Cast or forged flanges shall be machined flat on the front faces and either spot faced at the bolt holes, or fully machined, on the back faces. Spot facing shall be at least 3 mm greater in diameter than the washers to be used, shall be truly parallel to the front face and the distance between the two faces shall be not less than the specified flange thickness.

- Temporary end covers shall be provided by the Contractor for protection of flanges, and prepared plain ends of pipes and fittings to prevent damage to internal lining during transportation and during handling on site.
- All piping and flanged surfaces shall be cleaned before connections are made.

- The (raised) faces of flanges that are in to be in contact with gaskets shall be masked and shall not be painted or coated. The mating flange shall then receive one coat of rust inhibitor (Plascon Rustix 84 or equal approved). Care shall be exercised to ensure that after the application of all coatings there are no runs or drips on the mating surfaces of the flanges and that the flange profiling is clearly visible over the entire face. Excessive coating build up in flange bolt holes that could snag bolts will not be permitted.
- Flanged joints shall be connected with the specified bolts, nuts and washers, all of which are to be supplied by the Contractor.
- All bolts, tie-bolts, nuts and washers shall be galvanised to ISO 1461 and SANS 121:2000 and shall comply with the relevant requirements of SABS 135 – 1985 and SANS 136 – 1985 where applicable.
- The length of each bolt shall be such that after the bolt has been tightened, the end of the bolt shall project beyond the outer face of the nut, but not by more than two threads. Tie-bolts on restrained/anchoring couplings shall be fitted with “backing nuts” and washers.
- Each flanged joint is to be fitted with an approved and suitably rated gasket and sealed watertight such that there will be no visible sign of leakage under the specified factory and field test pressures and under the in-service working conditions (pressures).
- All bolts are to be tightened in a predetermined pattern with opposing bolts being tightened sequentially. When all bolts are tight, each bolt is to be torqued to the required/recommended torque in a predetermined pattern with opposing bolts being tightened sequentially.
- All bolt threads shall be liberally coated with “Copper slip” or similar approved compound prior to assembly. Upon completion, bolt heads, washers and nuts shall be wrapped with the “Denso Mastic Blanket System” comprising of a priming solution, mastic blanket, petrolatum tape and lay-flat sheeting as described elsewhere.

PSL 3.8.4 Loose Flanges for Welding

Add to the Sub-Clause :

Flange jointing material, when installed in the complete pipeline, shall be capable of withstanding transient pressures of up to the specified field test pressure. Under this condition no damage shall be caused, or leakage occur through the joint. Bolts and nuts shall comply with SANS 1700. All bolts, nuts and washers shall be electro-galvanised.

PSL 3.9 Corrosion Protection

PSL 3.9.2 Steel Pipes

PSL 3.9.2.2 Steel Pipes of Nominal Bore over 150 mm

a) Delete Sub-Clause 3.9.2.2 (a) and substitute:

in the case of bitumen coatings, all steel pipes, fittings and specials shall be coated in accordance with the requirement of SANS 1178:2002 Edition 1.02 – Type CB6A.

PSL 3.9.2.3 Repairs to Epoxy Coatings

Add to the Sub-Clause:

Notwithstanding the requirements of Sub-clause 3.9.2.3 of SANS 1200 L, repairs to epoxy linings shall be carried out in accordance with the requirements of PSL 3.9.3 below.

PSL 3.9.2.4 Holiday Testing (New Sub-Clause)

All Holiday Testing shall be carried out with an instrument approved by the Employer's Agent. The sparking detection test shall conform to the standards as set out in SANS 1217:2001. The Contractor shall familiarise himself/herself with the dielectric strength (breakdown strength) of all the coatings and linings he/she works with for the different pipe sizes. The Contractor shall also have an in-depth knowledge of the Holiday Testing equipment he/she works with, in order to calculate the Corona discharge effect for the typical brush being utilised, with reference to the specific ambient conditions for any specific test.

All Holiday Testing shall be executed at a voltage which is set at 50 % of the value of the dielectric strength of the lining or coating being tested. The Contractor shall carefully analyse the loss in test voltage as a result of the Corona Effect, specific to the ambient conditions surrounding the test. The test voltage of the Holiday Testing equipment shall be adjusted such that the voltage drop as a result of the Corona Effect will be taken into account when the actual 50% threshold of the dielectric strength is calculated.

The Holiday Test equipment shall be calibrated by an approved supplier and checked every 30 minutes or every time a test at a different location is started. Each piece of equipment shall have a unique identification number with calibration certificates and detail of equipment utilized shall be submitted to the Employer's Agent for approval. Method Statements for the process of Holiday Testing shall be submitted to the Employer's Agent for approval.

The correct equipment for the type of application will be utilized. For example, where pin holes have been repaired and re-testing for effectiveness of repair work being done, the Contractor shall utilize the correct equipment to effect same and this shall include the use of a pencil brush which concentrates the efforts of Holiday Testing at the repair. Where spark tests are performed on Tape Wrap systems, the minimum brush width shall be 300 mm. The brushes utilized shall be brass bristle cone brushes. The typical brush speed shall be 200 to 300 mm/sec when doing spark tests.

The Contractor shall, at his/her expense, test each and every surface area, that is internal lining, as well as external coating, during construction as per this specification. Holiday Testing shall be done after inclusion of materials, manufactured specials and equipment, as well as pipes, into the permanent Works. Any defects found on manufactured pipes, fittings and specials installed by the Contractor shall be repaired and the costs for remedial work shall be deemed to be included in the tendered rates for the construction of the pipeline.

Holiday Testing shall also be done, where requested by the Employer's Agent, on existing pipes, fittings and specials in existing manifolds/chambers. Any defects found on these existing pipes, fittings and specials shall be repaired as deemed by the Employer's Agent and the costs for such remedial work is included in the Bill of Quantities.

These tests and results shall be recorded on the quality control plan as approved by the Employer's Agent.

PSL 3.9.3 Protection Against Electrolytic Corrosion

PSL 3.9.3.1 Preparation of Steel Surfaces for Repairs and/or Reinstatement of Internal Lining and/or External Coating (New Sub-Clause)

The following method is applicable to the preparation of exposed steel surfaces prior to the carrying out of any repair procedure to internal linings and/or to external coatings. This specification is applicable to all steel surfaces that have been stripped of its corrosion protection layer, internally or externally, as a result of the manufacturing of specials, construction activities or pipe laying, welding and/or damages caused by handling or latent defects in application.

- Degreasing

  All bare metal surfaces shall be degreased in order to remove grease and oil from the pipe surface as a first step in the preparation process i.e, before grit blasting and/or power brushing starts. Degreasing shall be carried out using an approved water-based solvent degreaser such as that complying with SANS 1216 or, for use in enclosed systems, with SANS 1365. The surface shall then be cleaned with potable water and left to dry completely before the next step is taken.

- Grit Blasting – Internal Lining Repair

  Grit blasting of bare metal surfaces shall take place after degreasing of the area. The finished grit blasted surface shall be to Sa 2,5 of ISO 8501-1 with a 75-micron angular profile.

  Transition areas from epoxy internal lining to bare metal which has been grit blasted, shall be smooth without rough edges or flaking appearances.

  All grit blasting within the pipeline that is under construction, shall be performed by way of a “vacuum blast“ process in order to limit the generation of dust. Grit blasting shall, under all circumstances, be carried out using equipment suitable for the size of the work to be undertaken.

  Damp hessian sacking or other suitable material is to be temporarily fixed around the pipe on both sides of the work areas to prevent damage to the adjoining pipe coating/lining.

  All residual dust and debris shall be removed.

  The Contractor shall provide the Employer’s Agent with a Method Statement for approval for each type/location of grit blasting before work commences.

- Power Brush – External Coating Repair

  Power brushing of bare metal surface shall take place after degreasing of the area as specified. The area that has been power brushed shall be free from rust, laitance, dust, oil or other deleterious matter before the application of primer. Any areas in the region where power brushing took place shall be free from signs of disbonding of lining and/or coating once power brushed. The surface finish, once power brushing has been completed, shall conform to minimum St 2 standard.

PSL 3.9.3.2 Insulation of Fittings in Contact with Soil (New Sub-Clause)

All fittings shall be electrically insulated from contact with the bedding or backfill materials in accordance with the specifications set out elsewhere.

PSL 3.9.3.3 Coating of Permanently Exposed Pipes/Fittings (New Sub-Clause)

All pipes which are to be permanently exposed shall, in addition to the specified corrosion protection at flange/adaptor/anchoring joints, be protected with the "Denso Acrylic Pipeline Tape (Steelcoat 500)" system or similar approved UV resistant coating. The pipe surface shall be prepared, and the coating applied in strict accordance with the manufacturer's instructions.

Surface Preparation:

The pipe surface to be wrapped shall be cleaned of dirt, grime, grease and other deleterious matter, using white spirit if necessary and then allowed to dry thoroughly.

Priming:

"Denso Primer D" shall be applied to the prepared surfaces at a nominal coverage rate of 8 m² per litre. Care shall be taken to obtain an even film with no runs or sags. Only those areas that are to be wrapped the same day shall be primed. If primed areas are to be left overnight, these areas shall be re-primed before wrapping.

Tape Wrapping:

The joint shall be spirally wrapped (minimum 55% overlap) with "Denso Acrylic Tape" (or approved equivalent) in accordance with the manufacturer's requirements such that the start and end points are located at buried sections of the pipe, before it daylights. A 100% overlap is required on the first and last revolutions of the tape wrapping operation. It is important that tension in the tape be released when the wrapping of the last half circumference of the pipe.

Final Coating:

One coat of "Densoflex Fire Retardant" shall be applied to the exposed pipe at a nominal application rate of 3 m² per litre.

PSL 3.9.3.4 Preparation, Mixing and Application of Epoxy Compounds (New Sub-Clause)

When mixing two part epoxies the base and activator shall be mixed in accordance with the manufacturer's instructions. Mixing in the original container will only be permitted by means of methods that ensure full integration of different parts of the compound into a homogeneous compound with the characteristics as intended by the manufacturer. The different parts of the compound shall not be diluted. Mixing shall only be allowed with full batches and reduction of volumes from mixing packs by means of weight or volume measurement, which will result in smaller portions to be mixed, will not be allowed. In the application of the epoxy the following shall be strictly in compliance with the manufacturer's instructions:

- Method of application (Type of brush or roller.)
- Over coating time.
- Temperature range for application.
- Method of mixing base and activator.
- Number of coats to achieve the specified thickness.
- Safety aspects e.g, Eye and hand protection, ventilation, fire precautions, etc.
- Note that roller and brush applicators shall be replaced once the product application expiry time
- Note that roller and brush applicators shall be replaced once the product application expiry time has been reached on any specific applicator tool.

Uncured epoxy must be regarded as being toxic and shall be handled in accordance with the manufacturer's instructions. Adequate lighting and ventilation shall be provided whilst working within the pipeline.

Only solvent free epoxy repair kits shall be utilized to repair the internal linings of the pipeline. This specification refers to 'two-part epoxy' as an epoxy repair kit which consists of a base and an activator approved by the Employer's Agent and could be products similar to 'Denso ST100', 'Sigma SF 523', 'Nordbak', etc.

Attention is drawn to the fact that 'Nordbak 1' or similar approved, shall be used on this Contract. For the repair of cement mortar linings, 'Epidermix 338' or similar approved shall be used.

The Contractor's tendered rates for the laying of the pipe shall be deemed to include for all the repairs and make-goods that have to be effected in order to deliver a serviceable and acceptable pipeline. (This excludes such repairs as instructed by the Employer's Agent as a result of manufacturing defects, if any. Items have been included in the Bill of Quantities for such repairs).

Two-part epoxy may only be applied on steel surfaces prepared as specified in PSL 3.9.3.1.

PSL 3.9.3.5 Repair and Making Good of Solvent Free Epoxy Linings (New Sub-Clause)

All making good of internal solvent free epoxy linings at damaged areas and at welded and flanged joints that is required to ensure continuous internal corrosion protection to steel surfaces shall be carried out strictly in accordance with the solvent free epoxy manufacturer's specifications. The surfaces shall be prepared as specified in PSL 3.9.3.1.

The epoxy material shall be sufficiently thixotropic that 500 micrometres dry film thickness can be achieved in one application without sagging. The material shall be applied to the clean, dry, abraded area so as to fully cover it and extend to not less than 50 mm of the edge of the abraded area. A 'halo' of abraded area shall be visible around the repair material.

After curing, the repaired section and at least 250 mm of the surrounding area, shall be tested for electrical insulation defects as specified elsewhere. There shall be no electrical insulation defects.

The Contractor shall ensure that repairs and particularly the making good of linings at welded joints, is carried out progressively as the pipe is being laid and shall not be permitted to lag behind the pipe installation work.

PSL 3.9.3.6 External Corrosion Protection of Factory Welded Joints and Coating Repairs (New Sub-Clause)

All factory coated steel pipes shall be supplied with the external coating cut back 100 mm from each pipe end. Where pipes are cut, either on site, or for the purpose of fabricating bends, fittings and specials, or in the event of the pipe coating being damaged, the pipe coating shall be cut back 100 mm from the intended cut area before the pipe is cut. Damp hessian sacking or other suitable material shall be temporarily fixed around the pipe to prevent damage to the pipe coating during welding operations. Once welding is complete, and all weld splatter and burnt coating has been removed, the welded pipe joints shall be wrapped in the following manner.

The following specification is based on 'Denso' products and systems. Alternative products and procedures may be proposed by the Contractor and, if approved by the Employer's Agent, they may be used. Irrespective of which products are approved by the Employer's Agent and used by the Contractor, all procedures shall be carried out strictly in accordance with the Contractor's Method Statements which must conform to the manufacturer's recommendations.

A fundamental outcome is a sound and continuous coating that is free from wrinkles and that does not have any entrapped air pockets or any air bubbles.

- Surface Preparation

  The bare metal shall be cleaned, and wire brushed to minimum St 2 standard and degreased with white spirit. The adjacent pipe coating shall be cleaned to a minimum of 300 mm either side of the joint and the edges 'feathered' to achieve a tapered transition over a distance of 100 mm. The sound, parent coating surface shall be roughened with sandpaper over an area 250 mm either side of the joint.

- Priming

  The entire pipe and coating surface over a length of 250 mm on either side of the joint shall be primed using 'Denso Primer D' (or equivalent approved). Care shall be taken to obtain a thin even film with no runs or sags. The primer shall be allowed to cure until 'tack dry' before the application of the tape commences. Priming may only be carried out on those areas that are wrapped that same day. If primed areas are left overnight, those areas shall be re-primed before wrapping.

- Profiling Tape

  A 1,5 mm thick x 50 mm wide 'Denso Mastic Sealing Tape' (or equivalent approved) shall be applied to the full circumference of the weld bead in accordance with the manufacturer's specifications. Care shall be taken to ensure a smooth profile and to avoid air bubbles being trapped beneath the tape. (Note: The profiling tape may be omitted at the discretion of the Employer's Agent. Tenderers shall nonetheless allow for the profiling tape in their tendered rates).

- Tape Wrapping

  The joint shall then be wrapped (minimum 55% overlap) with 'Denso CPT 1250/300 Polyethylene/Bitumen' tape starting at the roughened section (250 mm from the welded joint) in accordance with the manufacturer's requirements to create a 500 mm wide wrapping, centred over the welded joint. A 100% overlap is required on the first and last revolutions of the tape wrapping operation. It is important that tension in the tape be released when the wrapping of the last half circumference of the pipe. The Contractor shall ensure that the wrapping overlaps or covers a minimum of 150 mm of the pipe coating. A secondary or outer tape wrap layer is then applied over the first layer with a 10% tape overlap.

  An alternative tape wrapping system that may be used is the 'Densotherm 35 Hot Applied Bitumen Tape' system. The procedures are similar to those for the 'Denso' system described above except that the underside of the tape shall be heated as it is applied, and the overlaps and seams of the tape are sealed by means of a heated tool.

PSL 3.9.3.7 External Corrosion Protection of Shop-Fabricated Pipe Bends and Fittings (New Sub-Clause)

The external coating of shop fabricated bends and fittings shall be carried out as follows:

- Where a substantial part of the external coating on the parent pipe is intact, the coating repairs/make good shall be carried out in accordance with PSL 3.9.3.6, or
- Where black (uncoated pipe has been used), the coating shall be carried out with an approved solvent-free epoxy (SFE) system such as 'Nordbak 1' or similar approved system, or
- Where only a relatively small proportion of the external coating on the parent pipe remains, all of the remaining coating shall be removed, and the entire bend/fitting shall be coated with an approved solvent-free epoxy (SFE) system such as 'Nordbak 1' or similar approved system.

All crotch plates and wrappers/collars shall be coated an approved solvent-free epoxy (SFE) system such as 'Nordbak 1' or similar approved system.

After application of the SFE coatings to the crotch plates and collars/wrappers, approved mastic (refer PSL 3.9.3.8) shall be placed in all crevices that may become moisture traps.

No additional payment will be made for any of this work as the costs are deemed to be included in the scheduled rates for pipelaying.

PSL 3.9.3.8 External Corrosion Protection of Site-Fabricated Pipe Bends and Fittings (New Sub-Clause)

The coating repairs/make good shall be carried out in accordance with PSL 3.9.3.7.

PSL 3.9.3.9 Corrosion Protection of Flanges and Flexible Adaptor/Anchoring Joints (New Sub-Clause)

All flanges and flexible joints and adaptor/anchoring joints and their associated bolts, nuts and washers, shall, notwithstanding that the flexible and adaptor/anchoring joints shall be epoxy coated as specified elsewhere, be protected as described below.

(Note: This specification is based on a 'Denso' system. Alternative products may be used, subject to approval by the Employer's Agent.)

- Surface Preparation

  The entire surface area of the flange/adaptor/anchoring joint, and its bolts, nuts and washers, up to not less than 250 mm either side of the joint, shall be cleaned of all dirt and other deleterious matter.

  The cleaned area, up to 200 mm either side of the flange/adaptor/anchoring joint, shall then be wire brushed.

- Priming

  The cleaned flange/adaptor/anchoring joint, bolts, nuts, washers and the adjoining 200 mm length either side shall be primed with 'Denso Priming Solution', or if moisture is present, with 'Denso S105 Paste'

- Application of Mastic Blankets

  Narrow strips cut from 'Denso Mastic Blanket' shall be applied to the flange/ adaptor/anchoring joint to achieve a smooth profile with a 50 mm splayed fillet being formed at the joint/pipe interface. Care shall be taken, particularly at bolts, to avoid the formation of air pockets. Complete 'Denso Mastic Blankets' shall then be applied (mastic side down) to the flange/adaptor/anchoring joint until the flange/adaptor/anchoring joint is completely enveloped.

  The blanket shall be overlapped at least 50 mm and shall extend at least 150 mm along the pipe barrel on each side of the flange/adaptor/anchoring joint. The ends of the blanket shall be bound to the barrel of the pipe on each end with 100 mm wide 'Denso Tape'. The 'Denso Tape' overlaps shall be 50 mm and shall extend 100 mm onto the blanket and 150 mm onto the pipe barrel.

- Application of Protective Sheeting

  The entire flange/adaptor/anchoring joint shall then be wrapped with 350-micron polyethylene sheeting which shall end 400 mm beyond the joint. The protective sheeting shall be secured to the pipe barrel and along the seam with 48 mm wide 'Denso Adhesive Tape'.

PSL 3.9.3.10 Repair of FBMDPE Coating (Large Areas) (New Sub-Clause)

A large area repair is defined as an area larger than 650 mm².

All damaged and blistered FBMDPE coating caused by welding or other mechanical means shall be removed back to sound coating by mechanical grinding or other approved means.

The exposed steel surface shall be power wire brushed to remove dirt, scale, rust and other foreign matter to a surface profile equivalent to a Class St 2 finish. Weld spatter shall be removed by chipping or grinding to a smooth surface flush with the surrounding steel. Welds shall have a smooth contour free from sharp edges, protrusions and undercut. Sharp edges and protrusions shall be removed by grinding to a smooth radius of curvature of not less than 3 mm.

Degreasing of the exposed steel surface shall be done in terms of Clause PSL 3.9.3.1.

The surrounding sound FBMDPE surface shall be feathered from steel surface to maximum thickness and then abraded to a distance of 100 mm beyond the defective area. The abrasion shall be carried out with clean emery paper of 80 to 100 mesh so as to produce a suitably rough surface profile without causing the removal of excessive amounts of protective material. Virgin Sintakote powder is to be melted into the defect to ensure proper mechanical bonding with the steel surface and chemical bonding with the existing Sintakote. The melting of the virgin material shall be such that melting is not effected with an open flame. The melted powder shall be shaped with a hot spatula to form a smooth surface over the repair area.

Under no circumstances will patching of damaged areas by means of pieces of tape wrap, be allowed.

PSL 3.9.3.11 Repair of FBMDPE Coating (Small Areas) (New Sub-Clause)

A small area repair is defined as an area less than 650 mm².

A small area repair is effected by means of the application of a hot spatula to repair the defect, provided that there is a residual layer of polyethylene adhering strongly to the steel surface. Alternatively, virgin Sintakote powder material may be melted with heated spatula over the damaged area, to fill the mechanical damages in the coating and fuse with the surrounding coating material, all as per the manufacturer's recommendations.

At each pinhole detected by the Holiday test, the surrounding area shall be abraded to 25 mm beyond the defective area. The abrasion shall be carried out with clean emery paper of 80 to 100 mesh so as to provide a suitably rough surface profile without causing the removal of excessive amounts of coating material. A hot spatula shall be utilized to work Sintakote into the pinhole defects. It is noted that any cluster of pinholes within a radius of 25 mm shall be regarded as one defect.

PSL 3.9.3.12 Corrosion Protection of Valves and Flexible and Flanged Joints (New Sub-Clause)

Every buried cast iron/steel coupling, joint, flange, and valve, where scheduled, shall be protected by the following 'Denso' or equal approved anti-corrosion system.

After the pipework has been satisfactorily tested (and bonded at the couplings for electrical continuity, if applicable) the exposed portion of the coupling, joint or flange and the unsheathed portions of the pipes at the joint and the bodies of all buried valves shall be covered with an approved petroleum based mastic/cloth system applied strictly in accordance with the manufacturer's instructions and then covered with two layers of approved adhesive PVC tape. The external sheathing system, which shall be to the approval of the Employer's Agent, shall be carried out as follows:

All loose dirt, rust, mill scale and flaking paint shall be removed by wire brushing all exposed metal surfaces. An approved priming solution shall be applied by brush with care being taken to ensure all exposed metal surfaces are coated.

'Denso', 'Corromastic' or equal approved mastic shall be packed around the joint and/or valve body to form an even contour for the application of tape. A fillet shall be formed between the flange and the pipe barrel/valve body and, in the case of flexible couplings, mastic shall be packed around the bolts to a height of 3 mm above the bolts. Care shall be taken to ensure that no air is entrapped.

A layer of impregnated tape/cloth shall be spirally applied with a minimum overlap of 50 mm. All air pockets shall be removed.

A 10 mm thick layer of mastic shall then be packed on top of the tape and a second layer of impregnated tape/cloth shall be spirally applied with a minimum overlap of 25 mm. The tape layer shall commence and terminate at least 100 mm over the pipe sheathing on either side of the joint. The surface shall then be smoothed off and all air pockets shall be removed.

An overwrap consisting of two separate layers of approved, 300-micron thick adhesive PVC tape shall be spirally applied with a minimum of 25 mm overlap and with at least two laps over the untreated sheathing on either side of the joint.

The whole sheathed area of the joint shall be subjected to Holiday Test detection and, if proved sound and approved by the Employer's Agent, it shall be covered with 'padding' sand.

PSL 3.9.3.13 Measurement and Payment for Coatings (New Sub-Clause)

The supply and application of coatings are not measured separately in the Bill of Quantities and payment for the costs of meeting the requirements of this specification which includes for the provision of all labour, plant, materials and testing necessary to carry out the complete coating and making good etc shall be included in the rates tendered for the supplying, laying and bedding of the pipeline as per Sub-Clauses 8.2.1 and 8.2.2 of SANS 1200 L.

Where coatings are requested by the Employer's Agent, these have been itemised in the Bill of Quantities.

PSL 3.9.4 Flexible Couplings

Delete the Sub-Clause and substitute:

All flexible ("Viking Johnson" or "Klamflex" type) couplings shall be lined and coated with epoxy as specified in Sub-Clause 3.9.2.2(b)(1) and PSL 3.8.2.1.

PSL 3.9.5 Jointing Material

Bolts and nuts shall conform to SANS 1700-8-2 or SANS 135. All bolts, nuts and washers shall be electro-galvanised.

Gaskets shall be full-faced gaskets made of rubber materials.

PSL 3.9.6 Corrosion Protection to Couplings, Joints and Flanges

Add to Sub-Clause:

Each steel or cast iron coupling, joint or flange and valve, where scheduled, shall be protected by application of a primer such as "Densotherm Primer" (or similar approved), as dictated by the material characteristics, and coated using 2,0 mm thick "Densotherm" (or similar approved) bituminous tape applied with a 55% overlap, all in strict compliance with the manufacturer's directions and instructions. In the case of couplings and joints a shrink-wrapped envelope shall then be applied around the entire wrapped coupling or joint for mechanical protection.

Add the following new Sub-Clause:

PSL 3.9.7 Corrosion Protection to Branches, Air Valves and Tees (New Sub-Clause)

Where they are to be backfilled, branches, scour and air valve tees and crotch plates shall be coated using an epoxy coating (Copon KSIR88 or similar approved) having a minimum dry film thickness of 250µm, which shall be applied strictly in accordance with the manufacturer's requirements. After the epoxy coating has been fully cured, the whole of the fitting shall be primed with "Densotherm Primer" (or similar approved) and coated using 2,0 mm thick "Densotherm" (or similar approved) bituminous tape applied with a 55% overlap, all in strict compliance with the manufacturer's directions and instructions.

Exposed specials in chambers including valves, flanges, crotch plates, flexible couplings etc, shall be protected externally by the application of Copon "KSIR88" or equivalent approved epoxy coating to a minimum dry film thickness of 300 microns. Each coat shall not exceed the maximum thickness specified by the manufacturer. Surface preparation and application shall be strictly in accordance with the manufacturer's instructions.

Alternatively, a suitable solvent free epoxy coating may be applied, in which case the required dry film thickness of a minimum of 300 micrometres may be achieved in one application.

PSL 3.10 Valves

Delete the Sub-Clause and substitute :

Valves supplied under this Contract shall comply with the requirements of Particular Specification PA.

PSL 3.10(a) Item Numbers

Item numbers which appear in the Bill of Quantities for all valves, steel and cast-iron pipes shall be painted on each valve, pipe, special and fitting in 75 mm high lettering except where the size of the item dictates the use of smaller lettering,

PSL 3.11 Manholes and Surface Boxes

PSL 3.11.1 Bricks

Delete the first sentence and substitute:

Bricks for manholes and surface boxes shall be Engineering bricks type FBXE45 or better, with a water absorption not exceeding 7% and complying with the applicable requirements of SANS 227.

PSL 3.11.5 Manhole Covers and Frames

Delete the Sub-Clause and substitute:

Covers and frames for manholes shall be of polymer concrete construction and shall comply with the requirements of SANS1882/2003 for Type 2B in the case of manholes in roads and other areas subject to road traffic loads, and Type 4 in the case of manholes not subject to such loads. Covers and frames shall be supplied in matching sets. The Contractor shall ensure that, when installed, the covers and frames still comply with the requirements of SANS 1882/2003 for freedom from warp and evenness of seating.

PSL 3.11.6 Surface Boxes

Delete the Sub-Clause and substitute:

Surface boxes shall be of polymer concrete construction and shall comply with the requirements of SANS1882/2003 for Type 3A in the case of surface boxes for gate and scour valves, and for Type 5 in the case of surface boxes for hydrants and air valves.

Add the following new Sub-Clauses:

PSL 3.11.7 Sand (New Sub-Clause)

Sand used for mortar (general purpose and for plaster (external)) shall comply with the applicable requirements of SANS 1090.

PSL 3.11.8 Cement (New Sub-Clause)

The cement used on the Works shall be Ordinary Portland Cement complying with the requirements of SANS 471 (or the equivalent in accordance with SANS ENV 197-1).

PSL 4 PLANT

PSL 4.1 Handling and Rigging

Add to Sub-Clause:

Pipes of length exceeding 6,0 m shall be moved with the use of padded slings of width sufficient to prevent damage to the coating. Chain slings, hooks, wire ropes, rope slings without canvas covers, composition belt slings with protruding rivets and any other equipment liable to damage the coating shall not be used. All pipes are to be lifted with the aid of a "spreader" lifting beam and special care is to be taken to ensure that no damages occur to the pipe coatings by preventing the pipes from sliding on or hitting adjacent pipes. Lifting centres shall be not more than 6 m apart.

To ensure that coated pipes do not bear against each other while being transported, either plastic or fibre bags containing resilient material that shall not disintegrate or deteriorate when exposed to the elements for prolonged periods shall be used. The padded bags shall have a minimum width of 500 mm and a minimum length of one and a half times the diameter of the pipe to be supported, or 500 mm - whichever is the greater. All ropes used for fastening shall be so padded as to prevent damage to the coating.

Padded bags shall also be used in the stacking of the pipes at the pipe yard on delivery, and the Contractor shall provide sufficient bags so that the pipes can be stacked a minimum of 300 mm clear of the ground and do not touch each other. Stacked pipes shall have a minimum clearance of 50 mm between adjacent pipe walls.

Add the following new Sub-Clauses:

PSL 4.4 Packing (New Sub-Clause)

Goods should be suitably packed in such manner as will ensure safe and efficient transport by road or rail, and the Contractor shall include in his/her prices for whatever packing may be necessary in this respect. Small items particularly liable to damage or loss in transit should be crated. All crates and packing material shall, after use, become the property of the Employer, unless distinctly specified otherwise, or if returnable, shall be so at the Contractor's expense.

PSL 4.5 Protection of Linings During Transportation (New Sub-Clause)

The ends of every pipe, fitting and special shall be fitted with suitable end closures as a precautionary measure against damage being caused to the lining material. The end closures shall be capable of preventing the ingress of dirt and at the same time allowing air to ventilate through the pipework which they protect but without drying the linings out (in the case of cement mortar lined pipes) so as to cause them to crack. They shall be secured in such a manner that they cannot be dislodged or damaged by normal pipe handling operations.

PSL 4.6 Markings (New Sub-Clause)

Every bend shall be marked as stated in PSL 3.4.1 above and, in addition, shall have its deflection angle in degrees and minutes painted on the outer surface.

Packaged items such as nuts and bolts, insertion rings, etc shall be marked with a metal label bearing the Contract Nº and the Schedule Item Nº with which they are to be used."

PSL 4.7 Advice Notes and Invoices (New Sub-Clause)

The Contractor shall submit one copy of every advice note in respect of each individual consignment, quoting the Contract Number, the truck or vehicle number, item numbers and a brief description of the articles so consigned. The advice note shall be lodged with the Employer's Agent's Representative on site at least two days before the arrival of the goods.

PSL 4.8 Delivery and Acceptance (New Sub-Clause)

The material to be supplied under this Contract shall be consigned and delivered to approved areas adjacent to the pipeline route, or to an approved and prepared storage area if not required for immediate use.

PSL 5 CONSTRUCTION

PSL 5.1 Laying

PSL 5.1.1 General

Add to the Sub-Clause:

The Contractor will be responsible for clearing the areas required for pipe storage that shall include the removal of rock, stones and all combustible material. He/she shall also be responsible for maintaining the area in a clean and tidy condition and securing the site for the duration of the Contract. No separate payment will be made for this operation.

Upon delivery of the pipes, fittings, specials and valves, these will be inspected jointly by the Employer's Agent's Representative and the Contractor. Any material found to be damaged shall be returned to the factory for repair or replacement; in which case the costs of additional transport, repair or replacement shall be borne by the Contractor, if the pipes were supplied by the Contractor and not by the Employer.

The Contractor will be held fully responsible for the care and safety of all pipes and fittings, etc, on site, and shall bear the cost of all renewals, which may be necessary to make good losses, damages or breakages. Furthermore, he/she shall be fully responsible for handling and re-loading material at the storage areas and for transporting and offloading of all such materials at their correct places along the pipelines routes.

Add the following new Sub-Clauses:

PSL 5.1.1.1 Distribution of Material (New Sub-Clause)

Before commencing pipelaying, the Contractor shall properly distribute pipes, fittings and specials, along the trenches. Valves and couplings shall not be distributed until they are actually required for laying in their designed position.

PSL 5.1.1.2 Prevention of Fire Damage to Pipes (New Sub-Clause)

The Contractor shall be responsible for protecting pipes etc., from grass and brush fires at all times. He/she shall keep grass cut short in the vicinity of all unlaid pipework items.

PSL 5.1.1.3 Pipelaying Personnel (New Sub-Clause)

The laying of all pipework items shall be performed only by qualified and experienced persons or who are registered as artisans in the plumbing, pipefitting or drain-laying trades or who are qualified by reason of having attended and passed the course on pipelaying of the Civil Engineering Industry Training Board.

PSL 5.1.1.4 Inundation of Pipe Trenches and Floating of Pipes (New Sub-Clause)

Should trenches be inundated by water, there is a risk of movement of the pipes by flotation. The Contractor shall ensure that trenches are not flooded by stormwater and that pipes laid in the trench are backfilled as soon as possible after laying, except at joints made with couplings or flanges which must be kept visible until the pipeline has been satisfactorily tested. Steel pipes with welded joints may, after all specified testing and corrosion protection has been satisfactorily completed and with prior approval from the Employer's Agent, be backfilled at the same time as backfilling the pipeline.

Should movement of the pipes occur, the Contractor shall remove the pipes from the trench and thoroughly clean and relay the pipes. This work shall be carried out at the Contractor's expense.

PSL 5.1.2 Damage

Add to the Sub-Clause:

The Contractor shall be responsible for protecting pipes fittings and valves from any damages at all times.. including from flooding and fires. The Contractor shall keep grass cut short in the vicinity of all unlaid pipework items and shall ensure that pipework items are not stored where there is a potential of flooding occurring..

Steel pipes with welded joints may, after all specified checks, testing and corrosion protection has been satisfactorily completed and with prior approval from the Employer's Agent, be backfilled in accordance with the specification.

Should movement of the pipes occur, the Contractor shall remove the pipes from the trench and thoroughly clean and relay the pipes. This work shall be carried out at the Contractor's expense.

Should any pipework that has been laid be found to be irreparably damaged by whatever reason, the Contractor shall remove the pipework from the trench and replace the damaged pipework. This work shall be carried out at the Contractor's expense.

PSL 5.1.3 Keeping Pipelines Clean

Add to the Sub-Clause:

The Contractor shall take all of the steps necessary to prevent flooding of the Works and hence ensure that all work is carried out in the dry, and that the ingress of dirt and or dirty water into the pipes is prevented.

Add the following new Sub-Clauses:

PSL 5.1.3.1 Cleaning Pipe Internals (New Sub-Clause)

The Contractor shall ensure that all pipe work is installed internally free of any contaminants. All traces of dirty water, swarf, cuttings, coupons, grinding dust, dirt and other debris are to be removed from the inside of the pipe as it is installed.

The Contractor shall ensure that all dust, grit and powder that accumulates in the pipe as a result of grit blasting for the repair of internal linings, be removed from the pipe in an acceptable manner before the internal lining repairs are carried out.

The Contractor shall take note that flushing of the completed pipeline may not be allowed after construction has been completed and therefore clean house-keeping practices will be required under all circumstances during construction. The tendered rates for pipe laying shall include for the clean house-keeping practices required.

Each section of the pipeline is to be internally inspected and passed by the Employer's Agent once construction has been completed. If the pipework is not satisfactory, the Contractor shall re-clean the pipe at his/her own expense until the pipe is passed clean. The Employer's Agent reserves the right to utilize cameras or any other means to inspect inaccessible areas.

PSL 5.1.3.2 Cleaning of Valves and Fittings (New Sub-Clause)

All flanges, valves, fittings and equipment are to be installed in pipe work only after they have been thoroughly cleaned. Flange faces shall be checked for damage before being incorporated into the permanent Works and any damage shall be reported to the Employer's Agent.

PSL 5.1.4 Depths and Cover

Delete Sub-Clause 5.1.4.1 and substitute the following :

Unless otherwise shown on the drawings or scheduled in the Bill of Quantities or ordered, the depth of excavation for trenches for medium-pressure pipelines shall not exceed 1,2 m.

Add the following new Sub-Clauses:

PSL 5.1.5 Marker Posts (New Sub-Clause)

Pre-cast concrete marker posts as shown on the drawings and painted white in colour shall be set at all horizontal direction changes and where otherwise indicated by the Employer's Agent.

The standard marker post rate shall include the supply and erection of painted and inscribed posts. The rate shall be inclusive of erection and shall include for all necessary excavation, mass concrete footing and formwork.

PSL 5.1.6 Working Inside Pipes and Protection of Internal Linings (New Sub-Clause)

All possible care shall be exercised during construction in order to avoid damage being inflicted to the pipe lining as a result of the installation and welding activities, and the following procedures shall be adopted at all times:

- Placing of rubber protection mats in the pipeline to ensure that no damage occurs as a result of foot traffic, falling tools and equipment, weld splatter and or grinding spray.
- Labourers working inside the pipe shall wear soft soled shoes.
- Wet sacking or rubber matting shall be placed on the pipe invert in the areas where welding or flame cutting operations are in progress to minimise the extent of damage to the lining from weld splatter or molten metal from flame cutting. This requirement shall be strictly enforced.
- Tools shall be placed on rubber foam or resilient rubber matting to protect the epoxy pipe lining against mechanical damages.
- Particular care shall be taken inside the pipe when tie ins into the pipe is done for the purpose of fitting air valves, scour valves, by passes and other tie ins.
- Once internal work in a specific pipe sections has been completed and the pipe has been successfully cleaned, Holiday Testing detected and approved as being constructed to the satisfaction of the Employer's Agent, the Contractor shall block off that section of pipe to prevent any further man entry into same.
- The rates tendered in the Bill of Quantities shall include for all the measures required under this Sub-clause.

Detection of holidays in the internal epoxy lining will only commence once all internal activities in the pipeline have been completed. That is welding of joints, preparation of joints for epoxy reinstatement, as well as epoxy reinstatement in terms of the requirements of this specification. This excludes repair of epoxy lining as a result of damage incurred before the pipe is transported to the construction site as these defects shall be repaired in the pipe yard.

Once all work is complete in a particular length of pipe, the Contractor shall arrange for the pipe to be thoroughly swept of all dust and debris. The pipe lining and joint repair will then be tested with a 'wet sponge' detector set at 90 Volts in order to detect any electrical insulation defects.

PSL 5.1.7 Equipment for Inspecting Internal Surfaces of Pipes (New Sub-Clause)

The Contractor shall make the following equipment available for use by the Employer's Agent for the inspection of the internal surfaces of the pipes 450ND and larger:

- One pair of boots having leather uppers and rubber soles
- One one-piece overall with at least one breast pocket
- One adjustable safety harness
- Two screw drivers, 5 cm and 10 cm long
- One small peen hammer
- A two-cell torch with a 10 W light bulb with two sets of rechargeable batteries and a battery charger and spare bulbs
- A sufficient length of 16 mm diameter rope to suit the conditions on site
- One trolley suitable for inspecting pipes of the appropriate diameter(s).

The equipment shall be kept in good condition and operating order throughout the duration of the Contract. No separate payment shall be made for this equipment and the costs therefore shall be deemed to be included in the tendered rates.

PSL 5.1.8 Pipe Support (New Sub-Clause)

Temporary pipe supports may be used to assist setting up and assembly. However, it is preferred that permanent pipe supports are installed as soon as possible to minimize double handling and/or omission during construction.

Permanent pipe supports shall be constructed as indicated on the drawings or as directed on site.

Before testing, all permanent supports shall be complete and all temporary supports removed, unless otherwise agreed by the Engineer.

PSL 5.1.9 End Caps (New Sub-Clause)

The Contractor shall, at the end of each day's work, fit end caps to the open ends of the pipeline under construction. The end caps shall be manufactured in such a manner that it can be fitted to seal off the pipeline to the extent that it is totally dust and waterproof. The end cap must be able to withstand a pressure of 5 m head of water externally when fitted.

End caps shall be maintained during non-working periods.

The tendered rates for the laying of pipes shall be deemed to include for the supply, fitment, and maintenance of the end caps.

PSL 5.2 Jointing Methods

PSL 5.2.2 Flanges (Steel Pipelines)

Add to the Sub-Clause :

Before being brought together, the ends of the pipes, fittings, couplings and all flanges are to be inspected and cleaned to ensure that all parts forming the joint are undamaged and clean.

When jointing flanges, the faces shall be cleaned thoroughly and approved jointing material (rubber or similar approved), cut properly to size, is to be inserted immediately before bringing the two flanges together.

Before closing the joints, the flanges must be parallel to each other, with all bolts inserted in the bolt holes. After the fittings have thus been aligned and well supported, the joint shall be bolted up to a uniform tightness. Jointing material shall be flush with, or protrude beyond, the outer circumference of the flange. On completion of the joint, the flanges and bolts shall be protected as described in Clause PSL 3.9.6.

PSL 5.2.3 Welding (Steel Pipelines of Diameter 450 or Greater)

Delete the title and replace with “Welding (Steel Pipelines)”

Delete the first sentence and replace with:

Field and shop welding of steel pipes, bends and fittings shall be carried out in accordance with the relevant requirements of the latest version of API 1104. Prior to commencement of welding, the Contractor shall produce a qualified welding procedure in accordance with the latest version of API 1104, for the intended sizes, processes, positions, and consumables to be used on the project.

Welding shall be carried out by welders who are competent in terms of the procedure approval test given in API 1104. Prior to commencement of welding, the current qualification of each welder shall be produced in accordance with the welding procedure. Should constant repairs be required on welds carried out by one particular welder, the Employer’s Agent may require that the welder be re-tested or removed from the project."

Add the following new Sub-Clauses:

PSL 5.2.3.1 Radiographic Examination of Shop Welds

The Contractor shall include in his/her prices for the manufacture of bends, fittings and specials for the cost of carrying out, under the supervision of an inspector appointed by the Employer’s Agent or Employer, examination of shop welds on the following basis:

- Field Welds

  Radiographic testing shall be performed on butt welds and dye penetrant testing on fillet welds. All welds shall be tested and adjudicated in accordance with API 1104. Radiographic testing of butt welds shall be carried out on 100 % of the welds.

  Repairs of welds shall be permitted in accordance with approved repair procedures. Repairs shall be re-examined using the relevant non-destructive testing method. All costs associated with the repair of defective welds shall be borne by the Contractor.

- Fabrication of Bends, Fittings and Specials
  - 100 % radiographic examination of all weld deposited manually or semi-automatically in bends, fittings and specials which cannot be hydraulically tested because they have a plain end.
  - 10 % radiographic examination of all welds deposited manually or semi-automatically in all flanged bends, fittings, and specials which shall be tested hydraulically.

The Employer's Agent shall, in all cases, determine which welds are to be radiographed on the quantity basis specified above. All radiographs and records thereof shall be made available to the Employer's Agent to enable him to determine whether the welds are acceptable or not and no lining or wrapping of pipes, bends or fittings shall be permitted until the welds have been accepted by the Employer's Agent. To avoid any unnecessary delays, at the option of the fabricator, radiographs may be approved by the manufacturer's inspectors subject to them being subsequently submitted to and approved by the Employer's Agent.

When a section of the weld is shown by radiography to be unacceptable and, if the limits of the deficient weld are not defined by the radiograph, additional radiography shall be carried out at the Contractor's expense until the limits of the deficiency are determined.

Repairs shall be made to defective welds at the Contractor's expense. All repair welds shall be identified with a stamp marking, indicating which welder conducted the repair. Repaired welds shall be radiographed at the Contractor's expense but, after any repair welder has had ten consecutive repairs approved, the extent of the radiography of the repairs conducted by the welder may be decreased by agreement between the Employer's Agent and the Contractor.

PSL 5.2.3.2 Welding Procedure

Welding shall, unless otherwise prescribed in the approved welding procedure, commence at the top of the joint and proceed downwards. In addition to the root weld, at least two further passes shall be made, none of which is to exceed 3 mm in depth, but this is subject to the approved welding procedure.

PSL 5.2.3.3 Aligning

The alignment of abutting ends shall be such that the offset does not exceed 1,5 mm. Line-up clamps ('dogs') shall not be used for the 'fit-ups'. The use of 'bridges and wedges' or any other method that may reduce the pipe wall thickness when removed or in any way introduce unnecessary stresses into the pipe is forbidden.

PSL 5.2.3.4 Weather Conditions

Welding shall not be performed under conditions that could affect the quality of the welded joint (e.g, high moisture or windy conditions). Windshields may be used where practical.

PSL 5.2.3.5 Clearance

The minimum clearance around the pipe during welding shall be 500 mm or such other minimum distance that may be required to facilitate compliance with the approved welding procedure. When welding is carried out inside a trench, adequately sized 'fox holes' shall be excavated or formed to provide adequate access for the welders.

PSL 5.2.3.6 Visual Inspection

100 % of each joint shall be examined and the following criteria shall be met:

All welds shall be substantially uniform in appearance with the inner and outer weld beads not exceeding 1,0 mm and 3,0 mm in height respectively unless otherwise required in terms of the approved welding procedure.

Undercut shall not be permitted under any circumstances.

The weld, heat affected zone, and surrounding parent metal shall be free from cracks, porosity and trapped slag.

All weld splatter shall be removed prior to corrosion protection application.

PSL 5.2.3.7 Quality Control

Records of which welds were carried out by each individual welder as well as non-destructive testing results shall be submitted to the Employer's Agent monthly. Should there be repetitive or serious defects, this information shall be forwarded to the Employer's Agent immediately.

PSL 5.2.5 Flexible Coupling Joints (New Sub-Clause)

Where ordered, steel flexible couplings are to be of the "Viking Johnson"/"Klamflex" or similar approved type without central registers, each comprising one centre collar, two special flanges, two rubber rings and electro-galvanised mild steel bolts.

Adaptor couplings shall be of a similar design, but one end shall be flanged to enable connection of plain ended pipes to flanged specials.

Steel couplings shall be assembled strictly in accordance with the manufacturer's instructions. Where the coupling has no internal register a 6 mm joint gap shall be central within the coupling. On completion of testing and continuity bonding, the entire joint shall be protected as described in Clause PSL 3.9.6.

The tendered prices for laying and jointing are to include for the supply of all necessary materials, plant and labour to complete the joint.

Add the following new Sub-Clause:

PSL 5.2.6 Cut Pipes (New Sub-Clause)

Cut pipes shall be used where required as closure lengths. The cut ends shall be dressed square and to a smooth even finish which shall not be inferior to that of the ends of uncut pipes. Cold rolling of grooves to specification according to SANS 815-2 shall be allowed for grooved end pipe. The finished dimensions of ends cut at Site must be within the tolerances applicable to the ends of the particular types of pipe to be laid. The cost of cutting and trimming of pipes shall be included in the rates tendered for laying and jointing pipes.

The corrosive protection shall be repaired on any cut pipe end as per approved Method Statement.

PSL 5.3 Setting Valves, Specials and Fittings

Add to the Sub-Clause:

Valves are to be set correctly in the positions indicated and supported on concrete stools, unless otherwise directed by the Employer's Agent. Valve spindle guide brackets and stays where provided shall be secured into position against concrete work and these must be set and carefully adjusted in order to give true vertical alignment of the spindle.

PSL 5.4 Concrete Casing

In the first and second lines delete "a strength 15 mPa/37,5 mm or such other strength as scheduled" and substitute "concrete grade 20/19".

PSL 5.5 Anchor/Thrust Blocks and Pedestals

In the fourth line delete "15 mPa/37,5 mm" and substitute "20/19"

PSL 5.6 Valve and Hydrant Chambers

PSL 5.6.2 Construction of Chambers

Delete the references to drawings L1, L2 and L3 and substitute "the tender drawings"

PSL 5.7 Manholes

PSL 5.7.2 Precast Manholes

Add to the Sub-Clauses:

Drawings showing details of the manholes are included with this tender document.

PSL 5.8 Brickwork in Chambers and Manholes

Delete the eleventh line and substitute the following :

Mortar for brickwork and plasterwork shall be composed of one part of cement to four parts of sand.

Twelfth and thirteenth lines to be deleted.

Add to the Sub-Clause :

Plaster is to be applied in one coat not less than 12 mm in thickness.

PSL 5.10 Disinfection of Potable Water Pipelines

Delete the Sub-Clause and replace with:

The Contractor will be required to submit a detailed Method Statement for approval by the Employer's Agent. Refer Particular Specification PVN: Disinfection of Pipeline.

Once a successful hydraulic test of the entire pipeline has been achieved and the connections have been completed, the pipeline shall be drained. The pipeline shall then be re-charged in accordance with PSL 7.3.4 – "Initial Filling of the Pipeline". The disinfection of pipelines will require the use of potable water.

The entire pipeline disinfection will be monitored by the Employer's Agent's Representative. The disinfection criteria are stringent, and the Contractor shall keep the pipeline clean throughout the Contract.

A minimum requirement will be that the Method Statement deals with the method of dosing and how the dosing rate will be controlled to ensure a uniform distribution throughout the pipeline being disinfected, the chemicals to be used, the anticipated range of dosing rates and equipment to be used, and the name and qualification the Contractor's person supervising the disinfection.

Once satisfactory disinfection has been achieved, the pipeline shall be drained via the scour valves (or by other means approved by the Employer's Agent) and sufficient sodium thiosulphate (typically 1 part of total chlorine) shall be dosed into the scour-wet wells to fully neutralise the chlorine before discharging to watercourse.

The pipeline shall then be re-charged with potable water in accordance with the stated procedure and, after 24 hours, samples will be taken for analysis (at no cost to the Contractor). Should a zero level of E. Coli and Total Coliforms not be achieved, the Contractor shall carry out at his/her own cost, all steps deemed necessary by the Employer's Agent to achieve satisfactory disinfection.

The price for testing and disinfecting pipelines and fittings is included in the scheduled items for supply and installation.

PSL 6 TOLERANCES

PSL 6.2 Control Points

In the third line delete "+ 100 mm" and substitute:

"± 50 mm provided that there shall be no reversal of gradients and provided that, in those areas where gradients shown on the drawings is less than 1 %, the permissible deviation will be ± 25 mm".

PSL 6.3 Alignment (Plan and Level)

In the third line delete "+ 100 mm or + 20%" and substitute "+ 50 mm or + 10 %".

In the fourth line delete "+ 20 mm" and substitute "+ 10 mm".

In the sixth line delete "+ 50 mm or + 10 %" and substitute "+ 25 mm or + 5 %"

Wall Thickness; delete '±10 % or -8 %' and replace with '+10 % or -0 %.

PSL 7 TESTING

PSL 7.3.1 Test Pressure and Time of Test

Delete second line of Sub-Clause 7.3.1.1 and substitute the following:

attained the strength specified in terms of Sub-Clause 5.5.

PSL 7.3.1.2 Delete this Sub-Clause

PSL 7.3.1.3 Delete the Sub-Clause and substitute the following :

Each pipeline shall be subjected to a field test pressure as shown on the drawings or as specified by the Employer's Agent.

Generally, the field test pressure applied to any section of the pipeline under test, taking differences in elevation along the pipeline into account, shall be such that the pressure at any point along the section under test shall not exceed the appropriate of the values set out in Sub-clause 7.3.1.4 and that the minimum pressure shall be not less than the design (working) pressure.

The sections in which the pipeline may be tested will be at the discretion of the Contractor, except that the pipeline shall not be tested in sections exceeding a maximum allowable length of 1 000 m unless otherwise agreed by the Employer's Agent and also taking cognisance of the requirements of Clause C3.5.11 of the Project Specification.

At all times when there is water in the pipeline, and particularly during filling, testing and draining of the pipeline, all air valves shall be in operation and their individual isolating valves shall be open.

PSL 7.3.3 Permissible Leakage Rates (Sub-Clause 7.3.3)

Delete the title of the Sub-Clause and substitute the following:

Permissible Make-up Water

Delete the sixth line and substitute the following:

Fibre cement and concrete pipes and concrete-lined steel pipes:

The permissible leakage for welded and flanged joints is zero litres.

PSL 7.3.4 Initial Filling of the Pipeline (New Sub-Clause)

Add new Sub-Clause:

The Contractor shall devise a suitable plan for filling of pipelines so as to exclude excess air. The Contractor should consider, as part of a successful plan, to limit the length of pipeline to be filled at one time, filling the pipelines from the lowest point and providing a vent(s) at high point(s) for the escape of air. The rate of filling of water should be limited to not more than 0,3 m/s effective velocity in order to prevent trapping of air.

Add the following new Sub-Clauses:

PSL 7.3.5 Connections After Testing (New Sub-Clause)

The connections of the new pipework to the existing pipework shall only be carried out after the pipeline testing has been completed and accepted by the Employer's Agent. For this reason, testing must be carried out against a blank flange or bullnose end cap at these locations.

PSL 7.3.6 Remedial Measures (New Sub-Clause)

In the event that a pipe section fails a test, the Contractor shall carry out all remedial measures necessary to obtain a successful test of each individual section and the entire pipeline, at his/her own expense. Such remedial measures shall in no way compromise the original pipeline specifications.

PSL 7.3.7 Draining of the Pipeline (New Sub-Clause)

The pipeline may have to be drained to carry out remedial measures and it must be drained before the disinfection process commences. The pipeline shall be drained via the scour valves in a manner that does not cause erosion of the streambeds or negatively impact on the environment in any way. All such drainage of the pipeline shall be carried out under the supervision of the Employer's Agent.

PSL 7.6 Commissioning (New Sub-Clause)

The pipeline shall be considered to have been commissioned and practically complete once all the associated structures are sufficiently complete to carry out their structural and hydraulic function and the hydraulic test and disinfection of the entire pipeline has been successfully completed.

PSL 8 MEASUREMENT AND PAYMENT

PSL 8.2.1 Supply, Handle, Lay, Joint, Bed, Test and Disinfect Pipes Complete with Couplings

Add to the Sub-Clause:

The pipes shall be measured per metre as scheduled.

The rate shall cover the cost of the supplying as scheduled complete with coatings and linings, handling, inspecting, transporting, forming joint ("fox") holes in all materials, bedding, laying, welding, radiographic and/or hydraulic testing as specified, and the completion of the internal and external corrosion protection (make good) and jointing materials (e.g, nuts, bolts, washers, gaskets, welding rods etc).

A maximum payment of 85 % of the tendered rate may be made for the completed section of pipeline which has not yet been hydraulically pressure tested and disinfected. A further payment of 10 % of the tendered rate will be made upon successful completion of the pressure testing for the relevant section of pipeline. The final 5 % of the tendered rate will be made upon completion of disinfection of the pipeline.

PSL 8.2.1(b) Manufacture, Supply, Handle, Deliver, Transport, Lay, Joint, Bed, Test and Disinfect Pipe Bends, Fittings and Valves Complete with Couplings (New Sub-Clause)

The manufacture, supply, handle, deliver transport, fabricate, install pipe bends, fittings, valves, etc, by number as scheduled in the Bill of Quantities.

The rates shall cover the cost of the manufacture, supply, and delivery of the pipe bends, fittings specials, and for fabricating and radiographic and/or hydraulic testing of bends, fittings specials, and supplying and installing flanges, couplings, valves and other appurtenances as scheduled, making good the coatings and linings, handling, inspecting, marking bends, fittings and specials with item numbers, transporting, holiday detection testing for coatings of steel pipes, forming joint ("fox") holes in all materials, bedding, laying, welding, jointing, cutting, all testing and disinfecting and where relevant all welding, radiographic and other testing as specified, and the completion of the internal and external corrosion protection (make good) and jointing materials (e.g. nuts, bolts, washers, gaskets, welding rods etc).

The rates for the supply and installing of valves and specials shall cover the cost of any cutting, trimming, and jointing of pipes required for the installation of valves, bend, fittings in the positions shown on the drawings. Unless specific provision is made in the Bill of Quantities, no separate payment will be made for forming of any additional joints and/or for the supply of additional jointing materials which may be required for the connection of cut pipes.

A maximum payment of 85 % of the tendered rate may be made for the completed section of pipeline which has not yet been hydraulically pressure tested and disinfected. A further payment of 10 % of the tendered rate will be made upon successful completion of the pressure testing for the relevant section of pipeline. The final 5% of the tendered rate will be made upon completion of disinfection of the pipeline.

PSL 8.2.11 Anchor/Thrust Blocks and Pedestals

Delete the last line and substitute the following:

formwork, concrete, reinforcement (if any), and screeding to top surfaces.

PSL 8.2.12 Concrete Encasing at Stream Crossing

Add the following to L8.2.12:

The rate tendered for concrete shall include for the provision of additional excavations, formwork, reinforcement (if any), trimming and finishing of the concrete encasing.

PSL 8.2.15 Special Wrapping in Corrosive Soil

Delete the Sub-Clause and substitute the following:

Payment for corrosion protection of joints shall cover the cost of the provision and fixing of the sheathing/wrapping in accordance with the relevant specification and the cost of any delay and inconvenience caused by the requirement to sheathe/wrap. Separate items will be scheduled for each type and size of joint to be protected Unit : No

Payment for corrosion protection of valves shall cover the cost of the provision and fixing of the sheathing/wrapping in accordance with the relevant specification and the cost of any delay and inconvenience caused by the requirement to sheathe/wrap. Separate items will be scheduled for each type and size of valve to be protected, and the rate shall include for protection of the whole of the valve body, all flanges integral to the valve, the connecting flanges to the valve (i.e, including the two flanges of the pipework connected to either side of the valve) and the packing of mastic (without tape or sheathing) over the gland adjusting bolts and nuts Unit : No

Add the following new Sub-Clauses:

PSL 8.2.16 Cut Pipes (New Sub-Clause)

Extra over for cutting of pipe Unit: N°

The rate shall cover the cost of the cutting of the pipe and all making good of lining and coating, welding, testing and forming joint holes in all materials.

PSL 8.2.17 Scarf and Mitre Cut Joints and Pipe Closures (New Sub-Clause)

(a) Extra over for forming scarf joint Unit: N°

(b) Extra over for forming mitre cut joint Unit: N°

(c) Extra over for cutting pipe as closure Unit: N°

Scarf joints, mitre cuts (two-piece bends) up to 10º in steel pipelines and pipe closures may be carried out in the field only if ordered by the Employer's Agent.

The rate shall cover the cost of cutting, forming, and bevelling the ends of the pipes at the joint, all welding, testing and forming joint holes in all materials and for completion of the internal and external corrosion protection at the joints and closures.

Payment will only be made where shown on the drawings or where instructed by the Employer's Agent's Representative. No payment shall, however, be made for cutting pipes to suit the installation of bends, fittings, and valves that are shown on the drawings.

The rates shall cover the cost of cutting, forming and bevelling the ends of the pipes at the joint, all welding, testing and forming joint holes in all materials and for completion of the internal and external corrosion protection at the joints.

PSL 8.2.18 Connecting to Existing Pipeline (New Sub-Clause)

Connecting to existing pipeline Unit: Sum

The rates for connecting to existing pipelines and proposed flanged connections shall cover the cost of exposing the existing pipeline (or blank flange), cleaning and preparing the pipe for cutting, cutting and preparing the pipe ends for jointing, jointing (or removing the existing blank flange and connecting the new pipework), testing and recommissioning the pipeline including all bedding and backfilling and making arrangements with the Employer's staff to temporarily shut off the existing pipeline whilst effecting the connection(s).

PSL 8.2.19 External Corrosion Protection to Valves, Flexible & Flanged Joints Complete as Specified in 3.9.3.12

External corrosion protection to valves, flexible and flanged joints complete Unit: N°

Separate items will be scheduled for each item by pipe nominal diameter.

In the case of valves, the rate shall include for protection of the whole of the valve body, all flanges integral to the valve, the connecting flanges to the valve i.e, including the two flanges of the pipework connected to either side of the valve, and the packing of mastic (without tape or sheathing) over the gland adjusting bolts and nuts."

Add the following new Sub-Clauses:

PSL 8.2.20 Pipeline Markers (New Clause)

The rate shall cover the cost of supplying the markers and for the installation as shown on the drawings. Unit: No

PSL 9 DRAWINGS L-1, L-2 AND L-3

PSL 9.1 Drawings

References to mortar mixes to read:

1 to 4 mortar

C3.7.13 PSLB : BEDDING (PIPES)
(Applicable to SANS 1200 LB - 1983)

PSLB 2.3 DEFINITIONS

Main fill:

Delete "150 mm" in second line and substitute "300 mm".

PSLB 3 MATERIALS

PSLB 3.1 Selected Granular Material

Delete the Sub-Clause and substitute:

Selected granular material shall be a granular material with a PI not exceeding 6, grading modulus not less than 1,2, free from lumps or stones retained on a 10 mm sieve and having a compactibility factor (as determined by the test given in Section LB of Part 3 of SANS 0120) not exceeding 0,4.

PSLB 3.2 Selected Fill Material

In the first line delete "PI not exceeding 6" and substitute "PI not exceeding 10.

In the second line delete "30 mm" and substitute " 20 mm".

PSLB 3.3 Bedding

The pipes to be laid under this Contract are to be considered as ‘flexible’ for the purpose of bedding.

PSLB 3.4 Selection

PSLB 3.4.1 Suitable Material Available from Trench Excavation

Add to the Sub-Clause:

If, in the opinion of the Employer’s Agent bedding material can be produced from the excavated material and if ordered by the Employer’s Agent, the Contractor shall screen the excavated material in order to produce material suitable for bedding. (see also PSLB 8.2.1).

PSLB 5 CONSTRUCTION

PSLB 5.1.2 Details of Bedding

Add to the Sub-Clause:

The pipelines are to be laid on the class of bedding indicated in the Bill of Quantities and/or on the drawings.

PSLB 5.1.4 Compacting

Delete the second line and substitute:

top of the pipeline) shall be 93 % modified AASHTO.

Add to Sub-Clause 5.1.4:

No heavy compaction equipment will be permitted for compaction of any pipe bedding, only pneumatic or hand rammers being acceptable.

To this end, and to achieve the 100 % compaction specified it is recommended that bedding be brought up evenly on either side of the pipe. The use of complete saturation of the material as a method of achieving the specified compaction may, subject to the Employer's Agent's approval, be used. However, in this regard, Contractors are advised that the presence of excessive quantities of water in the pipe trench could lead to flotation of the pipe.

Prior to the commencement of pipelaying the Contractor will be required to submit to the Employer's Agent, for his/her approval, a Method Statement detailing his/her proposed methods of placing, and compacting methods which he/she proposes to implement in order to ensure compliance with the specification.

Add the following new Sub-Clause:

PSLB 5.1.5 Testing (New Sub-Clause)

Flexible joints shall be left exposed with a minimum of 100 mm clearance around the bottom of the pipe during hydraulic pressure testing of the pipe to facilitate inspection.

PSLB 5.2 Placing and Compacting of Rigid Pipes

PSLB 5.2.2 Class 'C' Bedding

Delete the third, fourth and portion of the fifth lines and substitute the following:

The pipes shall be bedded on a layer of compacted granular bedding material on which a 25 mm thick layer of uncompacted granular bedding material has been placed and spread. Loose granular bedding material lying next to the pipe shall be placed into the haunch area and compacted with suitable hand tools, and additional selected granular material shall be added and compacted in layers until levels for the bedding cradle as shown on Dwg LB - 1 (c) are reached. The remainder of the bedding i.e, the selected fill blanket, shall be placed in layers up the sides of the pipe, each layer being compacted until levels are reached as shown on Dwg LB-1 (c).

Add the following new Sub-Clause:

PSLB 5.2.5 Stone Bedding (New Sub-Clause)

In areas where waterlogged conditions exist or where ordered by the Employer's Agent, special drains consisting of a 150 mm thickness (See PSDB 5.5) of single sized stone with a geofabric filter surround ("Bidim" Grade A4 or similar approved) extending the full width of the trench shall be provided below the bedding to the pipes. The excavation for these drains will be measured in cubic metres at the contract rate applying to unsuitable excavation below the bottom of the trench. The stone filling will be paid for per cubic metre and the geofabric filter will be paid for per square metre. All measurements in this connection will be to a width equal to the base widths and depths ordered.

PSLB 5.3(b) Selected Fill Blanket

Delete "200 mm" from title.

PSLB5.4 Concrete Casing to Pipes

Add to the Sub-Clause:

Where concrete casing is ordered by the Employer's Agent it is to be of grade 20/19 concrete with a minimum thickness of 150 mm above the top of the pipe.

PSLB 6 TOLERANCES

PSLB 6.1 Moisture Content and Density

Add to the Sub-Clause:

The permissible deviations applicable are to be those for Degree of Accuracy II class of work.

PSLB 8 MEASUREMENT AND PAYMENT

PSLB 8.1.3 Volume of Bedding Materials

Add to the Sub-Clause:

(c) The volume of bedding material shall be measured net, i.e, the volume of the pipe is to be deducted.

PSLB 8.1.6 Freehaul

Delete the Sub-Clause and substitute the following:

All haul will be regarded as free haul. No overhaul will be paid for under this Contract.

PSLB 8.2.1 Provision of Bedding from Trench Excavation

Delete the Sub-Clause and substitute the following:

Without the need for screening:

(a) Selected granular material..... Unit : m³
(b) Selected fill material..... Unit : m³

The rates shall cover the cost of acquiring, from any point along the trench excavation, bedding that complies with the relevant requirements of the specification, of delivering it to points alongside the trench spaced to suit the Contractor's methods of working, of making good any backfill deficiency from points where backfill has been acquired, and of disposing of displaced material.

Including for screening:

(a) Selected granular material..... Unit : m³
(b) Selected fill material..... Unit : m³

The rates shall cover the cost of screening or otherwise treating excavated material, at any point along the trench excavation, in order to produce bedding that complies with the relevant specification, delivering it to points alongside the trench, spaced to suit the Contractor's methods of working, of making good any backfill deficiency there may be from points where screened backfill material has been acquired, and of disposing of displaced material.

NOTE: The rate for the supply and laying of pipelines covers the cost of handling the bedding material from alongside the trench, placing it under the pipeline, forming joint holes and completing the bedding around and over the pipeline.

PSLB 8.2.3 Concrete Bedding Cradle

Add the following paragraph to the Sub-Clause:

“All concrete bedding to pipes will require formwork. The rate for concrete bedding shall include for the supply, installation and stripping of all formwork.”

PSLB 8.2.4 Encasing of Pipes in Concrete

Delete the fifth and sixth lines and substitute the following:

“encasing the pipe in concrete 150 mm thick each side of the pipe and to 150 mm above the crown of the pipe including the cost of formwork, (if any), etc. and the cost of formwork to form stopends on either side of collars, couplings, joints etc if instructed by the Employer’s Agent and substitute along the length of the pipeline as shown on the drawings or scheduled, or, if instructed by the Employer’s Agent, on either side of collars, couplings, joints, etc."

The rate for concrete encasing shall include for the supply, installation and stripping of all formwork.” Unit : m

PSLB 8.2.5 Overhaul of Material for Bedding Cradle and Selected Fill Blanket

Delete the Sub-Clause.

Add the following new Sub-Clause:

PSLB 8.2.6 Drainage Layer (New Sub-Clause)

Supply and place beneath pipe, 150 mm crushed stone layer as ground water drainage layer. The excavation for these drains will be measured in cubic metres at the tendered rate applying to unsuitable excavation below the bottom of the trench (SANS 1200 DB 8.3.2 c).

The rate for stone Filling shall be per cubic metre of stone fill, measured according to a width equal to the base widths and depths ordered. Unit : m^3

Supply and installation of geofabric filter material (BIDIM Grade A4 or similar) around stone. The rate shall be per square metre of geofabric to enclose the stone material, measured net according to a width equal to the base widths and depths ordered. Unit : m^2

PSLB 8.2.7 Royalty Payment for Borrow Pit

A Provisional Sum has been provided for the compensation of landowners for the procurement of selected bedding and blanket material from existing borrow pits and/or sand sources.

Unit: Prov Sum

C3.7.14 PSLC: CABLE DUCTS
(Applicable to SANS 1200 LC - 1981)

PSLC 3 MATERIALS

Add the following to LC 3.1:

Pipes for services ducts shall be:

- Class 34 main core sewer pipes (DN160 or DN350),
- Precast concrete pipes with ogee joints and rubber collars (≥ DN450).

PSLC 5.9 Duct Route Markers

Add the following to LC 5.9:

Markers blocks shall consist of a 300 mm x 1000 mm concrete block with a “W” embedded into the section of concrete that will be above ground. The markers shall be painted red with the lettering in black.

PSLC 8 MEASUREMENT AND PAYMENT

PSLC 8.2 Scheduled Items :

PSLC 8.2.5 Supply, Lay, Bed, Joint, and Prove Duct

Replace LC 8.2.5 with the following:

The unit of measurement shall be the linear metre (m) service duct pipe laid. The rate tendered shall include the procuring and furnishing of the pipe and couplers and the labour and equipment to lay, joint and bed the pipe to the required grade.

Replace LC 8.2.8 as follows:

PSLC 8.2.6 Duct Route Markers

The unit of measurement shall be the N° of duct route markers installed. The route markers tendered shall cover the cost of the manufacture and installation of the markers, the inscribing of the lettering, the painting of the markers and the preparation and submitting of records of all duct route markers.

C3.7.15 PSLD: SEWERS
(Applicable to SANS 1200 LD - 1982)

PSLD 2 INTERPRETATIONS

PSL 2.3 Definitions

Add to the Sub-Clause:

Flexible pipe: All Concrete, Steel, HDPE and uPVC pipes to be installed under this Contract shall be defined as being flexible pipes for bedding purposes.

PSLD 2.4 Additional Abbreviations

Add to the Sub-Clause:

HDPE: High density polyethylene.

PSLD 3 MATERIALS

PSLD 3.1 Pipes, Fittings and Pipe Joints

PSLD 3.1.3 AC Pipes

Delete 3.1.3 and all other reference in the specification for AC pipes.

PSLD 3.1.5 uPVC Pipes

Replace LD 3.1.5 with the following:

All pipes shall be heavy duty uPVC (Class 34) fitted with integral spigot and socket joints with rubber rings. The pipes shall comply with the relevant requirements of SANS 791.
Add the following new Sub-Clause:

PSLD 3.1.9 Quality Control (New Sub-Clause)

The Contractor shall ensure that all materials used in the execution of the Contract comply with the technical requirements specified. The Contractor shall maintain accurate and up to date records of all materials, processes, process parameters and measurements necessary to ensure compliance with this specification.

PSLD 3.5 Manholes, Chambers, etc

PSLD 3.5.2 Precast Concrete Sections

Add the following to LD 3.5.2:

Precast concrete sections shall comply with the provisions of Clause 3.5.2 of SANS 1200 LD. Dolomitic aggregate is not required.

PSLD 3.5.4 Concrete

Add the following to LD 3.5.4:

Due to non-availability, on reasonable proximity, dolomitic aggregates are not specified for use on the Works.

PSLD 3.5.5 Sand

Add the following to LD 3.5.5:

Due to non-availability, on reasonably proximity, dolomitic sands are not specified for use on the Works.

PSLD 3.5.8 Manhole Covers and Frames

Add the following to LD 3.5.8:

Precast concrete manhole covers, and frames shall comply with the applicable requirements of SANS 1294 and to the details shown on the Drawings. The precast concrete lid cover shall be so designed as to withstand a point load, as specified in Clause 7.1.2 of SANS 1294, in the centre of the lid

Manhole covers shall be 560 x 150 mm thick precast concrete circular covers with galvanised iron rim as per Drawing.

Where cast iron manhole covers and frames are installed, all exposed portions of the cast iron cover and frame shall be thoroughly cleaned and painted with two coats of epoxy tar, with particular attention being paid to the painting of the underside of the covers and frames.

PSLD 5 CONSTRUCTION

PSLD 5.2.1 Preliminary Inspection

Add to the Sub-Clause:

The Contractor will be responsible for clearing the areas required for pipe storage that shall include the removal of rock, stones and all combustible material. He shall also be responsible for maintaining the area in a clean and tidy condition and securing the site for the duration of the Contract. No separate payment will be made for this operation.

Upon delivery of the pipes, fittings, specials and valves, these will be inspected by the Contractor. Any material found to be damaged shall be returned to the factory for repair or replacement; in which case the costs of additional transport, repair or replacement shall be borne by the Contractor.

The Contractor will be held fully responsible for the care and safety of all pipes and fittings, etc, on site, and shall bear the cost of all renewals, which may be necessary to make good losses, damages or breakages. Furthermore, he shall be fully responsible for handling and re-loading material at the storage areas and for transporting and offloading of all such materials at their correct places along the pipeline route."

Add the following Sub-Clause:

"PSLD 5.2.6 Inundation of Pipe Trenches and Floating of Pipes (New Sub-Clause)

Should trenches be inundated by water, there is a risk of movement of the pipes by flotation. The Contractor shall ensure that trenches are not flooded by stormwater and that pipes laid in the trench are backfilled as soon as possible after laying, except at joints made with couplings or flanges which must be kept visible until the pipeline has been satisfactorily tested.

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Should movement of the pipes occur, the Contractor shall remove the pipes from the trench and thoroughly clean and relay the pipes. This work shall be carried out at the Contractor's expense."

PSLD 5.3 Sewers to be Kept Clean

Add to the Sub-Clause:

The Contractor shall take all of the steps necessary to prevent flooding of the Works and hence ensure that all work is carried out in the dry, and that the ingress of dirt and or dirty water into the pipes is prevented.

The Contractor shall ensure that all pipe work is installed internally free of any contaminants. All traces of dirty water, swarf, cuttings, coupons, grinding dust, dirt and other debris are to be removed from the inside of the pipe as it is installed.

The Contractor shall ensure that all dust, grit and powder that accumulates in the pipe as a result of grit blasting for the repair of internal linings, be removed from the pipe in an acceptable manner before the internal lining repairs are carried out.

The Contractor shall take note that flushing of the completed pipeline may not be allowed after construction has been completed and therefore clean house-keeping practices will be required under all circumstances during construction. The tendered rates for pipe laying shall include for the clean house-keeping practices required.

Each section of the pipeline is to be internally inspected and passed by the Employer's Agent once construction has been completed. If the pipework is not satisfactory, the Contractor shall re-clean the pipe at his/her own expense until the pipe is passed clean. The Employer's Agent reserves the right to utilize cameras or any other means to inspect inaccessible areas.

PSLD 5.4 Connections to Manholes

Replace LD 5.4 with the following:

The ends of uPVC sewer pipes built into manholes shall have clean dry sand glued to the outside using special PVC Cement, Tangit or similar approved.

PSLD 5.6 Manholes, Inspection Chambers, etc.

PSLD 5.6.1 General

Add the following:

The underside of all manhole roofs and edges of the access opening therein and precast concrete covers and lids shall be painted with two coats of "Proofex 3", as supplied by Fosroc (Pty) Ltd, P O Box 477, New Germany, 3620, or similar approved rubberized bitumen coating so as to protect the concrete from the effects of sewage gases.

The tendered rates for manholes shall include for this work.

PSLD 5.6.2 Benching

Add the following to LD 5.6.2:

Concrete for benching shall be 25 MPa concrete with 13 mm stone.

PSLD 5.6.5 Precast Concrete Manholes

In the first sentence delete "Drawing LD-5" and replace with "the drawings"

PSLD 5.7 Concrete Casing to Pipes

Add the following*:*

Where concrete casing is ordered by the Employer's Agent, it is to be of grade 20/19 concrete with a minimum thickness of 150 mm above the top of the pipe.

PSLD 6 TOLERANCES

PSLD 6.2 Overall Centreline Control and Manhole Locations

Replace the first and last sentences of LD 6.2 with the following sentences:

The permissible deviation of the location in plan of the centreline of the sewer from the designated location shall be ±100 mm.

The permissible deviation in location along the centreline for manholes and chambers not situated at control points shall be ±100 mm.

PSLD 6.3 Manholes Invert Levels

Replace LD 6.3 with the following:

The permissible deviation from the designated level of the invert at each manhole shall be ±10 mm.

PSLD 6.5 Manholes and Chamber Structures

Add the following to LD 6.5:

The depth of each manhole or chamber shall not deviate from the designated depth by more than ±50 mm measured from invert level to top of cover level.

PSLD 7 TESTING

PSLD 7.2 Tests and Acceptance/Rejection Criteria

PSLD 7.2.6 Watertightness of Manholes

Replace LD 7.2.6 with the following:

All sewer manholes shall be completely watertight on completion of construction. On completion of each manhole a watertightness test will be called for by the Employer's Agent. This will be carried out by plugging the incoming and outgoing pipelines, filling the manhole with clean water and leaving it for a period of 24 hours to "take-up". Thereafter, the water level shall again be topped up and the manhole left for a further period of 24 hours after which the drop-in water level over the second 24 hours period shall be measured. Should this exceed a figure of 10 mm per meter of water depth then the manhole will be deemed to have failed the test and the Contractor will be required to carry out, at his/her own expense, whatever repairs may be necessary to seal the manhole and render it capable of passing the test as specified.

PSLD 8 MEASUREMENT AND PAYMENT

PSLD 8.2 Scheduled Items

PSLD 8.2.3 Manholes Unit : No

Add the following to LD 8.2.3:

The depth of manholes shall be measured from invert level to top of finished cover level.

PSLD 8.2.4 Extra over Backdrops/Drop Manholes Unit : No

The rate tendered shall include for all material, labour and plant to construct the drop manholes as per drawing.

Separate items will be scheduled for different drop heights.

PSLD 8.2.6 Extra-over Items for erf connections

Extra over erf connection for 100 mm dia x 45° bends.....Unit : No

Extra over erf connection for 100 mm dia pipe ..... Unit : metres

The tendered rates shall include for material and labour to install bends and pipes that may be required additional to the standard erf connections shown on the drawings.

The tendered rate shall include full compensation for excavation, making an opening in the existing manhole, installing new pipes in the new opening, breaking out and modifying the channelization inside the manhole to suit the new pipe layout, ensuring the watertightness of the new connection, supplying all the necessary materials, removing surplus material and debris, all labour and equipment required to make the connection, liaison with the local authorities and for dealing with flow of sewage in the existing manhole during the intervening period of time.

Add the following new subclause:

PSLD 8.3 "Watertightness Testing of Manholes Unit : No

The rate tendered shall cover the cost of providing expanding plugs, water and all labour and attendance required for and during the test as specified in PSLD 7.2.6 and for pumping out of water on completion to enable the expanding plugs to be removed. Retesting in the case of failure of a test will not be measured for payment."

C3.7.16 PSLE: STORMWATER DRAINAGE
(Applicable to SANS 1200 LE - 1982)

PSLE 3 MATERIALS

PSLE 3.1 Culvert units and Pipes

PSLE 3.1(a) Precast concrete pipes

Add the following to LE 3.1(a)

“Concrete pipes shall be with ogee joints and rubber collars and manufactured in conformity with the latest SANS 677 specification for type SC pipes. The class of pipe to be used will be selected by the Engineer from the classes listed in the Schedule of Quantities to suit the varying cover depth and types of bedding.”

PSLE 3.1(c) Precast Portal and Rectangular Concrete Culverts

Add to the Sub-Clause:

"Design calculations shall be submitted to the Employer’s Agent for approval before precast culverts are manufactured."

PSLE 3.1 (d) Skewed Ends

Add to the Sub-Clause:

"Wherever required skew ends may be cut on Site."

Add the following new Sub-Clauses:

“PSLE 3.1 (f) Corrugated Metal Pipe Culverts and Pipes

The materials and manufacture of nestable and riveted metal culverts and pipes shall conform with the Contractor’s design which shall be carried out in accordance with ASTM A796 “Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches”.

PSLE 3.1 (g) Pipes for Subsoil Drains

Pipes for subsoil drains shall have the specified internal diameter, which shall not be less than 100 mm, and shall be slotted uPVC or HDPE pipes with a wall thickness in accordance with Class 4 pressure pipes to SANS 966 or SABS ISO 4427.

The size of the perforations in perforated pipes shall in all cases be 8 mm +1,5 mm diameter and the number of perforations per metre shall not be less than 26 for 100 mm pipe and 52 for 150 mm pipe. Perforations shall be spaced in two rows for 100 mm pipes and four rows for 150 mm pipes, except where shown otherwise on the drawings.

Slotted uPVC or HDPE pipes shall have a slot width of 8 mm with a tolerance of 1,5 mm in width. The arrangement of slots shall be to the Employer-s Agent’s approval but the total slot area shall not be less than specified for the perforations."

PSLE 3.1(h) Synthetic – Fibre Filter Fabric

The filter blanket shall consist of "non-woven" spun bound polyester fabric having a mass of 210g/m², permeability of 0,003 m/s and multi-direction tensile strength of 16 000N/m such as KAYMAT Grade U24.

PSLE 3.4 Manholes, Catchpits and Accessories

PSLE 3.4.1 Bricks

Add to the Sub-Clause*:*

The brickwork shall consist of good quality burnt clay common bricks manufactured in accordance with SANS 227 specification, or cement bricks manufactured in accordance with SANS 987 specification, uniform in size and shape laid in stretcher bond style with the skins tied together with galvanised crumped wire wall ties. Brick force shall be placed every fourth course."

ADD NEW SUBCLAUSES:

"PSLE 3.6 Concrete

Concrete shall comply with the relevant requirements of SANS 1200 G or SANS 1200 GA, whichever is included in the Project Specifications.

PSLE 3.7 Permeable Material for Groundwater Drains

Permeable filter materials for groundwater drains shall consist of crushed stone of suitable grading and shall conform to the following requirements:

Crushed stone shall be clean, hard single sized stone and shall be free from shale, clay and other deleterious substances. The aggregate crushing value of the stone shall not exceed 30 when tested in accordance with TMH 1 Test Method B1."

PSLE 5 CONSTRUCTION

PSLE 5.1 Trench Bottom

PSLE 5.1.3 Unsuitable Founding Conditions

In the fourth line replace "90 %" with "93 %, or as specified by the Employer's Agent".

PSLE 5.1.4 Width of Excavation

Add to Sub-Clause (a) Portal and Rectangular Culverts:

Wherever possible portal and rectangular culverts shall be laid under trench conditions. In the case of a culvert to be installed in fill, the compacted fill shall first be constructed to a height of 300 mm above the top of the proposed culvert before excavating in the fill for the culvert.

A working width of 600 mm each side shall be allowed for rectangular culverts

Add to Sub-Clause (b) Pipe Culverts:

Wherever possible pipe culverts shall be laid under trench conditions. In the case of a culvert to be installed in fill, the compacted fill shall first be constructed to a height of 300 mm above the top of the proposed culvert before excavating in the fill for the culvert.

The trench width shall not exceed the outside diameter of the pipe plus 600 mm.

PSLE 5.2 Bedding and Laying

PSLE 5.2.2 Pipe Culverts

Add to the Sub-Clause:

The bedding for stormwater pipes shall be to the requirements for Class C bedding of SANS 1200 LB, unless otherwise specified or shown on the Drawings.

The ogee joints shall be fitted with 200 mm x 6 mm rubber sealing collars conforming to the latest SANS 4633 specification and with a shore hardness of approximately 40 degrees, or alternatively, the ogee joints shall be primed and double wrapped in accordance with the manufacturer's recommendations with 200 mm wide wrapping tape, type CDP or similar approved.

PSLE 5.2.3 Concrete Casing of Pipelines

In the second line of the Sub-Clause replace "mix 15" with "grade 15/19".

PSLE 5.2.5 Portal and Rectangular Culverts

Add the following to LE 5.2.5 (a).

"Precast Portal and rectangular culverts shall be constructed on cast in-situ floor slabs. Culvert inlets and outlet slabs, wingwalls and headwalls shall also be cast in-situ. Cast in-situ concrete shall be measured under the relevant items in section 4: Concrete (Small works). Precast Culverts to be installed shall be the Rocla type 100 SRP or similar approved constructed as indicated on the drawings."

Add the following new Sub-Clause:

"PSLE 5.2.6 Construction of Groundwater (Subsoil) Drains

Groundwater (Subsoil) drains shall be constructed where directed by the Employer's Agent.
'

On completion of excavation, and in lieu of any other type of pipe bedding layer, the trench shall be lined with geotextile as scheduled or as shown on the Drawings ("Bidim" Grade A4 or similar approved). The geotextile fabric shall extend sufficiently on each side of the trench such that the entire stone layer can be protected on the sides of the trench with the fabric.

A layer of permeable material of the class and thickness as shown on the Drawings shall be placed on the bottom of the trench (on top of the geotextile material) and lightly tamped and finished to the required gradient. The minimum thickness of the permeable stone bedding layer shall be 150 mm.

Pipes of the type and size required shall then be firmly bedded on top of the permeable bedding layer true to level and grades coupled where required.

The trench shall then be backfilled in layers not exceeding 100 mm with further permeable material to such height above the pipes as shown on the Drawing or directed by the Employer's Agent for the blanket layer. The permeable material shall be lightly compacted and finished to the required level. The trench must be specially protected against the ingress of water before completing the impermeable layer.

When placing successive layers, the lower layer shall not be walked on or disturbed more than can be avoided. Care shall be taken to prevent the contamination of permeable material during construction of the groundwater (subsoil) drains and all permeable material contaminated by soil or silt shall be removed and replaced by the Contractor at his/her own expense.

The top of the blanket layer must be sealed with the geotextile fabric by folding the fabric over the top from each side and ensuring that there is at least 150 mm overlap of the fabric before conventional backfilling of the trench may proceed.

Where plain butt joint pipes are used they shall be laid firmly together to prevent infiltration of backfill material. Perforated and slotted pipes shall be joined by couplers. Perforated pipes shall be laid with the perforations at the bottom, as instructed.

The higher end of groundwater (subsoil) pipe drains shall be sealed off with a cap or a loose concrete cap of Class 20/19 concrete, as shown on the Drawings, and at the lower end the pipe drain shall be built into a concrete headwall providing a positive outlet or connected to stormwater pipes or culverts."

PSLE 5.2.7 Stone Bedding (New Sub-Clause)

In areas where waterlogged conditions exist or where ordered by the Employer's Agent, special drains (See PSDB 5.2.6) consisting of single sized stone with a geofabric filter surround ("Bidim" Grade A4 or similar approved) extending the full width of the trench shall be provided below the bedding to the pipes. The excavation for these drains will be measured in cubic metres at the contract rate applying to unsuitable excavation below the bottom of the trench. The stone filling will be paid for per cubic metre and the geofabric filter will be paid for per square metre. All measurements in this connection will be to a width equal to the base widths and depths ordered.

PSLE 5.5 Catchpits, Manholes, Inlets, and Outlet Structures

PSLE 5.5.3 Plaster

Preface the Sub-Clause with the following:

"All catchpits shall be constructed in brick and plastered internally."

In the fourth line replace "steel trowel" with "wooden trowel".

PSLE 5.6 Culverts on Steep Gradients

In the fourth line delete "mix 10" and replace with "grade 10/40"

In the seventh line delete "mix 15" and replace with "grade 15/19"

Add the following new Sub-Clauses:

"PSLE 5.8 Open Drains (New Sub-Clause)

Open drains shall be constructed to the details shown on the drawings, or as directed by the Employer's Agent, to the correct line, level and cross-section. The material excavated from open drains shall be stockpiled for future cover.

Measurement of open drain excavation shall be calculated from natural ground level or, in the case of drains within a road reserve, from the reduced level in the road excavation, and payment shall be made on a rate per m^3 basis irrespective of depth. The rate shall include for all work required to trim the drain(s) to the correct line and level.

PSLE 5.9 Stone Pitching (New Sub-Clause)

Where ordered by the Employer's Agent, open drains, stormwater outlets, etc, shall be pitched with stone. Stone for pitching shall be of good, sound, durable rock of good shape and face, with a minimum size of 100 x 100 x 75 mm deep. Before pitching is commenced, all slopes and surfaces to receive pitching shall be carefully trimmed and dressed to the correct lines and grades. The pitching stones shall be laid with joints broken as much as possible and shall be hammered solid into position to present a regular and uniform surface. All joints shall be grouted to their full depth in 4:1 cement mortar.

PSLE 5.10 Cutting of Pipes (New Sub-Clause)

As far as is possible culvert lengths shall be such that pipe units need not be cut. Should any straight of skew cuts be necessary, such cutting will not be measured and paid for separately in terms of Sub-Clause 8.2.4 since all additional work required in cutting the pipes, as well as the wasted pipe ends shall be regarded as being included in the payment for the supply, lay, joint, bed and test of the relevant pipe culverts, as per Sub-Clause 8.2.1.

PSLE 5.11 Demolishing of Minor Drainage Structures (New Sub-Clause)

The Contractor shall make the necessary measurements and submit a method statement for the approval of the Employer's Agent. Upon receiving notice of the Employer's Agent's approval, the Contractor shall demolish the structure, remove all rubble to an approved spoil site, backfill the excavation and compact to 90% mod AASHTO and make good the ground surface. The reinstatement of road surfaces or paving shall be paid separately. The price for demolishing minor drainage structures shall include the cost of dealing with stormwater flow during the procedure and the testing and re-instatement of normal flow upon completion."

PSLE 8 MEASUREMENT AND PAYMENT

PSLE 8.2 Scheduled Items

PSLE 8.2.1 Supply and Lay Concrete Pipe Culverts

Delete the description of the Sub-Clause and replace with:

"PSLE 8.2.1 Supply, Lay, Joint, Bed and Test Pipelines Unit: m"

Add to the Sub-Clause:

"The bedding shall be Class C, unless otherwise specified or shown on the drawings.

The rates shall cover the cost of providing the pipes as well as the cost of laying, bedding, jointing, and making connections into manholes, including dealing with stormwater flow and testing the pipeline. The rate tendered shall include for the supply and installation of all rubbers collars required for the pipelines."

PSLE 8.2.2 Supply and Lay Precast Culverts……..Unit : m

Add the following to LE 8.2.2:

"Precast culverts to be installed as detailed on the Drawing shall be Rocla Type 100SRP, or similar approved, constructed on a cast in-situ floor slab. The rate tendered shall exclude the floor slab which will be measured under Section 4: Concrete Small Works. The tendered rates shall include for mortar bedding and mortar filling and Geofabric strips over joints.

PSLE 8.2.4 Extra Over Items 8.2.1 and 8.2.2 for Cutting End Units for Culverts on Site

Delete this Sub-Clause as no extra payment will be made for cutting end units for culverts.

PSLE 8.2.8 "Supply and install Manholes, Catchpits Drop Inlets, Headwalls and Wingwalls Unit : No

Add the following to LE 8.2.8:

Manholes, Catchpits, Drop Inlets, Headwalls and Wingwalls constructed will be measured and paid for as complete units.

The tendered rate shall include for all materials, plant labour, supervision and incidentals for the construction of the drainage units complete and in accordance with the drawings.

The tendered rate shall further include for all necessary excavation in all materials, backfilling and disposal of surplus materials, formwork, concrete, benching, concrete finish, reinforcement, precast elements, steel channels and grids, step irons and all other items not specifically measured elsewhere, necessary for completion of the unit in accordance with the drawings.

The tendered rate shall include for all costs involved in complying with the requirements of the relevant specifications in respect of the individual types of work involved in completion of the units.

The tendered rates shall exclude for excavation in intermediate and hard material, payment for which shall be made as an extra over in the Bill of Quantities.

"The brickwork shall consist of good quality burnt clay common bricks manufactured in accordance with SANS 227 specification, or cement bricks manufactured in accordance with SANS 987 specification, uniform in size and shape laid in stretcher bond style with the skins tied together with galvanised crumped wire wall ties. Brick force shall be placed every fourth course."

Manholes, catchpits, drop inlets, headwalls and wingwalls will be classified as per the drawings. The Contractor shall allow in his overall rates for the various types and sizes of manholes, catchpits, drop inlets, headwalls and wingwalls for the complete construction of the manholes, catchpits, drop inlets, headwall and wingwalls, including benching and all accessories (where required)."

Where manholes have to be constructed within the road carriageway the manhole covers and frames shall be heavy duty (HD). The strength of manhole walls to be checked for additional traffic loads.

The rate tendered shall include the supply and construction of the masonry sections as detailed, supply and construct of bricks of grade specified and finishing and cleaning of the structure.

The rate shall also include any cast insitu, or precast concrete lids or covers complete as detailed and shall include all formwork, reinforcing, concrete, finishing and hooks required, in accordance with the drawings for manholes catchpits drop inlets, or headwalls and wingwalls."

Add the following new Sub-Clauses:

PSLE 8.2.14 "Supply, Lay and Bed Subsoil Pipes

(i) Slotted uPVC Pipe or Similar Approved ..... Unit : m

The unit of measurement shall be the linear metre (m) of pipe laid. The rate tendered shall be for the supply, lay, joint, bed, test and proving of the subsoil pipes and shall include the procuring and furnishing of the pipe and couplers and the labour and equipment to lay, bed, joint, test and prove the pipe to the required grade.

(ii) Slotted HDPE pipe or similar approved ..... Unit : m

The unit of measurement shall be the linear metre (m) of pipe laid. The rate tendered shall be for the supply, lay, bed, joint, test and proving of the subsoil pipes and shall include the procuring and furnishing of the pipe and couplers and the labour and equipment to lay, joint, test and prove bed the pipe to the required grade.

(iii) Geofabric for the subsoil drain ..... Unit : m

The unit of measurement shall be the square metre (m²) of geofabric material (BIDIM Grade A4 or similar) installed around stone. and shall include for a 300 mm overlap. The rate tendered shall be for the supply and installation of the geofabric and shall include the procuring and furnishing of the geofabric and all labour and equipment necessary to install the geofabric for the subsoil drain. The geofabric material shall be measured net according to a width equal to the base widths and depths ordered by the Employer's Agent ..... Unit: m²

(iv) Drainage Layer (New Sub-Clause)

Supply and place beneath pipe the 19mm single-sized crushed stone layer as ground water drainage layer (as detailed on the Drawings. The excavation for these drains will be measured in cubic metres at the tendered rate applied elsewhere.

The rate for stone filling shall be per cubic metre of stone fill, measured according to a width equal to the base widths and depths ordered. ..... Unit: m³

PSLE 8.2.15 Stone Pitching Unit: m²"

Payment for stone pitching (PSLE 5.9) shall made at a rate per unit finished area and the rate shall include for all trimming and dressing of the excavation, laying of the stones and grouting of the joints.

PSLE 8.2.16 Demolish Drainage Unit of the Type, Size Category and Depth Stated in the Bill of Quantities, Including Dealing with Stormwater Flows (Provisional) .Unit : No (Prov)"

The demolishing of manholes, catchpits, headwalls, wingwalls and any other minor drainage unit (PSLE 5.11) shall be measured and paid for as complete units demolished and all rubble removed to approved spoil sites and the excavation backfilled and compacted to 90 % Mod AASHTO and the ground surface made good. The rate for demolishing minor drainage structures shall include for the cost of dealing with stormwater flow during the procedure and the testing and re-instatement of normal flow upon completion.

The reinstatement of road surfaces or paving shall be measured and paid separately.

PSLE 8.2.17 Connection to Existing Manhole:

(a) (State pipe diameter and type)..... Unit: Sum

(b) Etc for other diameters and types

The tendered rates shall include for the supply of all labour, plant and materials, forming an opening in the existing manhole, installing the new pipe in the new opening, grouting and sealing watertight around the pipe, breaking out the existing benching and channels where required and reconstructing them complete with rendering to suit the new pipe arrangement, disposing of all debris off site and backfilling around the manhole.

PSLE 8.2.18 Breaking into Existing Stormwater Pipe:

(a) (State new pipe diameter and type)..... Unit: No

(b) Etc for other new pipe diameters and types

The tendered rates shall include for the supply of all labour, plant and materials, removing a section of the existing stormwater pipe, installing the new pipe, constructing a complete new manhole, grouting and sealing watertight around the pipes, disposing of all debris off site and backfilling around the manhole."

C3.7.17 PSLF: ERF CONNECTIONS
(Applicable to SANS 1200 LF - 1983)

PSLF 1 SCOPE

Delete 1.1 and replace with :

This specification covers the general construction requirements for connections from water reticulation mains to individual erven.

PSLF 2 CONSTRUCTION

PSLF 2.1 Service Connections

Add the following :-

PSLF 2.1.1 General

The Provision of service connections in accordance with the Drawings, the standardised specifications as applicable and with these specification clauses forms part of the Contract. One connection off the main shall generally be provided for each of two erven.

PSLF 2.1.2 Construction

Service connections shall consist of HDPE pipes.

Excavation and backfill shall comply with the relevant clauses of the standardised specifications.

Holes for ferrules shall be drilled and not punched. On pipes in which ferrules are intended to be fitted while the pipes are under pressure, an approved special drilling and tapping machine shall be used.

Any length of pipe showing leakage when tested under the test pressure specified for the water supply main will be considered a defective sections and the pipe length with the defective section shall be replaced and retested by the Contractor at his/her own expense.

PSLF 8 MEASUREMENT AND PAYMENT

The different types of house connections as per the Drawings consists of the following pipes and specials :

PSLF 8.2.2(i) Type 1 (Single short) Unit : Number

20 mm x ¾ " Male Threaded Adapter	1 N°
20 mm dia HDPE class 10 pipe	3 m
20 mm dia Ball valve	1 N°

PSLF 8.2.2(ii) Type 2 (Single long) Unit : Number

20 mm x ¾ " Male Threaded Adapter	1 N°
20 mm dia HDPE class 10 pipe	10 m
20 mm dia Ball valve	1 N°

PSLF 8.2.2(iii) Type 3 (Double short) Unit : Number

25 mm x ½" Male threaded adapter	1 N°
20 mm x ½" Female Threaded Tee	1 N°
20 mm x 90° Elbows	2 N°
25 mm Dia HDPE class 10 pipe	3 m
20 mm Dia HDPE class 10 pipe	2 m
25 mm x ¾ " Male threaded adaptor	1 N°

PSLF 8.2.2(iv) Type 4 (Double long). Unit : Number

25 mm x ½" Male Threaded adapter	1 N°
20 mm x ½" Female Threaded Tee	1 N°
20 mm x 90° Elbows	2 N°
25 mm Dia HDPE class 10 pipe	9 m
20 mm Dia HDPE class 10 pipe	2 m
25 mm x ¾ " Male threaded adaptor	1 N°

PSLF 8.2.4 Water Meters Unit : Number

The rate shall cover the cost of supplying the meter and box and all other material for installation as shown on the Drawings.

C3.7.18 PSLM: ROADS (GENERAL) (SABS 1200 M)
(Applicable to SANS 1200 M – 1996 First Revision)

PSLM 6 TOLERANCES

PSLM 6.3 Frequency of Checks

Replace the table in M 6.3 with the following table:

OPERATING CONSTRUCTION TOLERANCES BEING CHECKED	FREQUENCY OF CHECKS	
	Length of roadway to which one measurement is applied	Number of measurements per lot (minimum)
Grade (surface levels)	20 m	3 points per x-section
Width of Section	100 m	
Thickness of		
a) Selected layer	100 m	3
b) Subbase	40 m	3
d) Base	40 m	3
Cross-section	20 m	-
Smoothness	40 m	-
Cut and fill Slopes	20 m	-

C3.7.19 PSME: SUBBASE
(Applicable to SABS 1200 ME – 1981)

PSME 1 SCOPE

This specification covers the requirements for the subbase and gravel shoulder layer. It is intended to utilise G5 minimum quality US Base material, from commercial sources, mechanically modified with specified cement as subbase.

PSME 3 MATERIALS

PSME 3.2 Physical Properties

Clause 3.2 of SANS 1200 ME shall be replaced with Clause 3.3.3 and Clause 3.3.6 of SANS 1200 M (Specification requirements for G5 quality materials).

The maximum stone size shall be 37.5 mm.

PSME 3.5 Selection

Add the following to ME 3.5:

Before the stabilised material is compacted, it shall first be thoroughly mixed by a grader or other suitable plant so as to obtain an even mix. Water shall be sprayed evenly over and mixed into the material to bring it to the correct uniform moisture content. The moisture content to which the material shall be brought shall be just sufficient to bring the material to the optimum moisture content for the compacting equipment being used and the compaction required."

PSME 5 CONSTRUCTION

PSME 5.2 Excavation

PSME 5.2.2 Borrow Pits

Add the following to ME 5.2.2:

"Natural gravel will be from commercial sources, but should the Contractor have his/her own source this will be acceptable, provided that test results submitted by the Contractor proves the material to be of acceptable quality."

PSME 5.4 Placing and Compaction

PSME 5.4.1 Placing

Add the following to ME 5.4.1:

"Approval of underlying layers must be obtained in writing from the Employer's Agent prior to any construction of subbase layers."

PSME 5.4.4 Compaction

Add the following to ME 5.4.1:

The G5/C4 subbase layer shall be compacted to minimum 95% Mod AASHTO density.

"PSME 5.4.4.3 Thicknesses

The thicknesses of the layers after compaction shall be the thicknesses shown on the Drawings."

PSME 5.7 Transport

PSME 5.7.1 Freehaul

"All haul from commercial sources or from designated borrow pits shall be regarded as freehaul."

Add the following new Sub-Clauses:

"PSME 5.8 Weed Killer

The subbase layer shall be treated before compaction by applying and mixing in granular 'HYVAR X', or similar approved, weed-killer in accordance with the manufacturer's instructions.

PSME 5.9 Insecticide

An approved insecticide such as 'Termidor', or similar approved, insecticide shall be applied strictly in accordance with the manufacturer's instructions over the total area of the subbase. The Employer's Agent's Representative will issue instructions as to whether the poison shall be applied before or after compaction of the layer."

PSME 8 MEASUREMENT AND PAYMENT

PSME 8.1 Basic Principles

Delete Sub-Clause (b) and replace with:

"(b) that the provision of material shall be paid for once only;"

Delete Sub-Clause (d) and replace with:

"(d) that, in the case of material from a commercial sources or from borrow pits selected and/or established by the Contractor, no additional payment shall be made for the class of excavation, method of processing (except stabilizing), or overhaul."

PSME 8.3 Scheduled Items

PSME 8.3.2 Construct the Subbase/Shoulders/Gravel Wearing Course with G5 Minimum Quality Material from Designated Excavations

Add to Sub-Clause (a):

"Supply and construct to the thicknesses shown on the Drawings G5 subbase layer and compact to 95% Mod AASHTO density. The maximum stone size shall be 37,5 mm.

The rate tendered shall include the basic selection, transporting from the source to the point of depositing on the road, spreading, mixing, watering, compacting, final grading, complying with the tolerances and testing of the natural gravel.

Irrespective of whether it becomes absolutely necessary to stockpile the material for later use, the rate shall be deemed to include compensation for stockpiling, shaping and grading the stockpile so that it is free-draining and for loading and transporting the material to the road."

PSME 8.3.3 Construct the Subbase Course/Shoulders/Gravel Wearing Course with Material from Commercial Sources or Designated Borrow Areas

Replace the above descrption of the item with the following:

"PSME 8.3.3 Construct the Subbase/Shoulders/Gravel Wearing Course with G5 minimum quality US Base, or Similar Approved, Material from Commercial Sources Unit: m³ "

Add to the Sub-Clause:

"This item shall also apply to the construction of subbase/shoulders/gravel wearing course with G5 minimum quality material from borrow pits selected by the Contractor and approved by the Employer's Agent.

Supply and construct to the thicknesses shown on the Drawings G5 subbase layer and compact to 95% Mod AASHTO density. The maximum stone size shall be 37.5 mm.

The rate tendered shall include the procurement, basic selection, transporting from the source to the point of depositing on the road, spreading, mixing, watering, compacting, final grading, complying with the tolerances and testing of the natural gravel."

PSME 8.3.5(d) Process Subbase material with Cement Stabilising Agent to C4 minimum quality ……..Unit : m³

Add the following to ME 8.3.5(d)

"For tendering purposes the percentage stabiliser to be added shall be 4%.

The rate tendered shall include the spreading to specification of the cement over the G5 layer, spreading, mixing, watering, compacting, final grading, complying with the tolerances and testing of the natural gravel."

PSME 8.3.8(b) Stabilising Agent……..Unit : t

Add the following to ME 8.3.8(b)

"For tendering purposes the percentage stabiliser to be added shall be 4% Ordinary Portland Cement (OPC).

The rate tendered shall include the procurement, load, transporting from the source to the point of depositing on the road and offload of the stabilising agent in close proximity to where it will be used on the road. "

Add the following new Sub-Clauses:

"PSME 8.3.11 Treatment of Subbase:

(a) Treatment of Subbase with weed-killer.....Unit: m²

(b) Treatment of Subbase with insecticide .....Unit: m²

The tendered rates shall include full compensation for supplying, spreading and mixing-in or applying the poison.

Only areas that were treated on the written instructions of the Employer's Agent will be measured for payment."

C3.7.20 PSMF: BASE
(Applicable to SANS 1200 MF – 1981)

PSMF 3 MATERIALS

PSMF 3.2 Graded Crushed Stone Classification

Clause 3.2 of SANS 1200 MF shall be replaced with Clause 3.3.3 of SANS 1200 M.

PSMF 3.3 Physical and Chemical Properties

Clause 3.3 of SANS 1200 MF shall be replaced with Clauses 3.3.3 of SANS 1200 M.

The maximum stone size shall be 37.5 mm.

PSMF 5 CONSTRUCTION

PSMF 5.4 Placing and Compaction of a Base Other Than a Waterbound Macadam Base

PSMF 5.4.1 Placing

Delete the contents of this Sub-Clause and replace with:

“Approval of underlying layers must be obtained in writing from the Employer’s Agent prior to any construction of subbase layers.”

Before construction of the base is commenced, the Contractor shall ensure that the underlying layer on which the base is to be constructed and the kerbing and channelling have been completed, comply with the requirements of the Specifications and that the underlying layer and kerbing and channelling and have been approved by the Employer’s Agent. All cast in situ mountable kerbing, channelling, vehicle entrances, transitions, etc., shall have been laid for a period of at least 72 hours before construction of the base course is commenced.

Where a nominal thickness exceeding 150 mm has been specified, the base shall be constructed in approximately equal layers not exceeding 150 m each.”

PSMF 5.4.4 Compaction

Delete Sub-Clause PSMF 5.4.4.2and replace with:

The G2 base layer shall be compacted to minimum 86 % of Apparent Relative Density, or such other density as may be indicated in the Bill of Quantities.”

Add the following new Sub-Clause*:*

“PSMF 5.4.4.3 Thicknesses

The thicknesses of the layers after compaction shall be the thicknesses shown on the Drawings.”
The thicknesses of the layers after compaction shall be the thicknesses shown on the drawings.”

PSME 5.9 Transport

PSME 5.9.1 Freehaul

Add to the Sub-Clause:

"All haul from commercial sources shall be regarded as freehaul."

PSMF 7 ROUTINE INSPECTION AND TESTING

PSMF 7.3.2 Replace MF 7.3.2 with following:

"The frequency of checks shall be as specified in the amended table M6.3 of Clause PSM 6.3 – Roads General. Approval of underlaying layers must be obtained from the Engineer in writing, prior to commencing construction of the base layer.

PSMF 8 MEASUREMENT AND PAYMENT

PSMF 8.3 Scheduled Items

PSMF 8.3.3 Construct Base with Material from Commercial Sources or Designated Borrow Areas

Replace Sub-Clause MF8.8.8, including the description of the item, with the following:

"PSMF 8.3.3 Construct Base Course with Crushed Stone (G2) Material from Commercial Sources and Compact to 86% of Apparent Relative Density

Supply and construct to the thicknesses shown on the Drawings G2 basecourse layer and compacted to 86% of Apparent Relative Density. The maximum stone size shall be 37.5mm.

The tendered rate shall include the procurement, basic selection, transporting from the source to the point of deposition on the road, spreading, watering, compacting, final grading, slushing, compiling with the tolerances, and testing of the crushed stone base (G2) material."

C3.7.21 PSHM: ASPHALT BASE AND SURFACING
(Applicable to SANS 1200 MH – 1986 First Revision)

PSMH 3 MATERIALS

PSMH 3.1 Prime Coat

Replace MH 3.1 with the following:

"The prime coat shall be MC 30 outback bitumen applied at a nominal rate of 0,7 litre/m² to the finished basecourse, or as directed by the Employer's Agent."

PSMH 3.2 Curing Coat

Replace MH 3.2 with the following:

"A curing coat is not required."

PSMH 3.3 Tack Coat

Replace MH 3.3 with the following:

"The tack coat shall be a 60% anionic stable grade emulsion applied at a nominal rate of 0,5 litre/m² to the finished basecourse, or as directed by the Employer's Agent."

PSMH 3.4 Bituminous Binder

PSMH 3.4.2 Surfacing

Replace MH 3.4.2 with the following:

"The bituminous binder for surfacing shall be 50/70 penetration grade bitumen conforming to the latest SANS 307 specification. The nominal rate shall be based on 5,5 % binder content in the asphalt mix."

PSMH 3.5 Aggregates

PSMH 3.5.1 General

Replace MH 3.5.1 with the following:

"The asphalt finishing courses shall be continuously graded asphalt and shall comply with the following:

a) Coarse Aggregate

Coarse aggregate shall be hard, durable and sound crushed unweathered rock free from deleterious material conforming to SANS 1200M Table 1 (Grade 2) and to the following requirements in particular when tested before mixing:

(i) The maximum absorption of the aggregate shall be 1,0 % when tested in accordance with SANS test method 843.

b) Fine Aggregate

(i) Fine aggregate shall consist of a blend of crusher dust and clean, non-plastic sand. Continuous graded mixes shall contain a minimum of 15% of crusher dust (expressed as a percentage of the total aggregate in the mix). The fine aggregate shall conform to the following limits when tested before mixing.

Sieve Size (microns)	Percentage Passing Sieve (mass)	
	Sand	Crusher Dust
9 500	-	100
4 750	100	90 – 100
2 360	100	70 – 90
1 180	90 – 100	40 – 70
600	80 – 100	30 – 50
300	60 – 80	20 – 40
150	30 – 50	10 – 25
75	8 - 20	8 - 16

(ii) The mean sand equivalent of 5 random samples from the batch tested shall not be less than 35. If two or more sands are blended, the minimum sand equivalent of any sand shall be 25.

(iii) The maximum water absorption of the sand shall not exceed 0,5% when tested in accordance with TMHI method B15."

PSMH 3.6 Mineral Filler

"Active filler shall consist of milled blast furnace slag, limestone dust, or cement in accordance with the requirements for filler material of BS 594 specification. Natural filler may be used instead of active filler but shall be subject to the approval of the Engineer. The type of filler shall not be varied during the Contract."

PSMH 3.5.6 Grading

Combined Aggregate Grading

Replace the first paragraph of MH 3.5.6 with the following:

A grading of the combined aggregates, submitted by the Contractor, shall conform to the grading envelope of Clause 3.5.6; Table 2 (Grading of Combined Aggregate for Surfacing); Continuously graded; medium material. (Envelope No.6).

PSMH 5 CONSTRUCTION

PSMH 5.1 General Requirements

PSMH 5.1.1 Preparation of Surface

Add the following to MH 5.1.1:

"After the surface has been prepared in accordance with MH 5.1.1, the moisture content of the Subbase (in the case of asphalt surfaced base) and basecourse layers shall be determined. The prime layer shall only be applied when the moisture content of the upper 50 mm of the layer is lower than 50% of the optimum moisture content determined according to TMH1 Method A7. Unless directed otherwise by the Employer's Agent or indicated on the drawings, the edges of the prime shall be wider than the edges of the surfacing where the road is not contained by kerbs and channels."

PSMH 6 TOLERANCE

PSMH 6.2 Working Mix

PSHH 6.2.1 Grading

Replace MH 6.2.1 with the following:

(i) "The final composition of the mixture laid on the road for asphalt surfacing shall conform to the approved grading as specified in PSMH 3.5.6 or to such amended aggregate or binder contents as may be ordered by the Employer's Agent, subject to the following limits:

Material	Tolerance (% mass of total mix)	
	75% of all Results	All Results
Coarse Aggregate (% mass retained on 2,36 mm sieve)	±4	±6
Fine Aggregate (% mass passing 2,36 mm retained on 0.075 mm sieve)	±4	±6
Filler (% mass material passing 0,075 mm sieve)	±1,5	±2
Bitumen	±0,3	±0,5

Any unauthorised increase outside these limits shall not be paid for.

The Employer's Agent shall have the right to instruct the Contractor to make up any deficiency, or blind any over-application, of prime or tack without additional payment.

If under-spraying occurs, and it is accepted by the Employer's Agent, only the actual quantities applied shall be paid for."

PSMH 6.3.4 Thickness

Add the following to MH 6.3.4:

"The average thickness of asphalt surfacing, as measured through cores, shall not be less than 30 mm and no asphalt core measured shall be less than 25 mm. The Employer's Agent may request that sections of asphalt be removed and reconstructed where the above-mentioned thickness tolerances are not achieved

PSMH 6.3.6 Smoothness

Add the following to MH 6.3.6:

"Degree of Accuracy 1 shall apply for the asphalt surfacing layer."

PSMH 7 TESTING

PSMH 7.1 Mix design

Add the following new clause to MH 7.1:

PSMH 7.1.2 "Asphalt

(i) Mix Proportions and Marshall Design Criteria

The Marshall design criteria for asphalt surfacing shall conform to Clause MH 5.5.2; Table 6; continuously graded asphalt

(ii) Nominal Rate

The nominal rate for bitumen content of the asphalt mixes shall be 5,5%.

(iii) Compaction

The minimum density as a percentage of the theoretical maximum density shall be 92%."

PSMH 8. MEASUREMENT AND PAYMENT

PSMH 8.4 Computation of Quantities

Replace MH 8.4.2(b) with the following:

PSMH 8.4.2(b) Asphalt Wearing Course

Supply, placing and compaction.

The unit and measurement shall be the square metre of asphalt placed and compacted to the dimensions shown on the drawings or specified by the Employer's Agent. The tendered rate shall include for any excess width, wastage and any asphalt laid in excess of the specified thickness."

PSMH 8.5 Scheduled Items

Replace MH 8.5.4(b) with the following:

PSMH 8.5.4(b) "Asphalt Wearing Course……Unit : m²

The rate tendered shall cover the cost of supplying, hauling, heating and mixing all the various ingredients of the specified asphalt and for hauling, placing and compacting the asphalt and testing, protecting and maintaining the work as specified. Different thickness shall be scheduled separately."

PSMH 8.5.5 Variations

Add the following to MH 8.5.5:

"The Contractor's attention is drawn to the right of the Employer's Agent to amend the specification in any respect, subject to the provisions for adjustment in the measurement and payment."

C3.7.22 PSMJ: SEGMENTED PAVING
(Applicable to SANS 1200 MJ – 1984)

PSMJ 5 CONSTRUCTION

PSMJ 5.2 Edge Restraints

Add to the Sub-Clause:

"Where segmented paving is specified on areas that are to be constructed in half-widths or under traffic the Contractor shall provide, at his/her expense, suitable temporary edge restraints to free edges of the paving to prevent the displacement of the units."

PSMJ 5.4 Laying of Units

Add the following to the twelth line after "manholes.":

"No cut unit of size less than one-quarter of a full-size unit or with a dimension less than 25 mm shall be used on sidewalks, medians and islands, and no cut unit of size less than one-half of a full-size unit or with a dimension less than 50 mm shall be used on roadways."

PSMJ 5.5 Filling Gaps in Unit Pattern

At the end of the first sentence, replace the stop with a comma and add the following:

"and pigmented or coated in an approved manner to match the colour of the units in the pattern."

PSMJ 8 MEASUREMENT AND PAYMENT

PSMJ 8.2 Scheduled Items

"PSMJ 8.2.2 Construction of Concrete Block Paving Complete……Unit : m²

The rate tendered shall include the supply and construction of paving units and required sands for the bedding layer add to fill the gaps and joints, edge restraints, cutting of units to fit edge restraints and rolling to locked-up position as specified and as shown on the Drawings and Bill of Quantities."

PSMJ 8.2.3 Cutting Units to Fit Edge Restraints

Delete the first sentence of the description of this item as no distinction shall be made between straight, raking or circular cuts.

C3.7.23 PSMK: KERBING AND CHANNELLING
(Applicable to SABS 1200 MK - 1983)

PSMK 3 MATERIALS

PSMK 3.2 Precast Kerbing and Channelling

PSMK 3.2.1 General

Add to the Sub-Clause:

"Notwithstanding anything to the contrary in the Specifications or in the Bill of Quantities, all barrier kerbs and semi-barrier kerbs shall be precast kerbs except for curved kerbs where the radius is less than 1 m."

PSMK 3.3 Cast In Situ Kerbing and Channelling

Add the following new Sub-Clause to MK 3.3.

"PSMK 3.3.3 Strength

Cast Insitu kerbs, channels and edge beams shall be minimum grade 25 MPa/13 mm concrete."

PSMK 3.9 Bedding Material

DELETE THE CONTENTS OF THIS SUBCLAUSE AND REPLACE WITH:

"The material on which the precast concrete kerbs and channels are bedded shall be in accordance with the material specifications and dimensions shown on the Drawings and shall consist of a 1:3:6 concrete mix with a 13.2 mm single size coarse aggregate." (15 MPa concrete), where the layer is more than 30 mm thick."

PSMK 5 CONSTRUCTION

PSMK 5.1 Excavation and Bedding

Delete the first paragraph and replace with:

"Kerbing and channelling shall be constructed on the completed road subbase layers."

PSMK 5.2 Precast Concrete Kerbing and Channelling

In the second line, delete "50 mm thick layer of bedding that complies with 3,9,". And replace with

"concrete bedding complying with the requirements of PSMK 3.9 and to the dimensions shown on the Drawings."

Delete the last paragraph of the Sub-Clause and replace with:

"After the grouting of kerb joints has been completed, the kerbs shall be backed with a well-punned 15 MPa concrete backing to the dimensions as shown on the Drawings. On curves of radius less than 20 metres, the concrete backing shall be continuous, but on straights and curves of radius greater than 20 metres, the concrete backing shall be placed in short lengths across the joints. The backing concrete shall extend a minimum of 150 mm in each direction from the kerb joints."

PSMK 5.4 Cast-In-Situ Concrete Kerbing and Channelling

In the first sentence add the words “and edge beams” after the words “and channelling” in MK 5.4.

Delete the second sentence of the first paragraph of Sub-Clause 5.4 and replace with:

"The lengths of sections of kerbing between joints shall be uniform throughout and shall not exceed 2 m except where shorter sections are necessary for closures or where otherwise shown on the Drawings or required by the Employer’s Agent. In the case of cast-in-situ channelling constructed against precast kerbing, the joints in the channelling shall be constructed opposite the centre of every second length of precast kerbing. Joints shall be cut immediately after placing of the concrete."

Add the following new Sub-Clause:

“(i) Shrinkage Joints for Cast In-situ Concrete Work

Unless shown otherwise on the drawings, cast in-situ channels shall be provided with shrinkage joints spaced a maximum of 3 m apart. Shrinkage joints shall be constructed so that shrinkage cracks are generated at the joints. Sections of channel which have cracked between shrinkage joints shall be removed and replaced by the Contractor at his/her own cost.”

PSMK 5.8 Machine Placed (Extruded) Kerbing and Channelling

PSMK 5.8.3 Subbase Preparation

Delete the words "500 mm beyond ..... as relevant" in the first paragraph of this Sub-Clause and replace with:

"150 mm beyond the back face of the kerb or edging strip."

PSMK 5.11 Transition Sections and Inlet and Outlet Structures

Replace the first sentence of the second paragraph of MK 5.11 with the following:

“Inlet and outlet structures shall be in accordance with the details shown on the Drawings.”

Add the following new Sub-Clause:

“PSMK 5.13 Sequence of Construction

Before construction of the segmented paving is commenced, the Contractor shall ensure that the kerbing has been completed, complies with the requirements of the Specifications covering kerbing and has been approved by the Employer’ Agent."

PSMK 7 TESTING

PSMK 7.2 Cast-In-Situ and Extruded Kerbing and Channelling

PSMK 7.2.1 General Test

Delete the Sub-Clause.

PSMK 7.2.2 Alternative Tests

Delete the Sub-Clause and Replace with:

"PSMK 7.2.2 Tests

The Contractor shall carry out a minimum of three cube crushing tests per 1 000 m of kerbing, channelling and edge beams placed. The cost of such tests shall be deemed included in the rates tendered for kerbing, channelling and edge beams.

One cube crushing test shall consist of a set of six cubes made with concrete taken from the mixer, the kerbing machine or from any part of the work as ordered.

If, after 28 days in an approved laboratory, after three cubes of any set of six cubes have been tested, the average crushing strength is found to be more than 3 MPa below the specified strength, the concrete work represented by the cubes will be rejected.

The Contractor may apply for resubmission of the rejected section on the basis of cores drilled from this section and tested for the estimated actual crushing strength in accordance with SANS 865 (excluding Appendix A). The cost of drilling and testing the cores is for the Contractor's account, regardless of the outcome of the tests on the cores. The number of cores required will be determined by the Employer's Agent and the criterion for rejection or acceptance of the section represented by the cores shall be as specified above for cubes."

PSMK 7.3 Responsibility for Costs of Testing, Etc

Delete the Sub-Clause.

PSMK 8 MEASUREMENT AND PAYMENT

PSMK 8.2 Scheduled Items

PSMK 8.2.1 Concrete Kerbing

Delete Sub-Clause 8.2.1(b) and replace with:

"(b) The unit rate for precast kerbing shall cover the cost of supply of all materials for the kerbing, bedding, jointing and backing, and for all labour for bedding, jointing, backing, excavating, compacting, testing in terms of Sub-Clause 7.2, together with all backfilling, compacting and removing of excess material."

In the third line of Sub-Clause (e), delete "5.8.2" and replace with "5.8.3".

PSMK 8.2.3 Variation of Tests on Extruded Kerbing

Delete the Sub-Clause.

Add the following new Sub-Clauses:

“PSMK 8.2.14 Removal of Existing Kerbing:

"(a) Removal of existing kerbing and disposing of .....Unit: m

(b) Removal of existing kerbing and setting aside for re-use on the Site.....Unit: m

The tendered rates shall include full compensation for providing all labour and equipment, excavations, lifting the kerbs and, in the case of subitem (a), loading and transporting the kerbs from the Site and, in the case of subitem (b), cleaning the kerbs, and temporarily storing them and relaying them elsewhere on the Site."

C3.7.24 PSMM: ANCILLARY ROADWORKS
(Applicable to SANS 1200 MM – 1984)

PSMM 1 SCOPE

This specification covers the supply and installation of guardrails, road markings, road signs, and other ancillary works installed on completion of the road.

PSMM 3 MATERIALS

PSMM 3.2 Road Signs

PSMM 3.2.1 General

Replace MM 3.2.1 with the following:

"Guardrails, road signs and road markings as detailed on the drawings and wherever indicated by the Employer's Agent shall conform to the requirements given in the South African Road Traffic Manual and relevant SANS specifications."

Add the following new subclause after MM 3.4:

PSMM 3.2.9 Retro-reflective Materials

Add the following to MM 3.2.9.

"All sign faces shall be faced with retro-reflective material. Painted front sign faces shall not be used.

Where applied to Chromadek sections, retro-reflective material shall be applied as specified for aluminium section in Clause 5603(d) of the Standard Specification, and of Clause B5603(a)(ii) of this project Specification."

PSMM 3.3 Road-Marking Materials

PSMM 3.3.1 Paint

Add the following to MM 3.3.1.

"The commercial product supplied by the Contractor shall be subject to the approval by the Employer's Agent and the submission of a certificate of the SANS permitting the manufacturer to apply the SANS standardising mark to the supplied product."

PSMM 3.3.1.2 Retro-reflective Paint

The product supplied for permanent road markings shall be subject to the approval by the Employer's Agent, who may request the Contractor to provide sufficient supporting evidence to compare the durability of the proposed product with that of hot-melt thermoplastic material.

PSMM 3.5 "Additional Traffic Calming Devices

Additional traffic calming devices (e.g., rumble strips) shall be installed as specified by the Employer's Agent."

PSMM 5 CONSTRUCTION

PSMM 5.2 Road Signs

PSMM 5.2.4.2 Erection

Add the following to MM 5.2.4.2.

"After erection the signboard shall be thoroughly cleaned with a cleaning agent approved by the retro-reflective material's manufacturer.

All vegetation obstructing the new or replaced sign board shall be removed and disposed of as instructed by the Employer's Agent."

PSMM 8 MEASUREMENT AND PAYMENT

PSMM 8.2, 3 &4 Scheduled items

PSMM 8.2.1 Guardrails on Posts (supply and erect complete) ..... Unit : m

Replace MM 8.2.1 with the following:

"The rate tendered for guardrails shall cover the cost of supplying and erecting the complete galvanised, guardrail on posts and end units and reflector plates at specified spacing with spacer blocks, bolts, nuts, washers and reinforcing plates. The tendered rate shall include for excavation, backfilling and concreting of all posts."

PSMM 8.3.1 Road Signs (Supply and erected complete) .....Unit : No

Replace MM 8.3.1 with the following:

"The rate tendered for road signs shall cover the cost of supplying and erecting the completed signboard supports, face, frame and fixing brackets and shall include the cost for providing retro-reflective background, symbols, characters, legends and borders of the type specified in the South African Road Traffic Manual. The tendered rate shall include for excavation, backfilling and concreting of sign supports."

PSMM 8.4.1 Retro-reflective Road markings ..... Unit : m (lines)
Unit : m² (symbols)

Replace MM 8.4.1 with the following:

"The Contractor's attention is drawn to the rate for retro-reflective road marking which shall include for the setting out and pre-marking of line, traffic islands marking, characters and symbols.

The rate tendered for road markings shall cover the cost of supplying all materials and equipment necessary and for painting and protecting, including the setting out lines, characters and symbols, with reflectorised paint applied at a nominal rate of 0.42l/m² and with retro reflective glass beads applied to the wet paint at a nominal rate of 0,8 kg/ℓ of paint."

PSMM 8.6 Additional traffic calming devices .....Prov.Sum

A Provisional Sum is included in the Schedule of Quantities for payment of any additional traffic calming devices (e.g., rumble strips) that the Engineer may specify.

C3.8: PARTICULAR PROJECT SPECIFICATIONS

In addition to the Standard Specifications the following Particular Specifications shall apply to this Contract and are bound in hereafter.

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C3.8.1 PQA: Brickwork, Blockwork and Plastering (Supplementary to SABS 1200 – 1986)

PQA 1 BRICKS AND BLOCKS

PQA 1.1 Burnt Clay Masonry Units

Solid clay masonry units (bricks) shall be of nominal dimensions 222 x 106 x 73 mm, shall comply with SANS 227 and conform to the types scheduled, as selected from the following:

		Nominal Compressive Strength	Max Water Absorption
FBX -	face brick extra	17,0 Mpa	10%
FBS -	face brick standard	17,0 MPa	12%
NFP -	non facing to be plastered	10,5 MPa	15%
NFX -	non facing extra for damp conditions	14,0 MPa	15%

Engineering bricks shall carry the suffix ‘E’ and the compressive strength in MPa and shall be of one or more of the following types as scheduled:

		Max Water Absorption
FBXE 45	the best engineering brick	7%
FBSE 30	a good engineering brick	8%
NFXE 14	the lowest acceptable category	10%

Sample bricks shall be taken at random by the Employer’s Agent, should he consider tests to be necessary. These tests shall normally comprise an inspection for defects, a compressive strength test and a water absorption test. Should any deficiencies become apparent after testing in accordance with SANS 227, the Employer’s Agent shall have the right to reject the complete consignment.

PQA 1.2 Concrete Masonry Units

Concrete masonry units (blocks) shall comply with SANS 1215 and shall be either solid or hollow as called for in the Bill of Quantities or shown on the drawings.

The preferred dimensions of units, where not otherwise called for, are as follows:

Solid Units		222 x 106 x 73 mm
	or	190 x 90 x 90 mm
Hollow Units		390 x 90 x 190 mm
	or	390 x 190 x 190 mm

Preferred size when used in conjunction with clay bricks:

FU	-	Face Units	the nearest matching size to the clay bricks
FUA	-	Face units aesthetic	being used, especially in regard to height in order to suit brick courses

The nominal compressive strength of solid units or hollow blocks shall be at least 14 MPa except where shown otherwise on the drawings or the Bill of Quantities. The alternative strengths shall be either 7 or 21 MPa (3,5 MPa strength is not acceptable).

Masonry units manufactured with aggregates which contain slag, clinker or burnt clay brick shall not be used unless prior approval has been obtained from the Employer's Agent.

The average drying shrinkage of units shall not exceed 0,06 % and the average expansion on rewetting shall not exceed 0,02 % in excess of the actual drying shrinkage obtained from manufacturer's tests.

Sample units shall be taken at random by the Employer's Agent, should he consider that tests are necessary to satisfy himself that there are no deficiencies in any consignment. Should deficiencies occur when tested in accordance with SANS 1215, the complete consignment may be rejected.

PQA 2 BONDING OF BRICKWORK AND BLOCKWORK

PQA 2.1 Brickwork Bonds

Brickwork shall be laid in the following bonds, except where shown otherwise on the drawing or scheduled to the contrary:

Brickwork	230 mm thick	English bond
Brickwork	280 mm thick to cavity walls	Stretcher bond
Brickwork	350 mm thick below damp proof course	English bond

Cavity brickwork shall include wall ties which connect the inner and outer skins of the wall. The ties shall be galvanised and of approved pattern, fixed along every fifth course at spacings not exceeding 600 mm, with alternate rows staggered.

PQA 2.2 Blockwork Bonds

Bonding of blockwork shall be carried out in full compliance with SANS 10145.

PQA 3 BRICKLAYING AND BLOCKLAYING

PQA 3.1 Laying Clay Bricks

Brickwork shall be well and regularly bonded, with no false headers and none but whole bricks, except where legitimately required as closers. All bricks must be thoroughly wetted before laying and each brick is to be pressed into its bed so as to squeeze out superfluous mortar and give a finished joint generally 10 mm thick, but in no case shall it exceed 12 mm thickness. All joints, both horizontal and vertical, notwithstanding any trade custom to the contrary, are to be filled solid with mortar for their full width and depth, each course being flushed with mortar, worked well down into all vertical joints before the succeeding course is laid. All brickwork shall be built true and plumb with the perpends vertically in line.

Horizontal and vertical joints shall be rounded, square or flush pointed as required by the Employer's Agent. All joints of facework shall be pointed flush. Walls to be plastered shall have the joints raked out to a depth of 6 mm to form a key for the plaster.

Bricklaying is to be carried out uniformly so that no part of the work shall be in advance of any other part by more than six courses, unless otherwise authorised by the Employer's Agent. In the latter case, the work is to be stepped back as toothing will generally not be allowed.

The cavity in cavity walls shall be kept free from mortar droppings and movable boards of the appropriate widths shall be used for that purpose. Vertical joints in the outside leaf on the course immediately above the damp proof course shall be raked out every fifth brick to drain the cavity. Around the periphery of all built-in frames the cavities shall be closed with interior brickwork.

PQA 3.2 Laying Concrete Blocks

Concrete blocks shall be laid in compliance with Code of Practice SANS 10145.

Blocks shall not be wetted prior to laying in a wall and the moisture control at the time of laying shall comply with Table 2 of that Code of Practice. The drying shrinkage of the blocks to be laid shall be available to the Employer's Agent in the form of a directive from the manufacturer of each type of masonry unit. The average annual humidity shall likewise be made available to the Employer's Agent.

Blocks shall be laid on a full bedding of mortar. All joints are to be nominally 10 mm thick and both vertical and horizontal joints shall be completely filled. Blocks shall be laid with the thicker shell face outermost. They shall be laid in stretcher bond with the horizontal distance between vertical joints in adjacent course equal to at least one quarter of the length of the block. All blockwork shall be built true and plumb with the perpends vertically in line.

Control joints shall be formed at spacings indicated in Table 3, should joints not be detailed on the drawings. The spacing is a function of the vertical spacing of the horizontal reinforcement.

Corners and other work where the blocks are necessarily laid to a higher level than the general progress of work, shall be stepped back and not raised above the level of the remaining blockwork by more than one metre.

Blocks below damp proof course level shall be concrete-filled using concrete having the same mix proportions as the concrete in the strip foundations. The concrete shall be struck off flush at damp proof course level.

Horizontal reinforcement shall be placed at 600 mm vertical spacings unless shown otherwise on the drawings and bond beams shall be incorporated in the structure as shown on the drawings.

Fire resistance ratings as shown in Table 4 of the Code of Practice shall be adhered to, if required by the drawings.

PQA 4 LOUVRE VENTS AND AIR FILTERS

Where indicated on the drawings or ordered by the Employer's Agent, openings for louvre vents shall be formed through walls, and approved vents shall be built in or installed in the opening and neatly finished off.

Where indicated on the drawings, openings shall be formed through walls for air filters and the filters, supplied by an approved manufacturer, shall be joined together to form panels as shown on the drawings and fitted in accordance with the manufacturer's instructions.

PQA 5 BUILDING IN PIPES, FRAMES, STEELWORK ETC

All window and door frames and wall vents are to be set up and built-in as the brickwork proceeds. Window and door frames are to be set, bedded and pointed in 4:1 sand cement mortar and the tendered unit rates are to include for any cutting and fitting of brickwork and for making good thereafter. The unit rates are also to include for attending to windows, doors and vents etc, in order to leave them in perfect working order. The Contractor will be held liable for the repair of any damage done to such items during progress of the work.

Where pipes, frames, brackets or other such parts pass through or have to be set into brickwork, the bricks shall be carefully cut and fitted around the parts so as to maintain regularity of courses and uniformity of joints, the shaped bricks being bedded and pointed to conform to the surrounding brickwork. Where such parts have to be set into position after brickwork is built, holes shall be left wherever possible, in preference to cutting out bricks, and the work shall be subsequently made good in the manner described.

PQA 6 DAMP PROOFING

PQA 6.1 Damp Proof Course

Where indicated on the drawings, and at windowsills, a damp proof course is to be embedded into the work, consisting of a SABS approved bituminous sheeting of mass not less than 1,3 kg/m² or PVC sheeting of 0,375 mm thickness laid over the full width of the wall, lapped and sealed at all joints. Where shown on the drawings, the damp proof course is to be stepped up one course of brickwork in the inner skin. Proper returns are to be made at all door frames.

Damp proof courses in blockwork shall be laid strictly in accordance with Subclause 5.3.6 of SANS 10145 at all places indicated in that Code or Practice.

PQA 6.2 Underfloor Waterproofing

Underfloor waterproofing membranes, where called for, shall be of approved 250 micron thick PVC sheeting lapped to a minimum of 200 mm at all joints.

PQA 6.3 Waterproofing Blockwork Faces

Where the external faces of blockwork are not to be plastered, they shall be treated with an approved waterproof coating applied in accordance with the manufacturer's instructions.

PQA 7 WINDOWSILLS

Windowsills shall be constructed as shown on the drawings, including items such as damp proof course and expanded metal reinforcement, where called for.

PQA 8 PRECAST CONCRETE LINTELS

Precast concrete lintels over doors and windows shall be E-type, supplied by an approved manufacturer and suitable for the thickness of the walls being constructed. Shoring of soffits of lintels shall be fixed on spans exceeding 2,5 m and left in place for as long as the Employer’s Agent considers necessary. The length of lintels shall be such as to give at least 200 mm of bearing at each end.

PQA 9 EXTRACTION FANS

Where indicated on the drawings, openings shall be formed through walls for extraction fans. The required fans, complete with bird proof weather cowls, shall be supplied and fitted therein by an approved specialist firm. Making good around the fan unit shall be carried out by the Contractor.

PQA 10 WALL CHASING

Where directed by the Employer’s Agent, the Contractor shall chase brickwork to accommodate electrical conduits. Such chasing shall precede plastering or rendering and on no account shall the plastering or rendering be commenced until the conduits have been installed. The rates for chasing shall include for making good the brickwork after the conduit has been fixed.

In the case of unplastered concrete walls, electrical conduits shall either be cast into the concrete during pouring or shall be surface mounted as indicated on the drawings or in the Bill of Quantities.

Chasing in masonry units shall be carried out in compliance with SANS 10145 and, where possible, as directed by the Employer’s Agent, shall be cut prior to laying the blocks.

PQA 11 CEMENT MORTAR

PQA 11.1 Mortar for Brickwork

Sand for mortar shall comply with SANS 1090 and be well graded from 5 mm down in accordance with Table 1. Sand shall not contain an excess of dust or fine material. Cement shall be Portland cement Type CEM.I 42,5 to SABS.ENV 197-1.

Cement mortar shall be in the proportion 1 part Portland cement to 4 parts sieved sand in the case of face brickwork, and 1 part cement to 5 parts sand for all other brickwork.

PQA 11.2 Mortar for Blockwork

Mortars to be used for block laying are to be in accordance with either Classes I, II or III as specified in SANS 0145, Subclause 3.2.3 as called for in the Bill of Quantities or on the drawings. Should no specific strength be specified then Class II, mortar having a compressive strength of 5 MPa at 28 days shall be used. The mortar mix shall be 170 l of sand to 50 kg of Portland cement 42,5 and shall be used in conjunction with an approved mortar plasticiser conforming to BS EN 934-3: 2009+A1: 2012.

Alternatively, 50 kg of an approved masonry cement (supplied by a reputable manufacturer) may be used in lieu of 50 kg of Portland cement in the mix to give the same 28 day strength as required under the previous paragraph, but in that case no mortar plasticiser is to be used.

PQA 12 REINFORCEMENT

PQA 12.1 Reinforcement to Brickwork

Brickforce mesh or similar approved welded mesh supplied in rolls shall be built into brickwork where specified or shown on the drawings.

Reinforcement to brickwork shall comprise galvanised welded mesh as called for on the drawings supplied in rolls. The mesh shall be of suitable width to suit the brickwork thickness and the minimum cover from any external face shall be at least 10 mm. Reinforcement is to be built in every third course except where shown otherwise on the drawings. Except where shown to the contrary on the drawings, galvanised steel strips of dimensions 1 360 mm long x 40 mm wide x 1,6 mm thick shall be used to tie brickwork into concrete columns at every fourth course.

PQA 12.2 Reinforcement to Blockwork

Reinforcement to blockwork shall comprise galvanised welded mesh supplied in rolls. The mesh shall be of suitable width to suit the blockwork thickness and the minimum cover from any external face shall be at least 20 mm. The number of courses where reinforcement is to be built in shall be at 600 mm (maximum) vertical spaces, except where shown otherwise on the drawings.

PQA 13 HOOP IRON TIES AND ANCHORS

Galvanised hoop iron ties shall be provided for securing roof timbers to brick walls and shall be built-in to a vertical depth of not less than six courses of brickwork with bottom ends bent square to form an anchor. The upper ends shall project at least 450 mm above the brickwork for attachment to roof timberwork.

Anchoring of roofs and floors in blockwork shall be carried out in accordance with SANS 10145 except where shown otherwise on the drawings.

PQA 14 PLASTERING

Plastering shall be composed of one part Portland cement 42,5 plus one tenth part lime to four parts fine plaster sand from an approved source. An equivalent mortar comprising other cementitious materials may be approved by the Employer's Agent, after testing. Plaster shall be applied to walls in one coat 12 mm thick and well worked into brickwork or blockwork joints, which shall have been previously raked out to form a key. The surface of the work shall be finally smoothed with a wooden float or steel trowel, as may be called for, depending upon the nature of the surface required. Angles and edges are to be carefully plumbed or levelled, as the case may be, and corners shall be arris rounded.

In the case of plastering to concrete work, the surface of the concrete shall first be hacked sufficiently to afford proper bond and the plaster applied as a thin skimming coat, or coats. V-joints shall be formed at the junction of concrete and brickwork. Plaster adhesive supplied by a reputable manufacturer may be used on the concrete faces in lieu of hacking, subject to prior approval by the Employer's Agent.

Where scheduled or shown on the drawings, the external faces of brickwork, blockwork and/or concrete shall be cement mortar plastered.

Should any plaster show signs of cracking, blowing or other defects at any time before or during the Defects Liability Period, the defective work shall either be stripped and re-plastered or locally repaired by the Contractor, all at his own expense, as directed by the Employer's Agent. The defective areas shall be cut out to a rectangular shape unless otherwise permitted, with edges undercut to form a key and the joint carefully smoothed off flush with the surrounding plaster. Plasterwork should in all cases be commenced at the top and proceed downwards and every care must be taken to prevent staining of face brickwork and other finished parts with plaster droppings. Such droppings shall not be allowed to harden, but shall be cleaned off continuously as plastering proceeds. Plaster droppings in sumps must be removed to the satisfaction of the Employer's Agent. Plastering must be carried out from ceiling to floor and from wall to wall without any breaks in the plastered surface.

PQA 15 PAYMENT FOR BRICKWORK

PQA 15.1 Brickwork ..... Unit: m²

Payment for brickwork will be made by area of finished brickwork of the various wall thicknesses and types as scheduled, measured in elevation.

Prices shall be inclusive of the supply of all materials, plant and labour necessary for completing the work, including the supply and building in of wire ties, all plumbing of corners and faces, lining, levelling, forming reveals and openings, cutting where necessary but not specially scheduled. The measurement of the work will be taken net with window and door openings deducted, but no deductions from the measurements will be made for lintels, air bricks, pipes up to and including 150 mm diameter or fittings up to 150 mm square built into the work. Small openings of area up to 0,05 m² will not be deducted.

Items for brickwork are scheduled separately for reinforced and unreinforced brickwork, except for small areas of reinforced brickwork over openings, windows and doors etc, which are deemed to be included in the rate for unreinforced brickwork.

PQA 15.2 Louvre vents ..... Unit: No

Payment for louvre vents and air filters will be made by number supplied and installed.

PQA 15.3 Building in window frames, door frames, pipes, Steelwork, etc. ..... Unit: No

Payment for building in window frames, door frames, pipes, steelwork etc shall be paid separately for each type and size as scheduled.

PQA 15.4 Damp proof course ..... Unit: m²

Payment for damp proof course will be made by the net area of each size supplied and installed. No payment will be made for overlaps, etc.

PQA 15.5 Lintels ..... Unit: m

Payment for lintels will be made by length installed.

PQA 15.6 Extraction fans ..... Unit: No

Payment for extraction fans will be made by number supplied and installed. The tendered rate shall include for forming the necessary openings through the walls.

PQA 15.7 Chases in brickwork ..... Unit: m

Payment for chases in brickwork for electric conduits will be made per linear metre of chase cut.

PQA 15.8 Hoop iron ties ..... Unit: No

Payment for hoop iron ties will be made by number supplied and installed.

PQA 15.9 Brickforce brick reinforcement ..... Unit: m

Payment for Brickforce brick reinforcement will be made for each different wall thickness.

PQA 16 PAYMENT FOR BLOCKWORK

PQA 16.1 Blockwork ..... Unit: m²

Payment for blockwork will be made by area of finished blockwork of various thicknesses and types, measured in elevation.

Prices shall be inclusive of the provision of all materials, plant and labour necessary for completing the work, including the building in of wire ties, all plumbing of corners and faces, lining, levelling, forming reveals and openings, cutting where necessary and plastering where specified. The measurement of the work will be taken nett with window and door openings deducted, but no deductions from the measurements will be made for lintels, air bricks, pipes up to and including 150 mm diameter or fittings up to 150 mm square built into the work. Small openings of areas up to 0,05 m² will not be deducted.

PQA 16.2 Infilling of blockwork with concrete ..... Unit: m²

Payment for infilling of blockwork with concrete shall be extra over the payment item PQA 16.1 above, for various thickness and types, measured in elevation. The rate shall include the provision of expanded metal mesh where indicated.

PQA 16.3 Brickforce brick reinforcement ..... Unit: m

Payment for Brickforce brick reinforcement will be made for each different wall thickness.

PQA 16.4 Waterproof coating of external faces ..... Unit: m²

Payment for waterproof coating of external faces shall be by the surface area actually treated.

PQA 17 PAYMENT FOR PLASTERING

PQA 17.1 Plastered finish to walls. ..... Unit: m²

Payment for plastered finish to walls will be made by area of finished plaster, measured in elevation, for each surface finish specified. Prices shall be inclusive of the provision of all materials, plant and labour necessary for carrying out the plastering work, including the plumbing of corners and faces and forming reveals and openings. The measurement of the work will be taken net with window and door openings deducted. Small openings of areas up to 0,05 m² will not be deducted.

C3.8.2 PQB: Floor Finishes and Wall Tiling
(Supplementary to SABS 1200 – 1986)

PQB 1 GRANOLITHIC FLOOR SCREEDS

PQB 1.1 Materials

Granolithic screed shall consist of one part Portland cement Type CEM.I 42,5 to SABS.ENV 197-142,5, one part sand and two parts 5 mm stone chippings, thoroughly mixed as for concrete and applied to the surface of the underlying concrete in a layer not less than 20 mm thick, levelled or graded and trowelled to a smooth uniform surface. Granolithic shall be either untinted or tinted, as called for in the Bill of Quantities.

PQB 1.2 Laying

The laying of the granolithic finish shall be in full compliance with the relevant clauses of SANS 10109 Part 2. To ensure thorough bond, the granolithic should, where possible, be applied before the concrete below has become properly set and preferably while it is still green, and every precaution must be taken to keep the concrete damp and clean until the granolithic is placed. If this is not possible, then the underlying concrete must be chipped or otherwise roughened to the satisfaction of the Employer's Agent, flushed with clean water and then coated with cement grout before the granolithic is laid.

Granolithic paving is to be V-jointed in squares of approximately 1,25 metres side length, the V-joint being formed while the surface is still soft.

Where floor cables are not covered by chequered plate or other steel flooring, cable ducts in the floor shall be filled with clean river sand to a depth of 70 mm from the finished granolithic level after all cables are in position and have been tested and approved. A 50 mm thick layer of Grade 20 concrete shall be placed on top of the sand, which in turn shall be covered with granolithic screed. V-joints shall be formed at both sides of all cable ducts, the joints being accurately positioned.

V-joints are to be formed in straight lines and extend to 75 % of the full depth of the granolithic layer.

The screed shall be finished with its upper surface perfectly smooth and continuous without voids or float marks.

Where shown or directed by the Employer's Agent, 100 mm high granolithic skirtings are to be formed. They shall include rounded top edges, and radiused corners and a 38 mm radius coving at junctions with the floor. The tendered rates shall include for forming all internal and external mitres, returns, stopped ends, etc, all finished smooth with a steel trowel. At steps a sloping skirting shall be formed, 100 mm high above the noses of the steps. Where ordered, the tread risers and sides of steps, shall also receive a granolithic finish and at the edge of steps and slabs rounded nosing and reeded treads shall be provided. A sunk and weathered threshold shall be provided in the granolithic at all doors.

The risers and treads of stairs shall also receive a granolithic finish and the treads shall be reeded and the front edges are to have a rounded nosing.

PQB 2 FLOOR SCREEDS

Floor screeds shall comply with all of the requirements set out above for "Granolithic Floor Screeds" save that the mix shall not contain any stone chippings and shall comprise four parts sand to one part Portland cement Type CEM.I 42,5 to SABS.ENV 197-142,5 and be of 25 mm average thickness and minimum of 20 mm thick, except where otherwise scheduled or shown on the drawings.

PQB 3 VINYL (PVC) FLOOR TILING

PQB 3.1 General

Where indicated on the drawings or scheduled in the Bill of Quantities, vinyl (PVC) semi-flexible floor tiles or sheeting shall be supplied and installed.

PQB 3.2 Materials

The tiles/sheeting shall comply with SANS 581: 2007 and shall receive the prior approval of the Employer's Agent. Unless otherwise indicated, the tiles shall be 300 x 300 mm and the tiles/sheeting shall be 2,5 mm thick. The vinyl flooring shall be of an approved colour chosen from the manufacturer's standard range. Vinyl cove skirtings shall be of similar quality and colour to the floor tiles and 70 mm in height unless otherwise stated. Where sheeting is called for, it shall be welded at all joints and to the skirting.

PQB 3.3 Laying and Fixing

Floors to receive vinyl tiles/sheeting shall be covered with a mortar screed comprising four parts sand to one part Portland cement 42,5 and of 25 mm average thickness and minimum of 20 mm thick, except where laid on an unbonded damp-proof membrane, in which case the screed shall be 50 mm thick. The screed shall be finished with its upper surface perfectly level and continuous without voids or float marks. The screed materials and methods of laying shall be in full compliance with SANS 10109 Part 2. The screed shall be at least 7 days old and perfectly dry, to the satisfaction of the Employer's Agent, prior to laying the vinyl tiles. The underlaying concrete shall be thoroughly cleaned to the Employer's Agent's satisfaction prior to laying the screed.

The tiles shall be laid strictly in accordance with the manufacturer's instructions onto the screed using the recommended adhesive. This adhesive shall be spread with a Vee notched trowel 1,5 x 1,5 x 1,5 mm triangular notches at 4 mm centres. The coverage of adhesive shall be between 5,0 and 5,5 m² per litre. After laying, the tiles are to be rolled with a suitable roller to ensure complete adhesion. The floor tiles shall be cut where required and neatly fitted against adjoining walls, floors, thresholds, etc. Vinyl skirtings shall be close fitted to floors and walls, butted and end jointed, neatly mitred at internal angles and dressed around external angles, and fixed with adhesive as for the flooring.

Finished floors and skirtings shall be protected from damage during the progress of the remaining work, and at completion shall be cleaned and handed over in a perfect condition. The work shall be carried out by skilled workmen experienced in laying this type of floor finish.

PQB 4 TEXTILE FLOOR COVERING

PQB 4.1 Materials

Textile floor coverings shall be of the type shown on the drawings or scheduled in the Bill of Quantities, and shall include an underlay where called for, and laid in full compliance with SANS 10186.

Skirtings shall comprise standard meranti hardwood skirting mitred at all corners and joints and fixed with steel nails.

PQB 4.2 Substrate

The substrate on which textile floor coverings are to be laid shall be as shown on the drawings, and where textile floor coverings are laid on a concrete screed, the screed shall comply with Clause PQB 3.3 above.

PQB 5 INTERFACE BETWEEN DIFFERENT FLOOR FINISHES

At junctions of differing floor finishings, a 25 x 3 mm brass strip with a 3 mm wide top edge flush with the adjoining finishings shall be supplied and installed.

At each external door, a 25 x 3 mm brass strip with a 3 mm wide top edge flush with the internal surface shall be supplied and installed so as to create a vertical step 6 mm high in line with the inner face of the opening outwards door(s).

PQB 6 WALL TILING

PQB 6.1 Tiles for Interior Work

Glazed ceramic tiles and fittings shall comply with the requirements of SANS 22 and, unless otherwise called for on the drawings or Bill of Quantities, shall be white, size 150 x 150 mm and 6,5 mm thick.

PQB 6.2 Fixing of Tiles

The tiles shall be fixed to previously sand/cement rendered walls with an approved cementitious tile adhesive. Horizontal and vertical joints in the tiling shall be continuous and be at least 2 mm wide. After fixing and setting for at least 12 hours, the joints shall be filled in completely with an approved white cement grout. Tiles shall not be soaked in water before fixing except where recommended by the tile manufacturer. The finished work shall be thoroughly cleaned off after grouting is completed.

Unless otherwise specified, the wall tiling shall project approximately 4 mm beyond the face of adjoining plaster with all exposed edges finished with glazed edge tiles.

Tiling shall be returned into reveals of openings and onto windowsills, and shall be butted at internal angles and provided with glazed edged tiles to external angles, unless otherwise specified. All necessary cutting of tiles shall be properly performed.

Unless otherwise specified on drawings, tiles are to be fixed outwards from the centre of the walls and upwards from approximatey140 mm above the floor, with cut tiles at the extremities of the wall face and floor areas. Exposed external edges must be finished with a full glazed edge tile. The 140 mm of height below the bottom tiles shall be filled in with the same type of tile cut to fit where no special skirting tile is scheduled or shown on the drawings.

Provision must be made for any pipework or protrusions through the walls. Tiles must be finished off around the protrusion and take the necessary shape to accommodate any pipework, etc.

Joints around such protrusions are to be similar in width to joints in the rest of the tiling unless the Employer’s Agent instructs otherwise.

Expansion joints for wall tiles, unless otherwise specified by the manufacturers, are to be provided in areas that are in excess of 6,0 metres, measured horizontally along the floor and 3,0 metres, measured vertically along the wall, or as indicated on drawings. These joints are to have a maximum width of 4 mm and be filled with white silicone.

PQB 7 MEASUREMENT AND PAYMENT

PQB 7.1 Payment for Granolithic finish

PQB 7.1.1 Granolithic finish ..... Unit: m²

Payment for granolithic finish shall be by area of finished surface irrespective of whether it is horizontal, vertical (except for skirting) or on the slope. The price shall include for all the work specified, including treating the underlying concrete surface.

PQB 7.1.2 Granolithic skirting ..... Unit: m

Payment for granolithic skirting shall be per linear metre of completed skirting, for each height scheduled. Price shall be inclusive of the provision of all materials, plant and labour necessary to complete the granolithic work and for any material which is wasted.

PQB 7.1.3 Extra over Item PQB 6.1.1 for rounded nosing and reeded treads on stairs ..... Unit: m

PQB 7.2 Payment for Vinyl Floor Tiling/Sheeting

PQB 7.2.1 Vinyl flooring ..... Unit: m²

Payment for vinyl flooring shall be per net area of completed floor surface. The rate shall include for all the work specified above including the cement mortar screed and the preparation of the surface of the concrete structural floor.

PQB 7.2.2 Skirting ..... Unit : m²

Payment for skirting shall be by length of the completed skirting of each height scheduled.

Prices shall be inclusive of the provision of all materials, plant and labour necessary to complete the required work and for all cutting and waste.

PQB 7.3 Payment for Textile Floor Coverings

PQB 7.3.1 Textile floor coverings ..... Unit : m²

Payment for textile floor coverings shall be per net area of completed floor surface. The rate shall include for all work specified, including the preparation of the structural surface, the cement mortar screed, the underlay where called for and the laying of the textile floor covering.

PQB 7.3.2 Skirting ..... Unit : m

Payment for skirting shall be by length of completed skirting for each height scheduled.

Prices shall be inclusive of the provision of all materials, plant and labour necessary to complete the required work and for all cutting and waste.

PQB 7.4 Payment for interface between different floor finishes

PQB 7.4.1 Brass strips ..... Unit : m

Payment for the brass strips shall be by length and shall be inclusive of the provision of all materials, plant and labour necessary to complete the required work and for all cutting and waste.

PQB 7.5 Payment for Wall Tiling

PQB 7.5.1 Tiling.....Unit : m²

Payment for tiling will be by area of completed tiling including exposed tiled ledges, window and door returns, etc but the area of window and door openings will be excluded.

PQB 7.5.2 Expansion joints.....Unit : m

Expansion joints will be paid for separately per linear metre.

PQB 7.5.3 Supply and installation of toilet roll holders and soap dishes. .....Unit: No

PQB 7.5.4 Skirting .....Unit: m

Payment for skirting will be measured separately by length only if and where a special skirting tile is called for.

Tendered rates shall include for the provision of all materials, including all special tiles, e.g, stair treads, skirting tiles, external and internal angle tiles and cover base skirting tiles, and for all labour and plant necessary to complete the work shown on the drawings or scheduled and for all cutting and waste.

C3.8.3 PQC: Carpentry, Joinery and Ironmongery
(Supplementary to SABS 1200 – 1986)

PQC 1 TREATMENT OF TIMBER

All timber, other than that to be used for joinery, shall be treated with an approved industrial wood preservative such as CCA (Copper-Chrome-Arsenate) in accordance with the statutory regulations and SANS 10005. Proof that such treatment has been carried out shall be given to the Employer's Agent, should he request it.

PQC 2 WROUGHT FACE

All exposed woodwork, unless otherwise described, is to be wrought and for each wrought face a maximum of 1,5 mm will be allowed off the specified sizes. All wrought faces are to be finished smooth and free from tool marks.

PQC 3 STRUCTURAL AND ENGINEERING TIMBER

All timber to be used in general structural work shall conform to the requirements of SANS 1783-2 for stress Grade V.5 with a density of at least 360 kg/m3, unless otherwise scheduled.

Where a stress grade other than V.5 is called for, the timber used shall conform to SANS 1783-2 for engineering timber. Where reference is made to SABS 1783 for Engineering Timber, the strength grade shall be V.10 with a density of at least 475 kg/m^3, unless otherwise scheduled or shown on the drawings.

PQC 4 SHRINKING, WRAPPING AND TWISTING

Should any timber member shrink or wrap more than 3 mm, or twist more than 2º over its full length, it shall be removed and new timber supplied and re-fixed in its place, together with any other member which may thereby be affected, at the Contractor's expense.

PQC 5 PREFABRICATED ROOF TRUSSES

Prefabricated timber roof trusses shall be made from South African pipe complying with PQC 3 above, having a stress grading of V.6 and bearing the SABS mark. The joints shall be butted and joined with suitably sized "gangnail" or similar approved galvanised connector plates. Each joint shall be capable of withstanding a loading of at least 50% in excess of that imposed by the maximum design load for the truss.

The designs of the prefabricated trusses the Contractor proposes shall be carried out and signed off by a registered Professional Engineer and a copy of the drawings and a signed certificate to that effect shall be submitted to the Employer's Agent prior to the trusses being delivered to site. The drawings shall show the following minimum information for each type of truss required:

(a) The design span.
(b) The overall height from underside of cross beam to apex.
(c) An elevation of the truss showing the size of all the members, the position of the purlins and the spacing of the trusses along the line of the roof.
(d) The "gangnail" plate sizes at every joint.
(e) The type of roof covering material and the design loading.

PQC 6 ROOF TIMBER WORK

PQC 6.1 Bolted Roof Trusses

These trusses, including the tie beams shall be made from timber having a stress grading of V.4 and shall be constructed to the dimensions shown on the drawings or as scheduled. The trusses shall be strongly framed, halved, checked and bolted together in the best manner and in accordance with acceptable practice. The work is to be soundly secured and accurately lined and set to conform with the overall sizes given. The timber shall be wrought where exposed to view.

Bolts, unless otherwise specified or scheduled, shall be 12 mm diameter of adequate length and provided with a pair of 50 mm diameter x 2,0 mm thick circular washers.

Notwithstanding the above requirements, the Contractor shall arrange to have the truss designs checked by a registered Professional Engineer and submit a copy of a signed certificate to that effect to the Employer's Agent prior to the materials required to manufacture the trusses being placed.

PQC 6.2 Timber Wall Plates, Purlins and Other Members

Timber roof members shall be manufactured from timber complying with PQC 3 above and shall be cut to the dimensions shown in the drawings, mitred and jointed where necessary. Joints in straight runs of timber shall be spliced and nailed, with the length of splice being at least 5 times the depth of the member and the nail centres equal to the depth. The number of joints shall be minimised to the satisfaction of the Employer's Agent.

All members which are built into brickwork or blockwork, and all faces of members exposed to the weather, shall receive a suitable, approved wood treatment.

PCQ 6.3 Facias and Barge Boards

Facias and barge boards shall be equal or similar to "Nutec" as manufactured by Everite.

PQC 6.4 Eaves Closures

Eaves shall be concealed if scheduled and/or shown on the drawings.

PQC 7 CEILINGS

PQC 7.1 Normal Sheeted Ceilings

The underside of roof tie beams shall be lined with the ceiling material shown on the drawings or as scheduled. Ceiling materials shall be nailed to the brandering with galvanised clout nails in countersunk holes and stopped with putty, where not covered with cover strips. Brandering shall be of at least 38 x 38 mm square section and shall be provided at no more than 560 mm centres to suit ceiling panels and with cross brandering, where required, at not more than 1 200 mm centres, cut in flush at joints and side nailed. All joints in the brandering shall be scarfed joints. The ceiling panels which shall not exceed the sizes recommended by the manufacturer, shall be nailed every 150 mm along the panel edges and at a distance of 10 mm in from the edge. Suitable metal strips, covering the joints and returned around cornice lines, shall be provided. Special serrated ceiling nails shall be used in accordance with the manufacturer's recommendations.

Ceilings shall be fitted only after completion, testing and acceptance of all electric wiring required to be laid in the roof space above, except where ordered to the contrary by the Employer's Agent.

A trapdoor 600 x 600 mm covered, framed and supported in accordance with acceptable practice, shall be provided to gain entry into each void in the ceilings.

Formed cove cornice 55 x 55 mm shall be fixed to the ceiling, plugged to walls and neatly mitred at all corners. Coving shall extend for the full peripheral length of all ceiling to wall junctions.

PQC 7.2 Patented Ceilings

Where the ceiling shown on the drawings or schedule is to be of a patented type, the materials supplied and the workmanship of fixing shall be strictly in accordance with the manufacturer's specifications.

PQC 7.3 Thermal Insulation to Ceilings

Thermal insulation materials shall comply with SANS 1381 and be of the required thickness, but not less than 50 mm. The insulation shall fully cover the total ceiling area, to be insulated as indicated on the drawings.

PQC 8 WOODEN DOORS AND FRAMES

PQC 8.1 Door Frames

All wooden door frames shall be manufactured from hardwood (dark red meranti or better), rebated, and grooved if required for plaster, and dowelled into the floor with 16 mm diameter x 125 mm long steel dowels. Hardwood quadrant fillets, neatly mitred at angles, are to be fitted around all frames where abutting on concrete, plaster or brickwork. Door frames shall be secured to brickwork and concrete work with an approved type of fastening, spaced at not more than 600 mm centres.

PQC 8.2 Hardwood Doors

Hardwood doors shall be heavy duty framed, ledged, braced and battened solid wood doors of dark red meranti or similar approved hardwood manufactured in compliance with SANS 545, for Class 2 (semi-interior) exposure. The timber shall comply with SABS 1099 without any laminations and the finished door shall be 44 mm thick for use with solid timber frames.

Where steel frames are specified on the drawings or scheduled, the doors shall be 40 mm thick or such other thickness to suit the steel frames being supplied.

Double leaf doors shall be one way opening with rebated meeting stiles.

All exterior doors shall be of standard dimensions, except where scheduled to the contrary.

PQC 8.3 Interior Timber Doors

Interior timber doors shall be medium duty veneered doors in compliance with SANS 545 and suitable for Class 4 (dry interior) exposure. All doors shall have both edges concealed.

The veneer shall be of the natural finish suitable for varnishing, except where painting of the doors is required by the drawings or is scheduled in the Bill of Quantities, in which case the veneer shall be suitable for such painting.

All interior doors shall be of standard dimensions and 40 mm thick.

PQC 9 IRONMONGERY

PQC 9.1 General

Approved locks, hinges, cabin hooks, door stops and other hardware shall be provided to doors. All ironmongery and fixings shall be chromium plated on brass, except where otherwise specified.

PQC 9.2 Hinges

Hardwood doors in hardwood frames are to be provided with brass washered, brass pinned, brass butt hinges as scheduled with three hinges per leaf.

Hinges on steel door frames shall be supplied with, and be part of, the pre-manufactured steel door frames.

Parliament hinges are to be supplied and fitted to doors where scheduled or shown on the drawings to enable those doors to open through approximately 180 degrees.

PQC 9.3 Door Locks and Furniture

Internal doors shall be fitted with a two lever mortice lock unless otherwise scheduled.

External doors are to be fitted with a lock as scheduled, either a night latch (to be supplied by the Employer) and a Henderson No 463 bow handle, secured with brass bolts passing through the door with nuts on the inside or, a three lever mortice lock which shall be rebated if fitted on a pair of double doors.

WC doors are to be fitted with an approved indicator bolt and keep.

PQC 9.4 Keys

All keys supplied shall be clearly labelled. Two keys are to be supplied for each lock. Where scheduled, two identical master keys are to be supplied for each suite of locks e.g, two master keys for all of the two lever locks, two master keys for all of the three lever locks and two master keys for all night latches.

PQC 9.5 Cabin Hooks and Eyes

One 200 mm brass cabin hook complete with eye shall be supplied and fitted to each outward opening door and hardwood blocks are to be securely fixed to the adjoining walls, or to a 100 x 100 mm hardwood post set in concrete as scheduled.

PQC 9.6 Sundry Items

On all double doors, the second leaf to open shall be fitted with a brass barrel bolt and keep at top and bottom. In the case of doors with a height greater than 2,2 m, the upper barrel bolt shall be a monkey tail bolt with a tail of a suitable length.

Towel rails, toilet roll holders, hat and coat hooks, door stops and the like that are scheduled in the Bill of Quantities and/or shown on the drawings, are to be supplied and installed in accordance with good practice.

PQC 10 MEASUREMENT AND PAYMENT

PQC 10.1 General

Carpentry and joinery will be measured and paid for in accordance with the units and rates scheduled. The Contractor is to include for all beads, fillets, stops, grounds and all rebating, tenoning, grooving, housing, morticing, framing and planning and all other necessary work to complete the whole of the carpentry and joinery work in the best manner according to details on the drawings and/or in the Bill of Quantities. Payment for wood preservation will not be made separately as the cost is deemed to be included in the rates tendered for timberwork.

PQC 10.2 Scheduled items

PQC 10.2.1 Timberwork ..... Unit: m

Prices for timberwork, where scheduled separately, shall include for all necessary working, cutting, trimmings, application of preservative to built-in portions of the work, etc, and for providing all necessary cleats, spikes, bolts, nails, etc. Measurement of the various members shall be taken as that of each size of timber from which the member can be cut, taken to the nearest length of 150 mm in excess of the actual required length.

PQC 10.2.2 Factory made roof trusses ..... Unit: No

Factory made roof trusses shall be paid for by number for each building.

PQC 10.2.3 Wall plates and purlins ..... Unit: m

Wall plates and purlins will be paid for per lineal metre.

PQC 10.2.4 Facias ..... Unit: m

Facias will be paid for per lineal metre.

PQC 10.2.5 Barge boards ..... Unit: m

Barge boards will be paid for per lineal metre.

PQC 10.2.6 Ceilings ..... Unit: m²

Payment for ceilings will be made by the actual surface area of finished ceiling taking into account whether the ceiling plane is horizontal or sloping.

PQC 10.2.7 Ceiling brandering ..... Unit: m²

Payment for ceiling brandering shall be made by area of ceiling to be attached thereto but only where scheduled separately.

PQC 10.2.8 Thermal insulation to ceilings ..... Unit: m²

Payment for thermal insulation to ceilings, if scheduled or shown on the drawings, will be made on the same basis as for the ceiling and for each specified thickness of insulation layer.

PQC 10.2.9 Covered cornices ..... Unit: m

Prices for coved cornices shall be per linear metre.

Prices for ceilings and associated activities shall include the provision of all materials (including waste and fastenings) and for all labour and plant required to complete the ceilings as shown on the drawings.

PQC 10.2.10 Eaves closures/cladding ..... Unit: m²

Payment for eaves closures/cladding will be made on the same basis as for ceilings (see PQC 10.7 above).

PQC 10.2.11 Ironmongery ..... Unit: No

Payment for ironmongery will be made per item supplied and installed and shall include for the provision of all labour, plant and materials required to complete the respective items of work.

C3.8.4 PQD: Steel Doors and Windows
(Supplementary to SABS 1200 – 1986)

PQD 1 STEEL DOORS AND FRAMES

PQD 1.1 Pressed Steel Door Frames

Pressed steel door frames shall be of welded one piece construction or of an approved knock-down type for assembly on site, and constructed of mild steel sheet, pressed or rolled to the required shapes.

Frames for walls one brick thick shall have a single rebate profile and the frame material shall be at least 1,6 mm thick. All other frames, unless otherwise specified, shall be double rebated and manufactured from metal at least 1,6 mm thick.

Frames shall be of widths required to suit the thickness of walls into which they are to be built, and shall be fitted with suitable tie-bars and braces at bottom, and lugs for building in three to each jamb of frames without fanlights, and four to each jamb of frames with fanlights. Where fanlights are shown over doors, the frame shall be fitted with transoms of pressed or rolled steel sheet as above rebated for fanlights and for doors if required and shall have a nominal thickness of at least 1,6 mm thick metal. The rebates in frames and transoms for doors and fanlights shall be of widths required to suit the thickness of doors and fanlights.

Frames shall have holes as and where required for screws for fixing fanlight openers, keeps of spring catches, etc. Where fanlights are shown to be fixed into frames, the frames shall be holed and tapped in the rebates suitable for screws for fixing the top centres.

Frames for single doors shall be fitted with an approved chromium plated, or stainless steel (unless otherwise specified) adjustable striking plate keep, boxed in at the back of the frame with a sheet metal box welded on, and not less than two rubber buffers.

All welding shall be cleaned off smooth and flush on exposed surfaces and frames shall be cleaned and primed as described for steel windows, before leaving the manufacturer's works.

PQD 1.2 Steel Doors, Sidelights and Fanlights

PQD 1.2.1 General Requirements

Steel doors shall comply with the requirements of SANS 727, constructed from mild steel sheet of at least 1,6 mm thick metal.

All doors, sidelights and fanlights shall, in addition, comply with the following requirements:

(a) Suitable weather bars shall be provided to render external doors, etc, perfectly watertight.
(b) Frames of doors, etc. where fixed to concrete columns, beams, etc, shall be provided with suitable lugs for fixing to plugs in the concrete at same spacing as the standard fixing lugs.
(c) Doors, sidelights, fanlights and components, except where specified to be hot dip galvanised, shall be cleaned and primed as described below.

Door, sidelights and fanlights unless otherwise shown, shall be of "one piece" construction, but where shown to be in two or more "one piece" units, the units shall be coupled together with standard coupling mullions and/or transoms.

Bottom openings in doors and sidelights shall be fitted with kicking plates of one thickness of 1,6 mm thick mild steel sheet fixed with metal beads.

Frames for outward opening doors shall be fitted at the bottom with sills of door framing section (stepped sills) and frames for inward opening doors with metal ties, welded to frames, for embedding in thresholds (flush sills).

After doors, sidelights and fanlights have been built in and before being glazed, they shall be checked for alignment, adjusted as necessary, and left in a satisfactory state and in good working order.

PQD 1.2.2 Stock Doors Units

Stock doors, sidelights and fanlights shall be of the type scheduled or shown on the drawings. The doors shall be constructed of not less than 33 mm universal steel sections, and sidelights and fanlights of 25 mm sections as described for windows.

Each leaf of a double door and each single door shall be hung on three steel hinges having brass pins. Hinges shall be of the parliament type where frames are set back from wall faces and where doors are shown to fold back against these faces.

Fanlights shall be hung and fitted as described for steel windows.

PQD 1.2.3 Purpose Made Door Units

Purpose made doors, sidelights and fanlights shall be as described in 1.2.2 above but constructed to the forms and sizes shown on the drawings. Unless otherwise specified, the doors shall be of not less than 33 mm universal sections and the sidelights and fanlights to standard 25 mm sections.

PQD 2 STEEL WINDOWS

PQD 2.1 Materials

Stock residential and industrial type steel windows shall comply with the requirements of SANS 727, and all other types shall comply with the constructional and other requirements of the above specification wherever applicable. All windows shall, in addition, comply with the following additional and/or amended requirements, viz:

(a) Suitable weather bars shall be provided to the bottom of inward opening and vertically pivot hung ventilators and also to the bottom of all outward opening ventilators where they occur above other ventilators and elsewhere as may be required to render the windows perfectly watertight.
(b) Frames for windows where fixed to concrete columns, beams, etc, shall be provided with suitable lugs for fixing to plugs in the concrete, or with holes for screwing to plugs in the concrete, all at the same spacing as the standard fixing lugs.
(c) Windows and components, except where specified to be hot dip galvanised, shall, before leaving the manufacturer's works, be cleaned by acid pickling, rinsing and drying, as laid down in SANS 10064, or by other approved means, to remove all scale, rust, grease, oil and foreign matter, and then primed with an approved red oxide zinc chromate primer applied by dipping or by means of spray guns.

Ventilators hung at one side to open outwards for windows above ground floors and not accessible for cleaning from an adjoining opening ventilator in the same window or from verandahs, balconies and the like, shall be hung on projecting hinges.

Windows, unless otherwise specified, shall be of one piece construction but where shown to be in two or more "one piece" units, the units shall be coupled together with standard coupling mullions and/or transoms.

Windows shall be fitted with brass handles, stays, catches and other fittings as later described. Those for windows constructed of universal sections shall have a polished finish, whereas all other windows shall have a tumbled finish. The fittings shall be fixed in such a way as to be removable after the windows are glazed.

After the windows have been built in, but before being glazed in accordance with Particular Specification: PQE Glazing, they shall be checked for alignment, adjusted as necessary, and left in a satisfactory state and in good working order.

PQD 2.2 Construction

The various type of windows shall be constructed as follows:

(a) Stock Residential Type Windows:

Stock residential windows shall be of the types shown on drawings, constructed of standard 25 mm steel sections with metal not less than 3 mm thick.

Side hung ventilators shall be hung on steel hinges having brass pins, and shall each be fitted with a casement fastener and sliding stay.

Top hung ventilators shall be hung on hinges as above, and shall each be fitted with combined fanlight stay and fastener size 200 mm for one pane high ventilator and size 250 mm for two panes with ventilators.

Bottom hung ventilators shall be hung on hinges as above, and shall each be fitted with approved concealed friction side arms and a spring catch and keep.

Pivot hung ventilators shall be hung on friction pivots and shall each be fitted with a spring catch and keep.

Projected out ventilators shall slide on approved spring loaded brass shoes, sliding in the channels of the fixed frame, and shall be balanced on steel arms, pivoted at ends and housed within the vertical frames; ventilators shall each be fitted with an approved casement fastener at the bottom.

(b) Purpose Made Residential Type Windows:

Purpose made residential type windows shall be as described in (i) above, but constructed to the forms and sizes shown on the drawings.

(c) Stock Industrial Type Windows:

Stock industrial type windows shall be of the types shown on the drawings, constructed with main frames of not less than 33 mm steel sections with metal not less than 3 mm thick, and with ventilators of standard 25 mm sections with metal not less than 3 mm thick.

Pivot hung ventilators shall be hung on friction pivots and shall each be fitted with a spring catch and keep.

Bottom hung ventilators shall be hung on steel hinges having brass pins, and shall each be fitted with approved concealed friction arms and a spring catch and keep.

(d) Purpose Made Industrial Type Windows:

Purpose made industrial type windows shall be as described in (iii) above, but constructed to the forms and sizes shown on drawings.

PQD 3 MEASUREMENT AND PAYMENT

PQD 3.1 Steel doors and frames

PQD 3.1.1 Door units .....Unit: No

Door units shall be supplied and installed complete with frame, hinge, locks and bolts as scheduled or detailed on the drawings. Each size and type shall be measured separately.

PQD 3.2 Steel windows

PQD 3.2.1 Window units.....Unit: No

Window units shall be supplied and installed complete as specified, scheduled and detailed on the drawings, excluding glazing which is measured separately. Payment will be by number for each type and size.

The tendered rates shall include for the provision for all materials (including fastenings, hinges and ironmongery) except where scheduled separately, and for all labour and plant required to build the windows into the structures.

C3.8.5 PQE: Glazing
(Supplementary to SABS 1200 – 1986)

PQE 1 GLAZING

PQE 1.1 Glass Material

Glass panes, not exceeding 0,65 m² surface area, shall be cut from 3 mm thick, best quality clear float glass.

Glass exceeding 0,65 m² and up to 1,0 m² surface area of glass pane, shall be cut from 4 mm thick best quality clear float glass.

Panes larger than 0,66 m²shall be glazed with approved laminated safety glass at least 5 mm thick. Where scheduled or shown on the drawings, laminated glass is to have a solar barrier of the specified UV reduction factor.

PQE 1.2 Fixing of Glass Panes

Steel and wooden window frames shall be primed with an approved wood (or metal) primer before glazing is commenced.

Each pane of glass is to be well bedded at both back and front with putty and sprigged or otherwise mechanically located in the window frames. All putty shall be carefully trimmed and cleaned off and finished to neat straight lines. The finished surface of the putty is to be allowed to partly dry and then painted - usually after a few days of applying the putty - the actual timing of the painting will depend on the putty used and the prevailing site conditions.

Glazing putting shall be in accordance with SANS 680, suitable for use with metal or wooden window frames, as appropriate, and shall be of the self-setting type.

PQE 1.3 Payment for Glazing

PQE 1.3.1 Glazing ..... Unit: No

Glazing will be measured and paid for separately (except where otherwise scheduled) and will be deemed to include all costs associated with the glazing. Measurement will be based on the overall area of the window glazed irrespective of the number of individual panes and without deduction for glazing bars.

C3.8.6 PQF: Plumbing
(Supplementary to SABS 1200 – 1986)

PQF 1 SCOPE

PQF 1.1 Pressure Piping

Pressure piping for water supply and distribution shall comprise galvanised steel, polypropylene and/or copper piping together with the associated fittings, for medium pressure duty and suitable for installation within buildings.

PQF 1.2 Drainage Piping

Drainage piping for domestic wastewater shall comprise galvanised steel, cast iron, black polyethylene and uPVC piping with the associated fittings, for installation within buildings.

PQF 1.3 Applicable Specifications

PQF 1.3.1 Pressure Piping Specifications

SANS 62	Steel Pipes and Fittings
SANS 460	Copper Tubes for Domestic Plumbing
SANS 14	Malleable Cast Iron Pipe Fittings
SANS 1067	Copper-Based Fittings for Copper Tubes
SANS 15874-1, 2, 3, & 5	Plastic Piping Systems for Hot and Cold Water Installations - Polypropylene (PP)

PQF 1.3.2 Drainage Pipe Specifications

SANS 746	Cast Iron Pipes and Fittings for use above Ground
SANS 791	uPVC Sewer and drain Pipes and Fittings
SANS 967	uPVC Soil, Waste and Vent Pipes and Fittings
SANS 1321-1	Non-Metallic Waste Traps

PQF 1.3.3 Installation Specifications

SANS 791	Appendix C : Notes and Uses of uPVC Pipes
SANS 1011	The Installation of Polyethylene and uPVC Pipes
SANS 10252-1:	Part 1 - Water supply installations for buildings

PQF 2 MATERIALS

PQF 2.1 Pressure Pipework

PQF 2.1.1 Steel Pipes and Fittings

Steel pipes shall comply with SANS 62 Part 1 and shall be of the nominal bore stated in the Bill of Quantities or shown on the drawings and be of medium class, except where scheduled to the contrary. Exact length pipes are not required. The pipe ends shall be screwed (or plain-ended if scheduled) and all piping, irrespective of the class scheduled, shall be galvanised inside and outside in accordance with SANS 32 for general applications. The screw threads shall not be coated. Each pipe shall be supplied, complete with a screw-on socket at one end. A certificate of workmanship as specified under Subclause 4.13 of SANS 62 Part I shall be provided if requested by the Employer's Agent.

Pieces and pipe fittings made from steel pipe shall comply with SANS 62 Part II and shall be of the nominal bore stated in the Bill of Quantities. The class and surface treatment shall correspond to those for the pipes with which they are to be used. Ninety degree bends shall be Type 1 bends, except where Type 2 are specifically called for in the schedule.

Malleable cast iron fittings shall comply with SANS 14, which are suitable for working pressures up to 1 400 kPa in the case of water. The types and sizes of fittings to be provided are as scheduled and all fittings shall be galvanised.

The piping layout shall be as shown on the drawings.

PQF 2.1.2 Polypropylene Pipes and Fittings

Polypropylene pipes shall comply with SANS 15874-1, 2, 3, & 5 and shall be of the classes and nominal sizes stated in the Bill of Quantities or shown on the drawings. The extrusion polymer (either homo-polymer Type PP or co-polymer Type PPC) shall be the most suitable for pipe runs to be installed within buildings.

The nominal length of pipes of nominal diameter 63 mm and larger shall be ..... m. Pipes of small diameter may be provided in manufacturer's standard coils, subject to them not being kinked or deformed whilst being coiled.

Fittings shall be manufacturer's standard fittings to suit the size and classes of pipe with which they are to be used, all as detailed in the Bill of Quantities or shown on the drawings. Special fittings shall be scheduled or detailed on the drawings.

The piping layout(s) shall be such as to supply water to all of the outlets shown on the drawings and/or scheduled in the Bill of Quantities.

PQF 2.1.3 Copper Tubes and Fittings

Copper tubes shall comply with SABS 460 and shall be of the nominal outside diameter and of Classes 2 or 3 (as detailed hereunder) or as scheduled or shown on the drawings.

Class 2 (Medium)	-	for pipework having a maximum working pressure of 2 000 kPa chased into walls and floors.
Class 3 (Heavy)	-	for pipework having a working pressure over 2 000 kPa up to a maximum of 3 250 kPa, surface mounted internally or externally to buildings.

Tubes shall be supplied in standard lengths of 5,5 m, except that Class 2 tubes of 15 mm diameter may be provided in standard annealed copper coils, subject to them not being kinked or deformed in the coils.

Fittings shall comply with SANS 1067 and be the manufacturer's standard fittings to suit the sizes and classes of pipes with which they are to be used. Fittings shall be of the capillary type where a permanent joint is required and the compression type where it may be necessary to occasionally disconnect the joint.

The piping layout(s) shall be such as to supply water to all of the outlets shown on the drawings and/or scheduled in the Bill of Quantities.

PQF 2.1.4 Steel Pipes and Fittings

Steel piping shall comply with SANS 62 Part 1 and shall be of the nominal bore stated in the schedules or shown on the drawings and be of light class, except where indicated to the contrary. Exact length pipes are not required. The pipe ends shall be screwed and all piping shall be galvanised inside and outside in accordance with SANS 32 for general applications. The screw threads shall not be coated. A screw-on socket shall be provided at one end of each pipe.

The piping layout(s) shall be such as to supply water to all of the outlets shown on the drawings and/or scheduled in the Bill of Quantities.

PQF 2.1.5 Cast Iron Pipes and Fittings

Cast iron pipes and fittings for use above ground shall comply with SANS 746 and shall be supplied without a socket anti-siphon vent and without ears, except where called for to the contrary on the drawings or in the schedule.

Pipes and fittings shall be printed with a bituminous coating and lining.

Alternative primers and/or uncoated and lined pipes shall be provided where specifically called for.

The piping layout(s) shall be such as to supply water to all of the outlets shown on the drawings and/or scheduled in the Bill of Quantities.

PQF 2.1.6 uPVC Soil Waste and Vent Pipes and Fittings

uPVC pipes and fittings shall comply with SANS 967 and shall be of the nominal sizes and effective lengths scheduled or shown on the drawings. Plain ends shall not be chamfered and sockets shall be suitable for use with rubber ring seals.

Standard fittings shall be provided as shown on the drawings and shall be of a size to suit the pipes with which they are to be used. Inspection openings and covers shall be provided on all bends 45º and over. Vent horns are not required except where specifically called for.

PQF 2.1.7 Sanitary Ware, etc

Sanitary ware, etc shall be of the types indicated on the drawings or scheduled. The quality of items such as washbasins, baths, shower fittings, lavatory cisterns, water closets, hot water geysers, etc shall be consistent with the prime cost price allowed for in the documents or indicated on the drawings.

All stopcocks and valves to be used shall bear the SABS mark and shall be of brass or gunmetal and be suitable for the application in all respects. All other fitments, which are the subject to a SANS specification, shall comply with such specification and bear the appropriate mark.

PQF 2.1.8 Rainwater Goods

Rainwater gutters and downpipes shall be of the seamless type without joints, as supplied and installed by an approved roof gutter specialist.

PQF 3 INSTALLATION

PQF 3.1 General

Installation of plumbing pipework, both pressure and drainage pipes, shall generally be chased into the walls and/or floors of the building and only where specifically called for on the drawings, or elsewhere, shall it be surface mounted. All plumbing work shall be carried out by suitably registered firms and by suitably qualified plumbers.

PQF 3.2 Installation Work

PQF 3.2.1 General

The method of carrying out the installation shall be in accordance with the best practice and in the case of water piping in accordance with the relevant sections of SANS 0252.

PQF 3.2.2 Pipework in Chases

Chases in walls and floors shall be wide enough and deep enough to contain the full diameter of the pipework and jointing sockets, etc. No part of any pipe run shall extend into the finishing plaster work. Fastenings shall be adequate to hold pipes firmly in position and all pipework shall be tested for possible leakage prior to being grouted in.

PQF 3.2.3 Surface Mounted Pipework

Surface mounted pipework shall be adequately and suitably fixed in position in accordance with the best practice and in accordance with the applicable SABS specifications. The pipework shall be able to withstand, without movement or damage, the normal wear and tear to be expected within the building.

PQF 3.2.4 Sanitary Ware, etc

All items of sanitary ware shall be firmly fixed to withstand expected normal usage without movement. The items shall be fixed truly plumb and/or horizontal as the case may be. Any article damaged after acceptance from the supplier up to the time of completion of the work shall be replaced by the Contractor at his own expense.

No electrical connections to hot water geysers and the like may be made by the plumber but shall be carried out by a suitably qualified electrician.

PQF 4 TESTING

All pipework and fittings including stopcocks, valves, taps, etc shall be tested for operation and for watertightness. Any malfunction or leak shall be rectified by the Contractor at his own expense.

PQF 5 MEASUREMENT AND PAYMENT

PQF 5.1 Provision of all material, plant and labour necessary to complete the required installation and testing..... Unit: Sum/m/No

Measurement and payment for the provision of all materials, plant and labour necessary to complete the required installation and testing shall be in accordance with the method of scheduling in the Bill of Quantities.

C.3.8.7 PQH: Painting
(Supplementary to SABS 1200 – 1986)

PQH 1 SCOPE

This specification covers the normal work required for small to medium size buildings. It does not cover the painting of steelwork (which is covered by SANS 1200 HC as amended by PSHC), but does include painting of galvanised iron for roof sheeting, gutters, downpipes, etc.

This specification should be adhered to, but as the formulation of paints is subject to continual modification, the specification for a particular material may be amended, should the paint manufacturer recommend an improvement thereto and provided such amendment receives the prior approval of the Employer's Agent.

A change of specification purely to reduce costs by using less suitable materials will not be acceptable.

PQH 2 MATERIALS

PQH 2.1 General

All materials which are to be used for painting under this Contract shall be from the same approved manufacturer (except in special cases which have had prior approval from the Employer's Agent) and shall be supplied in unopened containers. Thinning will be permitted only in conformity with the applicable manufacturer's recommendations.

The approved manufacturer of the paints shall be either Plascon or Dulux or as selected by the Contractor. Other manufacturer's products may be used, subject to them being approved by the Employer's Agent prior to any orders being placed.

The paint systems to be applied shall be the applicable of the systems itemised in PD 3.2 to 3.5 hereunder.

PQH 2.2 Approved Materials

The following materials, as supplied by the selected paint manufacturer, are approved for use under this Contract.

	Applicable Clauses	Kansai Plascon References	Dulux References
Pre-paint treatment:			
Bonding liquid	3.4.1	CVI.14	5147198
Knotting for timber	3.1	PK.2	-
Wood stopping	3.1	BS	-
Porous surface sealer	3.1	CVI 14	-
Primers for:			
Acrylic coat filler	3.2.1	PP 500	5147618
Plaster (alkali resistant)	3.2.1	UC.56	5147200
Hardboard	3.2.2	UC 56	-
Softwood timber	3.2.2	UC.2	5147196
Galvanised iron	3.5.1 3.5.2	G.I.P.	5147204
Aluminium	3.5.3	SNS 1	-

	Applicable Clauses	Kansai Plascon References	Dulux References
Water-Based Paint Systems:			
PVA emulsion	3.2.1	EPL	5147037
Acrylic PVA	3.3.1	PEM 600	5147037
Texture coating	3.3.2	FLX	5147080
Acrylic roof paint	3.4.1	TRP	5147005
Oil-Based Paint Systems:			
Universal undercoat	3.2.2, 3.3.3, 3.5.2	UC.1	5147206
Stain for wood	3.2.3	W 1	5147400
Alloyed roof paint	3.5.1	AW 255	-
Gloss enamel	3.2.2, 3.3.3, 3.5.2	G - Range	5147208
Interior varnishes:			
wood-gloss	3.2.3	X.33	5147426
matt	3.2.3	X.44	5147430
Exterior varnishes:			
wood-gloss	3.3.4	-PNW - Gloss	5147422
matts	3.3.4	-PNW - Suede	-

PQH 3 APPLICATION

PQH 3.1 Surface Preparation

All surfaces to be painted must be thoroughly degreased, clean and dry prior to commencement of painting. The local environs are to be free from dust whilst painting is in progress.

Ironmongery and fittings not to be painted shall either be removed and subsequently replaced, or be suitably masked to prevent paint spots or streaks adhering to the surfaces.

All cracks are to be filled with the paint manufacturer's recommended filler suitable for the purpose and for the location (i.e, interior or exterior work). After drying, the filler is to be rubbed down to a smooth surface, flush with the adjacent surfaces.

Porous surfaces must be sealed in accordance with the paint manufacturer's recommendations. Timber work shall be knotted and stopped as necessary prior to commencing painting. All surface preparation shall be in accordance with the paint manufacturer's specifications.

PQH 3.2 Painting Interior Surfaces

PQH 3.2.1 PVA Emulsion System

3.2.1.1	Cement plaster, & concrete	Apply one coat of acrylic filler coat followed by two coats of PVA emulsion paint
3.2.1.2	Gypsum plaster, hardwall plaster & gypsum board	Apply one coat of alkali resistant primer followed by two coats of PVA emulsion paint
3.2.1.3	Hardboard	Apply one coat hardboard primer followed by two coats of PVA emulsion paint

PQH 3.2.2 Gloss Enamel System

3.2.2.1	Cement plaster, gypsum plaster, hardwall plaster & gypsum board	Apply one coat of alkali resistant primer followed by one coat universal undercoat and one coat of gloss enamel
3.2.2.2	Hardboard	Apply one coat hardboard primer followed by one coat of universal undercoat and one coat of gloss enamel
3.2.2.3	Softwood timber	Apply one coat of oil based wood primer followed by one coat of universal undercoat and one coat of gloss enamel

PQH 3.2.3 Stain and Varnish System

3.2.3.1	Softwood timber	Apply one coat of stain followed by two coats of varnish (matt or gloss as ordered)
3.2.3.2	Hardwood timber	Apply two coats of varnish (matt or gloss as ordered)

PQH 3.3 Painting Exterior Surfaces

PQH 3.3.1 Acrylic PVA System

3.3.1.1	Cement plaster, & concrete	Apply one coat of acrylic filler coat followed by two coats of acrylic PVA paint
3.3.1.2	Asbestos board	Apply one coat of undercoat followed by two coats of acrylic PVA paint

PQH 3.3.2 Texture Coating System

Cement plaster & concrete:	Apply two coats of texture coating paint

PQH 3.3.3 Gloss Enamel System

Cement plaster:	As per 3.2.2.1 for interior surfaces
Softwood timber:	As per 3.2.2.3 for interior surfaces

PQH 3.3.4 Varnish System

Hardwood:	Apply two coats of ultra violet resistant varnish (matt or gloss as ordered)

PQH 3.4 To Roof Areas (Other than Galvanised Iron)

PQH 3.4.1 Acrylic PVA System

Cement and clay tiles:	Apply one coat of bonding liquid followed by two coats of acrylic emulsion roof paint

PQH 3.5 To Non Ferrous Metal Surfaces

PQH 3.5.1 Galvanised Iron Roofs

Apply one coat G.I metal primer followed by one coat micaceous iron ore roof paint

PQH 3.5.2 Galvanised Iron Tubes etc

Apply one coat G.I metal primer followed by one coat universal undercoat and one coat gloss enamel

PQH 3.5.3 Aluminium Surfaces

Apply one coat of aluminium primer followed by one coat of universal undercoat and one coat of gloss enamel.

PQH 4 MEASUREMENT AND PAYMENT

PQH 4.1 Provision of all materials, plant and labour necessary to prepare surfaces and complete painting work as specified: Unit: Lump Sum/Individual Sum/m²

Measurement and payment for paintwork will not be made separately, except where so scheduled in the Bill of Quantities. In the latter case, the prices tendered are to cover for the provision of all materials, plant and labour necessary to prepare the surfaces and complete the work as specified. Payment will be made by lump sum for the entire painting work, or by individual sum for each unit scheduled, or by area.

PQH 4.2 Painting of windows Unit: m²

Painting of windows will be measured as the overall size of the window frame with both sides being measured and with no deductions made for glazed areas.

C.3.8.8 PQI: Roof Coverings (Other than thatch)
(Supplementary to SABS 1200 – 1986)

PQI 1 STEEL SHEET ROOF COVERINGS

For steel sheet roof coverings refer to Specification SANS 1200 HB Cladding and Sheeting and the amendments thereto in PS HB.

PQI 2 CEMENT ROOFING SLATE COVERINGS

Cement roofing slates shall be of the texture, size and colour shown on the drawings or scheduled, and manufactured by Everite Building Products or other equally approved manufacturer.

Care shall be taken to avoid damage by dropping or rough handling, this being especially important to the edges and the surface coating.

Roofing slates must be stored under cover, clear of the ground on suitable timber supports. The maximum height of stored materials must not exceed 25 bundles (10 slates per bundle). Snips must be used to remove the bundle strapping (on no account must straps be levered off).

PQI 3 CONCRETE TILE ROOF COVERINGS

PQI 3.1 General

Concrete roof tiles shall be of the texture, size and colour shown on the drawings or scheduled. The tiles are to be of the interlocking type and shall be laid with underlaying sheeting as required by the drawings. Generally, tiles with an underlay may be laid to a flatter pitch (minimum 17,5º) than those without (minimum 26º).

PQI 3.2 Materials

Concrete roof tiles shall be manufactured in accordance with SANS 542 and be supplied by an approved manufacturer to the type, size and colour called for on the drawings or in the Bill of Quantities. Approved manufacturers are Marley Roofing (Pty) Ltd, Coverland and Watson Tile and Concrete. Other manufacturer's products may be acceptable but are subject to approval by the Employer's Agent.

Fittings and accessories shown on the drawings or scheduled are to be supplied by the same manufacturer from his standard range, where applicable.

Purpose-made fittings shall be approved by the tile manufacturer for use with his products and shall conform with the requirements shown on the drawings. Such purpose-made fittings shall be ordered by the Contractor sufficiently early to ensure delivery to suit his roof construction programme.

PQI 3.3 Construction of Concrete Tiled or Cement Slate Roofing

PQI 3.3.1 Safety

The laying of roof coverings shall be carried out only by workmen approved by the Contractor and who have had previous experience of such work. No other person, except those authorised for supervision and inspection, shall be permitted either onto the roof area being constructed or onto the floor vertically below that area at any time until such work has been completed. The Contractor shall be responsible for ensuring full adherence to the Occupation Health & Safety Act whilst construction of the roofing is being carried out.

No unfastened materials shall be left on the roof at any time, to avoid any possible dislodgement by wind or other natural force over which the Contractor has no control.

PQI 3.3.2 Laying Operations

In addition to complying with the aforesaid safety requirements, the laying of concrete tiles and cement slates and the associated fittings and accessories shall be carried out fully in accordance with the manufacturer's specifications. A copy of such specifications shall be available on site at all times.

Where underlay sheeting is called for, it shall have the SABS mark and must be laid in accordance with the drawings with sufficient overlap at all joins. Care must be taken to avoid cutting or tearing the underlay during subsequent operations and no rubbish or debris shall be left between the top of the sheeting and the underside of the tiles/slates.

Handling concrete tiles and cement slates and the fittings and accessories shall at all times be such as to cause no damage to the products and such handling methods shall be to the manufacturer's approval.

Walking on complete sections of the roof shall be permitted only in accordance with the tile/slate manufacturer's recommendations.

PQI 4 TESTING ROOFS FOR WEATHERTIGHTNESS

After laying operations have been completed, the Employer's Agent shall have the right to test the roof for tightness against penetration by rain or other weather condition by any means he considers necessary to simulate natural conditions. Should any part of the roofing be shown to be defective due to faulty workmanship or the use of sub-standard materials, the Contractor shall repair such defective parts as his own cost. The repairs shall be of the extent necessary to satisfy the Employer's Agent that the roof is weathertight.

PQI 5 PAYMENT FOR ROOF COVERINGS

PQI 5.1 Roof coverings ..... **Unit: m²**

Payment for roof coverings will be made for the exposed surface area of the finished roof where ancillaries are measured separately.

PQI 5.2 Ancillaries, such as flashing, ridging, ventilator openings, etc. ..... Unit: m/No

Payment for ancillaries such as flashing, ridging, ventilator openings, etc where scheduled separately, will be paid for by length or number of each item concerned.

PQI 5.3 Roof coverings with all ancillaries ..... Unit: m²/Sum

Payment for roof coverings, where scheduled complete with all ancillaries as shown on the drawings, will be made either by roof surface area or by lump sum (small roofs only).

PQI 5.4 Weather testing .....Unit: Sum

Payment for weather testing of completed roof shall be made if such tests are ordered by the Employer's Agent and the roof is thereby proved to be weathertight. No payment for testing will be made should the roof be found to be defective. Payment, where called for by the foregoing shall be made at a lump sum mutually agreed by the Employer's Agent and Contractor.

The tendered rates shall cover for the supply, delivery, storage and handling of all materials, including waste, plant and labour necessary for the complete construction of the roof covering in accordance with the drawings.

C.3.8.9 PRA: Security Fence with Steel Posts

PRA 1 SCOPE

This specification covers the requirements for a steel mesh security fence (generally for use in inland, non-corrosive, areas) supported on galvanised steel posts and having a strength at least equal to that specified in SABS CKS 451 - Anti Intruder Fences.

The fence shall be installed in the positions shown on the drawings or as directed on site.

Alternative fence designs to suit a fencing manufacturer's standard components will be considered and may be approved, provided that they are not in any way inferior to the requirements of this specification and provided that the Employer's Agent's prior approval is obtained.

PRA 2 DEFINITIONS

For the purpose of this specification the following definitions shall apply:

Aperture:	An opening between two adjacent wires of the mesh.
Intermediate post:	A fencing component that supports the straining wires.
Stay:	A component of the fence that is connected to a straining post and embedded in the ground at an angle to assist the straining post to withstand the pull of the straining wires.
Straining post:	A component of the fence that withstands the pull of the straining wires and, in addition and when relevant, supports a gate.

PRA 3 MATERIALS

PRA 3.1 Straining Posts

Straining posts, which include corner and gate posts, shall be manufactured from DN 100 mild steel tubes having a minimum wall thickness of 2,8 mm. The vertical length of each post shall be at least 3,5 m.

Every post shall have a mild steel base plate welded to its lower end. The upper end of the post shall incorporate a vertical/45 degree outward sloping extension arm 450 mm long.

PRA 3.2 Intermediate Posts

Intermediate posts shall be manufactured from DN 50 mild steel tubes having a minimum wall thickness of 2,0 mm. The length of each post shall be identical to, and the end treatment and drilling shall be similar to, that of the straining posts.

PRA 3.3 Stays

Stays shall be of DN 50 mild steel tubing with a minimum wall thickness of 2,0 mm and shall be at least equal in length to the straining posts.

Each stay shall have a mild steel base plate welded to its lower end and the other end shall be flattened and bent to an angle of approximately 135° and drilled for bolting to the vertical post.

PRA 3.4 Mesh Panels

Mesh shall be rectangular pattern galvanised steel mesh. It shall be manufactured from 3,15 mm mild steel wire with Class A (heavy) zinc coating to SANS 675. The width of the fence (i.e, sheet width corresponding to the height of the vertical portion of the fence) shall be 2,4 m and the nominal panel length shall be 35 m. The aperture size of the mesh shall not exceed 100 high x 50 mm wide. The edge finish shall be to the manufacturer's standard finish.

PRA 3.5 Fencing Wire

Fencing wire shall be zinc coated mild steel wire complying in all respects with the relevant requirements of SANS 675 with Class A (heavy) zinc coating and shall be of the following diameters:

Straining wire	-	4 mm diameter
Tie wire	-	1,6 mm diameter
Razor wire	-	Shall be of approved diameter supplied in maximum 700 mm diameter flattened coils and erected with 50% overlays on each coil.

PRA 3.6 Gates

Gates and their extension arms shall be of mild steel tubing having continuously welded seams. The height of the gate(s) shall be the same as that of the fence, and the mesh (and razor wire sections if called for) shall align approximately with the adjoining sections of the fence. The mesh filling panels shall comply with the relevant requirements of PRA 3.5. The main frame shall be of DN 50 mild steel tubing with minimum wall thickness of 2,0 mm and bracing members of DN 25 mild steel tubing with a minimum wall thickness 1,6 mm.

Double leaf gateways shall have a 4,8 m wide clear opening, with each leaf being of equal width. Single leaf gateways shall have a clear opening of 850 mm.

Gates shall be of welded construction with all corners of the main frame members mitred. Gates shall have at least one diagonal bracing member. Extension arms shall be provided for each vertical main frame member and these shall be attached by welding. All welds shall be continuous.

Gates shall be fitted with mesh securely attached to each main frame member and bracing member by tie wires. Razor wire shall be securely attached to the top and bottom of the gate. The razor wire shall be in flattened coils identical to those used on the fence and erected in a similar manner.

PRA 3.7 Base Plates and Caps

Base plates shall be of mild steel, and caps shall be of mild steel or cast iron. Base plates for straining posts shall be at least 200 mm x 200 mm x 3 mm and for intermediate posts and stays at least 150 mm x 150 mm x 3 mm. Each base plate shall have a central hole of diameter 17 mm. Caps shall be of acceptable thickness and large enough to cover the top of the extension arms.

PRA 3.8 Bolts, Nuts and Washers

Strain eye bolts, hinge bolts, bolts and nuts shall comply with the relevant requirements of SANS 1700-7 Sections 3 & 5. Washers shall comply with the requirements of SANS 1700-16.

The nominal diameter of the bolts shall be M10 in the case of strain eye bolts, M12 in the case of bolts for bolting stays to straining posts, and M16 in the case of hinge bolts for gates. The length of a bolt shall be appropriate to its application. Nuts and washers shall be of the correct sizes for the bolts with which they are used.

PRA 3.9 Drop Bolts and Sleeves

Drop bolts and sleeves shall be of galvanised mild steel rod and mild steel tubing. Drop bolts shall be at least 16 mm diameter and 380 mm long. The bore of the sleeves cast into the concrete sill shall be just large enough to allow its drop bolt to move freely and the length shall be at least 230 mm.

PRA 3.10 Hasps, Staples and Padlocks

Hasps and staples shall be of galvanised mild steel. Padlocks shall comply with the requirements for SANS 1533 Type LP, Category 3 padlocks of nominal size at least 50 mm. Hasps and staples shall be of approved size.

PRA 3.11 Anchor Pegs

Anchor pegs shall be of approved design and be manufactured from galvanised mild steel rod, 8 mm diameter and be of a length sufficient to satisfy the requirements of PRA 4.6(c) Method 1.

PRA 3.12 Hairpin Staples

Hairpin staples shall be of wire of diameter 3,55 mm that complies with the requirements of SANS 675 for Class B (Medium) galvanised mild steel wire. Hairpin staples shall be of length sufficient to satisfy the requirements of PRA 4.6(c) Method 2.

PRA 3.13 Galvanising (other than for wire mesh and fencing wire)

All steelwork, comprising straining posts, intermediate posts, stays, extension arms droppers, base plates, gate frames, caps, bolts, nuts, washers, drop bolts, sleeves, hasps, staples and anchor pegs, shall be treated in the following manner after all drilling and welding has been completed:

- Surfaces shall be prepared for galvanising by being shot/grit blasted to a Sa 2½ standard in accordance with Swedish Standard SIS 05-59-00 or alternatively be treated by some other method to achieve the same standard of preparation

- The components shall then be hot dipped galvanised to the requirements of SANS 121 for heavy duty applications.

PRA 3.14 Concrete

Concrete for the bases shall be at least Grade 15 (15 Mpa).

PRA 4 CONSTRUCTION AND ERECTION

PAA 4.1 Means of Attachment to Posts

The following means of attachment shall be used:

For the purpose of attaching straining wires, posts shall have five pairs of holes of such diameter as to just clear the shank of a strain eye bolt and intermediate posts shall have the same number of holes of such diameter as to just clear a tie wire. The spacing of the holes shall be the same in each post and the holes shall be so positioned that the lowest will be just above ground level, the highest will be approximately level with the top of the razor wire flattened coil and the remainder spaced as shown on the drawing.

For the purpose of supporting a gate, two holes per gate of such diameter as to clear the shank of the hinge bolt, shall be drilled in the appropriate positions.

For the purpose of bolting a stay to the post, one pair of holes of diameter to just clear the bolt, shall be drilled in positions appropriate to the lengths of post and stay to be joined.

PRA 4.2 Posts

Straining posts shall be provided at all corners and all other changes in direction, at acute variations in the level of the fence, and as supports for gates. On straight lengths of fencing, straining posts shall be spaced not more than 35 m apart. Intermediate posts shall be spaced not more than 3,5 m apart.

PRA 4.3 Stays

Two stays shall be bolted or otherwise attached to each straining post, other than for a straining post supporting a gate, which shall have one stay. The stay(s) shall be positioned behind the mesh and on the line of the fence.

PRA 4.4 Foundations for Posts and Stays

Each straining post, stay, and intermediate post shall be encased in concrete for a depth of 840 mm. The foundation hole shall be of the following dimensions:

(a) for straining posts:
450 mm x 450 mm and a depth of 800 mm

(d) for gate posts:
500 mm x 500 mm and a depth of 800 mm and brought up to a height approximately 50 mm above ground level.

(c) for intermediate posts:
300 mm x 300 mm and a depth of 800 mm

(d) for stays:
The hole shall have a length of 600 mm along the line of the fence, and a width of 300 mm. Three sides shall be vertical, and the other shall slope down approximately 45° away from the post being stayed to a depth of 500 mm. (The stay, when in position, shall be at approximately 45° to the post.)

PRA 4.5 Straining Wires

Five straining wires shall be provided, four for supporting the mesh and an additional wire to support the top of the razor wire flattened coils. They shall all be parallel to each other. Each straining wire shall have one end taken at least twice around a straining post, and the other end passed at least twice around the eye of a strain eye bolt attached to the next straining post. Free ends of the wire shall be twisted at least three times around the wire. The straining wire shall be secured to each intermediate post by a tie wire, and the tie wire shall be secured to the straining wire by at least three complete turns on either side of the post.

PRA 4.6 Mesh

The mesh shall, after being suitably tensioned to ensure that the apertures remain rectangular, be attached by tie wires to the straining wires and, when relevant, to the top rail. The positions of attachment shall be as follows:

(a) To the top straining wire or, when relevant, the top rail: at each aperture
(b) To the bottom straining wire: at apertures not more than 150 mm apart
(c) To the intermediate straining wires: at apertures not more than 300 mm apart.

In addition, the mesh shall be attached to each straining post by means of tie wires around the post at every aperture.

The bottom of the mesh shall be attached to the ground in accordance with Method 1 hereunder. Method 2 shall only be used where specifically called for.

Method 1: A continuous trench, of depth and width approximately 100 mm, shall be provided between the posts. The bottom of the mesh shall be positioned at a depth of at least 50 mm in the trench. Anchor pegs shall be attached to the bottom row of apertures of the mesh at spacings not exceeding 1,0 m, and their free ends driven into the base of the trench to a depth of at least 400 mm. The trench shall be filled with earth or other suitable material well rammed and compacted.

Method 2: A continuous concrete sill/ground beam, of width and height at least 125 mm and 225 mm respectively, shall be so cast between the posts, that its top is approximately 25 mm below the bottom of the mesh. Hairpin staples shall be threaded through the bottom row of apertures of the mesh at spacing not exceeding 1,0 m, and their free ends set in the sill to a depth of at least 150 mm. The concrete shall be well floated and trowelled to an acceptable smoothness. This “concrete sill” may be made wider and deeper to prevent intruders excavating under the fence to gain entry in which case it must be detailed on the drawings.

PRA 4.7 Razor Wire

Razor wire coils shall be supplied and attached to the upper extension of the posts and to the top and bottom of the gates.

Where shown on the drawings and/or scheduled in the Bill of Quantities, razor wire coils shall be supplied and attached to the mesh panels as suitably sized flattened coils with a 50% overlap on each loop of the coil and covering the whole surface area of the mesh. Each intersection of each loop of the razor wire shall be tied to its adjacent loop as well as at each intersection of the loops with the straining wires and posts to provide at least 8 ties to each loop. The top of the upper razor wire loops shall be at the same level as the top of the posts and the bottom of the lower razor wire loops shall be flush with the bottom of the rectangular mesh panels.

PRA 4.8 Gates

Gates shall be erected such that:

(a) there is a gap of not less than 35 mm and not more than 75 mm between the hinge stile(s) and the straining posts;

(b) there is a clearance of not less than 50 mm and not more than 75 mm between the bottom horizontal frame member(s) and the ground; and

(c) when closed, there is a space of not more than 15 mm between the closing stiles and/or the straining post for each leaf of the gateway.

Except where gates re installed over surfaced roadways, a full length concrete sill rectangular in section having a width at least 400 mm, and depth of at least 225 mm, shall be installed under and on the line of the gates, with its top at ground level. The concrete shall be well vibrated to prevent voids being formed, and the top surface shall be floated and trowelled to an acceptable smoothness. The sleeves for the drop bolts shall be so set in the concrete sill, or concreted into the roadway (as relevant), that their tops are just above the level of the sill or roadway.

PRA 4.9 Bolts

All bolts used for erection of the fence shall be provided with nuts and washers and shall have their ends burred over after erection.

PRA 4.10 Marking

Each fence shall bear the manufacturer's name on the main gate at eye level.

PRA 5 TOLERANCES

PRA 5.1 Out-of-straightness of any component shall not exceed 3 mm/m length of the component.

PRA 6 MEASUREMENT AND PAYMENT

PRA 6.1 Clearing and grubbing line of fence ..... Unit: m

The rate for clearing and grubbing shall cover the cost of clearing a 2 m wide strip (1 m on either side of the fence centre line) along the entire length of the fence, removing boulders of size up to 0,15 m^3, grubbing of trees of girth up to 1 m, grubbing of tree stumps, cutting of trunks and branches exceeding 0,5 m girth into transportable lengths, backfilling of cavities and removing, transporting and disposing of material thus cleared, grubbed and cut.

Boulders exceeding 0,15 m^3 and removal and grubbing of trees exceeding 1 m girth shall be paid for separately.

PRA 6.2 Fencing ..... Unit: m

The rate for fencing shall include for all setting out, supplying, transporting and erection of the fence, all as specified and including for the razor coils on the fence above the mesh. The measured length shall include the length of all gateways.

PRA 6.3 Extra over PRA 6.2 for the supply and installation of razor coil covering to the entire area of the mesh ..... Unit: m

PRA 6.4 Extra over PRA 6.2 for:

(a) Single gate ..... Unit: No
(b) Pair of double gates ..... Unit: No

The extra over rate for gates shall include for supplying, transporting and erection of single gates and/or double gates as applicable.

PRA 6.5 Extra over PRA 6.4 for the supply and installation of razor coil covering to the entire area of the mesh on the gate..... Unit: m

PRA 6.6 Concrete Bases for Posts ..... Unit: No

The rate shall include for excavation, placing concrete and setting in post and base plate and holding down bolts and finishing exposed surfaces.

PRA 6.7 Concrete sill/ground beam ..... Unit: m

C.3.8.10 PRD: Demolition of Concrete
(Supplementary to SABS 1200 – 1986)

PRD 1 SCOPE

This specification covers the demolition of concrete structures and/or portions of concrete structures together with the removal of the demolished material to the specified disposal area.

PRD 2 INTERPRETATIONS

PRD 2.1 Definitions

PRD 2.1.1 Concrete structures shall include all types of concrete including mass concrete, reinforced concrete, prestressed concrete and pneumatically applied concrete.

PRD 2.1.2 Demolition

The breaking down of concrete to the required outline and into separate, manageable and disposable sizes with no repair work to be undertaken. Where necessary, reinforcement shall be trimmed back in both the material left in place and in the material to be carted to disposal areas.

PRD 2.1.3 Removal

The breaking away of material from an existing concrete structure to expose sound concrete surfaces and/or reinforcement.

PRD 3 MATERIALS

Materials to be used in the demolition process shall be handled, stored and used strictly in accordance with the manufacturer's instructions.

PRD 4 PLANT

PRD 4.1 General

The plant and equipment to be used for the demolition of entire concrete structures or for portions of concrete structures shall be suitable for the particular application, based on proven and acceptable methods.

The proposed method of working shall, where so required, be demonstrated on a representative test section selected by the Employer's Agent.

PRD 4.2 Temporary Work and Safety

The Contractor shall provide suitable and safe temporary structures, including debris collection and removal chutes, as well as bins. Protection screens shall be provided, at each location of concrete demolition operations.

Any temporary propping required by the Employer's Agent for safety purposes shall be securely fixed in position and be subject to the approval of the Employer's Agent, prior to carrying out any stage of the work.

All work shall be carried out in full compliance with the Occupational Health and Safety Act No 85 of 1993 as well as to the approval of the Local Authority.

PRD 5 CONSTRUCTION

PRD 5.1 Access to Structures

The access to each structure to be demolished shall be completed prior to the commencement of demolition or removal work.

PRD 5.2 Programme

The demolition programme shall be in accordance with the drawings and any written instructions issued by the Employer's Agent.

PRD 5.3 Demolition of Structures

The demolition of structures, or major portions of a structure, shall be carried out in a manner that will ensure that no damage is caused to adjacent structures or structural members. The demolition activities shall not contaminate the surrounding environment making it unfit for normal activities, except at times and for durations approved by the Employer's Agent.

The Contractor shall ensure that nuisances associated with his work are minimised by taking appropriate precautions that shall be subject to the approval of the Employer's Agent. Nuisances include *inter alia*: noise, dust, flying fragments, heat, vibration and fumes.

Demolition shall be carried out without the use of explosives, (except where otherwise approved by the Employer's Agent) and in compliance with all relevant health and safety regulations.

PRD 5.4 Removal of Concrete

The Employer's Agent shall clearly mark or define the extent of the concrete to be removed. The marked outline shall be cut at least 10 mm deep into the concrete by the Contractor before commencing the associated removal work.

The concrete to be removed may be either the full depth and width of the member or a surface area removed to a prescribed depth, as shown on the drawings or ordered by the Employer's Agent.

Reinforcement to concrete which is not to be removed shall be cut back to lines as detailed on the drawings. The method used shall be selected by the Contractor and be subject to the approval of the Employer's Agent prior to commencing such activity.

Methods of demolition and/or removal that do not damage the structure or strength of the remaining sound concrete shall be used. Thermal cutting shall not be used closer than 100 mm from the outline marked on the structure or as indicated on the drawings. The remaining concrete shall be removed using appropriate mechanical means.

Where a concrete member is subsequently to be extended or partially replaced, the concrete around the reinforcement bars shall be removed to expose the bars to the extent required by the Employer's Agent. Care shall be taken to avoid reducing the strength of the bars to be exposed.

The equipment to be used for cutting back concrete to such contact surfaces shall be such as to avoid cracking the structure which is to remain in place. No reduction of bond between reinforcement and existing concrete will be tolerated.

PRD 5.5 Removal of Embedded Steelwork

Steel, or other metal, sections embedded in concrete structures shall be carefully removed, where so required, without damaging the structural concrete. Suitable tools, subject to the approval of the Employer's Agent shall be used for this work.

PRD 5.6 Surface Preparation for Contact Surfaces

The required concrete contact surfaces shall be cut to a plane and even surface with exposed faces perpendicular to the horizontal face or side faces as applicable.

All loose and shattered concrete, as well as foreign material such as oil, paint, grease, etc shall be removed from the contact surfaces. The contact surfaces thus prepared shall be cleaned by water jetting or other methods subject to the approval of the Employer's Agent and, in the case where the new concrete will not be cast against the surface within 3 days, shall be protected with plastic sheeting.

PRD 5.7 Drilling Holes into or though Concrete

Prior to drilling into or through concrete members a non-destructive survey shall be carried out by the Contractor in conjunction with the Employer's Agent over areas outlined by the Employer's Agent in order to locate existing reinforcement steel. The located bar positions shall be clearly marked, and using this information, final positions for drilling will be determined by the Employer's Agent.

PRD 6 TOLERANCES

The maximum deviation from the required line, level or dimensions indicated on the drawings shall be 25 mm, unless otherwise approved by the Employer's Agent.

PRD 7 TESTING

Should the Employer's Agent require the Contractor to demonstrate the suitability of the equipment and method he proposes to use for demolition work, the Employer's Agent will specify where such a demonstration shall be carried out and the Contractor shall comply with such requirements. No payment will be made for any such demonstration.

PRD 8 MEASUREMENT AND PAYMENT

PRD 8.1 Demolition of Concrete ..... Unit: m^3

The unit of measurement shall be the volume of concrete to be demolished, measured in its original position prior to demolition.

The tendered rates shall include full compensation for the prevision of all materials, plant, labour, screening and protective measures that are required to demolish the concrete and to load, transport and dump the concrete segments and rubble at the nearest approved dumping area.

PRD 8.2 Cutting Back of Concrete to a New Surface ..... Unit: m^3

The unit of measurement shall be the volume of concrete to be removed, as measured in its original position prior to cutting back operations.

The tendered rates shall include full compensation for the provision of all materials, plant, labour, screening and protective measures, that are required to cut back the concrete and reinforcement to the profile shown on the drawings and to load, transport and dump the spoil material at the nearest approved dumping area.

PRD 8.3 Removal of Concrete to Expose Reinforcement ..... Unit: m^3

The unit of measurement shall be the volume of concrete removed, measured in its original position on a structural member.

The tendered rate shall include full compensation for the provision of all labour, materials, screening and protective measures, equipment, plant, etc that is required to cut back the concrete and expose reinforcement to the profile shown and to load, transport and dump the material at the nearest approved dumping area.

PRD 8.4 Removal of Surface Concrete ..... Unit: m^2

The unit of measurement shall be the area of concrete of specified thickness that is removed, measured in its original position of a structural member.

The tendered rate shall include full compensation for the provision of all labour, materials, screening and protective measures, equipment, plant, etc, that is required for the removal of the surface concrete to the profile shown or specified including the exposure of reinforcement bars, and to load, transport and dump the material at the nearest approved dumping area.

PRD 8.5 Removal of Metal Sections Embedded in Concrete ..... Unit: No or Sum

The unit of measurement shall be the number of metal sections removed.

The tendered rate shall include full compensation for the provision of all labour, material, screening and protective measures, plant and equipment required for the removal of embedment grout or concrete surrounding the metal section by means of chiselling, cutting or grinding, the removal of the metal section stub and disposal of all rubble at a suitable waste site, and the cleaning of the pocket as specified.

PRD 8.6 Drilling or Coring of Holes through Concrete Members ..... Unit: No

The unit of measurement shall be the number of holes of specified type and size drilled or cored into or through a concrete member.

The tendered rate shall include full compensation for the provision of all labour, protective measures, plant or equipment required for the execution of work, including the provision of fixings, power cabling, etc and the disposal of resultant rubble at the nearest approved dumping area.

C3.8.11 PUB: Joints in Hydraulic Structures

(Supplementary to SABS 1200 – 1986)

PUB 1 SCOPE

This specification covers the requirements for watertight expansion, contraction, and construction joints in water retaining and water excluding concrete structures. Should there be any discrepancy between the requirements of the specification and the drawings, the requirements of the drawings shall prevail.

PUB 2 MATERIALS

PUB 2.1 General

All joint materials shall be subject to the approval of the Employer's Agent prior to their use. A written recommendation regarding the suitability of the materials that the Contractor proposes to use shall be obtained from the manufacturer by the Contractor and submitted to the Employer's Agent at the time of requesting approval for the use of such materials.

All the materials required for each separate jointing system shall be obtained from the same manufacturer, except where other specific manufacturer's products are called for on the drawings, or scheduled.

The types of liquid to be retained within, or excluded from, the structures included under this Contract, are as follows:

- Potable water treated with chlorine
- Raw sewage
- Aerobic sewage sludges
- Anaerobic sewage sludges
- Sewage effluent

PUB 2.2 Joint Filler Materials

PUB 2.2.1 Expanded Polyethylene Fillers

The material shall comprise a semi-rigid, closed cell expanded polyethylene sheet suitable for use in movement joints in water/sewage retaining structures and water excluding structures.

The material shall be rot-proof, resistant to biological attack, non-absorbent, ultraviolet stabilised and non-toxic when used for potable water applications. The last quality is not required for use with sewage systems. The material shall also be able to withstand the maximum hydraulic head which may be applied at the joint.

Suitable approved materials are not limited to but include:

(a) For hydraulic heads up to 3 m:
"Jointex" manufactured by Sondor Industries Ltd
"Hydrocell" manufactured by Fosroc (Pty) Ltd

(b) For hydraulic heads over 3 m up to 15 m:
"Aquajoint SPX 120" manufactured by Sondor Industries Ltd
"Hydrocell" manufactured by Fosroc (Pty) Ltd

PUB 2.3 Waterstops

PUB 2.3.1 PVC Waterstops

PVC waterstops shall be manufactured from new materials (regenerated PVC is not acceptable) and shall be of the sections shown on the drawings and/or scheduled in the Bill of Quantities. The sections detailed may vary from being a complex section of large surface area which offers a difficult path for possible leakage water, to a surface-mounted waterstop. The waterstops shall be manufactured with fixing lugs, an eyeletted edge or nailing flange.

Suitable approved materials are not limited to but include the following that are manufactured by Fosroc (Pty) Ltd:

(a) Large Surface Area Type

(i) "Supercast Hydrofoil" sections with centre bulb from 150 mm up to 330 mm wide for use in expansion, contraction and construction joints.

(ii) Heavy duty "Hydrofoil" sections 250 mm wide for use where large volumes of concrete are being placed or where the lift is high in deep shutters.

(b) Surface Mounted Waterstops

(i) "Supercast Rearguard S" with central hollow box from 150 mm up to 250 mm wide for use in expansion joints.

PUB 2.3.2 Rubber Waterstops

Rubber waterstops shall be manufactured from a high grade rubber compound to give the characteristics of flexibility and longevity. They shall be of the sections detailed on the drawings and may be of the plain dumbbell type or the centre bulb type.

Suitable approved materials are not limited to but include the following that are manufactured by Fosroc (Pty) Ltd:

(a) Plain Dumbbell Type

Two section profiles, 150 mm and 230 mm wide are available and are suitable for contraction joints where no shear movement is possible but otherwise high movement is expected.

(b) Centerbulb Type

Four profiles from 115 mm to 355 mm wide are available and are suitable for contraction and expansion joints where high movement is expected.

PUB 2.3.3 Swellable Hydrophilic Waterstops

Water swellable waterstops shall be manufactured from high performance synthetic elastomer strips with the swelling action resulting from the strips coming into contact with water. They shall have an unrestrained volumetric expansion of not less than 170% and must not deteriorate under prolonged wet/dry cycling.

The strips shall be of the sizes shown on the drawings and fastened to the concrete with the manufacturer’s recommended adhesive. Fosroc (Pty) Ltd manufactures a material, supplied in strips referenced “Supercast SW20 or SW10". "SW20" is 10 x 20 mm in cross-section whilst "SW10" is 5 x 10 mm. This material is suitable for construction and contraction joints but is not suitable for expansion joints.

The swellable waterstop is particularly suitable for joints formed under difficult conditions, as well as for pipe entries. The maximum hydrostatic pressure resistance of this product is 50 m head of water.

"Supercast SW" swellable waterstops may be used in conjunction with the same manufacturer's Rearguard waterstop.

PUB 2.3.4 Other Manufacturer's Waterstops

Waterstops manufactured by other specialist manufacturers may be used where they are of similar specification, provided prior approval is obtained from the Employer's Agent in compliance with Clause PUB 2.1 above.

PUB 2.4 Joint Sealant Materials

PUB 2.4.1 General

Before ordering any joint sealant materials the Contractor shall obtain, and submit to the Employer's Agent for his approval, written evidence from the manufacturer that the proposed materials are suitable for their required purpose(s).

All materials shall be insoluble in water and not deteriorate if subjected to any chemical action or biological attack when in contact with the liquids listed in Clause PUB 2.1 above.

PUB 2.4.2 Elastomeric Sealants

PUB 2.4.2.1 Polysulphide Sealants (Not suitable for sewage uses)

Polysulphide sealants shall be manganese cured and lead free and shall be used with the primer and bond breaker as may be required to comply with the manufacturer's specifications.

A suitable sealant is "Thioflex 600" manufactured by Fosroc (Pty) Ltd but subject to meeting the requirements of Clause PUB 2.4.1 above, and subject to the joint dimensions being within the limits laid down by the sealant manufacturer.

PUB 2.4.2.2 Polyurethane Sealants

Polyurethane sealants may be either one component or two component materials. Suitable materials, but subject to Clause PUB 2.4.1 above, are as follows:

(a) One component:
- "Sikaflex 1a" for a wide variety of applications
- "Sikaflex 11FC" for low movement joints
- "Sikaflex 35SL" with high abrasion and weathering resistance.

(b) Two components:
- "Expoflex 800" for a wide variety of applications
-

"Sikaflex" materials are manufactured by Sika (Pty) Ltd and "Expoflex" by Fosroc (Pty) Ltd.

PUB 2.5 Bandage Joint Systems

PUB 2.5.1 General

Proprietary bandage joint waterproofing systems shall conform in all respects to the manufacturer's specifications and a written recommendation is to be obtained by the Contractor from the manufacturer with regard to the suitability of the material for the specific application.

Bandage systems are particularly useful for remedial purposes in water retaining structures.

PUB 2.5.2 Fosroc Bandage Material

A suitable bandage material supplied by Fosroc (Pty) Ltd is "Expoband" but the complete joint comprises:

"Expoband" bandage
"Expoband" adhesive
"Thioflex 600" joint sealant
"Hydrocell" joint filler
"Famguard strap" (may be omitted)

PUB 2.5.3 Sika Bandage System

A suitable bandage material supplied by Sika (Pty) Ltd is "Sikadur-Combiflex" and the complete joint comprises:

A suitable joint filler
"Sikadur 31" (2 layers)
"Combiflex" hypalon sheeting
Masking strip

PUB 3 CONSTRUCTION

PUB 3.1 Joint with Waterstops

Where shown on the drawings, joints shall be formed in concrete work embodying waterstops within the concrete. Such waterstops shall provide a continuous watertight membrane made from strip welded in accordance with the manufacturer's instructions.

It is essential that the waterstops are held securely during concreting by using split wooden shuttering and a clamping device; nailing is not permitted except through the lugs where such are provided for that purpose. The concrete around the waterstop shall be carefully placed and compacted to avoid honeycombing and to ensure full contact between the waterstop and the concrete around the embedded periphery to the seal.

After one half of the waterstop has been set into concrete, the faces of the concrete against which the succeeding section is to be cast shall be thoroughly cleaned by brushing with a wire brush, care being taken not to damage the waterstop.

PUB 3.2 Placing Filler Material

Where scheduled and/or shown on the drawings, filler material shall be placed against concrete work or shuttering and held firmly in position to prevent distortion or displacement while adjacent concrete is being placed. Adhesives, as recommended by the manufacturer of the filler material, shall be used where necessary for this purpose.

PUB 3.3 Sliding Joints

Sliding joints are to be formed where shown on the drawings. The upper concrete surfaces forming the sliding joints, whilst still green, are to be sprinkled with cement and brought to a hard smooth and level finish by trowelling the concrete with a steel trowel. When thoroughly set and dry, these surfaces are to receive one priming coat and two finishing coats of an approved bituminous solution prior to the upper concrete being cast thereon.

PUB 3.4 Joints with Recesses

Joint recesses provided for sealants are to be formed to the dimensions and shapes indicated on the drawings by suitable shuttering which can be removed without any timber having to be left in the recesses. Shuttering shall however be left in place until the joints are ready for cleaning, priming and filling with sealant. Joints shall be thoroughly cleaned and all dust removed.

PUB 3.5 Cutting Joint Recesses

Whilst cutting of recesses will not normally be permitted, should the Employer's Agent so agree in particular situations, the recesses for expansion and contraction joints may be cut into the concrete after concreting has been completed. Such cutting, to accurately achieve the joint dimensions, shall be carried out immediately prior to the filling of the joints with sealant. Great care shall be taken to ensure that no dust or other loose material remains in the recess. All such material shall be removed in the same manner as specified in the previous clause.

PUB 3.6 Sealing Joints with Recesses

The sealing of expansion and contraction joints is to be carried out by the Contractor under the supervision of a representative from the manufacturer of the sealant material. The Contractor is to be responsible for supplying approved materials, transporting them to site, storing and using them as required, and providing all labour, tools and all other apparatus necessary to prime and fill the joints.

The sealing of joints is to be carried out precisely in accordance with the instructions previously obtained from the manufacturer, or in accordance with his representative's requirements should these differ from the written instructions.

No sealing of joint recesses is to be carried out until at least 21 days after the adjacent concrete has been cast.

PUB 4 MEASUREMENT AND PAYMENT

For measurement and payment items for joints refer to PSG.

C3.8.12 PVH: Wedge Gate, Resilient Seal, Butterfly and Air Valves
(Applicable to Project Specification PSL and SANS 1200 L)

PVH 1 SCOPE

This specification covers the materials, manufacturing and testing requirements for wedge gate, resilient seal, butterfly, and air valves for use in water and wastewater installations. The installation of valves is dealt with in PSL Medium Pressure Pipelines.

PVH 2 ABBREVIATIONS/ACRONYMNS

EPDM	Ethylene Propylene Diene Monomer (M-class) rubber
DN	Nominal Diameter
PN	Nominal Pressure - pressure rating
AWWA	American Water Works Association

PVH 3 Materials, Workmanship and Construction

PVH 3.1 General

The types, sizes, end connections, pressure ranges and other details of the valves required are detailed on the drawings and/or on the tender documents. Technical Data Sheets are included in the Returnable Schedules section of the tender document to enable tenderers to provide specific details of their products being offered.

PVH 3.2 Wedge Gate Valves

Wedge gate valves shall comply with the requirements of SANS 664 for waterworks pattern valves save as amended by this specification.

All valves shall comply with the following minimum requirements:

a) Non rising spindle.

b) The direction of rotation of the operating hand wheel (or square cap) to close the valve shall be anti-clockwise closing when viewed from above.

c) A square cap or a suitably sized handwheel (as scheduled) shall be supplied.

d) Fully enclosed gearing, where necessary to limit the maximum torque to be applied at the handwheel spindle or square cap top to 120 Nm under an unbalanced pressure equal to the maximum working pressure of the valve, shall be provided.

e) The facility to permit repacking of the gland whilst the valve is under working pressure.

f) Stainless steel jacking/limiting screws are required for valves with a nominal bore greater than DN 600 and with metal gates.

g) Seats shall be glued and pinned into place.

h) Valve-trim comprising Grade 316 stainless steel, highly polished to prevent galling, unless otherwise indicated. Trim rings shall be pinned into the body and plug. Trim rings secured by pressing are not permitted. Bonding liquids are not acceptable as the primary means of securing trim rings.

i) Supporting feet are required on all valves greater than DN 300.

j) Channel-guides and shoes are required for valves DN 600 and above.

k) Each valve shall be capable of being easily operated by one man against the maximum, unbalanced pressure, and the effort required to operate shall not exceed a torque of 120Nm. In order to comply with the above requirements, it has been found that ball thrusts are required for valves DN300 and greater.

Notwithstanding the above, the spur gear ratio shall be selected by the manufacturer to suit his valve design and to satisfy the specified maximum operating torque requirements.

The spur-gear ratio, whether the valves are fitted with ball thrust bearings, and the maximum torque required to operate the valves against the working pressure shall be stated by the Tenderer in the Data Sheets. Shear pins shall be fitted to gearboxes in order to provide protection against damage.

l) Each valve shall seal drip-tight at all pressures up to one and a half times the rated working pressure.

PVH 3.3 Resilient Seal Valves (RSV's)

In addition to the relevant requirements of PVH 3.2 above, RSV's shall have the following minimum requirements:

- Comply with SANS 664-3 and carry the SABS mark.
- Spindles of Grade 304 stainless steel or EN57 steel.
- Gates covered in bonded nitrile-rubber or vulcanized EPDM.
- Gates capable of being replaced without removing the valve body from the installation.
- Spindle is to be of high tensile stainless steel.
- Replacement of the spindle seal (gland re-packing) shall be possible under full working pressure.
- Multiple "O" ring seals in lieu of gland packings.
- Spindle seal housed in a corrosion resistant bush.
- If Allen-head screws/bolts are used to fasten the stuffing box to the bonnet, and/or the bonnet to the valve body, these shall be of stainless steel and be recessed and wax encapsulated to minimise corrosion.

PVH 3.4 Butterfly Valves

Butterfly valves shall comply with the requirements of SANS 1849 save as amended by this specification.

All valves shall comply with the following minimum requirements

- Valves shall be double flanged and be suitable for installation in terminal positions.
- A replaceable, carefully machined and polished, stainless steel seat shall be bolted to the body with stainless steel studs. The seat shall be sufficiently wide to permit at least 10 mm "lead" distance on each side for the resilient seal.
- A replaceable EPDM or nitrile high strength continuous resilient seal shall be clamped to the disc with a removable stainless-steel locating ring that shall in turn be secured to the disc with stainless steel studs. Where the resilient seal is in contact with the outside diameter of the disc, the disc shall be stainless steel. This stainless-steel edge may either be deposit weld, or the disc may be entirely stainless steel. The cross-sectional profile of the resilient seal locating ring shall provide maximum protection against tear out during

operation. As tubercular growths may be deposited on internal surfaces of the valve the seal must be protected against possible damage. Designs where the resilient seal is clamped to the valve body rather than the disc will be considered provided that all performance and operational requirements of this specification are met. The resilient seal shall be “non-stick” and shall be stable and not deteriorate under conditions of continuous submersion in the medium indicated.

- The valve seal and seat shall be replaceable without otherwise dismantling the valve.
- All stainless-steel components shall be Grade 316 stainless-steel.
- The valve shall be suitable for installation with the main shaft in the horizontal position and the hand wheel shaft shall be vertical. The shaft shall be Grade 316 stainless steel and shall be located inside the disc and not be in contact with the water.
- The valve shall be of the off-centre stub shaft type and may be of double or triple eccentric configuration.
- The stub-shafts shall be fabricated from high strength stainless steel that shall be located in bronze bushes. Shaft sealing shall be achieved with two O-rings per stub shaft. Whilst pinning of the disc to the drive shaft will be considered, the preferred method of connection is to positively spline or key internally the disc to the driving shaft.
- Each valve shall be so protected as to minimize the possibility of damage during transit and storage. The body ends of all new valves shall be effectively sealed to prevent entry of foreign matter. All valves shall be individually crated.
- The direction of opening shall be such that the bottom of the disc moves in a downstream direction.
- Each valve shall be equipped with a gearbox.

All gearboxes on butterfly valves shall comply with the following:

i. Gearboxes shall be side mounted and of the spur/worm type capable of being manually operated, by one person under the maximum unbalanced working pressure whilst applying a torque of no more than 120 Nm.

ii. Shear pins shall be fitted to gearboxes in order to provide overload protection.

iii. Water must not be able to leak past the main shaft and enter the actuator.

iv. Disc position indicators shall be fitted to the gearbox and shall clearly indicate the fully open and closed positions.

v. A suitable arrow indicating the preferred flow direction through the valve, where such preference is applicable, shall be cast onto the body of the valve.

vi. The gearbox shall be fitted to either the left or the right hand side of the valve when viewed from the upstream side as shown on the drawings.

vii. The handwheel shall be of appropriate size and the direction of rotation of the operating hand wheel to close the valve shall be anti-clockwise when viewed from above.

PVH 3.5 Air Valves

The design and performance characteristics of the valves must have been approved by a recognized authority.

Valves shall react immediately to negative pipeline pressure in order to prevent the formation of unacceptably high negative pressure conditions. Valves shall be capable of discharging high volumes of air through the large orifice under positive line pressure filling conditions and shall be capable of letting in high volumes of air under negative pressure conditions. In addition, the valve shall be capable of releasing small quantities of dis-entrained air at all line pressures up to the rated working pressure of the valve.

During air discharge conditions, the large orifice shall close at a differential pressure across the large orifice of between 4 and 6kPa in order to minimize transient pressure effects. The design shall include for means to release intermediate volumes of air once the large orifice has closed under such conditions. This may be achieved by means of a secondary orifice or other approved manner.

The valve shall seal drop tight at all line pressures from 0,5 bar up to the rated working pressure of the valve.

All valve bodies shall be pressure tested to twice the rated working pressure of the valve.

The intake/discharge orifice shall be equivalent in cross-sectional area to the nominal diameter of the valve. The discharge/intake port shall be protected by a stainless-steel screen that shall not impair the discharge characteristics of the valve.

The valve floats and seals shall require minimal maintenance and it shall be possible to carry out such maintenance without removing the valve.

The floats shall be of HDPE or similar approved maintenance free material. Float seals shall be nitrile rubber or similar approved.

The valve body shall be either coated mild steel or Grade 304 stainless steel as scheduled.

All bolts, nuts, studs and tie rods in the valve assembly shall be Grade 304 stainless-steel.

PVH 3.6 Marking

In addition to the requirements of the applicable SANS specifications regarding marking, all valves shall be provided with an identification plate on which the following information shall be indelibly cast or embossed;

a) The item or tag number.

b) The size or nominal bore of the valve.

c) The class or working pressure of the valve.

PVH 3.7 End Connections

End connections shall be flanged or screwed as scheduled.

a) Flanges - Where flanged connections are specified the dimensions and drilling of the flanges shall comply with SANS 1123 Table 1000 or to BS10:1962 Table E where required to mate with existing flanges. The front faces of flanges shall be flat and normal to the bore of the valve. The back of the flanges, bonnets etc shall be flat and normal to the bore or be spot-faced over an area large enough to freely accommodate the washer and the nut. Drilled holes for the passage of bolts must be provided where wafer type butterfly valves are scheduled.

b) Multi drilled/slotted holed flanges will not be acceptable. Flange gaskets must be suitable for purpose. All ferrous nuts, bolts and washers must be galvanized.

c) Screwed ends - Where screwed ends are specified the valve shall be threaded to BSP.

PVH 3.10 Drawings

The supplier shall fully dimensioned drawings for each type of valve and actuator in .PDF format and in an approved CAD format.

PVH 3.11 Lifting Eyes

A lifting eye at the top of the valve body shall be provided, where the combined mass of the valve, bypass, gearbox/gears, and actuator exceeds 75 kg.

PVH 3.12 Protection Prior to Installation

Valves shall be temporarily covered and protected against UV radiation at all times prior to installation.

PVH 4 INSPECTION AND TESTING

PVH 4.1 Test Certificates

PVH 4.1.1 Factory Pressure Test Certificates

A certificate shall be provided for each valve prior to delivery of the valve to site giving details of the specified hydraulic/pressure tests that have been carried out.

PVH 4.1.2 Inspection certificates

A certificate shall be provided for each valve wherein it is certified that the valve has been inspected and tested and that it complies with the specification. An independent inspector may be appointed by the Employer to witness the testing, in such case the inspector must also sign the certificate. The charges made by the independent inspector will be paid by the Employer.

At least three working days written notice must be given of the proposed date and time of the test. In the event that the valve(s) to be tested not being ready the Employer reserves the right to deduct any fruitless inspection costs from moneys due to the Contractor.

PVH 4.2 Test Requirements Prior to Installation

Hydraulic tests shall be carried out at the factory on each valve as per SANS 664.

PVH 4.3 Inspection

An independent inspector may be appointed by the Employer to witness the testing of valves and/or to inspect valves prior to their release for delivery to site. Where an independent inspector is appointed, the test and/or inspection certificates must be signed by the supplier and the inspector.

The following procedure will be employed for the inspection of all valves:

a) All valves will be subject to inspection at their place of manufacture or assembly or, where not manufactured or assembled locally, at the valve supplier.

b) Inspection may be carried out by the Employer's Agent or a third party appointed by or on behalf of the Employer's Agent.

c) Where valves are provided with corrosion protective coatings, the valve bodies and finishes must be inspected by the Employer's Agent or his/her representative prior to the application of the coating.

d) All valves shall be subject to inspection and testing following application of corrosion protection coatings and prior to release from the factory for delivery to site.

e) Tests on the coating may include visual inspection, dry film tests and wet sponge "holiday" detection tests.

PVH 5 CORROSION PROTECTION

The cleaning and corrosion protection of valves must be carried out at the factory prior to dispatch to the Site. Non-ferrous metal or stainless-steel surfaces must not be painted.

Particular attention shall be given to the thickness and integrity of the coating in the areas where the gate of RSVs is to operate. Low voltage, wet sponge EID detection of pinholes is to be conducted on all surfaces of the valve. The finished coating to be smooth and glossy, free from excessive runs, sags, "orange peel" finish, occlusions and other visible defects.

After installation on site, all valves shall be cleaned, and the paintwork refurbished where necessary to restore the condition to that pertaining at the time of leaving the factory.

Surface Preparation

All cast-iron and steel surfaces of every valve shall be prepared for painting to a thoroughly clean condition free of all grease and deleterious matter. Ferrous surfaces must be prepared in accordance with to Sa 3 of Swedish Standard SIS 05 5900, having an angular profile of 40µm to 60µm.

System 1 (Epoxy Coating)

Surfaces shall be coated with "Sigmaline 523" or "Denso ST 100" or similar approved, non-toxic epoxy resin paint to give a total minimum dry film thickness of 250 µm that is to be pinhole free over the entire painted surface.

Repairs shall be carried out using an approved repair system.

System 2 (Epoxy Powder Coating)

Surfaces shall be coated with electrostatically applied epoxy powder coating ("Mobilox 1004-R1" or Vedoc VPC 2001 or similar approved), to give a total minimum dry film thickness of 300µm that is to be pinhole free over the entire painted surface.

System 3 (External surfaces only)

Apply multi coats of an approved epoxy coal tar paint to give a minimum total dry film thickness of 240µm. The paint shall be applied in accordance with the paint manufacturer's recommendations.

PVH 6 MEASUREMENT AND PAYMENT

Valves will be scheduled per type, size and pressure class.....Unit: No

C3.8.13 PVJ: HDPE Pipes and Fittings
(Applicable to Project Specification PSL and SANS 1200 L)

PVJ 1 SCOPE

This specification outlines the requirements for the manufacture and installation of both solid wall and structured wall HDPE (High Density Polyethylene) pipes and fittings.

PVJ 2 QUALITY ASSURANCE

It is the responsibility of the manufacturer/supplier to establish Quality Assurance by means of a contract review meeting and signed off QCPs which shall ensure that the product will meet the requirements of this specification. Records of each weld shall be completed on a welding record sheet. An example of a welding record sheet will be provided during construction.

The manufacturer/supplier shall maintain a quality system that conforms to the requirements of the SANS ISO 9001:2008 or national equivalent. Applicable standard for manufacture of pipe shall be SANS ISO 4427 for pressure pipe and SANS ISO 21138-2 for structured wall pipe.

PVJ 2.1 Inspection

The Employer and/or the Employer's Agent may appoint an inspection agency to carry out pre-delivery audits at the manufacturer's/supplier's works.

The manufacturer/supplier shall allow the inspectors access to his/her works for the purpose of inspecting either during the course of manufacture, or when completed, and shall afford the inspector all reasonable facilities.

Copies of all test schedules and manufacturer's quality control records shall be available for examination by the inspector and hence the Employer and/or the Employer's Agent.

PVJ 2.2 Documents to be Submitted

The following documents are required:

Certificate of Registration – SANS ISO 9001:2008 or National Equivalent

Permit Certification – SANS 4427 for PE 100

Minutes of the Contract Review Meeting as well as the Quality Control Plan (QCP shall include Raw Material and Product Test Certificates)

SANS or National Equivalent Quality Systems Audit Reports – Last 2 Audits

PVJ 2.3 Requirements

The finished goods shall at all times comply with the requirements of the applicable standards and the requirements of the contract review and signed off QCP – and shall be free from cracks, voids, foreign inclusions and other defects which could impair the overall performance. The finished goods shall be smooth walled inside and out and shall conform to the material requirements outlined below and shall be fit for purpose.

PVJ 3 MATERIALS

All pipe and fittings are to be PE100, compliant to SANS ISO 4427 Part 1 otherwise specified. Pipes must be supplied from a SANS and ISO 9001 approved manufacturer and member in good standing with SAPPMA (South African Plastic Pipe Manufacturers Association).

Pipe Characteristics	Applicable Standard
Outer Diameter	ISO 11922-1 (Grade B)
Min Wall Thickness at any point	ISO 11922-1 (Grade U) – ISO 4065
Ovality	ISO 11922-1 (Grade N)

PVJ 4 MARKING

All HDPE Pipes shall be indelibly marked at 1,0 m intervals in accordance with the applicable SANS / ISO standard:

TRADE NAME	Manufacturer/Supplier Name
SPECIFICATION	SANS ISO 4427
PIPE OD	e.g, 630
PIPE OD TOLERANCE	Grade B
WALL THICKNESS	e.g, 51.4
NOMINAL PRESSURE	e.g, PN 12.5
MATERIAL DESIGNATION	PE 100
BATCH No.	Manufacturer/Supplier Trace ability
PROJECT NAME	Backwash Water Recovery Facility

PVJ 5 CONSTRUCTION

PVJ 5.1 Welding Requirements

PVJ 5.1.1 Applicable Standards

All pipes, fittings, welding processes and equipment are to comply with the relevant standards:

SANS 10270	-	Welding of Thermoplastics – Approval of Welding Procedures and Welds
SANS 10268-1	–	Welding of Thermoplastics – Part 1: Heated Tool Welding
SANS 10268-2	–	Welding of Thermoplastics – Part 2: Electrofusion Welding
SANS 10268-10	–	Welding of Thermoplastics – Part 10: Weld Defects
SANS 10269	–	Welding of Thermoplastics – Testing and Approval of Welders
SANS 1671-1	–	Welding of Thermoplastics – Machines and Equipment – Part 1: Heated Tool Welding
SANS 1671-2	–	Welding of Thermoplastics – Machines and Equipment – Part 2: Electrofusion Welding
SANS 6269	–	Welding of Thermoplastics – Test Methods for Welded Joints

PVJ 5.1.2 General Welding Requirements

Welding must take place in a dry and protected site. Suitable measures must be taken to protect the welding operation from adverse ambient conditions (rain, high humidity, wind). Ambient temperature must be recorded for each weld. The welding machine and the supports of the pipes must be erected so that they cannot move in any direction during welding.

The Contractor must apply for approval of welding procedures and welds in accordance with SANS 10270. The Welding Procedure Specification Qualification Report must be signed by the inspector with one copy handed to the Employer's Agent. The Qualification file as described in Clause 9 of SANS 10270 must be handed to the Client prior to commencement of any production / construction site welding activities.

Welding is to be carried out only by welders certified by the National approved training body (Thermoplastics Joining Committee – National Panel of Examiners). The operator's current and valid welding certificate must be presented to the Employer's Agent before any welding commences.

PVJ 5.1.3 Butt Fusion Welding

Butt Fusion Welding may only be used to join pipes of the same SDR (Standard Dimension Ratio).

Only automated, approved, and calibrated welding machinery will be permitted. A calibration certificate must be presented to the Employer's Agent before any welding commences. Every welding machine shall be marked in accordance with Clause 4.7 of SANS 1671-1, with the following items:

- The manufacturer's name
- Type of welding machine
- Manufacture date
- Serial number of machine
- Safety information for the operation of the machinery

The welding machinery shall allow for control and adjustment of the various welding parameters in accordance with Clause 4.5 of SANS 1671-1.

Instructions for the safe and correct operation, maintenance, servicing and calibration of the welding machinery must be supplied and shall include, as a minimum, the items a) to e) in Clause 4.8. of SANS 1671-1.

Process reports for each weld with the information listed in items a) to m) of Clause 4.5.4.1 of SANS 1671-1 must be complied and handed to the Employer's Agent prior to commencement of any welding activities.

Heated tools shall comply with Clause 5.4 and the specific requirements of Clause 6 in SANS 1671-1. Surface coatings for heated tools are permitted to allow for easy cleaning with the exception of PTFE spray and galvanic coatings containing copper and cuprous material. The requirements of Clause 5.4.3 in SANS 1671-1 shall be adhered to should PTFE be used as a surface coating. The heating plate shall be cleaned with an appropriate non-oil-based cleaning solvent using the method described in Clause 5.1 of SANS 10268-1.

Pipe joint ends shall be prepared using the method described in Clause 5.2 of SANS 10268-1. This includes proper alignment of the joint (maximum offset limited to 10% of pipe wall thickness), machine facing to ensure a smooth joint end and cleaning with an appropriate solvent such as isopropyl alcohol. All measures shall be taken to prevent contamination of the joint surface by grease, dirt and dust.

The Butt-Welding jointing process shall comply with Clause 5.4 of SANS 10268-1. Should the pipe manufacturer's specification and instruction differ from Clause 5.4, the manufacturer's instructions shall apply.

PVJ 5.1.4 Electrofusion Welding

Electrofusion welding may be used to join pipes of different SDR. Only automated, approved, and calibrated welding machinery is permitted. A calibration certificate shall be presented to the Employer's Agent before any welding activities commence.

Only bar-coded fittings and Electrofusion Control Units shall be used. The computerised printouts of the weld parameters and information for each weld shall be compiled and handed to the Employer's Agent upon his/her request. Every welding machine shall be marked in accordance with Clause 8 of SANS 1671-2, with the following items:

- Manufacturers name
- Serial number of machine
- Type of machine
- Input and outlet voltages
- Frequency
- Insulation protection class (to SANS 60529) and
- Duty cycle

Instructions for the safe and correct operation, maintenance, servicing and calibration of the welding machinery must be supplied and shall include, as a minimum, the items a) to e) in Clause 9 of SANS 1671-2.

Joint surfaces must be prepared in accordance with Clause 6.1 of SANS 10268-2. The pipe must be cut square and all oxidation shall be removed using a purpose made reaming/scraping tool, suitable for the outside diameter of the pipe to be reamed, immediately before welding. The external surfaces of the pipes to be joined and the inside surface of the electrofusion coupling shall be wiped clean with a suitable solvent such as isopropyl alcohol as described in Clause 6.1.4.2 of SANS 10268-2.

The manufacturer's instructions for the electrofusion welding process must be strictly adhered to and only approved, certified and calibrated machinery may be used. Welding is to be carried out only by welders certified under the Thermoplastics Welding Institute of South Africa (TWISA) or the Plastics Federation of South Africa.

The Electrofusion welding jointing process must comply with Clause 6.3 of SANS 10268-2. Should the pipe manufacturer's specification and instruction differ from Clause 6.3, the manufacturer's instructions shall apply. All completed welds will be visually inspected and will be recorded on an appropriate weld defects check sheet in accordance with SANS 10268-10. Weld assessment Class III will be applicable

PVJ 5.2 Fittings

PVJ5.2.1 Tees and Bends

Injection moulded fittings shall be used wherever possible. Where factory fabricated fittings are to be used for tees and bends their pressure class shall be de-rated in accordance with the appropriate standard. Injection moulded fittings are deemed to be fully rated and need not be derated as in the case of fabricated fittings.

PVJ 5.2.2 Compression Fittings

Compression fittings may be used to join pipes with diameter size smaller than DN110. Compression fittings shall comply with SANS 533 and shall conform to ISO 4427.

PVJ 5.2.3 Mechanical Couplings

Mechanical couplings must be of the tension resisting type to counter the shortening of the pipe and resultant induced longitudinal stresses when pressurised due to Poisson effect and thermal contraction. External restraints must be provided for anchorage of the pipes to be joined, and specialist suppliers of pipes and fittings should be consulted for suitable jointing solutions.

The use of flexible couplings (“V.J couplings”) is expressly prohibited under all conditions and circumstances.

PVJ 5.2.4 Flanged Connections

Flanged connections comprise of butt-welded HDPE stub flanges and steel backing rings which are bolted to other flanges. Bolts are to be numbered and tightened in a criss–cross pattern sequence. Bolt torque must be as per the guidelines of the supplier of the stubs. Bolts are to be re-torqued 24 to 48 hours after initial tightening in accordance with the manufacturer’s specification to counteract reduced tension in the tie bolts resulting from visco-elastic relaxation of the HDPE material under stress thus maintaining sealing pressures and ensuring leak free joints. Gaskets are not required provided that the mating faces of the HDPE stub flanges have not been damaged.

PVJ 6 TESTING

PVJ 6.1 Raw Material Acceptance Tests:

The material used for the production of the pipes and fittings shall be a high-density polyethylene PE 100 complying to SANS ISO 4427 Part 1. To ascertain the quality of this product the following tests shall be performed, prior to manufacture of the pipes or fittings.

- Density
- Melt Flow Index
- Carbon Black Content
- Thermal Stability

PVJ 6.2 Testing of Pipes:

Testing as contained in the SANS 4427:1996/ ISO 4427:1996 specification Part 1 and 2 will be used as guidelines. Tests shall also be conducted ad-hoc by a registered and authorised testing authority.

PVJ 7 TESTING

PVJ 7.1.1 Destructive Testing of Welds

The testing of welds shall comply with the requirements of SANS 6269 Edition 1.1.

The standard destructive tests described are as follows:

- Tensile test;
- Tensile-creep test; (not required –chemical high-end applications only)
- Bend test; and
- Peel test (for electrofusion joints only).

PVJ 7.1.2 Non-Destructive Testing of Welds

The testing of welds by non-destructive testing will be conducted by the Employer's Agent's Representative on site and before any production weld is made by the Contractor on site. The following procedure shall be followed:

- The Contractor shall not undertake any welding without the presence of Employer's Agent's Representative;
- The testing machinery shall be checked and approved by the Employer's Agent's Representative before testing commences;

PVJ 7.2 Pressure Testing

IS0 1167:1996, Thermoplastics pipes for the conveyance of fluids – Resistance to internal pressure – Test method.

PVJ 7.2.1 Field Pressure Testing Procedure

The method described below describes the procedure to be followed for field pressure testing of HDPE pipe:

- Fill the pipe with water
- Bleed off any trapped air
- Over a period no longer than 10 minutes, increase the pressure at a constant rate to the specified field test pressure (the Field Test Pressure Horizon is shown on the small-scale long section drawing)
- Maintain the test pressure by continuous pumping for 10 minutes, then stop pumping
- Close the shut-off valve to the pipe and monitor the pressure for a period of 60 minutes. Inspect the pipe visually for leaks during this time.
- If the pressure has dropped more than 30% at the end of the 60-minute period, the pipe shall not have passed the pressure test. Continue to look for leaks and repair as necessary.
- If the pressure has dropped less than 30% at the end of the 60-minute period, rapidly decrease the pressure in the pipe by 2,0bar (200 kPa) by releasing water from the pipe.
- Monitor the pressure for 60 minutes. If the pressure remains constant or increases during this time the pipe is deemed to have passed the pressure test.

If the pipeline does not pass the pressure test:

- Remove the test pressure
- Permit the test section to ‘relax’ for not less than eight (8) hours
- Repeat the above procedure.

PVJ 8 PAYMENT

Payment will be in accordance with PSL8.

C3.8.14 PVN: Disinfection of Pipelines
(Applicable to Project Specification PSL and SANS 1200 L)

PVN 1 INTRODUCTION

The price for testing and disinfecting pipelines and fittings is included in the scheduled items for supply and installation.

On completion of construction, after pressure testing and prior to commissioning the pipeline is to be disinfected by the Contractor in accordance with this specification.

PVN 1.1 Scope of the Code of Practice

This Code of Practice relates to the disinfection of parts used for the disinfection of complete installations.

It includes the requirements for bacteriological sampling and dosage of disinfectants, dose rates of disinfectants, disposal of chlorinated water and quality standards for bacteriological samples.

PVN 1.2 Definitions

Within this document the term HYPOCHLORITE SOLUTION means a commercial solution of sodium hypochlorite containing 10% to 15% of available chlorine. Also, 10% HYPOCHLORITE SOLUTION means hypochlorite solution diluted one part in ten which thus has approximately 1% of available chlorine.

Within this document AVAILABLE CHLORINE and all chlorine concentrations means FREE CHLORINE available to the water environment for its disinfection.

'Water Supply Personnel' means any employee or contract or casual labour whose work includes, even temporarily, the performance of work concerned with partially or fully treated water and sources of underground water and who must possess a current certificate of medical suitability signed on behalf of the Authority.

PVN 1.3 Hygiene

Only 'Water Supply Personnel' may undertake the procedures laid out in this Code of Practice.

PVN 1.4 Safety

This Code of Practice does not cover the safety aspects of the construction or maintenance of installations or apparatus or of disinfection procedures.

Remember always that chlorinating agents are strongly corrosive so protect EYES AND HANDS especially.

PVN 2 GENERAL REQUIREMENTS FOR DISINFECTION OF POTABLE WATER APPARATUS

PVN 2.1 Components and Equipment

Clean all pipework components, equipment and tools used for repair and remove all grease or scale from components and equipment before use or assembly.

Where full chlorination and bacteriological testing is impractical, then disinfect all materials, components and equipment which could transmit contamination. Use a solution containing 1 % of available chlorine (e.g, 10 % Chloros or other commercial hypochlorite solution or 2 % solution of bleaching powder. Contact time must exceed 20 minutes. Rinse or flush the equipment with mains water to prevent excessive corrosion.

PVN 2.2 Completed Installations

Ensure that all water used for disinfection purposes has a free chlorine residual of at least 20 mg/ℓ. Refer to section PVN 4 and Tables 1 and 2 for volumes or dose rates.

During chlorination the pipeline shall be kept full of water.

Whenever possible keep the installation at normal operating pressure or greater during the contact period.

PVN 2.3 Portable Test Equipment

Portable test equipment which may be used in contact with potable water must be kept clean. Any equipment which is in uncertain condition or which is contaminated must be cleaned and disinfected before use.

PVN 3 DISINFECTION OF MAINS

PVN 3.1 New Mains

PVN 3.1.1 Introduction

Do not connect any new main into supply until the water from designated sampling points, having stood in the main for at least twenty (20) hours, has met the criteria specified herein.

New mains are laid with the intention of ensuring as far as possible, the exclusion of debris and contamination, but presume at the disinfection stage that debris and contamination does exist, and that this debris is resistant to disinfection, e.g, compacted soil or detritus in joints.

The disinfection procedures, which should follow pressure testing, include:

(a) swabbing and flushing of the main

(b) soaking of the main for a minimum period of 20 hours, using a minimum concentration of 20 mg/l of available chlorine in mains water.

(c) removal of excess chlorine by flushing the main

PVN 3.1.2 Pressure Testing

Only use potable quality mains water for pressure testing new mains. Pressure testing normally follows the construction of each section of the pipeline but precedes final connection to supply. Do not rely on a single sluice valve to isolate the new main from the supply network, while the main is under pressure until disinfection and approval are complete.

PVN 3.1.3 Swabbing and Flushing

Swab all new mains after pressure testing and prior to disinfection.

After insertion of a soft foam swab, which has been soaked in 10 % hypochlorite solution, recharge the pipeline at a rate less than 50 mm per second (3 m per minute) to ensure that the swab is not moved.

Open the inlet valve fully and drive the swab along the pipeline, at a velocity less than 0,5 m per second (30 m per minute), by controlling the valve at the discharge end.

When the swab reaches the discharge end of the pipeline, flush the main for at least 5 minutes to remove all excess chlorine and discoloured or dirty water. Where possible open inlet and outlet valves as fully as possible.

If the swab removes excessive amounts of debris then re-swab the main.

PVN 3.1.4 Chlorination

Chlorinate all new mains to a minimum of 20 mg/l available chlorine and leave to soak for a minimum of 20 hours, prior to flushing with mains water to a chlorine residual equal to that of the background level in the incoming mains water.

Tables in PVND 4 show the required minimum dose rates and volumes.

To chlorinate sections of distribution main, less than about 50 m long not exceeding 150 mm in diameter, use a soft swab which has been soaked in 10 % hypochlorite solution and proceed as follows:-

- Pour 1,0litre of hypochlorite solution for each 1 m³ of pipeline, into the end of the pipe upstream of the final connection.
- Insert the swab into the end of the upstream pipe to retain the hypochlorite solution.
- Make the final connection.
- Drive the swab past the final connection and along the pipeline, but do not allow the swab to travel at a speed greater than 0,3 metres per second (20 m per minute).
- Remove the swab and flush the main for twenty-five (25) minutes.
- Close up the main prior to soaking and sampling in accordance with section PD 3.1.6.

The volume of hypochlorite needed is shown in the following Table 1 (PVN 4.4)

PVN 3.1.5 Sampling for Bacteriological Analysis

Once all pressure testing, swabbing and chlorination is complete, fill the main with clean mains water free from excessive chlorine.

Flush all hydrants, washouts and other outlets until the water is clean and free from excessive chlorine. Shut the valves and leave the main to soak for a minimum period of 20 hours.

First check with the laboratory staff to determine a suitable time for collection of samples and delivery of them to the laboratory for analysis.

Then pressurise the main and take samples for bacteriological analysis in accordance with the procedure given in section PVN 3.1.6. Take these samples from sampling points agreed with the Employer's Agent's Representative.

Deliver all samples to the laboratory as soon as possible. Analysis must start within 6 hours but store the samples in a refrigerator if the delay between taking the sample and the start of analysis is likely to exceed 4 hours.

Then isolate and leave the main until the results of analysis are available. In the event that the samples fail, flush the main and re-sample after a further soak period of at least 20 hours.

Repeat the above process until disinfection criteria have been satisfied.

The costs of all necessary testing are to be borne by the Contractor.

PVN 3.1.6 Sampling Points

Sample points should consist of a ferrule connection, with a short length of polythene piping terminating in a ½" BSP gate valve or manual air valve. Protect this sampling outlet by suitable boxing. Attach a sampling standpipe to the gate valve, disinfect the apparatus with hypochlorite solution and then flame the bib tap outlet on the standpipe. Flush out all traces of hypochlorite, check that the residual chlorine level is not greater than the normal level in the incoming mains water.

At scour points and air valves, flush out all trace of hypochlorite, check that the residual chlorine level is not greater than the normal level in the incoming mains water, then take samples.

PVN 3.1.7 Temporary Cross Connections and Final Connections

Where a temporary cross connection supplies mains water to the new main, before making the final connection complete the disinfection procedure of the new main as set out above.
When the new main has been proved bacteriologically satisfactory the cross connection may be removed and isolated after suitable disinfection.

PVN 4 DOSAGE OF CHLORINATING AGENTS

PVN 4.1 Sodium Hypochlorite Solution

Bulk supplies of sodium hypochlorite solution (Chloros for instance) are supplied at 10 to 15% available chlorine. This fraction declines progressively as the hypochlorite decays to chloride, chlorate and oxygen. Assume in practice that there is only 10% available chlorine.

Assuming 10% available chlorine and using mains water having a zero-chlorine demand, then the following values give estimates of the dilutions required.

- 10% hypochlorite solution (1-part hypochlorite solution in 10 parts solution) contains 10,000 mg available chlorine per litre of 10kg available chlorine per cubic metre.
- 20 mg available chlorine per litre is equivalent to 200 mℓ of hypochlorite solution per cubic metre of water.
- 0,5 mg available chlorine per litre is equivalent to 5 mℓ of hypochlorite solution per cubic metre of water.

PVN 4.2 Chlorine Gas

Chlorine gas, dosed into water by weight, is likely to be about 98% available chlorine. A direct measurement therefore gives a reasonable estimate.

- Disinfection of replacement parts with chlorine gas in not a practicable possibility.
- 20 mg Chlorine gas (by weight) per litre for disinfection of complete installation is equivalent to 20 grams per cubic metre.
- 0,5 mg Chlorine gas (by weight) per litre of water is equivalent to 0,5 grams per cubic metre.

PVN 4.3 Bleaching Powder, Granules and Tablets

Bleaching powders, granules or tablets based on Calcium hypochlorite contains 50 % to 70 % of available chlorine by weight. These materials must be stored under dry conditions. During storage some available chlorine is lost. Follow the manufacturer’s instructions particularly concerning the shelf life of the material and dose rate of the tablets.

For calculation purposes presume a maximum value of 50% available chlorine i.e, 1gm of powder, granules etc in 1 litre of water provides 500 mg per litre available chlorine.

PVN 4.4 Dose rates

Tables 1 and 2 provide estimates of the minimum dose rates of sodium hypochlorite solution, chlorine gas or bleaching powder, tablets or granules to achieve available chlorine levels of 20 mg per litre when dilute with mains water which has a zero-chlorine demand.

Table 1 - Dosage for 1,000 m of Pipeline to give 20 mg Available Chlorine per Litre

Pipe Diameter	Volume of 1000 m of Pipeline	Weight of Bleaching Powder Granules or Tablets to give 20 mg/l	Weight of Chlorine to give 20 mg/l	Volume of Hypochlorite Solution to give 20 mg/l
mm	m³	gm	gm	litres
50	1,9	80	40	0,4
75	4,4	180	90	0,8
100	7,9	320	160	1,5
150	17,7	700	350	3,5
200	31,4	1,260	630	6,2
250	49,1	2,000	980	9,7
300	70,7	2,800	1400	14,0
350	96,2	3,800	1900	19,0
400	125,6	5,000	2500	24,6
500	196,3	7,800	3900	38,4
600	282,6	11,200	5600	55,4

Table 2 - Dose Rates for 20 mg Available Chlorine per Litre

Flow Rate in Pipeline		Hypochlorite Solution Injection Rate for 20 mg/l		Chlorine Injection Rate for 20 mg/l
litres/sec	m³/hr	litres/hr	Mℓ/sec	gm/hour
1	3,6	0,7	0,2	72
2	7,2	1,4	0,4	144
3	10,8	2,2	0,6	216
4	14,4	2,9	0,8	288
5	18,0	3,6	1,0	360
6	21,6	4,3	1,2	430
7	25,2	5,0	1,4	500
8	28,8	5,8	1,6	576
9	32,4	6,5	1,8	650

For flows greater than 9 litres/sec the dose rates can be calculated by multiplying by an appropriate factor of 10 e.g.

186 litres/sec = 100 + 80+ 6 litres/sec
hypochlorite solution = 70+ 58 + 4.3 = 132,3 litres/hr

PVN 5 DISPOSAL OF CHLORINATED WATER

PVN 5.1 Introduction

When the pipeline has passed all disinfection criteria if must be drained without causing hazard.

PVN 5.2 Methods of Disposal

PVN 5.2.1 Overland

Explore the possibility of soaking away disinfection water on adjacent land in rural situation.

PVN 5.2.2 Foul Sewers

Where disinfection water is discharged into a combined or foul sewer, no de-chlorination is normally necessary but in the former case take care that the rate of discharge of disinfection or flushing water avoids operation of storm sewage overflows and/or the creation of a hazardous atmosphere within the sewer.

PVN 5.2.3 Watercourses

In rural areas where disinfection water is discharged to watercourses, either directly or through surface water drains, do not permit a free chlorine concentration in the receiving stream in excess of 0,1 mg/ℓ about 50 metres downstream of the point of discharge. If the discharge is into a ditch, which is not a spawning ground or a nursery or a fishing stream, take advantage of that ditch to mop up chlorine provided that in a significant stream the earlier mentioned limit is not exceeded. In these circumstances use flush water to dilute the chlorinated water whenever possible. Avoid discharge of disinfection water to the head of a watercourse because this area is probably a spawning ground.

PVN 5.2.4 Disposal of Large Volumes

When disposing of large volumes of disinfection water from very long lengths of new main, or in any cases of doubt, consult through the Employer's Agent's Representative and the laboratory staff of the Employer.

PVN 5.3 De-chlorination

There is no objection to the use of thiosulphate or sulphur dioxide as de-chlorination agents. In some cases, at least partial de-chlorination may be achieved by discharge over land. In all cases consult the Employer's Agent's Representative.

PVN 6 QUALITY STANDARDS AND REPORTING PROCEDURES

PVN 6.1 New Mains

PVN 6.1.1 Bacteriological Standards

No coliform organisms shall be detected in 100 ml of the sample.

The increase in the yeast agar plate count when compared with that of the incoming water shall generally be less than 50 and never more than 150 colonies per ml when incubated at 37°C for 24 hours.

PVN 6.1.2 Procedure for Unsatisfactory Samples

Whenever even one E. Coli, or 5 or more coliforms per 100 ml are detected, re-chlorinate the main or serve reservoir. When E. Coli are not detected but the total coliform count is less than five (5) per 100 mℓ flush and re-sample the main.

PVN 6.1.3 Physical Standard

If the sample is unusually coloured, turbid or frothy flush the main until acceptable. If this condition is severe, re-sample the main but do not put into service until the samples have passed the required standards.

PVN 6.2 Reporting Procedure

Records of disinfection are to be handed to the Employer's Agent's Representative.

C3.8.15 PTA: Dayworks
(Applicable to Project Specification PSA and SANS 1200 A)

PTA 1 GENERAL

In cases where the Employer's Agent orders any variation in the form, quality or quantity of the work or any extra work to such an extent that the tendered rates for specific items are no longer applicable, or where a combination of tendered rates cannot be applied to compensate for such work, the Employer's Agent may, in terms of the General Conditions of Contract, order that the amended or extra work be carried out as daywork at the cost of labour, plant and materials. For that purpose, provision is made for the Contractor to tender his/her rates for labour and plant in the Daywork Schedule which forms part of this Contract.

No work will be measured as daywork unless:

(a) the Employer's Agent agrees that the varied work is not in accordance with the specification or scope of a measured item in the Contract;

(b) the Employer's Agent has issued an order in writing for the execution of such varied work; and

(c) statements of plant and labour are submitted daily to the Employer's Agent for his consideration and approval.

All work valued at the tendered rates in the Dayworks Schedule will be subject to Contract Price Adjustment as applicable to the Contract.

PTA 2 SALARIES AND WAGES OF WORKMEN

The amount to be paid for labour will be based on the rates tendered in the Dayworks Schedule for the workers executing the work. The tendered rates shall be all-inclusive and shall be held to cover all charges for the Contractor's profits, timekeeping, clerical work, insurance, establishment, superintendence, the use of hand tools, etc, and no additional surcharge over and above the tendered rates will be applicable.

PTA 3 CONSTRUCTION EQUIPMENT

The rates for Construction Equipment as tendered in the Daywork Schedule shall cover all costs, overheads and profit for the Contractor and no further surcharge will be payable on the tendered rates. The cost of operators shall be included in the tendered rates except where otherwise specified in Clause PTA 5 (Measurement and Payment) hereafter.

Where plant or equipment for which no rates exist in the Daywork Schedule are employed, the cost thereof shall be determined as agreed with the Employer's Agent in terms of the General Conditions of Contract. In such case contract price adjustment will only be applicable if the agreed cost is based on rental rates at the time of the base month before closing of tenders, or if the ruling rates current at the time of the execution of the work are de-escalated to the base month.

The Contractor will be paid for the transport to and from the site of constructional plant not on site and specially ordered by the Employer's Agent to be brought on site. No payment will be made for transport of equipment listed in the Contractor's Schedule of Construction Equipment in the tender document, or for equipment which has been removed from the site on request of the Contractor, or for equipment already on site, regardless of whether it appears on the Schedule of Construction Equipment or not.

PTA 4 MATERIALS

Materials required for daywork items which cannot be compensated under existing rates and have to be purchased, will be paid for at cost, excluding VAT, plus a surcharge of 15%. The cost of materials provided for daywork at current rates at the time when the work is executed, will not be subject to contract price adjustment unless the prices of the materials are de-escalated to the base month for escalation.

PTA 5 MEASUREMENT AND PAYMENT

PTA 5.1 Labour

Item	Unit	
(a)	Unskilled Workers	hour (h)
(b)	Semi-Skilled Workers	hour (h)
(c)	Skilled Workers (Artisans)	hour (h)
(d)	Construction Supervisor	hour (h)
(e)	Others (specify)	hour (h)

The unit of measurement is the hour or part thereof during which workers were engaged in daywork.

The tendered rate shall include full compensation for all salaries, wages, bonuses, pension, insurance, medical aid and other benefits as well as overheads arising from administrative personnel, Construction Manager(s), Construction Supervisor(s), tools and profit. No surcharge will be paid on the tendered rates

The cost of operators included in the rates for constructional plant, will not be measured again under Labour.

PTA 5.2 Construction Equipment

(a) Lowbed (transport of plant to and from the site) ton-kilometre (t.km)

(i) (Specify power and mass) hour (h)
(ii) etc. (for other graders) hour (h)

(b) Front-end Loaders

(i) (Specify type, power and mass) hour (h)
(ii) etc. (for other front-end loaders) hour (h)

(c) Back-acting Excavators

(i) (Specify type, power and mass) hour (h)
(ii) etc. (for other back-acting excavators) hour (h)

(d) Tractors and Drawn Rollers and Trailers

(i) Tractor ..... (Specify type, power and mass) hour (h)
(ii) Roller ..... (Specify types, masses) hour (h)
(iii) Tractor with trailer, complete (Specify tractor, And type and capacity of trailer) hour (h)

(e) Compactors

(i)	(Specify type and mass)	hour (h)
(ii)	etc. (for other types and masses)	hour (h)

(f) Compressors

(i)	(Specify capacity and number of tools)	hour (h)
(ii)	etc. (for other compressors and tools)	hour (h)

(g) Trucks

(i)	(Specify type, and capacity)	hour (h)
(ii)	etc. (for other trucks)	hour (h)

(h) Light Delivery Vehicles

(i)	(Specify load capacity)	kilometre (km)
(ii)	etc. (for other)	kilometre (km)

PTA 5.3 Cost of Materials Delivered to Site

(specify) Provisional sum or as scheduled

The unit of measurement for sub-item 5.2(a) is the ton Construction Equipment multiplied by the kilometre distance over which the plant has been transported with a lowbed transporter as ordered by the Employer's Agent.

The unit of measurement for sub-items 5.2(b) to (g) is the hour or part thereof during which the item of plant had been in active use for the daywork operation, including stopping time of less than 5 minutes.

Where applicable travel time to and from the normal parking position on site, or the position of the most recent non-daywork activity, as well as stopping time exceeding 5 minutes shall be multiplied by a factor of 0,6. Time shall be measured by means of a vibrating clock card.

The unit of measurement for sub-item 5.2(h) is the kilometre travelled to collect or transport small quantities of materials. Kilometres travelled in light delivery vehicles by Construction Managers, Construction Supervisors and their Assistants in the execution of normal supervision duties, shall not be measured for payment.

The tendered rates shall include full compensation for the supply, maintenance, service, repairs, depreciation as well as fuel, lubricants, licensing, insurance, overheads and profit. It shall also include the cost of drivers and operators except in the case of sub-item PSA 5.2(h) where the operators of tools are paid for under labour.

C3.8.16 PTC: Construction Environmental Management Plan
(Applicable to Project Specifications PSA, PSC, PSD and PSDB to SANS 1200 A, C, D and DB and to Particular Specification PTD: Landscaping and Grassing)

(Read with SANS 1921-1: 2004 Clause 4.19 and the above-mentioned Project and Particular Specifications).

PTC 1 PREAMBLE

PTC 1.1 General Statement

This specification has an objective to ensure that the Principal Contractor and Contractor(s) entering into a Contract with the Employer, to achieve an acceptable level of environmental management throughout the life of the Contract.

This document forms an integral part of the (main) Contract, and the Principal Contractor must make it part of their contract with their Contractors, Sub-contractors and Suppliers.

It is a requirement of this Contract that the Contractor shall provide a safe and healthy working environment and to direct all his/her activities in such a manner that his/her employees and any other persons, who may be directly involved with his/her activities, are fully conversant with and successfully execute the mitigation and control measures as specified in the National Water Act Nº 36 of 1998, the National Environmental Management Act Nº 107 of 1998, the Employer's Construction Environmental Management Plan and the Contractor's own Environmental Management Plan in order to preserve the natural environment in areas where the proposed pipeline will traverse.

To this end the Contractor shall assume full responsibility to conform to all the provisions of the Environmental Impact Assessment Regulations 2017, the WUL, the Environmental Audit and the Environmental Management Programme Report

If the Employer's Agent engages the services of an Environmental Compliance Officer (ECO) such Officer will be subject to approval by the Employer. The ECO shall comply with all legal requirements in terms of his/her appointment and status as an ECO. All documentation related to his/her appointment shall be forward to the Employer.

PTC 1.2 Environmental Management Specifications and Plans to be Submitted at Tender Stage

(a) Employer's Environmental Management Plan

The Employer's Construction Environmental Management Plan is included in the tender documents as part of the Project Specifications.

(b) Tenderer's Environmental Management Plan

The tenderer shall submit with his/her tender sufficient proof that he/she has an Environmental Management Plan in place.

In terms of the OHS Act the tender will be disqualified if the tenderer has no Environmental Management Plan.

The Contractor's Environmental Management Plan will be subject to approval by an Environmental Compliance Officer (ECO) appointed by the Employer, or amendment if necessary, before commencement of construction work. The Contractor will not be allowed to commence work, or his/her work will be suspended if he/she had already commenced work before he/she has obtained the ECO's written approval of his/her Environmental Management Plan.

The Contractor shall not be entitled to claim for extension of time or standing time and the related costs for any delays due to delayed commencement or suspension of the work arising from the lack of approval of or non-compliance with the Environmental Management Plan.

PTC 2 SCOPE

This specification covers the environmental management requirements to be fulfilled by the Contractor to ensure a safe and healthy working environment by preserving the natural environment in areas where the proposed pipeline will traverse, and construction activities will be implemented.

To this end the Contractor shall assume full responsibility to conform to all the provisions of the National Water Act Nº 36 of 1998, the National Environmental Management Act Nº 107 of 1998, the Environmental Impact Assessment, the WUL, the Environmental Audit, the Environmental Management Programme Report, the Construction Environmental Management Plan and the Contractor's own Environmental Management Plan.

This Construction Management Plan, Health and Safety Specification, the Environmental Impact Assessment, the WUL, the Environmental Audit, the Environmental Management Programme Report and the Contractor's own Environmental Management Plan shall be kept on site and made available for inspection by all employees, inspectors, the ECO and any other persons entering the site of Works.

PTC 3 DEFINITIONS

For the purpose of this Contract the following shall apply:

(a) "Employer" where used in the Contract documents and in this specification, means the Employer as defined in the General Conditions of Contract and it shall have the exact same meaning as "Client" as defined in the Construction Regulations 2014. "Employer" and "Client" is therefore interchangeable and shall be read in the context of the relevant document.

(b) "Contractor", wherever used in the Contract documents and in this specification, shall have the same meaning as "Contractor" as defined in the General Conditions of Contract.

In this specification the terms "Principal Contractor" and "Contractor" are replaced with "Contractor" and "Sub-contractor" respectively.

(c) "Engineer/Designer" where used in this specification, means the Employer's Agent as defined in the General Conditions of Contract. In terms of the Construction Regulations the Employer's Agent may act as Agent on behalf of the Employer (the Client as defined in the Construction Regulations).

(d) ''Construction Manager'' means the competent person responsible for the management of physical construction processes and coordination, administration and management of resources on the construction site.

PTC 4 PROJECT DESCRIPTION

The Works to be carried out under this Contract is as described in the Umdoni Municipality Bill of Quantities in the tender document in terms of Project description, location and Scope of Work.

PTC 4.1 Tenders

The Contractor shall make available the following during the tender evaluation:

(a) A documented Environmental Management Plan. The Environmental Management Plan must be based on the National Water Act Nº 36 of 1998, the National Environmental Management Act Nº 107 of 1998, the Environmental Impact Assessment, the WUL, the Environmental Audit, the Environmental Management Programme Report, the Construction Environmental Management Plan and will be subject to approval by ECO.

(b) A declaration to the effect that he/she has the competence and necessary resources to carry out the work safely in compliance with the approved Environmental Management Plan.

(c) The Contractor shall make a provision in the tender document that the cost for environmental management is covered.

Failure to submit the foregoing with his/her tender or during tender evaluation, will lead to the conclusion that the Contractor is not able to carry out the Work under the Contract in terms of environmental management in accordance with the Construction Environmental Management Plan and will result in his/her tender being disqualified.

PTC 5 LOCATION

The Bhobhoyi Waterworks is located within the coastal area of the Ugu District Municipality some 9km inland of Port Shepstone, along the N2 Freeway to Harding, on the KwaZulu-Natal Lower South Coast.

Approximate central coordinates for the site: 30°47'05" S; 30°23'06" E

PTC 6 MANAGEMENT OF THE ENVIRONMENT

PTC 6.1 In Preparation of the Contractor's Environmental Management Plan

The Contractor shall pay special attention to the following in their Contractor's Environmental Management Plan:

- **Clearing of Vegetation**

  The Contractor shall not destroy, remove or clear trees, timber or shrubs to any extent greater than that approved. The Contractor shall not carry out any activity outside the areas defined for clearing unless otherwise approved by the Environmental Control Officer.

- **Soil Erosion**

  The quality of topsoil in stockpiles will be maintained by measures including minimising contamination from other materials, minimising stockpiling periods and prevention of soil erosion by surface runoff or wind. Monitoring for erosion and soil erosion risk will be undertaken regularly to ensure that any erosion that occurs is mitigated as soon as possible.

(c) Risk of Faunal Injury and Death

The trenches will be kept open for the minimum period necessary to undertake the works. Temporary fencing or barriers will be placed along the trenches in all populated areas and in areas that are likely to be used as crossing points along the corridor.

- **Pollution Prevention**

  With particular regard to sanitation, solid waste facilities, fuels, hazardous substances and other liquid pollutants as elaborated in the Particular Specification for Environmental Management.

- **Rehabilitation**

  The Contractor is to ensure that the site and its surrounds are rehabilitated to the condition in which they were prior to commencement of construction activities.

- **Rehabilitation (Revegetation) of Exposed Areas**

  Site clearance must occur in a planned manner and cleared areas should be stabilised as soon as possible. Clearance of vegetation should be done only if deemed necessary and must be limited to only facilitate the execution of any work necessary. All areas of impact must be rehabilitated once work has been completed. To ensure stability in revegetated steep areas, geotextiles can be used if required.

  The Contractor shall ensure that the following Stormwater Management Principles as specified in the Environmental Management Plan are adhered to at all times on site:

- **Working in Watercourses**

  The Contractor shall execute the mitigation and control measures as specified in the Environmental Management Plan in order to preserve the natural environment in instances where the proposed pipeline may traverse any wetlands or watercourses. These objectives are as follows:

  - Surface water legislative requirements must be complied with;
  - Manage water quality; prevent sediment load from entering any water course;
  - Concentrated flow must be managed to prevent downstream erosion and the impact on surface water quality; and
  - Implement mitigation measures to minimise potential impacts.

- **Wetland Protection**

  Potential impacts to wetland areas associated with the construction of the proposed pipelines routes may include:

  - Loss of wetlands – trenching to install the pipeline may result in loss of wetland vegetation and soil and additional disturbance of the wetland. This could in turn affect the functionality of the wetland.
  - Wetland erosion - bare and exposed patches within the wetland may be caused by vehicles and machinery traversing the wetland during construction which in turn could cause erosion and dryness of the wetland.
  - Impediment of water – should the pipeline intercept or interrupt subsurface flows within the wetland this could reduce water input into the wetlands and cause unnatural damming of water.

- The wetland must be barricaded off to avoid potential damage and vehicular movement through the wetland. Any activities exposing the wetland to soil compaction, stormwater erosion and silting must be prevented.

- **Entry and Exit Points Onto Tarred Roads**

  Construction vehicles entering and exiting the construction area from tarred roads could convey and deposit mud on the road, which will be washed into the storm water system during rain events and lead to siltation of wetlands. It is advisable to place gravel on the entry/exit points of the construction site in order to reduce the amount of mud/soil clinging to tyres. Should soil be deposited on the tar road at the entry/exit points, it should be cleaned up on a daily basis.

- **Flow of Water Around Excavations**

  Cofferdams shall be constructed around trenched areas in watercourses using sealed plastic bags filled with sand and means of conveyance must be provided for the flow of water to bypass the excavation. The flow of rivers is not to be restricted. To this end the following must be adhered to:

  - Surface water legislative requirements must be complied with.
  - Manage water quality; prevent sediment load from entering any water course.
  - Concentrated flow must be managed to prevent downstream erosion and the impact on surface water quality.
  - Implement mitigation measures to minimise potential impacts.
  - Storm water should not be allowed to be concentrated or to flow down cut or fill slopes or along the pipeline route without erosion protection measures.
  - Any point of overland discharge must be located at least 50 m away from any water course.
  - In general, at steep slopes or where soil is dispersive or sandy, it must be stabilised.

PTC 6.2 Sequence of the Works

The Contractor can choose his/her own sequence of construction, bearing in mind the availability of water for the disinfecting and the pressure testing of pipelines. However, the Contractor must practice progressive reinstatement and remediation in line with the Particular Specification, PTC Construction Environmental Management Plan.

On no account will spoil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others or impact on the environment. In the event of this occurring, the Employer shall have the right to withhold payment for as long as may be necessary in respect of the relevant Works in the areas concerned without prejudicing the rights of others to institute claims against the Contractor on the grounds of unnecessary obstruction.

Finishing and tidying must not be deferred to the end of the Contract. All finishing and tidying shall be carried out to the best advantage of the project as a whole, and in close co-operation with other parties and residents.

PTC 7 A CONSTRUCTION STORMWATER MANAGEMENT PLAN

The Contractor shall make include in his/her Environmental Management Plan a Construction Stormwater Management Plan.

PTC 7.1 Proposed CSWMP Implementation

The following construction methods are proposed. (The Contractor may propose any alternatives, provided that these are approved by the Employer's Agent).

- Topsoil to be covered with a geotextile plus a seeded grass mixture for rehabilitation purposes
- Benches to be formed by placing sandbags wherever these are required, or where instructed to do so by the Employer's Agent.
- Storm water berms: earth or rock-pack cut-off berms to be constructed wherever these are required, or where instructed to do so by the Employer's Agent.
- The disturbance of steep slopes, for example by removing vegetation, may result in slope instability and erosion. All slopes that are disturbed during construction shall immediately be stabilised to prevent erosion. Storm water runoff from the stockpile sites (additional backfilling materials and stored topsoil) and surrounding areas shall not run freely into the surrounding environment or create "ponding" or accumulation of water. Stockpiles shall be stabilised if signs of erosion are visible.
- Erosion control measures such as silt fences must be placed around the stockpiles.
- Runoff from the site itself shall be free from oil, waste and litter. This shall be ensured by securing any hazardous substance containers in order to prevent runoff and by cleaning up any refuse and construction material from the site on a regular basis.
- High-risk works must be scheduled for a drier time of year.
- Stockpiles must not be located next to watercourses or wetlands.
- Surface water flows must be captured through a series of drainage ditches to prevent water entering excavations or eroding exposed surfaces. The flows must be controlled with settlement ponds, sediment traps and other hydraulic features to reduce water velocity (thereby reducing erosive power) as well as maximise infiltration and evaporation and to remove as much sediment as possible.
- Stockpiles will be covered with plastic sheeting or geotextile materials to prevent erosion through heavy rainfall.

PTC 7.2 Rehabilitation (revegetation) of Exposed Areas

Site clearance must occur in a planned manner and cleared areas should be stabilised as soon as possible. Clearance of vegetation should be done only if deemed necessary and must be limited to only facilitate the execution of any work necessary. All areas of impact must be rehabilitated once work has been completed.

To ensure stability in revegetated steep areas, geotextiles can be used if required.

PTC 8 WETLAND

PTC 8.1 Wetland Protection

The wetland must be barricaded off to avoid potential damage and vehicular movement through the wetland. Any activities exposing the wetland to soil compaction, stormwater erosion and silting must be prevented.

PTC 8.2 Entry and Exit Points Onto Tarred Roads

Construction vehicles entering and exiting the construction area from tarred roads could convey and deposit mud on the road, which will be washed into the storm water system during rain events and lead to siltation of wetlands. The Contractor is to place gravel on the entry/exit point of the construction site in order to reduce the amount of mud/soil clinging to tyres. Should soil be deposited on the tar road at the entry/exit points, the Contractor shall clean up these areas on a daily basis.

PTC 8.3 Wetland / Watercourse Crossing

The following general measures should be implemented in the event of a wetland or watercourse crossing:

- The area of disturbance shall be kept to a minimum. Clearing of construction to take place right away to ensure restoration as soon as possible.
- The construction footprint width must be kept to a minimum, for both the wetland and the water course crossing.

Wetland crossing locations and floodlines identified along the pipeline route has been included in the Environmental Management Plan.

PTC 8.4 Proposed Methods for Specific Crossings in the Wetland

Not applicable

PTC 8.5 Management of Stormwater Discharge at Existing Structures

The following strategies are needed to manage stormwater discharge at existing structures:

- All existing culverts along the pipeline route need be kept free of obstruction, e.g.: construction debris, construction litter and vegetation, so as to not compromise hydraulic capacity of these culverts.
- To prevent potential localised flooding and erosion, the draining of all temporary stormwater pipes and culverts into watercourses along the pipeline route is to be adequately designed and dissipated by the Contractor.
- Removal of vegetation, soil compaction and grading should be kept to the minimum during and after development activity.

PTC 9 CONCLUSION

The potential impacts of the installation of the 450ND bulk Steel water pipeline are largely linked to the construction phase of the Project. It is expected the potential impacts are likely to be further reduced should the above-mentioned mitigation measures be implemented.

A key management factor of wetlands and watercourses impacted is that of reshaping and levelling of rehabilitated areas such that these resemble pre-construction environments as fast as possible. In areas where construction activities have been completed and no further disturbance is anticipated, rehabilitation and re-vegetation shall commence as soon as possible.

PTC 10 MEASUREMENT AND PAYMENT

PTC 10.1 Principles

Shaping of areas prior to topsoiling, ripping and trimming, forming benches with sandbags and constructing stormwater cut-off berms with earth or rock-packings shall be regarded as earthworks and measured and paid in accordance with the requirements of SANS 1200D or SANS 1200DB (as applicable).

Concrete plinths for crossing of wetlands and/or the construction of the Transnet railway line crossing of the wetland shall be measured and paid in accordance with the requirements of SANS 1200GA or SANS 1200LB (as applicable).

No other separate items are scheduled for the application of all other control measures stated in this Construction Stormwater Management Plan, hence the costs of complying with the other requirements in this specification shall be deemed to be included in tendered rates in the Bill of Quantities for SANS 1200C, SANS 1200D, SANS 1200DB, SANS 1200DK and Particular Specification PTC (as applicable).

C3.8.17 PTD: Landscaping and Grassing

(Applicable to Project Specifications PSA, PSC, PSD and PSDB to SANS 1200 A, C, D and DB and to Particular Specification PTC: Construction Environmental Management Plan)

PTD 1 SCOPE

This specification covers the landscaping of designated areas and the establishment of vegetation for functional and aesthetic purposes.

PTD 2 INTERPRETATIONS

PTD 2.1 Application

This specification contains clauses that are generally applicable to the construction of landscaping and grassing.

PTD 2.2 Definitions

For the purposes of this specification the following definitions shall apply:

Weeds: Any declared weed, as well as any tree, shrub, bush, water plant or any other plant which, in the opinion of the Employer's Agent, are undesirable in specified areas at certain times.

PTD 3 MATERIALS

PTD 3.1 Fertiliser and Soil - Improvement Materials

Fertilisers and/or soil improvement materials shall be obtained from an approved commercial supplier and shall be either of the following types or any other type scheduled or prescribed by the Employer's Agent:

(a) Fertilisers comprise limestone ammonium nitrate, 2:3:2 (22) and 3:2:1 (25)

(b) Soil improvement materials comprise dolomitic lime, gypsum, superphosphate and agricultural lime.

PTD 3.2 Compost

Compost shall be obtained from a commercial supplier and shall be well-decayed, friable and free from weed seeds, dust and all other undesirable materials. Spent mushroom compost is not acceptable.

PTD 3.3 Manure

Manure shall, unless another type has been specified or approved by the Employer's Agent, be well-sweated pure kraal manure free from soil, weed seeds and other undesirable materials. It shall not contain any particles that are retained by a 50 mm screen and shall be subject to the approval of the Employer's Agent before being delivered to site.

PTD 3.4 Water Retention Agent

The water retention agent shall be "Terra-sorb" or such other agent which may be scheduled or prescribed by the Employer's Agent.

PTD 3.5 Anti-Erosion Compound

An approved anti-erosion compound shall consist of a plastic material in dispersion which can be sprayed onto the soil to bind it and protect it against erosion.

PTD 3.6 Straw Cover

Straw cover material shall be wheat, oats, or barley straw, or cut and dried tall grass.

PTD 3.7 Topsoil

Topsoil shall consist of fertile, friable soil of loamy character obtained from areas having a good coverage of natural vegetation, preferably grasses. It shall be free from deleterious matter such as large roots, stones, refuse, stiff or heavy clays and the seeds of noxious weeds.

Topsoil shall be obtained from wherever suitable material occurs on the site or borrow areas. The Employer's Agent shall indicate the areas from where topsoil is to be obtained, and unless otherwise permitted by the Employer's Agent, topsoil shall be taken from within 400 mm of the surface. If the Contractor fails to stockpile the topsoil indicated, he shall obtain suitable topsoil from other approved sources at no cost to the Employer.

Topsoil shall be stockpiled in separate loose heaps as tipped from trucks which heaps shall not exceed 2,0 m in height. Care shall be taken to prevent the compaction of topsoil in any way especially by trucks driven over.

In the event of an insufficient quantity of topsoil being obtainable from the site and designated borrow areas the Contractor shall procure and furnish topsoil from other sources which shall be subject to the approval of the Employer's Agent.

PTD 3.8 Grass Seeds

Grass seeds shall be fresh certified seed from an approved source and the types of seeds in the seed mixture shall be as scheduled or as approved by the Employer's Agent.

PTD 3.9 Grass Cuttings

Grass cuttings shall be fresh cuttings of an approved type of grass with sufficient root material to ensure good growth.

PTD 3.10 Grass Sods

Grass sods shall be either nursery-grown or veld sods. Either type shall be harvested, delivered, planted and watered within 36 hours of harvesting, unless otherwise agreed by the Employer's Agent. The grass sods shall be free from noxious weeds and diseases. Sods obtained from a nursery shall be in moist soil not less than 30 mm deep, and sods from the veld in moist soil not less than 50 mm deep.

Nursery-grown sods shall be the variety of grass scheduled, except where an alternative is approved by the Employer's Agent. The grass shall have been grown specifically for sod purposes, mown regularly and cared for to provide uniformity. It shall be harvested by machines manufactured for this purpose to ensure an even depth of cut whilst maintaining sufficient root material and soil in the sods.

Veld sods, where acceptable to the Employer's Agent, may be obtained from approved areas within or near the site where a suitable type and density of grass are found in a suitable soil.

PTD 3.11 Trees, Shrubs and Groundcover Plants

Plants shall be of the variety and size shown on the drawings or as scheduled in the Bill of Quantities.

The plants shall be obtained from approved commercial nurseries, shall be true to name. Each specimen shall be legibly labelled with the name of the species, the variety and the name of the supplier.

Plants shall be healthy, shapely and well-rooted. Roots shall show no evidence of having been restricted or deformed at any time. Plants shall be well-grown and free from insect pests and diseases. All plants shall be subject to the approval of the Employer's Agent and any plants that are in poor condition or suffering from a disease when delivered to site, shall be replaced by the Contractor at his/her expense.

All plants shall be packed and handled in the manner approved for that species or variety, and all necessary precautions shall be taken to ensure that the plants arrive at site in proper condition for satisfactory growth. Trucks used for transporting plants shall be equipped with covers to protect plants from windburn. All packaging shall be in good condition on arrival.

PTD 4 PLANT AND MACHINERY

PTD 4.1 General

The requirements of Subclause 4.1 of SANS 1200D or SABS 1200DB (as applicable) shall apply.

PTD 5 CONSTRUCTION

PTD 5.1 Landscaping

PTD 5.1.1 Shaping

Areas within the site which require shaping shall be excavated, filled, compacted when required, and shaped to the correct contours as shown on the drawings or as directed by the Employer's Agent. Such work shall be regarded as being earthworks and measurement and payment shall be made in accordance with the requirements of SANS 1200D or SANS 1200DB (as applicable), except that quantities may be calculated by means of levels taken on a grid system of 10 m squares measured before and after shaping. Alternatively, quantities may be determined from levelled cross-sections.

Care shall be taken to ensure that no unsuitable materials such as concrete, bricks, stones, tree stumps and roots, asphalt surfacing, refuse, road building materials, etc are placed in the areas where topsoiling and/or planting are to take place. Any unsuitable material found within 400 mm from the finished surface shall be removed by the Contractor at his/her expense.

PTD 5.1.2 Areas Not Requiring Topsoil

Where areas to be planted consist of organically suitable material, the areas shall be ripped to a depth of 400 mm and cultivated to a suitable tilth prior to application of fertilisers, soil-improvement materials, compost, manure, etc. All stones greater than 50 mm and other unsuitable materials shall be removed from the 400 mm thick upper layer.

PTD 5.1.3 Areas Requiring Topsoiling

Where areas to be planted consist of organically unsuitable material, the areas shall be ripped to a depth of 200 mm or more to permit the provision of an overlying 400 mm thick cultivated layer below the required finished surface level. Topsoil shall be placed on the prepared surfaces and trimmed to the uniform thickness specified. The topsoil and subsoil shall be cultivated to a suitable tilth prior to application of fertilisers, soil-improvement materials, compost, manure, etc. All stones greater than 50 mm and all unsuitable materials shall be removed from the 400 mm thick upper layer.

PTD 5.2 Preparation of Planting

PTD 5.2.1 General

The Contractor shall be responsible for setting the plants in position in accordance with the drawings and shall agree this with the Employer's Agent's Representative prior to the commencement of the work.

Preparation of areas for planting shall not be carried out until all adjacent construction work has been completed.

PTD 5.2.2 Trimming

Trimming shall consist of bringing the ground within the areas indicated to an even surface suitable for planting. Trimming may be done by machine or by hand and in either case the surfaces shall be left slightly rough.

During trimming all stones over 30 mm in size in the top 100 mm deep layer and all excess material shall be removed. Trimming shall be carried out in such a way that the finished surface shall be approximately 25 mm below the top of any adjacent kerbing, channelling or paving, unless otherwise directed.

PTD 5.2.3 Fertilising

The Contractor shall arrange to have samples from the top 200 mm of the prepared surfaces tested by an approved establishment to determine the quantity and type of fertiliser required for establishing proper growth conditions for the plants to be planted. The Employer's Agent shall be furnished with the test results, and only after approval by him/her of the types and quantities of the fertiliser it is proposed to use, may the application of fertiliser proceed.

The fertiliser shall be evenly applied over all surfaces where planting is to take place and shall be thoroughly mixed into a depth of 100 mm. Where hydroseeding is to be performed, the fertiliser may be mixed with the water used for hydroseeding.

PTD 5.2.4 Irrigation Systems

Where irrigation systems are to be installed, the sub-soil components of these systems shall be installed prior to planting or grassing the areas.

PTD 5.2.5 Plant Holes

Unless otherwise directed by the Employer's Agent, holes shall be dug, and all organically unsuitable material therein shall be disposed of and replaced with topsoil.

- For shrubs the holes shall be at least 600 mm square and 600 mm deep.
- For trees the holes shall be at least 1 000 mm square and 1 000 mm deep.

PTD 5.3 Planting Grass

PTD 5.3.1 Hydroseeding

The Contractor shall be solely responsible for establishing an acceptable grass cover and any approval by the Employer's Agent of seed or seed mixtures it is proposed to use, shall not relieve the Contractor from this responsibility.

Cellulose pulp shall be added to the hydroseeding mix at a rate of 25 kg of pulp per kilolitre of water for use on steep slopes and where ordered by the Employer's Agent.

Where the use of anti-erosion compound is required, and such compound is to be applied simultaneously with the hydroseeding, it shall be mixed with the hydroseeding mixture before application. In such cases the amount of cellulose pulp shall be decreased by one-third to one-half, depending upon the amount of anti-erosion compound added.

PTD 5.3.2 Grass Cuttings

The areas to be planted shall be thoroughly watered for a period from 12 to 24 hours before planting to ensure that the soil is uniformly wet to a depth of at least 100 mm when planting takes place.

An approved variety of grass cuttings shall be evenly planted at a rate of at least 70 grain bags of cuttings per hectare. Only well-rooted, fresh cuttings shall be used. Immediately after planting, the cuttings shall be given a copious watering and, when sufficiently dry, be rolled with a light agricultural roller.

PTD 5.3.3 Grass Sods

Areas to be grassed by sodding shall be thoroughly watered beforehand so that they are wet to a depth of at least 150 mm. The surface shall be slightly roughened to ensure good penetration of roots into the soil. Sods before laying, shall be protected against drying out and shall be kept moist from the time of harvesting until finally placed.

The first row of sods shall, where possible, be laid in a straight line and if on a slope starting at the bottom of the slope. The sods shall be butted tightly against each other, care being taken not to stretch or overlap sods. Where a good fit cannot be obtained, the intervening space shall be filled with topsoil. The next row shall be placed in the same manner tightly against the previous row with the joints staggered and so on until the full area is covered. On steep slopes, when instructed by the Employer's Agent, the sods shall be held in position by sufficient wooden stakes to prevent movement.

The sods shall be watered after placing to prevent unduly rapid drying out.

PTD 5.4 Planting Trees, Shrubs and Groundcover Plants

PTD 5.4.1 General

Upon delivery of the plants to site, the Employer's Agent will inspect them to ensure they are in good condition and free from obvious diseases. Any plants that are in poor condition or suffering from a disease shall be removed from site and replaced by others provided by the Contractor at his/her expense.

The root condition of plants delivered in containers will be inspected by the Employer's Agent by removing the soil from the roots of a minimum of two plants of each kind provided up to a maximum of 2% of the total number of plants of each kind. If the samples are found to be defective, the Employer's Agent may reject the entire lot or lots of plants represented by the defective samples.

PTD 5.4.2 Groundcovers

For rooted cuttings and container grown groundcovers, the areas to be planted shall be ripped and cultivated as specified above, prior to planting. Thereafter, compost to a depth of 50 mm, Terrasorb at a rate of 15 g/m² and other fertilisers, etc dependent on soil test reports (nominally 70 g/m² of 2:3:2 and 70 g/m² of superphosphate) incorporated in the soil. The plants shall be thoroughly watered immediately after planting.

PTD 5.4.3 Shrubs

After placing the shrubs, the shrub-hole shall be backfilled using a topsoil mixture consisting of 5 parts topsoil to 1-part compost plus Terra-sorb at a rate of 100 g/shrub hole and other fertilisers, etc dependent on soil test reports (nominally 100 g superphosphate and 50 g 2:3:2 per shrub-hole). The soil shall be thoroughly compacted while backfilling proceeds and continually watered to eliminate air pockets. A basin 1 000 mm in diameter and 150 mm deep shall be formed around each shrub-hole.

PTD 5.4.4 Trees

After placing the trees, the tree-hole shall be backfilled using a topsoil mixture consisting of 5 parts topsoil to 1-part compost plus Terrasorb at a rate of 500 g/tree hole and other fertilisers, etc depending on test results (nominally 250 g superphosphate and 125 g 2:3:2 per tree-hole). The soil shall be thoroughly compacted while backfilling proceeds and continually watered to eliminate air pockets. A basin 1 500 mm in diameter and 200 mm deep shall be formed around each tree-hole.

All trees shall be braced upright in position using timber stakes with adjustable plastic/rubber tree ties in at least two places. The timber stakes shall be tanalith treated, have a minimum diameter of 35 mm and be driven to at least 500 mm into the ground and have a maximum height of 3,0 m above the ground surface.

PTD 5.5 Time for Planting

Grass, trees, shrubs and groundcover plants shall be planted as far as is practicable during periods most likely to produce best growing results. The Contractor shall make every effort to programme his/her operations such that grass, trees, shrubs and groundcover plants shall be planted during those periods.

PTD 5.6 Transplanting Trees

Selected trees generally less than 2,5 m tall may be marked by the Employer's Agent for transplanting by the Contractor. The Contractor shall transplant these trees in accordance with the following procedure.

Each tree shall be well watered every day (not less than 50 litres/day) for a week prior to moving. For this purpose, the Contractor shall construct a small basin of minimum internal diameter 1 000 mm and 200 mm deep around each tree to retain the applied water. The original orientation of each tree shall be marked by spray-painting a small mark on the north side of the trunk.

The tree shall be removed by cutting out a block of soil at the base of the tree of minimum dimensions 0,8 m x 0,8 m x 0,8 m, retaining as much of the root system as possible. The branch material should be cut back as necessary so as to maintain a root to shoot ratio of 1:1.

The tree shall be planted at its new location, generally in accordance with Clause 5.4.4 above, ensuring that the tree is positioned in the new hole at the same depth and with the same orientation as its original position.

PTD 6 ACCEPTABLE GRASS COVER

An acceptable grass cover shall mean that not less than 75% of the area planted or hydroseeded shall be covered with grass within a period of 3 months after planting and that no bare patches of more than 500 mm maximum dimension shall occur. In the case of sodding, acceptable cover shall mean that the entire area shall be covered with live grass within 3 months after sodding.

PTD 7 MAINTENANCE

PTD 7.1 Grass

PTD 7.1.1 Watering, Weeding, Mowing and Replanting

All sodded and planted areas shall be adequately watered at regular and frequent intervals to ensure the proper germination of seeds and growth of grass until the grass has established an acceptable cover and regular watering continued thereafter until handed over to the Employer. The quantity of water and the frequency of watering shall be subject to the Employer's Agent's approval. With hydroseeding the commencement of watering may be postponed until a favourable time of the year, but watering shall commence as soon as the seeds have germinated, and growth has started. Watering shall continue until handed over to the Employer.

The Contractor shall mow the grass at least once per fortnight over all areas where grass has been established, commencing when so instructed by the Employer's Agent. All grass cuttings shall be collected and disposed of.

Weeds shall be removed and controlled by an approved means.

Any bare patches where the grass has not taken root or where it has been damaged or has dried out shall be recultivated, planted, sodded or hydroseeded at the Contractor's expense.

PTD 7.1.2 Handing Over to Employer

Grassed areas will be handed over to the Employer once the acceptable cover has been established and the grass has been mowed at least twice. In the case of sodding this shall not be earlier than 3 months after completion of the sodding. All areas that are not covered with live grass 3 months after handing over to the Employer shall be re-established and maintained for at least 3 months by the Contractor at his expense.

PTD 7.2 Trees, Shrubs and Groundcovers

PTD 7.2.1 Watering, Weeding, Maintaining and Replanting

The plants shall be adequately watered at regular and frequent intervals to ensure proper growth. The quantity of water and the frequency of watering shall be subject to the Employer's Agent's approval. The Contractor shall continue to water the plants up to the time of hand over to the Employer.

The Contractor shall maintain the plants and keep the plants free from weeds and pests.

PTD 7.2.2 Handing Over to Employer

Plants may be handed over to the Employer 3 months after completion of planting. All plants that are not healthy, show unsatisfactory growth or die within 3 months after handing over to the Employer shall be removed, replaced, re-established and maintained for 3 months by the Contractor at his own expense.

PTD 8 MEASUREMENT AND PAYMENT

PTD 8.1 Principles

(a) Shaping of areas prior to topsoiling, ripping and trimming shall be regarded as earthworks and measured and paid in accordance with the requirements of SANS 1200D or SANS 1200DB (as applicable).

(b) The scheduled rates covered applicable to this specification shall include for the provision of all labour, plant, materials and transport necessary to complete the specified work.

PTD 8.2 Schedule Items

PTD 8.2.1 Trimming:

(a) Machine trimming .....Unit: ha

(b) Hand trimming .....Unit: ha

The rates for (a) and (b) shall cover the cost of trimming the areas specified, including moving a small quantity of material that is inherent in this process and the removal of surplus material from site. Payment will distinguish between machine trimming and hand trimming.

PTD 8.2.2 Preparation of Areas for Planting:

(a) Ripping .....Unit: ha

(b) Topsoiling (thickness specified):

(i) Using material obtained from the site or borrow areas .... Unit: m²

(ii) Using material obtained from Contractor's own source of supply or commercial sources ..... Unit: m²

(c) Supply and apply fertilisers and/or soil improvement materials:

(i) 2:3:2 (22).....Unit: t

(ii) 3:2:1 (25).....Unit: t

(iii) Limestone ammonium nitrate .....Unit: t

(iv) Dolomitic Lime .....Unit: t

(v) Superphosphate .....Unit: t

(vi) Compost .....Unit: m³

(vii) Manure.....Unit: m³

(viii) Other (Specify)..... Unit: t or m³

(d) Supply and apply "Terra-sorb" or similar approved water-retention agent....Unit: kg

(e) Prepare areas for grassing/planting of groundcovers .....Unit: ha

The rates for (a) shall cover the cost of ripping the areas to be prepared to the specified depth and the removal of stones and undesirable materials. The rates for (b) shall cover the cost of procuring, transporting and placing the material to the thickness specified. The rates for (c) and (d) shall cover the cost of procuring and applying the materials at the rates specified. The rates for (e) shall cover the cost of preparing the specified areas for planting but excluding the cost of fertilisers/soil improvement materials included in (c) above.

PTD 8.2.3 Grassing:

(a) Planting of grass cuttings (type of grass specified) .....Unit: ha

(b) Sodding using:

(i) Nursery-grown sods (type of grass specified) .....Unit: m²

(ii) Veld sods .....Unit: m²

(c) Hydroseeding:

(i) Hydroseeding with approved seed mixture .....Unit: ha

(ii) Extra over for approved anti-erosion compound .....Unit: ha

Notwithstanding the above references to the measurement Unit being "ha", relatively small areas may be scheduled in the Bill of Quantities as "m2"

The rates shall cover the cost of supplying the materials, planting, sodding or hydroseeding, watering until handover to the Employer, establishing, weeding, maintaining and all incidentals necessary for establishing the specified cover.

The rates shall cover the cost of all plant and labour necessary to mow the grassed area at fortnightly intervals throughout the period from the instruction to commence mowing up to the time of hand over to the Employer, including for collecting and disposing of the grass cuttings.

PTD 8.2.4 Trees, Shrubs and Groundcovers:

(a) Trees and shrubs (species, varieties and size specified) ..... Unit: No

(b) Groundcover plants (species, varieties, size and number per square metre specified).....Unit: m²

(c) Transplanting of existing trees where indicated by the Employer's Agent .. Unit: No

The rates shall cover the cost of excavating and preparing the plant holes for shrubs and trees, supplying the plants, planting or transplanting as applicable, watering until handover to the Employer establishing, weeding, staking (where necessary), maintaining, and all incidentals necessary for the proper execution and maintenance of the work.

C3.8.18 PTJ: Training
(Applicable to Project Specification PSA and SANS 1200A)

PTJ 1 INTRODUCTION

PTJ 1.1 Scope

This specification covers Accredited On-Site Skills Training for nominated trainees from the local community in skills relating to specific areas related to construction. It is intended that candidates for training will be persons who are undergoing, or who have undergone, training at a University of Technology or FET College. Training is described in Section C3.5.15.

PTJ 2 EMPLOYMENT ARRANGEMENTS

The Employer will inform the Contractor of the number and names of candidates to be trained and confirm the categories of training to be provided (see PTJ 4 below) and the required timing (date for start of training and duration). The Contractor shall proceed to timeously employ such candidates for the duration of training and shall claim for salaries and other validated costs incurred, including an agreed mark-up, according to the Training Schedule. The trainees shall be employed under the Contractor's normal conditions of employment for unskilled labour, including registration for Workmen's' Compensation.

The trainees shall be included in the Contactor's Health & Safety Plan for the duration of training. The trainees will, however, not be available for deployment on site by the Contractor for the duration of training. Upon completion of training the employment contract with each trainee will cease and the Contractor shall have no obligation towards the trainees in respect of further employment. The Contractor may, however, employ the trainees on a permanent or other basis. The terms of such employment are to be mutually agreed between the Contractor and the trained person.

PTJ 3 TRAINING ARRANGEMENTS

The Employer will inform the Contractor of the number and names of candidates to be trained and confirm the categories of training to be provided (see PJ 4 below). The Contractor shall then obtain three quotations from suitable accredited Skills Training Service Providers on the basis of PTJ 4 below. The quotations and responses shall be submitted to the Employer for approval and appointment.

Upon notice of the Employer's approval, the Contractor shall proceed to appoint the selected firm to provide such Accredited Skills Training Facilitator(s) as are required according to the disciplines of training to be provided. The Contractor shall pay the training fees and charges of the accredited trainer according to the agreed fee scales and according to such validated registers of attendance and certificates of performance as are agreed in the training contract that is to be entered into.

The Contractor shall provide a suitable area for the purpose of training. The area shall be, in proximity to the worksite so as to allow for interaction with the workplace, as and when required, for training purposes. The Contractor shall make available a meeting room, with tables and chairs, for instruction purposes, together with water supply and sanitation facilities for male and female participants.

The Contractor shall be required to provide construction materials and tools for practical training. Any such materials and tools supplied shall be charged as per the Dayworks Schedule.

PTJ 4 TRAINING CATEGORIES AND OBJECTIVES

PTJ 4.1 Trench Excavation and Supervision

PTJ 4.1.1 Training Objective

At the end of training the trainee shall be able to and understand why it is necessary to:-

- Remove and preserve topsoil,
- Excavate straight pipe trenches by machine and by manual labour,
- Excavate the trench invert evenly,
- Excavate vertical trench sides,
- Deposit excavated material at a safe distance away from the trench edge,
- Be able to work with boning rods,
- Backfill around the pipe,
- Compact the backfill to the trench,
- Understand and apply the Construction Regulations with regard to trench excavation.

PTJ 4.2 Pipelaying

PTJ 4.2.1 Training Objective

At the end of training the trainee shall be able to:-

- Understand the principles and function of a pipeline,
- Measure the depth of a trench to establish the degree of bottoming up required,
- Supervise, level and prepare the bedding to receive the pipes,
- Set up a fishline at the bottom of the trench,
- Excavate a trench to the required depth and width to contain the pipeline,
- Prepare the bedding,
- Lay a pipeline using the correct tools, materials and equipment,
- Make a connection from the pipeline to a branch or house connection,
- Do initial, intermediate and final backfilling and compaction and ensure correct compaction by testing soil density,
- Backfill after laying the pipes in such a way that the pipes are protected from movement or damage from external pressure,
- Understand and apply the Construction Regulations with regard to pipelaying.

PTJ 4.3 Steel Fixing

PTJ 4.3.1 Training Objective

At the end of training the trainee shall be able to:-

- Understand basic structural drawings,
- Recognize the different bar profiles and strengths and their purposes,
- Interpret shape codes and bending schedules,
- Set up steel bars for bending,
- Select the correct steel bars for fixing,
- Fix in place steel bars,
- Carry out dimensional checks according to drawings and adjust where necessary,
- Understand and apply the Construction Regulations with regard to steel fixing.

PTJ 4.4 Formwork and Concreting

PTJ 4.4.1 Training Objective

At the end of training the trainee shall be able to:-

- Understand basic structural drawings,
- Set out work and determine placing of formwork,
- Fix formwork in place,
- Recognize the types of support, propping, etc. and determine the level of support requirements for specific formwork,
- Understand different prescribed mix and strength concretes,
- Understand various concrete constituents and their requirements,
- Conduct proportioning for a given prescribed mix concrete,
- Mix the concrete and transfer and place on site with minimum wastage,
- Conduct a concrete slump test and interpret the result,
- Understand concrete vibration and its function and limitations,
- Understand concrete set – false, initial and final,
- Carry out dimensional checks according to drawing and adjust where necessary,
- Understand and apply the Construction Regulations with regard to concreting work.

PTJ 4.5 Basic Construction Hand

PTJ 4.5.1 Training Objective

At the end of training the trainee shall be able to:-

- Demonstrate his/her knowledge of tools and equipment needed for excavation and concreting,
- Excavate and trim foundations according to specifications,
- Mix the concrete to the required proportions and methods, transporting without wasting and place correctly in foundations,
- Set up the floor shutter according to specifications,
- Placing the floor concrete according to specifications and using correct procedures and equipment,
- Understand and apply the Construction Regulations with regard to excavation of foundations and concrete work.

PTJ 4.6 Bricklaying & Block laying

PTJ 4.6.1 Training Objective

At the end of training the trainee shall be able to:-

- Interpret basic drawings,
- Demonstrate his/her knowledge of the tools necessary to set up internal dimensions,
- Erect a profile on position and plumb,
- Select and mix the correct mortar for the work,
- Build blockwork/brickwork using the correct methods and according to specifications,
- Understand and apply the Construction Regulations with regard to block laying/bricklaying.

PTJ 4.7 Finishing Hand

PTJ 4.7.1 Training Objective

At the end of training the trainee shall be able to:-

- Fix timber supports for roofing according to specifications,
- Erect concrete beams to superstructure according to specifications,
- Measure and cut roof sheets using correct methods and according to specifications,
- Fit a door and align it so that it works correctly,
- Construct a South African roof truss to specifications and within tolerances required,
- Erect and align roof trusses in accordance with the specifications,
- Align and fix purlins to take roof sheets,
- Clad roof with sheeting/tiles in accordance with specifications,
- Understand and apply the Construction Regulations with regard to construction and finishing of buildings.

PTJ 4.8 Task-based Labour Administration

PTJ 4.8.1 Training Objective

At the end of training the trainee shall be able to:-

- Record tools issued to labourers,
- Determine classification of excavation using trial pits,
- Set out daily tasks,
- Do basic task administration work,
- Reconcile monthly task sheets to task sheets,
- Reconcile monthly task sheets to physical measurements,
- Understand and apply the Construction Regulations with regard to labour-intensive construction.

PJ 4.9 Understanding the Scope of Works and Employer's Agent's Specifications

PTJ 4.9.1 Training Objective

At the end of training the trainee shall be able to:-

- Read basic plans and maps,
- Understand the Contractor's mobilization requirements,
- Understand statutory duties and requirements in Contractor's mobilization,
- Analyse the scope requirements and produce a construction programme,
- Plan tasks according to priorities and specifications,
- Understand and apply the Construction Regulations with regard to Contractor's mobilization and requirement for Commencement of Works.

PTJ 4.10 Labour Recruitment and Management

PTJ 4.10.1 Training Objective

At the end of training the trainee shall be able to:-

- Measure labour requirement using the two factors; time to complete a Contract and physical amount of work to be completed,
- Learn how to select and employ reliable staff and labour,
- Administer labour,
- Draw up a simple employment contract for labour,
- Complete time sheets and maintain records,
- Administer payroll functions,
- Understand and apply statutory requirements and regulations with regard to employment of staff and labour.

PJ 4.11 Contractor's Responsibilities and Requirements

PTJ 4.11.1 Training Objective

At the end of training the trainee shall be able to:-

- Understand the role of the Employer, Contractor, Employer's Agent, Local- and statutory authorities,
- Read and interpret a construction programme,
- Programme and plan to complete tasks on time,
- Interpret and adhere to specifications,
- Manage labour,
- Plan tool requirements,
- Choose correct tools and equipment,
- Have a knowledge of contract management,
- Facilitate and manage good relationships with all parties involved,
- Understand and apply the Construction Regulations with regard to construction in general.

PTJ 4.12 Payroll Management and Implementation

PTJ 4.12.1 Training Objective

At the end of training the trainee shall be able to:-

- Understand and compile payroll data,
- Learn coinage submission,
- Prepare a payroll for electronic payment,
- Implement the pay,
- Understand and apply statutory requirements and regulations with regard to employment and payment of staff and labour.

PTJ 4.13 Basic Tender and Contract Pricing

PTJ 4.13.1 Training Objective

At the end of training the trainee shall be able to:-

- Recognize and understand Fixed and Time-Related costs and charges,
- Read and understand Bills of Quantities,
- Apply rates and accurately extend to quantities,
- Refer and look up statutory rates and price indices,
- Accurately Calculate Contract Price Adjustment,
- Place orders and negotiate with suppliers,
- Understand a Health & Safety Plan and Environmental Management plan and recognize the cost implications of compliance,
- Learn contract pricing for future projects,
- Understand tender documentation and demonstrate competence in understanding scope and scale of inputs required to complete the contract.

PTJ 4.14 Community Liaison and Facilitation

PTJ 4.14.1 Training Objective

At the end of training the trainee shall be able to:-

- Understand the Basic Conditions of Employment and other relevant legislation and regulations,
- Understand the role of the Employer, Contractor, Employer's Agent, local- and statutory authorities,
- Understand the role of the Health & Safety Agent, health & Safety Office and Environmental Control Officer,
- Understand protocols in engaging and responding to Local- and statutory authorities,
- Demonstrate competence in engaging and responding to the general public and the local community,
- Demonstrate competence in convening and chairing informal and formal meetings,
- Lead discussions to a conclusion and take concise and accurate minutes of meeting,
- Complete reporting on labour generation and labour issues to National Treasury requirements.

PTJ 5 MEASUREMENT AND PAYMENT

PTJ 5.1 Appointment of Training Agent

The Service Provider for Skills Training will be paid by the Contractor and the cost recovered via the Contract as certified by the Employer's Agent. The Contractor shall apply a mark-up of 10% to the training fee to cover administration. The cost of obtaining quotations and appointing the successful Service Provider shall be deemed to be included in the Contractor's administration mark-up. Payment shall be on the basis of validated invoices for approved orders.

Payment item: A Provisional Sum, plus accompanying item for Contractor's 10% mark-up, is provided under BoQ Section PSA: Preliminary & General.

PTJ 5.2 Provision of Training Area and Facilities

The preparation of a suitably sized area for conducting training and including a training room with furniture and water supply and sanitation facilities for trainees is described in PSA.

Payment item: An item for provision and maintenance of training area and training room is provided under BoQ Section PSA: Preliminary & General.

PTJ 5.3 Employment of Trainees

Trainees shall be employed by the Contractor on the same basis as unskilled labour. Separate payroll records shall be kept for trainees. Payments in respect of wages and other validated costs for trainees will be recovered via the validated payroll records.

PTJ 5.4 Materials for Training

The Service Provider shall be responsible for requisitioning, via the Contractor at least 1,0 week in advance, the materials required for practical training purposes. The Contractor shall be responsible for obtaining these materials and for transporting these materials to the training location at least 1,0 day prior to the scheduled training date. Materials for training shall be deemed to be addressed by PTJ 4.

Payment shall be claimed under the respective item in BoQ Section PSA: Preliminary & General.

PTJ 5.5 Construction Equipment used in the Course of Training

Should any item of Construction Equipment and/or tools be required for the sole purpose of practical Skills Training, the Contactor shall keep separate records of the use of this equipment and /or tools used for training purposes. The Service Provider shall be responsible for requisitioning the use of Construction Equipment and tools from the Contractor at least 1,0 weeks in advance. The Contractor shall take reasonable steps to provide the equipment and / or tools on site at the training location at least 1,0 day prior to the scheduled training date. Use of Construction Equipment and / or tools for training shall be deemed to be addressed by PTJ 3 and payment shall be claimed under the Dayworks schedule (refer PSA 5.2).

C3.8.19 PYA: Perimeter Wall and Gate

PYA 1 SCOPE

This specification covers the requirements for a perimeter security wall.

The wall shall be installed in the positions shown on the drawings or as directed on site.

PYA 2 MATERIALS

PYA 2.1 Concrete Masonry Blocks

Concrete masonry units (blocks) shall comply with SANS 1215 and shall be hollow face units. Blocks are to be smooth faced and have neat cut edges (Coroblock or similar). The preferred dimensions of units are 390 x 190 x 190mm.

The nominal compressive strength of hollow blocks shall be at least 14 MPa.

Masonry units manufactured with aggregates which contain slag, clinker or burnt clay brick shall not be used unless prior approval has been obtained from the Engineer.

The average drying shrinkage of units shall not exceed 0,06% and the average expansion on rewetting shall not exceed 0,02% in excess of the actual drying shrinkage obtained from manufacturer's tests.

Sample units shall be taken at random by the Engineer should it be considered that tests are necessary to satisfy that there are no deficiencies in any consignment. Should deficiencies occur when tested in accordance with SANS 1215, the complete consignment may be rejected.

PYA 2.2 Mortars for Blockwork

Mortars to be used for blocklaying are to be in accordance with either Classes I, II or III as specified in SANS 10145 Subclause 3.2.3, as called for in the Bill of Quantities or on the drawings. Should no specific strength be specified, then Class II mortar having a compressive strength of 5 MPa at 28 days shall be used. The mortar mix shall be 170 □ of sand to 50 kg of Portland cement 42,5 and shall be used in conjunction with an approved mortar plasticiser conforming to BS EN 934-3: 2009+A1: 2012.

Alternatively, 50 kg of an approved masonry cement (supplied by a reputable manufacturer) may be used in lieu of 50 kg of Portland cement in the mix to give the same 28 day strength as required under the previous paragraph, but in that case no mortar plasticiser is to be used.

PYA 2.3 Barbed Wire

Barbed wire shall be 1.6mm Motto double strand barbed wire.

PYA 2.4 Razor Wire coils

Razor ripper coils shall be 500mm diameter and galvanised.

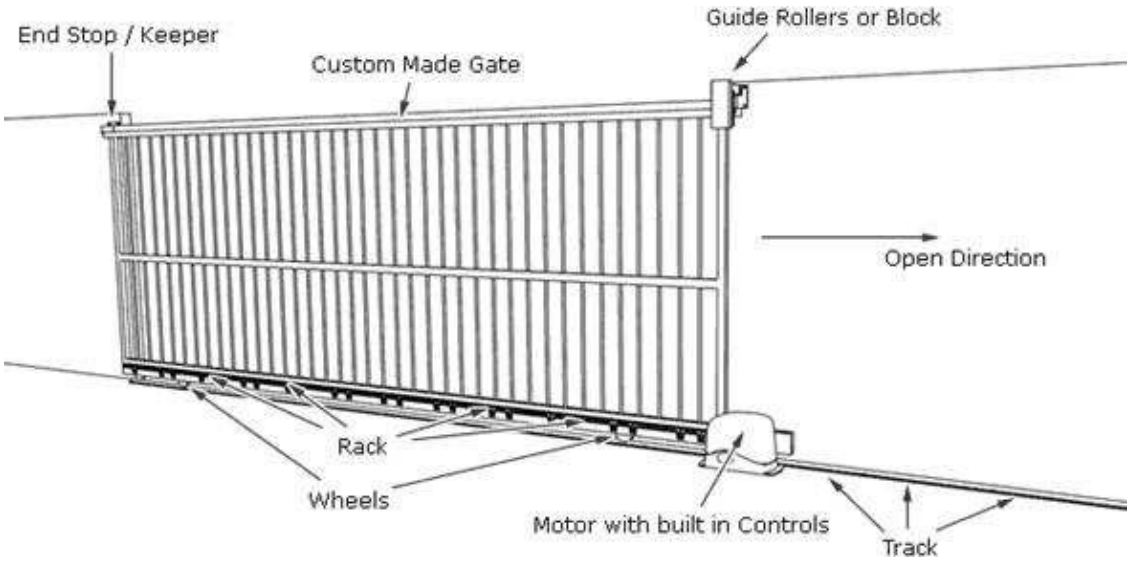
PYA 2.5 Sliding Gate

Gates shall be fabricated using mild steel and be hot dipped galvanised. The height of the gate(s) shall be 1.8m or as shown on the Drawings. The main outer frame shall be of 50mm x 50mm x 2.5mm mild steel square tubing and inner uprights shall be of 30mm x 30mm x 2.5mm mild steel angle iron at 150mm centres.

The gate track shall be fabricated using 50mm x 38mm x 3mm rectangular tubing with a 16mm Φ mild steel round bar welded on, as shown on the Drawings.

The sliding gate shall be provided with a Centurion D5 sliding gate motor or similar approved, with a 12 volt battery power backup. A galvanized theft protection bracket shall also be installed for the gate motor.

A drawing of the gate required is indicated below and on the relevant Drawings.



PYA 2.6 Concrete

Concrete for the bases shall be at least Grade 25 (25 MPa). Concrete for filling of hollow face units (blocks) shall be at least Grade 15 (15 MPa).

PYA 3 CONSTRUCTION AND ERECTION

PYA 3.1 Existing Fence

Along areas where the brick wall will be replacing the existing perimeter fence, the Contractor shall be responsible to ensure that no section of the existing fence is left open or exposed to vandalism during the construction of the brick wall.

PYA 3.2 Excavations

600mm wide x 500mm deep trenches shall be excavated for strip foundations along the entire wall (perimeter) except at the vehicular access.

Excavations for piers shall be 800mm x 800mm x 500mm for single and 1000mm x 1000mm x 500mm for double.

All levels shall be checked after excavations have been completed and prior to casting the concrete foundations.

PYA 3.3 Foundations

Strip foundations along the entire wall (perimeter) shall be 230mm thick x 600mm wide. The minimum depth to the underside of the foundation shall be 500mm.

PYA 3.4 Block Wall

Block laying may commence a minimum of 2 days after casting of the concrete foundation. Concrete blocks shall be laid in compliance with Code of Practice SANS 10145.

Blocks shall not be wetted prior to laying in a wall and the moisture control at the time of laying shall comply with Table 2 of that Code of Practice. The drying shrinkage of the blocks to be laid shall be available to the Engineer in the form of a directive from the manufacturer of each type of masonry unit. The average annual humidity shall likewise be made available to the Engineer.

Blocks shall be laid on a full bedding of mortar. All joints are to be nominally 10 mm thick and both vertical and horizontal joints shall be completely filled. Blocks shall be laid with the thicker shell face outermost. They shall be laid in stretcher bond with the horizontal distance between vertical joints in adjacent course equal to at least one quarter of the length of the block. All blockwork shall be built true and plumb with the perpends vertically in line.

Bonding of blockwork shall be carried out in full compliance with SANS 10145.

Double block piers shall be constructed at a distance of 6m with an intermediate single pier (390mm x 390mm) in the middle at 3m apart, in accordance with the detail of piers on the Drawings. A 16mm expansion joint shall be provided after every second pier (double). Soft board shall be used at expansion joints and a flexible filler (clear silicone or similar) shall be used to finish off the gaps on both sides. 2No. x 6mm steel rods shall be placed horizontally every 3 block courses for extra strength.

A galvanized steel frame made up of 30mm x 30mm x 3mm angle iron 850mm long embedded in 25 MPa concrete shall be installed at 3m centres to support the razor ripper coil and barbed wire along the entire perimeter, as per the detail on the Drawings.

All open spaces at the top of the block wall shall be closed off with 20MPa concrete shaped so that water does not collect but drains off the wall. The top of the wall shall then be provided with a float finish.

The wall shall be stepped as per the profile of the existing ground level. This will be decided and agreed on during the actual construction phase.

After construction of the foundation blockwork, the wall shall be backfilled to ground level on either side of the wall and compacted in layers not exceeding 150mm. All excess soil shall be disposed off.

PYA 3.5 Razor Wire

1.6mm Motto double strand barbed wire comprising 3 lines spaced at 166mm centres shall be supplied and attached to the galvanised angle iron. 500mm diameter razor ripper coil shall then be tied down onto the galvanised angle iron.

PYA 3.6 Sliding Gate

The sliding gate shall be provided with wheels as indicated on the Drawings. The gate guide as shown on the drawings shall be fabricated and installed by the Contractor.

The Contractor shall carry out all electrical supply installations from the “Offices and Staff Facilities” to the gate motor. The Contractor shall lay 2,5mm surfix electrical cabling in a SABS approved 20mm pvc conduit at a depth of 500mm from a 15amp plug point in the main office building to the sliding gate motor. The Contractor shall forward details of the electrical layout for approval by the Electrical Engineer. All electrical installations are to be carried out by a registered electrician.

PYA 4 TOLERANCES

PYA 4.1 Out-of-straightness of any component shall not exceed 3 mm/m length of the component.

PYA 5 MEASUREMENT AND PAYMENT

PYA 5.1 Clearing and grubbing line of wall ..... Unit: m

The rate for clearing and grubbing shall cover the cost of clearing a 2 m wide strip (1 m on either side of the wall centre line) along the entire length of the wall, removing boulders of size up to 0,15 m^3, grubbing of trees of girth up to 1 m, grubbing of tree stumps, cutting of trunks and branches exceeding 0,5 m girth into transportable lengths, backfilling of cavities and removing, transporting and disposing of material thus cleared, grubbed and cut.

Boulders exceeding 0,15 m^3 and removal and grubbing of trees exceeding 1 m girth shall be paid for separately.

PYA 5.2 Wall ..... Unit: m

The rate for the wall shall include for all setting out, excavation for foundations, construction of foundations and wall, all as specified and including for single and double piers along straight lengths of wall and for the erection of the galvanised angle iron together with the barbed wire and razor ripper coil. The measured length shall include the length of all gateways.

PYA 5.3 Extra over PYA 5.2 for single gate ..... Unit: No

Extra over PYA 5.2 for pair of double gates ..... Unit: No
Extra over PYA 5.2 for motorised sliding gate ..... Unit: No

The extra over rate for gates shall include for supplying, transporting and erection of gates, including all accessories as specified. For a motorised sliding gate, the supply and erection of the gate guide complete and the supply of 2 remote controls for the gate shall be included in this rate.

PYA 5.4 Extra over PYA 5.2 for corner pier/ bend ..... Unit: No

The rate shall include for complete supply of materials and construction of corner piers/ bends in accordance with the specifications for a double pier.

C3.8.20 Client Site Specific Health and Safety Construction Health and Safety Specification

Refer to Annexure A for the site specification.

ANNEXURE A

CLIENT SITE SPECIFIC HEALTH AND SAFETY CONSTRUCTION HEALTH AND SAFETY SPECIFICATION

Ugu District Municipality

DR Safety Consultants

Occupational Health & Safety Specifications in Accordance with Regulation 5 (1) (b) of the Construction Regulations, 2014 for the

The Construction of the Backwash Water Recovery Facility at the Bhobhoyi Waterworks

Prepared By: DR Safety Consultants

Professional Team

Client: The Ugu District Municipality

Designers / Project Managers: Royal Haskoning DHV

OHSA 1993 HEALTH AND SAFETY SPECIFICATION

DEFINITIONS

For the purpose of this contract the following shall apply:

Employer" where used in the contract documents and in this specification, means the Employer as defined in the General Conditions of Contract and it shall have the exact same meaning as "**client**" as defined in the Construction Regulations 2014. "**Employer**" and "**client**" is therefore interchangeable and shall be read in the context of the relevant document.

(a) "**Contractor**" wherever used in the contract documents and in this specification, shall have the same meaning as "**Contractor**" as defined in the General Conditions of Contract.
In this specification the terms "**principal contractor**" and "**contractor**" are replaced with "**Contractor**" and "**contractor**" respectively.

For the purpose of this contract The Principal Contractor will, in terms of OHSA 1993, be the mandatory, without derogating from his status as an employer in his own right.

(b) "**Engineer**" where used in this specification, means the Engineer as defined in the General Conditions of Contract. In terms of the Construction Regulations the Engineer may act as agent on behalf of the Employer (the client as defined in the Construction Regulations).

SCOPE

This specification covers the health and safety requirements to be met by the Principal Contractor, contractors & contractors to ensure a continued safe and healthy environment for all workers, employees and contractors under his control and for all other persons entering the site of works.

This specification must be read with the Occupational Health and Safety Act (Act No 85 and amendment Act No 181) 1993, and the corresponding Regulations, and all other safety codes and specifications referred to in the said Regulations.

In terms of the OHSA Agreement in terms of Section 37 (1) & (2), the status of the Principal

Health & Safety Specifications

Contractor as mandatary to the Employer (client) is that of an employer in his own right, responsible to comply with all provisions of OHSA 1993 and Regulations.

This health safety specification and the Principal Contractor's own Health & Safety Plan as well as the Occupational Health & Safety Act, 85 of 1993 & Construction Regulations 2014, shall be made available for inspection by all workers, employees, inspectors and any other persons entering the site of works.

Scope of Work:

- Site Establishment
- Surveying
- Proving & Relocation of Existing Services
- Clearing & Grubbing
- Excavation Work
- Construction of Foundations and Floor Slabs
- Construction of Brickwork
- Installation of Windows and Door frames
- Electrical Installations
- Plumbing
- Roof Work
- Plastering
- Installation of Ceilings & Partitions
- Tiling
- Fitting of doors
- Installation of Built in Cupboards and Countertops
- Installation of Laboratory Equipment

The Health & Safety Specifications was compiled in accordance with the Occupational Health & Safety Act, 85 of 1993 and Regulations as amended.

The Construction of the Backwash water Recovery Facility of the Bhobhoyi Waterworks

Site Establishment

- The Principal Contractor must use a suitable position within the construction zone to set up the site camp. The position must be approved by the client and the engineer.
- The site is currently fenced with a pre-cast palisade fence. The Principal Contractor may choose to fence off the site camp from the site using a Bonnox type fence with shade cloth.
- The entrance to the site camp must have a contractor's sign board displaying the PPE required on site as well as the hazards to be encountered while on site, i.e. "Caution: Deep Excavations", "Caution: Construction Vehicles & Mobile Plant", "Caution: Workmen Overhead", etc. The sign board must also include "No Unauthorised Entry", Visitors Report to Site Office" & "Danger – Construction Site".
- The Principal Contractor must notify the Department of Employment and Labour (DEL) of its intention to carry out construction work in the form of Annexure 2 of the Construction Regulations of 2014.
- The Principal Contractor must make provisions for the set-up of office containers, stores containers, clean drinking water, sufficient toilets for each gender, showers for each gender, changeroom facilities for each gender including lockable storage facilities for employees to store their belongings for safekeeping, sheltered eating areas, eye wash facility and fire-fighting equipment within the site camp.
- Where the Principal Contractor requires an electricity supply to the site camp, the electrical installation must be done by a registered electrical contractor / in house electrician who must issue a Certificate of Compliance (COC) in the form of Annexure 1 of the Electrical Installations Regulation of 2015, once the installation is completed.
- The site camp must be controlled by means of lockable gates as well as the placement of security personnel. The site camp must be locked and secured after hours. No fuel must be left unattended, fuel to be locked away in a suitable and well-ventilated flammable store.
- All persons entering the site must undergo a site-specific induction, including the client, professional team and other visitors to the site.
- All mobile plant which is parked at the site camp must have chock blocks placed in front of or behind their tyres and their blades, buckets and booms fully lowered when parked to prevent it from rolling.
- Drip trays must be placed under the engine compartment of each mobile plant to contain any oil or fuel spills.
- The Principal Contractor must ensure that sufficient bins are provided for the safe disposal of waste generated from the construction activities. All waste must be removed off site at least weekly and disposed of at a registered landfill site. Receipts must be obtained as proof of disposal.
- The Principal Contractor must compile a site-specific Traffic Management Plan (TMP) and submit it to the Client's Agent for approval. The TMP must outline the management of traffic approaching the site, construction vehicles & mobile plant entering & leaving the site and vehicles & plant driving on site. Once approved, the content of the Traffic Management Plan must be communicated to all site personnel.
- The Principal Contractor must ensure that the site camp complies with the local bylaws.

Surveying

- The surveying must be done by a suitably qualified surveyor who has at least a National Diploma in Civil Engineering and specializing in Surveying.
- The survey team must be inducted & trained on the company's policies, procedures and risk assessments prior to commencing with work on site.
- All hand tools used by the surveying team must be inspected prior to use and the results of such inspections recorded in a register provided for that purpose. The Surveyor must address all deviations without delay and remove all unsafe tools from service.
- The surveyors assistant must be issued with and instructed to wear suitable PPE which includes but not limited to reflective clothing, steel toe cap safety boots and gloves.

Proving & Relocation of Existing Services

- The Principal Contractor must obtain a copy of the updated services layout drawings from the local municipality which must be used as a guide for the proving of underground services.
- All identified services must be clearly identified and barricaded once located.
- Extreme care must be taken in order not to damage any of the existing services.
- The location and type of existing services must be communicated to all site personnel.
- The relocation of the services must be done by the local municipality or with instruction of the engineers by competent contractor or persons appointed by the Principal Contractor.

Clearing & Grubbing

- The Principal Contractor must obtain the updated services layout drawings from the local municipality which must be used as a guide for the proving of underground services before commencing with any activities on site.
- All proved services must be clearly identified and barricaded once located. Extreme care must be taken in order not to damage any of the existing services.
- The location and type of existing services must be communicated to all site personnel.
- The relocation of the services must be done by the local municipality or with instruction of the engineers by competent persons appointed by the Principal Contractor.
- All activities on site must be carried out under the supervision of competent Construction Supervisors.
- All construction vehicles and mobile plant must be operated by personnel who have been trained by accredited training service providers who are registered with the Department of Employment and Labour (DEL) and the relevant SETA.
- The Principal Contractor must ensure that dust is controlled on site, either by use of a water tanker or similar method of wetting down the loose material.
- The Principal Contractor must ensure that the clearing and grubbing is done in accordance with the client's specification.
- All material to be spoiled at a suitable spoil site. Topsoil to be stored on site for future use. The Principal Contractor must ensure that dust is kept to a minimum during the construction phase.
- All construction vehicles must be operated in accordance with Regulation 23 of the Construction Regulations of 2014.

Excavation Works

- The Principal Contractor must ensure that all excavation work is carried out under the supervision of a competent person who must be appointed in writing.
- All excavations must be suitably barricaded at the end of each shift or when excavations are not being worked in.
- All excavation work must be carried out in accordance with Regulation 13 of the Construction Regulations of 2014.
- The Principal Contractor must ensure that all work related to bulk earthworks is done in accordance with the engineer's specifications.
- In addition to this, the Principal Contractor must ensure that all Construction Vehicles & Mobile Plant operated on site to carry out work related to the access road, must comply with Regulation 23 of the Construction Regulations of 2014.
- Where small compaction plant is used for the compaction of foundations, the compaction equipment must be operated by employees who have attended trained on the safe use and Standard Operating Procedure (SOP) for the specified equipment, plant or tools.
- All equipment to be inspected by the authorised user prior to use.

Construction of Foundations and Floor Slabs

- All work relating to the construction of the foundations and floor slabs must be done in accordance with the designer's specifications.
- All concrete deliveries must be coordinated to avoid traffic congestion on site as well as obstruction of road traffic.
- All deliveries to be controlled by a staging clerk who must direct the concrete spinner trucks safely into position for discharging of concrete.
- All personnel carrying out of concrete work must be trained on the Method Statements, Risk Assessments and Safe Work Procedures for the activity
- All personnel operating the plant and equipment for concrete work must be trained on the Standard Operating Procedures for each piece of equipment that he / she is operating.
- All personnel carrying out of concrete work must be trained on the Material Safety Data Sheets (MSDS) for all Hazardous Chemical Substances (HCS) related to the concrete work.
- All personnel working with concrete must be issued with and instructed to wear steel toe capped gum boots and safety glasses in addition to the basic PPE while working.
- There needs to be an eye wash facility in close proximity to the employees for accidental splashes to the eye and clean water to wash up after working with concrete.
- The concrete spinner trucks must discharge their excess concrete in designated areas assigned by the Principal Contractor.
- Where small batches of concrete are mixed, this must be done on an impermeable surface and spills must be cleaned up as soon as reasonably practicable.
- Where a concrete mixer is used on site, the requirements of Regulation 20 of the Construction Regulations of 2014 and the relevant Regulations of the General Machinery Regulations of 1988,

must be complied with regards to a Bulk Mixing Plant and Supervision & Operation of machinery respectively.

Construction of Brickwork

- All brickwork must be carried out in accordance with the designer's specifications.
- All bricks stacked and stored on site must be carried out under the supervision of a competent stacking & storage supervisor.
- All stacks must be placed of firm level ground and not exceed a height of 3 x the base width.
- All cling plastic, straps, etc when opened from the bricks must be immediately disposed into the waste receptacles provided by the Principal Contractor on site.
- Mixing of Mortar must be done on an impermeable surface and spills must be cleaned up as soon as reasonably practicable.
- No work at heights must be carried out unless it is done safely from a safe platform or scaffold.
- Ladders should be used only to gain access and not used as a work platform. Only platform ladders are designed to be used as a safe work platform.
- Persons working at heights must undergo a Working at Heights evaluation during the medicals which will form part of the hazards listed in the Annexure 3.
- All persons working above 2 metres must wear and attach their safety harness to a suitable lifeline. All harnesses must be inspected by a competent person prior to each use.
- All persons working at heights must undergo Working at Heights Training by an accredited training service provider who is registered with the department of labour and the respective training authority. The accredited training service provider must also be registered with the Institute of Working at Heights (IWAH).
- Bricks must be passed hand to hand and not thrown to each other.
- Only up to 50 bricks may be stacked on the scaffold at any given time.

Installation of Windows and Door frames

- All Windows and Door frames must be installed in accordance with the designer's specifications.
- All tools and equipment used to install the Windows and Door frames must be inspected prior to each use.
- All employees carrying or installing Windows and Door frames must be issued with and instructed to wear suitable gloves.
- When lifting heavy items, get assistance from fellow employees and use correct lifting procedures, i.e. keep back straight and bend knees.
- All employees carrying or installing Windows and Door frames must beware of pinch points.
- Installations must be secured before removing props etc.

Electrical Installations

- All electrical installations to be carried out in accordance with the designer's specifications.
- All tools and equipment used for the electrical installations must be inspected prior to each use.

- All electrical installations to be carried out by qualified electricians who must issue a Certificate of Compliance in the form of Annexure 1 of the Electrical Installations Regulations, 2009.
- All live electrical cables to be isolated prior to installation.
- All loose wiring to be properly insulated and closed off before the installation is switched on.

Plumbing

- All plumbing to be carried out in accordance with the designer's specifications.
- All tools and equipment used for the plumbing must be inspected prior to each use.
- All excavation work to be carried out in accordance with Regulation 13 of the Construction Regulations of 2014.
- All plumbing to be carried out by qualified plumbers.
- All live water mains to be isolated prior to installation.
- All ends to be closed off before the installation is turned on.

Roof Work

- All roof work to be carried out in accordance with the designer's specifications.
- No work at heights must be carried out unless it is done safely from a safe platform or scaffold.
- Ladders should be used only to gain access and not used as a work platform. Only platform ladders are designed to be used as a safe work platform.
- Persons working at heights must undergo a Working at Heights evaluation during the medicals which will form part of the hazards listed in the Annexure 3.
- All persons working above 2 metres must wear and attach their safety harness to a suitable lifeline.
- All persons working at heights must undergo Working at Heights Training by an accredited training service provider who is registered with the department of labour and the respective training authority. The accredited training service provider must also be registered with the Institute of Working at Heights (IWAH).

Plastering

- Mixing of Mortar must be done on an impermeable surface and spills must be cleaned up as soon as reasonably practicable.
- No work at heights must be carried out unless it is done safely from a safe platform or scaffold.
- Ladders should be used only to gain access and not used as a work platform. Only platform ladders are designed to be used as a safe work platform.
- Persons working at heights must undergo a Working at Heights evaluation during the medicals which will form part of the hazards listed in the Annexure 3.
- All persons working above 2 metres must wear and attach their safety harness to a suitable lifeline. All harnesses must be inspected by a competent person prior to each use.
- All persons working at heights must undergo Working at Heights Training by an accredited training service provider who is registered with the department of labour and the respective

training authority. The accredited training service provider must also be registered with the Institute of Working at Heights (IWAH).

- Only up to one barrow load of mortar may be placed on the scaffold at any given time. This must not be placed directly on the scaffold hook on boards but on shutter boards placed on the scaffold hook on boards.
- No work must be carried out on scaffolding during inclement weather such as strong winds exceeding 45 Kmph or rain.

Installation of Ceilings & Partitions

- All Ceilings & Partitions to be installed in accordance with the designer's specifications.
- All tools and equipment used to install the Ceilings & Partitions must be inspected prior to each use.
- No work at heights must be carried out unless it is done safely from a safe platform or scaffold.
- Ladders should be used only to gain access and not used as a work platform. Only platform ladders are designed to be used as a safe work platform.
- Persons working at heights must undergo a Working at Heights evaluation during the medicals which will form part of the hazards listed in the Annexure 3.
- All persons working above 2 metres must wear and attach their safety harness to a suitable lifeline.
- All persons working at heights must undergo Working at Heights Training by an accredited training service provider who is registered with the department of labour and the respective training authority. The accredited training service provider must also be registered with the Institute of Working at Heights (IWAH).

Tiling

- All tiling must be carried out in accordance with the designer's specifications.
- All tools and equipment for the tiling must be inspected prior to each use.
- All employees carrying doing tiling must be issued with and instructed to wear suitable gloves.
- When lifting heavy items, get assistance from fellow employees and use correct lifting procedures, i.e. keep back straight and bend knees.
- All employees carrying or installing tiles must beware of pinch points.
- Installations must be allowed at least 24 hours before removing spacers, supports, etc.

Fitting of doors

- All Doors must be installed in accordance with the designer's specifications.
- All tools and equipment used to install the Doors must be inspected prior to each use.
- All employees carrying or installing Doors must be issued with and instructed to wear suitable gloves.
- When lifting heavy items, get assistance from fellow employees and use correct lifting procedures, i.e. keep back straight and bend knees.

- All employees carrying or installing Doors must beware of pinch points.
- Installations must be secured with hinges before removing props etc.

RISK ASSESSMENT

Before commencement of any construction work during the construction period, The Principal Contractor must have a risk assessment performed and recorded in writing by a competent person. (Refer Regulation 9 of the Construction Regulations 2014).

The risk assessment must identify and evaluate the risks and hazards that may be expected during the execution of the work under the contract, and it must include a documented plan of safe work procedures to mitigate, reduce or control the risks and hazards identified and must include a monitoring and review plan.

The risk assessment must be available on site for inspection by inspectors, Employer, Engineer, contractors, employees, trade unions and health and safety committee members, and must be monitored and reviewed periodically by The Principal Contractor.

The following are possible risks associated with this project:

- Working in elevated positions, most of the time in a restricted environment with limited landings (working platforms);
- Risk of falling objects;
- Traffic (Public and Construction Vehicles)
- Lifting and lowering of materials and equipment from the ground;
- Steep and restricted access into deep excavations;
- Potentially dangerous existing services, i.e. gas lines, water and sewerage mains, electrical high voltage cables buried and overhead
- Deep excavations in soils requiring shoring or reducing of slopes
- Movement of construction vehicles on site, taking into consideration steep slopes, other traffic and existing services
- Exposure to possible injuries due to mishandling or failure of power and hand tools
- Falling debris, tools and materials from structures
- Risks related to general safety and security on site

Additional risks may arise from specific methods of construction selected by The Principal Contractor which are not necessary covered in the above.

APPOINTMENT OF EMPLOYEES AND CONTRACTORS

Health and Safety plan

The Construction of the Backwash water Recovery Facility of the Bhobhoyi Waterworks

The Principal Contractor must appoint his employees and any contractors to be employed on the contract, in writing, and he must provide them with a copy of his documented Health and Safety Plan, or relevant sections thereof. The Principal Contractor must ensure that all contractors and employees are committed to the implementation of his Safety Plan.

Health and safety induction training

The Principal Contractor must ensure that all employees under his control, including contractors and their employees, undergo a health and safety induction training course by a competent person before commencement of construction work. No visitor or other person shall be allowed or permitted to enter the site of the works unless such person has undergone health and safety training pertaining to hazards prevalent on site.

The Principal Contractor must ensure that every employee on site is in possession of proof of the health and safety induction training issued by a competent person prior to commencement of construction work.

APPOINTMENT OF SAFETY PERSONNEL

Construction Managers and Supervisors

Construction Manager and Alternate Manager – CR 8 (1)

The Principal Contractor must in writing appoint one full-time competent person as the construction manager with the duty of managing all the construction work on a single site, including the duty of ensuring occupational health and safety compliance, and in the absence of the construction manager an alternate must be appointed in terms of Regulation 8 (1). The alternate construction manager must have similar or higher qualifications and experience as that of the appointed Construction Manager. The construction manager cannot manage any other site other than the single site for which he has been appointed. The construction manager must have at least a national diploma in civil engineering with post graduate work experience of five years in the Civil Engineering field.

Assistant Construction Manager(s) – CR 8 (2)

The Principal Contractor must in writing appoint one or more assistant construction managers for different sections thereof in terms of Regulation 8 (2): Provided that the designation of any such person does not relieve the construction manager of any personal accountability for failing in his or her management duties. The assistant construction manager cannot manage any other site other than the single site for which he has been appointed. The construction manager must have at least a national diploma in civil engineering.

Construction Supervisor(s) – CR 8 (7)

The Principal Contractor must in writing appoint construction supervisors responsible for construction activities and ensuring occupational health and safety compliance on the construction site in terms of

Regulation 8 (7). The construction supervisor cannot supervise any other site other than the single site for which he has been appointed. The construction supervisor must have at least five years' experience supervising construction activities on site.

Assistant Construction Supervisor(s) – CR 8 (8)

The Principal Contractor must in writing appoint one or more competent employees for different sections thereof to assist the construction supervisor contemplated in subregulation (7), and every such employee has, to the extent clearly defined by The Principal Contractor in the letter of appointment, the same duties as the construction supervisor in terms of Regulation 8 (8): Provided that the designation of any such employee does not relieve the construction supervisor of any personal accountability for failing in his or her supervisory duties. The assistant construction supervisor cannot supervise any other site other than the single site for which he has been appointed. The assistant construction supervisor must have at least two years' work experience in his specific task in order to supervise employees.

Construction health & safety officer

Due to the nature of the work, the degree of danger likely to be encountered and the accumulation of hazards or risk on the site, the Principal Contractor must in writing appoint one full time Construction Health & Safety Officer to assist in the control of all health and safety related aspects on the site, in terms of Regulation 8 (5). The Construction Health & Safety Officer must be registered and in good standing with the South African Council for the Project & Construction Management Professions (SACPCMP). Each contractor must appoint his / her Construction Health & Safety Officer who is registered and in good standing with the SACPCMP. The Principal Contractors' Construction Health & Safety Officer must conduct at least a weekly site visit and submit weekly reports on the findings on the construction site. The Principal Contractor may appoint a consultant to oversee the health and safety on site who must perform the same duties as a part time Construction Health & Safety Officer.

Provision must be made by The Principal Contractor in his rates, to cover the cost of this dedicated construction health & safety officer appointed after the award of the contract.

Health and safety representatives

In terms of **Section 17 and 18 of the Act (OHSA 1993)** The Principal Contractor, being the employer in terms of the Act for the execution of the contract, must appoint a **health and safety representative** in his employment on the site of the works. The health and safety representative must be selected from employees who are employed in a full-time capacity at a specific workplace.

The number of health and safety representatives for a workplace shall be at least one for every 50 employees.

The function of health and safety representative(s) will be to review the effectiveness of health

and safety measures, to identify potential hazards and major incidents, to examine causes of incidents (in collaboration with his employer, The Principal Contractor), to investigate complaints by employees relating to health and safety at work, to make representations to the employer (Contractor) or inspector on general matters affecting the health and safety of employees, to inspect the workplace, plant, machinery etc. on a regular base, to participate in consultations with inspectors and to attend meetings of the health and safety committee.

Health and safety committee

In terms of Sections 19 & 20 of the Act (OHSA 1993) The Principal Contractor (as employer), shall establish one or more health and safety committee(s) where there are two or more health and safety representatives at a workplace. The persons selected by The Principal Contractor to serve on the committee shall be designated in writing.

The function of the health and safety committee shall be to hold meetings at regular internals, but at least once every three months, to review the health and safety measures on the contract, to discuss incidents related to health and safety with The Principal Contractor and the inspector, and to make recommendations regarding health and safety to The Principal Contractor and to keep record of recommendations and reports made by the committee.

Competent persons

In accordance with the Construction Regulations The Principal Contractor must appoint in writing **competent persons** responsible for each of the following work situations that may be expected on the site of the works.

(a) Risk assessments as described in Regulation 9;
(b) Fall protection as described in Regulation 10;
(c) Structures as described in Regulation 11;
(d) Temporary Works as described in Regulation 12;
(e) Excavation work as described in Regulation 13;
(f) Demolition work as described in Regulation 14;
(g) Tunneling as described in Regulation 15;
(h) Scaffolding work as described in Regulation 16;
(i) Suspended platform operations as described in Regulation 17;
(j) Rope Access as described in Regulation 18;
(k) Material hoists as described in Regulation 19;
(l) Batch plant operations as described in Regulation 20;
(m) Explosive powered tools as described in Regulation 21;
(n) Cranes as described in Regulation 22;
(o) Construction vehicle and mobile plant as described in Regulation 23;
(p) Temporary electrical installations and machinery on construction sites as described in Regulation 24;
(q) Use & temporary storage of flammable liquids on construction sites as described in Regulation 25;

(r) Water Environments as described in Regulation 26;
(s) Housekeeping & general safeguarding on construction sites described in Regulation 26;
(t) Stacking and storage on construction sites as described in Regulation 28;
(u) Fire precautions on construction sites as described in Regulation 29; and
(v) Construction employees' facilities as described in Regulation 30.

A competent person may be appointed for more than one part of the construction work with the understanding that the person must be suitably qualified and able to supervise at the same time the construction work on all the work situations for which he has been appointed.

The appointment of competent persons to supervise parts of the construction work does not relieve The Principal Contractor from any of his responsibilities to comply with **all** requirements of the Construction Regulations.

RECORDS AND REGISTERS

In accordance with the Construction Regulations The Principal Contractor is bound to keep records and registers related to health and safety on site for periodic inspection by inspectors, the Engineer, the Employer, trade union officials and contractors and employees. The following records and registers must be kept on site and shall be available for inspection at all times.

(q) A copy of the OHSA 1993 Construction Regulations 2014;
(r) A copy of this Health and Safety Specification;
(s) A copy of The Principal Contractor's Health and Safety Plan (Regulation 7);
(t) A copy of the Notification of Construction Work (Regulation 4);
(u) A health and safety file in terms of Regulation 7(1) (b) with inputs by the Construction Health & Safety Officer - Regulation 8 (5&6);
(v) A copy of the risk assessment described in Regulation 9;
(w) A fall protection plan and the corresponding records of evaluation and training of employees working from elevated positions as described in Regulation 10 and Regulation 18 (2) (b);
(x) Drawings pertaining to the design of structures (Regulation 11 (1) (c)) and Temporary works (Regulation 12 (3) (c)) must be kept on site;
(y) Pronouncement of the safety of excavations must be recorded in a register to be kept on site (Regulation 13(2)(h));
(z) A copy of the certificate of the system design for suspended platforms (Regulation 17(3));
(aa) A notice must be affixed around the base towers of material hoists to indicate the maximum mass load, which may be carried at any one time by material hoists (Regulation 19 (5));
(bb) Maintenance records of material hoists and inspection results must be kept in a record book to be kept on site (Regulation 19 (8));
(cc) A record of any repairs to or maintenance of a batch plant must be kept on site (Regulations 20 (8));
(dd) A warning notice must be displayed in a conspicuous manner when and wherever an

explosive powered tool is used (Regulation 21 (2));

(ee) A register for recording of findings by the competent person appointed to inspect construction vehicles and mobile plant (Regulation 23(1)(k)).

CONTRACTORS RESPONSIBILITIES

For this contract The Principal Contractor will be the mandatory of the Employer (Client), as defined in the Act (OHSA 1993), which means that The Principal Contractor has the status of employer in his own right in respect of the contract. The Principal Contractor is therefore responsible for all the duties and obligations of an employer as set out in the Act (OHSA 1993) and Regulations.

Before commencement of work under the contract, The Principal Contractor shall enter into an agreement with the Employer (Client) to confirm his status as mandatory (employer) for the contract under consideration.

1. Occupational Health & Safety Act, 85 of 1993

(a) Section 7 – Health & Safety Policy

The Principal Contractor must prepare a written policy concerning the protection of the Health & Safety of his employees at work, including the description of his organisation and the arrangements for carrying out and reviewing that policy. This policy must be signed by the Principal Contractor's CEO and prominently displayed at the site camp where it will be accessible to all employees. This policy must be communicated to all his employees during the start up of a project and whenever the policy is amended.

(b) Section 16 – CEO & Contracts Manager

The CEO will accept responsibility for health & safety in the organization in terms of Section 16 (1). The appointment of the CEO must be done in writing and may include a board resolution. Where the CEO cannot directly oversee the project, he / she may appoint a Contracts Manager to accept responsibility for health & safety on all sites allocated to him or her in terms of Section 16 (2).

(c) Section 17 – Safety, Health & Environmental (SHE) Representatives

A SHE representative must be nominated by the Principal Contractor's employees and appointed in writing, (1 SHE representative for every 50 employees or part thereof) in terms of Section 17 (1). The SHE representative must attend formal training conducted by an accredited training service provider who is registered with the Department of Labour and the respective training authority. The SHE representative must be a full-time employee and must be familiar with the Principal Contractor's scope of work. The SHE representative must not be in any supervisory or management position. The SHE

representative must carry out regular inspections on site while performing normal duties at work. The SHE representative must participate in incident investigations, enquiries and will form part of the health & safety committee.

(d) Section 19 – Health & Safety Committees

The Principal Contractor must appoint a management representative in writing as a SHE committee member to attend health & safety committee meetings in terms of Section 19 (3). Where there are more than one SHE representatives, the Principal Contractor shall hold at least monthly SHE committee meetings. The number of management representatives shall not exceed that of the number of SHE representatives.

(e) Section 24 – Report to Inspector Regarding Certain Incidents

The Principal Contractor must report all incidents immediately, in relation to Section 24 of the Occupational Health & Safety Act, 85 of 1993, to the provisional director, Client and its agent:

(f) Section 37 – Acts or omissions by employees or mandataries

The client must engage in a mandatary agreement with the Principal Contractor to ensure that all aspects of health & safety are included within the Principal Contractor's scope of work and the agreement relieves the employer of any civil liability whenever an employee does or omits to do any act which it would be an offence in terms of this Act for the employer of such employee. This agreement shall be in writing and signed by both parties in terms of Section 37 (2). Where the Principal Contractor appointments contractors, there needs to be an agreement as The Principal Contractor is an employer in his own right.

2. General Administrative Regulations, 2003

a) Regulation 4 – Copy of the Act

The Principal Contractor must have a copy of the latest version of the Occupational Health & Safety Act, 85 of 1993 and Regulations, readily available at the site office for use by the Principal Contractor, employees, employer and inspectors.
In addition to the above, the Principal Contractor must prominently display size A1 laminated posters of the following Acts in the workplace:

- Occupational Health & Safety Act, 85 of 1993;
- Employment Equity Act, 55 of 1998, and
- Basic Conditions of Employment Act, 75 of 1997.

b) Regulation 9 – Recording & Investigation of Incidents

The Principal Contractor must appoint a competent person in writing as the accident and incident investigator to investigate all incidents on site. The reporting of incidents must be done in the form of WCL 1 (Diseases) / WCL 2 (Injuries) and investigated and recorded in the form of Annexure 1. The incidents must be investigated within 7 days by the appointed competent person with the assistance of the health & safety committee.

3. General Safety Regulations, 2003

a. Regulation 2 – Personal Safety Equipment & Facilities

The Principal Contractor must supply, free of charge, sufficient and suitable PPE to his employees for them to carry out their work safely. The Principal Contractor must demonstrate to the employee the safe use, care and limitations of such PPE. The employee must sign the PPE issue register for any PPE which was issued to him or her. The Principal Contractor must ensure that every reasonable effort has been taken to reduce if not eliminate the health & safety risk to his employees. PPE must and will always be the last resort.

b. Regulation 2 A – Intoxication

The Principal Contractor must ensure that no employee enters or remains in the workplace if he or she is under the influence of or in possession of intoxicating substances (Alcohol & Drugs). The Principal Contractor shall conduct random drug & alcohol tests to ensure that substance abuse is closely monitored in the workplace. Disciplinary action must be taken to employees who are found to guilty of misconduct.

c. Regulation 2 B – Substituted Notices & Signs

The Principal Contractor must display substituted notices and signs around the site which must be clearly visible and comply with the local bylaws. The Signage must include but not limited to the mandatory PPE requirements, First-Aid, Fire Equipment, Excavation Work, Hazardous Substances, Construction Activities and Public Notices.

d. Regulation 2 C – Admittance of Persons

The Principal Contractor must ensure that no unauthorized persons enter or remains in the work area. The Principal Contractor must strategically erect signage at the entrance to the site prohibiting entry. Where the site is on a public space, the Principal Contractor must ensure that adequate measures are in place to prevent unauthorized entry. The following information should also be included:

"No Unauthorized Entry"

"Visitors Report to Site Office"

"Construction Site" & indicate the specific hazards associated with the site.

"Induction to be Obtained Prior to Entry to the Site"

e. Regulation 3 – First Aid, Emergency Equipment and Procedures

The Principal Contractor must ensure that he / she has a fully stocked first aid kit on site. The first aid kit must contain the minimum contents as per the Annexure contained in this regulation. The Principal Contractor must appoint a trained & competent person as the first aider to attend to all injuries on site and to control the first-aid kit. The training of the first aider must be done by an accredited training provider who is registered with the department of labour and the respective training authority. The Principal Contractor must display the first aid signs at strategic points on the site to indicate the location as well as the name of the person in charge of the first aid kit.

f. Regulation 4 – Use & Storage of Flammable Liquids

The Principal Contractor must store all flammable liquids in a well-0ventilated store which is designed for this purpose. The store must be bunded and be able to contain 110% of the volume of the flammable liquids stored. The flammable liquids must not be stored with combustible material. The store must be clearly marked as to the content and approximate quantity of flammable liquids that are stored. The following signage (290 x 290 mm) must also be displayed at the entrance to the store:
"No Smoking"
"No Open Flames"
"Hazardous Chemicals"
"Flammable Store"

g. Regulation 6 – Work in Elevated Positions

No work at heights must be carried out unless it is done safely from a safe platform or scaffold. Ladders should be used only to gain access and not used as a work platform. Only platform ladders are designed to be used as a safe work platform. Persons working at heights must undergo a Working at Heights evaluation during the medicals which will form part of the hazards listed in the Annexure 3. All persons working above 2 metres must wear and attach a safety harness to a suitable lifeline. All persons working at heights must undergo Working at Heights Training by an accredited training service provider who is registered with the department of labour and the respective training authority. The accredited training service provider must also be registered with the Institute of Working at Heights (IWAH).

h. Regulation 8 – Stacking of Articles

The Principal Contractor must appoint a competent person in writing in accordance with Regulation 8 (1) (a) and to supervise the stacking of articles on site. All stacking and storage must be done safely, and stacks must not exceed three times the base width. Stacks must be wider or at the same size at the bottom than at the top. All storage areas must be adequately cordoned off.

i. Regulation 13 A – Ladders

The Principal Contractor must appoint a suitable person in writing to inspect the ladders on a regular basis. The Principal Contractor must ensure that every ladder is constructed of sound material and is suitable for the purpose for which it is used. Ladders should be used only to gain access and not as a work platform. Only platform ladders are designed to be used as a safe work platform. Ladders must not be painted as the paint may hide any cracks on the ladder. If the ladder is constructed from timber, the timber must be free from Knots and the rungs must be let into the styles.
The Principal Contractor's duties and responsibilities are clearly set out in the Construction Regulations, 2014 and are not repeated in detail but some important aspects are highlighted hereafter, without relieving The Principal Contractor of any of his duties and responsibilities in terms of the Construction Regulations, 2014.

4. Construction Regulations, 2014

a) Regulation 3 – Application for the Construction Work Permit

Where the project value is over R 60 000 000-00 or the duration of the project exceeds 12 months, then the client shall appoint an agent on its behalf to apply to the provincial director of the department of labour for a construction work permit. The permit application process takes up to 30 days and the Principal Contractor may only commence work once the construction work permit is received.

b) Regulation 4 – Notification of Construction Work

The Principal Contractor must, prior to commencing with any work, notify the provincial director of the department of labour, at least 7 days before, in the form of Annexure 2 of its intention to commence with construction work. If the client does an application for a construction work permit, the notification is not required.

c) Regulation 5 – Duties of Client

The Client will –

(g) ensure that potential principal contractors submitting tenders have made adequate provision for the cost of health and safety measures;
(h) ensure that the principal contractor to be appointed has the necessary competencies and resources to carry out the construction work safely;
(i) take reasonable steps to ensure co-operation between all contractors appointed by the client to enable each of those contractors to comply with these Regulations;
(j) ensure before any work commences on a site that every principal contractor is registered and in good standing with the compensation fund or with a licensed compensation insurer as contemplated in the Compensation for Occupational Injuries and Diseases Act, 1993 (Act No. 130 of 1993);
(k) appoint every principal contractor in writing for the project or part thereof on the construction site;
(/) discuss and negotiate with the principal contractor the contents of the principal contractor's health and safety plan contemplated in regulation 7(1), and must thereafter finally approve that plan for implementation;
(m) ensure that a copy of the principal contractor's health and safety plan is available on request to an employee, inspector or contractor;
(n) take reasonable steps to ensure that each contractor's health and safety plan contemplated in regulation 7(1)(a) is implemented and maintained;
(o) ensure that periodic health and safety audits and document verification are conducted at intervals mutually agreed upon between the principal contractor and any contractor, but at least once every 30 days;
(p) ensure that a copy of the health and safety audit report contemplated in paragraph
(o) is provided to the principal contractor within seven days after the audit;
(q) stop any contractor from executing a construction activity which poses a threat to the health and safety of persons which is not in accordance with the client's health and safety specifications and the principal contractor's health and safety plan for the site;
(r) where changes are brought about to the design or construction work, make sufficient health and safety information and appropriate resources available to the principal contractor to execute the work safely; and
(s) ensure that the health and safety file contemplated in regulation 7(1)(b) is kept and maintained by the principal contractor.

In accordance with Regulations, The Principal Contractor shall liaise closely with the Employer or the Engineer on behalf of the Employer, to ensure that all requirements of the Act and the Regulations are met and complied with.

d) Regulation 7 – Duties of the Principal Contractor & Contractor

The Principal Contractor must provide and demonstrate to the client a suitable, sufficiently documented and coherent site-specific health and safety plan, based on the client's documented health and safety specifications. The plan must be submitted to the client / client’s agent for approval. The approved plan will be submitted together with the application for the Construction Work Permit. Work may only commence once the plan has been approved. This plan must be applied, reviewed and updated as the work progresses.

Health & Safety Specifications

The Principal Contractor must provide a comprehensive health and safety file for review to the client / client's agent. The health and safety file will be audited by the client / client's agent prior to commencement with work on site. Once the file has been reviewed, the Principal contractor must address all outstanding items prior to commencement with work. The Principal contractor may only commence work if the outstanding items have been addressed. This health & safety file must be updated by the Principal contractor and must remain on site at all times. On completion of the project, The Principal Contractor must consolidate the health & safety file including that of The Principal Contractors and submit it to the client / client's agent.

The Principal Contractor must provide potential contractors, who are tendering for any work to be performed on site (including that of the plant hire companies and other service providers), with the relevant sections of the client's health & safety specifications.
The Principal Contractor must ensure that The Principal Contractors have the necessary competencies, resources and made adequate provision to carry the work out safely.

The Principal Contractor and contractors must enter into a health & safety agreement in terms of Section 37 (2) of the OHS Act and the Principal Contractor must appoint each contractor in writing for part of the project in terms of Regulation 7 (1) (c) (v) of the Construction Regulations, 2014. The Principal Contractor must have a comprehensive and updated list of all his contractors on site.

The Principal Contractor must ensure that The Principal Contractors are in Good Standing with the Compensation Commissioner in terms Section 89 of the COID Act, 130 of 1993.

The Principal Contractor must audit The Principal Contractors at least monthly. The Principal Contractors must submit a close out report with supporting documents, within 7 days of the audit, for addressing outstanding items.

The Principal Contractor must ensure that where changes are brought about sufficient health & safety information, including the necessary resources to carry out the work safely, is provided to The Principal Contractor.

The Principal Contractor must provide and demonstrate to the Principal Contractor a suitable, sufficiently documented and coherent site-specific health and safety plan, based on the client's documented health and safety specifications. The plan must be submitted to the Principal Contractor for approval. Work may only commence once the plan has been approved by the Principal Contractor. This plan must be applied, reviewed and updated as the work progresses.

The Principal Contractor must provide a comprehensive health and safety file for review to the Principal Contractor. The file will be audited by the Principal Contractor prior to commencement with work on site. Once the file has been reviewed, The Principal Contractor must address all outstanding items prior to commencement with work. The Principal Contractor may only commence work if the outstanding items have been addressed. This health & safety file must be updated by The Principal Contractor and must remain on site at all times. On completion of the project, The Principal Contractor

must consolidate the health and safety file including that of his or her contractors and submit it to the Principal Contractor.

The Principal Contractor must ensure that all his employees, including that of his / her contractors, have a medical certificate of fitness, for the type of work to be performed, issued by an Occupational Health Practitioner in the form of Annexure 3 and must include a general examination with the following tests, Blood Pressure, Snellen's Vision (20/20 Test), Spirometry (Lung Function) and Audiometry (Hearing Test). The copies of the employees medicals must only consist the Annexure 3 documents as the test results are confidential and shall not be disclosed to other employees. If employees are working at heights, then a 'Working at Heights" evaluation must be done.

The Principal Contractor must ensure that all his employees, including that of his / her contractors, have undergone induction training pertaining to the hazards prevalent to the site at the time of entry. The induction must be conducted by the Principal Contractor's appointed Construction Health & Safety Officer, prior to the employee entering the site.

The Principal Contractor must ensure that all visitors undergo an induction pertaining to the hazards prevalent to the site and that such visitors have the necessary PPE prior to entering the site. The PPE must include but not limited to: Hard Hats, Reflective Vests and Steel Toe Capped or similar approved Safety Boots.

e) Regulation 8 – Management & Supervision of Construction Work

The Principal Contractor must in writing appoint one full-time competent person as the construction manager with the duty of managing all the construction work on a single site, including the duty of ensuring occupational health and safety compliance, and in the absence of the construction manager an alternate must be appointed in terms of Regulation 8 (1). The construction manager cannot manage any other site other than the single site for which he has been appointed. The construction manager must have at least a national diploma in civil engineering with a post graduate experience of five years.

The Principal Contractor must in writing appoint one or more assistant construction managers for different sections thereof in terms of Regulation 8 (2): Provided that the designation of any such person does not relieve the construction manager of any personal accountability for failing in his or her management duties. The assistant construction manager cannot manage any other site other than the single site for which he has been appointed. The construction manager must have at least a national diploma in civil engineering.

Due to the nature of the work, the degree of danger likely to be encountered and the accumulation of hazards or risk on the site, the Principal Contractor must in writing appoint one full time Construction Health & Safety Officer to assist in the control of all health and safety related aspects on the site, in terms of Regulation 8 (5). The Construction Health & Safety Officer must be registered and in good standing with the South African Council for the Project & Construction Management Professions (SACPCMP). Each contractor must appoint his / her Construction Health & Safety Officer who is

registered and in good standing with the SACPCMP. The Principal Contractors' Construction Health & Safety Officer must conduct at least a weekly site visit and submit weekly reports on the findings on the construction site. The Principal Contractor may appoint a consultant to oversee the health and safety on site who must perform the same duties as a part time Construction Health & Safety Officer.

The Principal Contractor must in writing appoint construction supervisors responsible for construction activities and ensuring occupational health and safety compliance on the construction site in terms of Regulation 8 (7). The construction supervisor cannot supervise any other site other than the single site for which he has been appointed. The construction supervisor must have at least five years' experience supervising construction activities on site.

The Principal Contractor must in writing appoint one or more competent employees for different sections thereof to assist the construction supervisor contemplated in subregulation (7), and every such employee has, to the extent clearly defined by The Principal Contractor in the letter of appointment, the same duties as the construction supervisor in terms of Regulation 8 (8): Provided that the designation of any such employee does not relieve the construction supervisor of any personal accountability for failing in his or her supervisory duties. The assistant construction supervisor cannot supervise any other site other than the single site for which he has been appointed. The assistant construction supervisor must have at least two years' work experience in his specific task in order to supervise employees.

f) Regulation 9 – Risk Assessment for Construction Work

The Principal Contractor must in writing appoint a competent person as a Risk Assessor to draw up risk assessments for the project in terms of Regulation 9 (1). The Risk Assessor must be trained on Hazard Identification & Risk Assessment (HIRA) by an accredited training service provider who is registered with the department of labour and the respective training authority on the SAQA Unit Standard 244383 – Conduct continuous hazard identification and risk assessment within a workplace.

The Risk Assessment must cover all activities performed by the Principal Contractor in site and must be based on the method statements. The Risk Assessments must contain a Risk Matrix, a Monitoring Plan and a Review Plan. The Risk Assessments must include control measures and safe work procedures to reduce if not eliminate the risk or hazard.

The Risk Assessments should be reviewed at least annually, when an incident has occurred, when there is a change in the scope of work or when there is a change in the design which may affect the health & safety of persons.

The Risk Assessments must be communicated to all site personnel involved with the activities for which the Risk Assessment has been done.
All Risk Assessments must be carried out in accordance with Regulation 9 of the Construction Regulations, 2014.

g) Regulation 10 – Fall Protection

The Principal Contractor must in writing appoint a competent person as the Fall Protection Plan Developer when work must be carried out at an elevated position. The Fall Protection Plan Developer must be trained by an accredited training service provider who is registered with the department of labour and the respective training authority. The Training must cover both SAQA Unit Standards 229994 and 229998. The accredited training service provider must also be registered with the Institute for Working at Heights (IWAH).

The Principal Contractor must in writing appoint a competent person as the safety harness inspector to inspect all safety harnesses. The Safety Harness inspector must at least be trained on Unit Standard

The Principal Contractor must draw up, implement, maintain and amend where necessary, a Fall Protection Plan for all work to be carried out at an elevated position.

The Fall Protection plan must include:

- A risk assessment for work at a fall risk position and the methods and procedures to address such risk;
- A process to evaluate the medical fitness of employees who work at a fall risk position;
- A programme for the training of employees working from a fall risk position and the records thereof;
- the procedure addressing the inspection, testing and maintenance of all fall protection equipment; and
- a rescue plan detailing the necessary procedure, personnel and suitable equipment required to affect a rescue of a person in the event of a fall incident to ensure that the rescue procedure is implemented immediately following the incident.

The Principal Contractor must ensure that the construction manager appointed under regulation 8(1) is in possession of the most recently updated version of the fall protection plan.

All work carried out at a fall risk position must comply with Regulation 10 of the Construction Regulations, 2014.

h) Regulation 11 – Structures

The Principal Contractor must ensure where there are new or existing structures within the work zone, Regulation 11 of the Construction Regulations of 2014, must be complied with.

i) Regulation 12 – Temporary Works

The Principal Contractor must appoint a temporary works designer in writing to design, inspect and approve the erected temporary works on site before use. The designer must have at least a National Diploma in Structural Engineering and be registered as a professional engineer with the Engineering Council of South Africa (ECSA). The designer & inspector must be trained on the following Unit

Standards:
113974 – Understand and apply structural construction methods; and
263246 – Inspect falsework and formwork.

The Principal Contractor must ensure that all temporary works operations are carried out under the supervision of a competent person who has been appointed in writing for that purpose. The temporary works supervisor must be trained by the temporary works supplier / manufacturer on the safe installation of the temporary works as well as on the Unit Standard 263027 - Supervise the erection and dismantling of falsework and formwork.

The temporary works erectors must be trained by the temporary works supplier / manufacturer on the safe installation of the temporary works as well as in the Unit Standard 263204 - Erect, use and dismantle falsework and formwork.

All temporary works must comply with Regulation 12 of the Construction Regulations, 2014

j) Regulation 13 – Excavation Work

The Principal Contractor must in writing appoint a competent person as the excavation work supervisor. The excavation work supervisor must be trained by an accredited training service provider who is registered with the department of labour and the respective training authority on the Unit Standard 365183 - Implement safety procedures for open hole or deep excavations.

All excavation work must be carried out under the constant supervision of the appointed excavation work supervisor. The excavation work supervisor must be able to evaluate the stability of the ground before excavation work begins. The excavation work supervisor must inspect the excavation prior to entry of any employees. All excavations deeper than 1,2 metres must be shaped to the maximum angle of repose relative to the horizontal plane. The Principal Contractor and his contractors must make provision in their tender rates for the shaping of the excavations.

All excavations up to 2 metres must be barricaded at least 1 metre away from the edge with barrier netting at a minimum height of 900mm. No danger tape to be used for barricading. All excavations deeper than 2 metres must be barricaded with a barrier in the form of hand and intermediate rails with barrier netting attached to it or Bonnox type fencing on posts with the barrier netting attached to it. Excavations along public roads that are deeper than 1,2 metres must be barricaded by means of a solid concrete barrier with delineators. Excavations along public roads that are less than 1,2 metres but deeper than 0,5 metres must be barricaded by means of a plastic new jersey barrier with delineators. Excavations along public roads that are less than 0,5 metres but above 100 millimetres must be barricaded by means of a barrier netting with delineators. Excavations along public roads that are less than 150 millimetres must be cordoned off by means of delineators.

All excavations deeper than 1,2 metres must be accessed by means of a ladder which is placed within 6 metres of the employees working inside and must extend at least 900mm above the top of the landing or natural ground level.

All excavated material must be placed at least 1 metre away from the edge of the excavation. No mobile plant must come within 1 metre from the top edge of the excavation or within 2 metres when employees are working inside.

All employees working in excavations deeper than 1,2 metres must wear hard hats.

All excavation work must comply with Regulation 13 of the Construction Regulations, 2014.

k) Regulation 14 – Demolition Work

The Principal Contractor must appoint a competent person in writing to supervise and control all demolition work on site. The demolition work supervisor must have at least five years' experience in demolition work and must be trained on Unit Standard 115457 – Conduct basic demolition tasks.

All demolition work must comply with Regulation 14 of the Construction Regulations, 2014.

l) Regulation 16 – Scaffolding

The Principal Contractor must appoint a competent person in writing as the scaffolding supervisor who must ensure that all scaffolding work operations are carried out under his or her constant supervision. The scaffolding work supervisor must be trained on the Unit Standard 263224 - Supervise the erection and dismantling of access scaffolding, by an accredited training service provider who is registered with the department of labour and the respective training authority.

The Principal Contractor must appoint competent persons in writing as scaffold erectors for erecting the scaffold. The scaffolding work erectors must be trained on the Unit Standard 263245 – Erect, use and dismantle access scaffolding, by an accredited training service provider who is registered with the department of labour and the respective training authority.

The Principal Contractor must appoint a competent person in writing as an inspector to inspect the scaffolding once erected. The scaffolding work inspector must be trained on the Unit Standard 263205 Inspect access scaffolding, by an accredited training service provider who is registered with the department of labour and the respective training authority.

All scaffold must comply with SANS 10085 with regards to the design, erection, use and inspection of access scaffolding.

m) Regulation 23 – Construction vehicles and mobile plant

The Principal Contractor must appoint a competent person in writing as a Construction Vehicles and Mobile Plant Supervisor to ensure that the said regulations are complied with.

The Principal Contractor must ensure that all construction vehicles and mobile plant-

(a) are of an acceptable design and construction;
(b) are maintained in a good working order;
(c) are used in accordance with their design and the intention for which they were designed, having due regard to safety and health;
(d) are operated by a person who-

(i) has received appropriate training, is certified competent and in possession of proof of competency and is authorized in writing to operate those construction vehicles and mobile plant;

The following Unit Standards must be considered with regards to training.

Rigid Body Dump Truck Operator	262731	Operate a rigid body dump truck
Articulated Dump Truck Operator	262745	Operate an articulated dump truck
Front End Loader Operator	262747	Operate front end loader.
Grader Operator	262735	Operate a grader.
Tracked Dozer Operator	262729	Operate a tracked dozer.
Tractor Loader Backhoe Operator	257028	Operate a Tractor Loader Backhoe.
Skidsteer (Bobcat) Operator	262712	Operate a Skidsteer.
Tractor Operator	262804	Operate a tractor.
Excavator Operator	262744	Operate an excavator
Water Cart Operator	262764	Operate a water cart.
Roller Operator	262805	Operate a roller.
Tipper Truck Operator	262734	Operate a tip truck.
Truck Mounted Crane Operator (DMR Code C32)	242978	Operate truck mounted cranes.
Hydraulic Mobile Crane Operator (DMR Codes C33 – C36)	116254	Operate a mobile crane.

(ii) has a medical certificate of fitness to operate those construction vehicles and mobile plant, issued by an occupational health practitioner in the form of Annexure 3.;

(k) are inspected by the authorized operator or driver on a daily basis using a relevant checklist prior to use and that the findings of such inspection are recorded in a register kept in the construction vehicle or mobile plant.

The Principal Contractor must provide drip trays to be placed under the engine compartment when the mobile plant is parked for more than 3 hours.

All plant hire companies must be appointed in writing, sign the Section 37 (2) agreement and provide a valid Letter of Good Standing with the Compensation Commissioner.

The Principal Contractor must comply with Regulation 23 of the Construction Regulations, 2014 when using construction vehicles and mobile plant.

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n) Regulation 24 - Electrical Installations and Machinery on Construction Sites.

If the Principal Contractor intends on installing a temporary electrical supply, the installation must be done by a qualified registered electrician who will be able to issue a Certificate of Compliance (COC) in the form of Annexure 1 of the Electrical Installations Regulations, 2009. The electrician must be trained on at least the SAQA Unit Standard 113898 – Complete certificate of compliance for a single phased domestic installation. The Principal Contractor must appoint the electrician in writing in terms of Regulation 24 (c).

The Principal Contractor must appoint a competent temporary electrical installation inspector in terms of Regulation 24 (d). The inspector must be trained on at least the SAQA Unit Standard 258966 - Inspect and test a single-phase domestic installation. The temporary electrical supply must be inspected by a competent person at least weekly.

The Principal Contractor must appoint a competent person in writing as the electrical machinery inspector in terms of Regulation 24 (e).

All portable electrical tools must be inspected daily by the authorized inspector. The authorized inspector of portable electrical tools must be trained on at least the SAQA Unit Standard 12878 – Use and maintain Power Hand Tools on a construction Site.

The Principal Contractor must ensure that all electrical installations and machinery on the construction site complies with Regulation 24 of the Construction Regulations, 2014.

o) Regulation 25 – Use and Temporary Storage of Flammable Liquids on Construction Sites

The Principal Contractor must provide a lockable ventilated store for the storage of flammable liquids. The store must contain a bund which can contain up to 110% of the volume of the liquid stored therein. The Principal Contractor must provide adequate fire-fighting equipment and signage within the store.

A competent person must be trained and appointed to manage hazardous substances on the construction site. This person must be at least trained on the SAQA Unit Standard 264454 – Manage hazardous substances.

The Principal Contractor must, in addition to compliance with the provisions for the use and storage of flammable liquids in the General Safety Regulations, 2003, ensure that Regulation 25 is complied with when using and storing flammable liquids on site.

p) Regulation 26 – Water environments

The Principal Contractor must ensure that where construction work is done over or in close proximity to water, provision is made for-
(a) preventing persons from falling into water by providing hand and intermediate rails or a similar barrier; and
(b) the rescuing of persons in danger of drowning by providing a floatation device attached to a rope of suitable strength and length, a person who is able to swim with ease and rescue another person and a person trained in resuscitation, preferably a first-aider.

The Principal Contractor must ensure that where a person is exposed to the risk of drowning by falling into the water, the person is provided with and wears a lifejacket.

q) Regulation 27 – Housekeeping and General Safeguarding on Construction Sites

The Principal Contractor must appoint a competent person in writing as the housekeeping supervisor to ensure that good housekeeping is maintained at all times on site.

The Principal Contractor must provide adequate and suitable bins to separate and contain waste on site. This must be disposed off at a registered landfill at least weekly.

The Principal Contractor must ensure that Regulation 27 or the Construction Regulations is complied with regards to housekeeping and general safeguarding on construction sites.

r) Regulation 28 – Stacking and Storage on Construction Sites

The Principal Contractor must appoint a competent person as the stacking & storage supervisor on site who is at least trained on Unit Standard 254098 – Supervise the procurement, use and storage of equipment and materials for construction and maintenance.

All items that are stacked or stored on the construction site must be inspected by a competent person at least on a monthly basis.
The Principal Contractor must, in addition to compliance with the provisions for the stacking of articles
in the General Safety Regulations, 2003, ensure that Regulation 28 of the Construction Regulations, 2014 is complied with regards to stacking and storage on construction sites.

s) Regulation 29 – Fire Precautions on Construction Sites

The Principal Contractor must appoint a competent person in writing as the Emergency Co-ordinator / Controller in case of a fire.

The Principal Contractor must provide sufficient and suitable firefighting equipment near flammables within 5 metres of any generator or similar equipment, near portable electrical tools and in all

construction vehicles and mobile plant.

The Principal Contractor must appoint a competent person in writing as the fire equipment inspector in terms of Regulation 29 (h). The fire equipment inspector must be at least trained on the Unit Standard 12484 – Perform basic firefighting, by an accredited training service provider who is registered with the department of Labour and the respective training authority.

A fire team must be trained on the PASS sequence on site.

The Principal Contractor must ensure that adequate precautions are taken to prevent the risks of a fire and comply with Regulation 29 of the Construction Regulation, 2014.

t) Regulation 30 - Construction Employees' Facilities

The Principal Contractor must appoint a competent person in writing as the facilities inspector to ensure that all the employees' facilities on site are maintained in a clean and hygienic condition.

The Principal Contractor must, in addition to the construction site provisions in the Facilities Regulations, 2004, provide at or within reasonable access of the construction site, the following clean, hygienic and maintained facilities:
(a) Shower facilities after consultation with the employees or employees' representatives, or at least one shower facility for every 15 persons;
(b) at least one sanitary facility for each sex and for every 30 workers; (Toilets must be tied down to prevent it from toppling over in the wind and cordoned off to ensure privacy)
(c) changing facilities for each sex; and
(d) sheltered eating areas.

The Principal Contractor must ensure that in addition to Regulation 30 of the Construction Regulations, 2014 the Facilities Regulations, 2004 must be complied with.

u) Non-compliance with the Construction Regulations, 2014

The foregoing is a summary of parts of the Construction Regulations applicable to all construction projects.

The Principal Contractor, as employer for the execution of the contract, shall ensure that all provisions of the Construction Regulations applicable to the contract under consideration are complied with to the letter.

Should The Principal Contractor fail to comply with the provisions of the Regulations 3 to 30 as listed in Regulation 33, he will be guilty of an offence and will be liable, upon conviction, to the fines or imprisonment as set out in Regulation 33.

5. Environmental Regulations for Workplaces, 2003

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The Principal Contractor must ensure that the following Regulations are complied with regards to the Environmental Regulations for Workplaces.

i. Regulation 2 – Thermal Requirements

The Principal Contractor must take into consideration the extreme heat during the summer months and the precautions to be taken during this period to avoid possible heat strokes. These may include but not limited to:

- Drinking of ± 600ml of clean water every hour;
- Regular breaks within reason but avoiding possible delays on the project; and
- Training on of employees Heat Stroke Awareness.

The Principal Contractor must take into consideration the extreme cold temperatures during the winter months and the precautions to be taken during this period to avoid possible hyperthermia, cold sores, etc. These may include but not limited to:

- Provision of winter jackets and gloves;
- Running hot water; and
- Training of employees on working in cold temperatures.

While every effort should be made by the employee to keep warm, it must be noted that fires will not be allowed on site.

ii. Regulation 3 – Lighting

While there may be sufficient natural lighting, where work is carried out inside a building or closed space, sufficient artificial lighting must be provided and the above Regulation must be used as a guide for the number of lumens that will be required per square metre.

iii. Regulation 4 – Windows

Windows must provide for sufficient natural lighting and the panes must not be painted over.

iv. Regulation 5 – Ventilation

Adequate ventilation must be provided in store rooms and work areas to prevent the accumulation of fumes. Note that all hazardous chemicals must be stored separately from combustibles in a ventilated store.

v. Regulation 6 – Housekeeping

The Principal Contractor and other Contractors must ensure that good housekeeping is always maintained on site. A responsible person must be appointed as the housekeeping supervisor, however this should be the responsibility of all site personnel.

vi. Regulation 8 – Fire Precautions & Means of Egress

The Principal Contractor and other Contractors must make adequate provisions for the prevention of fires and escape routes should a fire occur. These may include but not limited to:
The provision of a ventilated store with sufficient signage to warn persons of the dangers likely to be encountered and the control measures to be taken. The signage may include but not limited to:

- "No Smoking"
- "No Open Flames"
- "No Cell Phones"
- "Flammable Liquids"

6. Facilities Regulation, 2004

The Principal Contractor must ensure that the Facilities Regulations are complied with. These may include but not limited to the provision of clean & hygienic:

- Shower facilities for each gender clearly marked with pictorial signs and cordoned off for privacy. (1 Shower per 15 employees)
- Toilet facilities for each gender clearly marked with pictorial signs and cordoned off for privacy. (1 toilet per 30 employees)
- Clean Drinking water. (± 5 Litres per employee per day)
- Eye wash facility. (A portable eyewash bottle can be used)
- Changerooms Facilities for each gender clearly marked with pictorial signs and cordoned off for privacy.
- Lockers to be provided for employees to store their personal belongings.
- Sheltered eating areas free from dust, rain, wind and other natural elements.

7. Hazardous Chemical Substances Regulations, 2008

The Principal Contractor must appoint a competent person in writing for the control of Hazardous Chemical Substances on site.

The Principal Contractor must ensure that there are MSDSs readily available for all Hazardous Chemical Substances on site and that employees are issued with and instructed to wear appropriate PPE when handling the Hazardous Chemical Substances.

The Principal Contractor must ensure that all employees handling the Hazardous Chemical Substances on site are training on the safety precautions and MSDSs.

All Hazardous Chemical Substances on site must be placed on a suitable drip tray or bunded area.

The Principal Contractor must ensure that the Hazardous Chemical Substances Regulations are complied with.

8. Noise-Induced Hearing Loss Regulations, 2003

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The Principal Contractor must ensure that adequate provisions are made to reduce the noise on site and to protect the employees who are exposed to the noise on site by providing adequate PPE and training on the use, care and limitations of the prescribed PPE.

The Principal Contractor must monitor those employees who are continuously exposed to high noise levels by means of periodic hearing tests done by an occupational health practitioner.

9. Driven Machinery Regulations, 2015

I. Regulation 18 – Lifting Machines, Hand-Powered Lifting Devices and Lifting Tackle

The Principal Contractor must appoint a competent person in writing to inspect all lifting tackle used on site. This person must be at least trained on the Unit Standard 253575 – Inspect, use and care for manual lifting equipment and tackle.

The Principal Contractor must ensure that the Provisions of Regulation 18 of the Driven Machinery Regulations, 2015 are complied with.

10. General Machinery Regulations, 1988

i) Regulation 2 – Supervision of Machinery

The Principal Contractor must ensure that where electrical machinery is used, it is used under the supervision of a competent person who is familiar with such machinery and understands the hazards and risks associated with using the machinery.

ii) Regulation 3 – Safeguarding of Machinery

The Principal Contractor must ensure that the machinery is installed, operated and maintained in such a manner that it does not pose a hazard to persons installing, operating or maintaining such machinery.

The Principal Contractor must ensure that all moving parts of the machinery which is within the normal reach of a person is effectively safeguarded by means determined in this regulation.

The machinery must be maintained in a good working condition and is used properly.

The Principal Contractor must ensure that no safety devices are removed from the machinery.

11. Electrical Installations Regulations, 2009

a. Regulation 6 – Electrical Contractor

The Principal Contractor must ensure that no person may do electrical installation work as an electrical contractor unless that person has been registered as an electrical contractor in terms of these regulations.

b. Regulation 7 – Certificate of Compliance

The Principal Contractor must ensure that the electrical installation done by the electrical contractor must have a Certificate of Compliance in the form of Annexure 1, which shall be accompanied by a test report approved by the chief inspector, in respect of every such electrical installation.

12. Electrical Machinery Regulations, 2011

a. Regulation 10 – Portable Electrical Tools

The Principal Contractor must ensure that the Provisions of Regulation 10 of the Electrical Machinery Regulations, 2011 are complied with regarding Portable Electrical Tools.

The Principal Contractor is advised in his own interest to make a careful study of the Act and as ignorance of the Act and the Regulations will not be accepted in any proceedings *related to non-conformance to the Act* and the Regulations.

Note:

This Health & Safety Specification serves as a guideline to assist the Principal Contractor in developing a Health & Safety Plan for the proposed project. The Principal Contractor does not necessarily have to use the format prescribed in this document however, all the items listed above must be covered in the health & safety plan.
The Principal Contractor must refer to the Occupational Health & Safety Act, 85 of 1993 and Regulations as amended as the minimum requirements for health & safety compliance.

Compiled by:

_____ 09th September 2022

Signature Date

Baseline Risk Assessment

Ugu District Municipality

DR

Safety Consultants

Occupational Health & Safety Baseline Risk Assessment in Accordance with Regulation 5 (1) (a) of the Construction Regulations, 2014 for The Construction of the Backwash Water Recovery Facility at the Bhobhoyi Waterworks

Prepared By: DR Safety Consultants

Project Details

Client: Ugu District Municipality

Designers: Royal Haskoning DHV

Scope of Work: The Construction of a Water Services Laboratory

- Site Establishment
- Surveying
- Proving & Relocation of Existing Services
- Clearing & Grubbing

- Excavation Work
- Construction of Foundations and Floor Slabs
- Construction of Brickwork
- Installation of Windows and Door frames
- Electrical Installations
- Plumbing
- Roof Work
- Plastering
- Installation of Ceilings & Partitions
- Tiling
- Fitting of doors
- Installation of Built in Cupboards and Countertops
- Installation of Laboratory Equipment
- Commissioning of Equipment

Risk Matrix

	1	2	3	4	5
POBABILITY	Rare	Uncommon	Occasional	Regular	Frequent
SEVERITY	Negligible	Marginal	Serious	Critical	Catastrophic
EXPOSURE	Negligible	Restricted	Significant	Widespread	Extensive

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

(LOW) (MEDIUM) (HIGH) (CATASTROPHIC)

PROBABILTY + SEVERITY + EXPOSURE = RISK RANKING

Risk Matrix: SAFETY

Evaluating PROBABILITY for SAFETY

PROBABILITY

5. Frequent	-	Continuous or Daily
4. Regular	-	More often than once per month
3. Occasional	-	A few times a year
2. Uncommon	-	Once or twice per 10 years
1. Rare	-	Less than once per 100 years

Evaluating SEVERITY for SAFETY

SEVERITY

5. Catastrophic	-	Multiple Fatalities
4. Critical	-	Fatality or number of Disabling injuries
2. Serious	-	Serious/Disabling Injury
2. Marginal	-	Minor injuries
1. Negligible	-	First Aid Treatment

Evaluating EXPOSURE for SAFETY

EXPOSURE

5. EXTENSIVE	-	80% - 100%
4. WIDESPREAD	-	60% - 80%
3. SIGNIFICANT	-	40% - 60%
2. RESTRICTED	-	20% - 40%
1. NEGLIGIBLE	-	01% - 20%

Risk Matrix: HEALTH

Evaluating PROBABILITY for HEALTH

PROBABILTY

5.	Frequent	-	Continuously present
4.	Regular	-	Daily
3.	Occasional	-	Monthly
2.	Uncommon	-	More than once per year
1.	Rare	-	Less than once per year

Evaluating SEVERITY for HEALTH

SEVERITY

5.	Catastrophic	-	Multiple Fatalities as a result of occupational diseases
4.	Critical	-	Fatality number of irreversible occupational diseases
3.	Serious	-	Irreversible occupational diseases
2.	Marginal	-	Reversible health condition
1.	Negligible	-	Over Exposure

Evaluating EXPOSURE for HEALTH

EXPOSURE

5.	EXTENSIVE	-	When the value is 2 x OEL*
4.	WIDESPREAD	-	When the value is between OEL and 2 x OEL
3.	SIGNIFICANT	-	When the value is equal to OEL
2.	RESTRICTED	-	When the value is between action level and OEL
1.	NEGLIGIBLE	-	When the value is below action level

* Occupational Exposure Levels/Limits

Risk Matrix: ENVIRONMENT

Evaluating PROBABILITY for ENVIRONMENT

PROBABILITY

5.	Frequent	-	Continuously or Daily
4.	Regular	-	More than once per month
3.	Occasional	-	Few times a year
2.	Uncommon	-	Once or twice per 10 years
1.	Rare	-	Less than once per 100 years

Evaluating SEVERITY for ENVIRONMENT

SEVERITY

5.	Catastrophic	-	Environmental Disaster
4.	Critical	-	Major environmental incidents
3.	Serious	-	Reportable environmental incident
2.	Marginal	-	Minor environmental incident
1.	Negligible	-	Environmental near miss

Evaluating EXPOSURE for ENVIRONMENT

EXPOSED

5.	EXTENSIVE	-	International
4.	WIDESPREAD	-	Regional / National
3.	SIGNIFICANT	-	Local
2.	RESTRICTED	-	Immediate Surroundings
1.	NEGLIGIBLE	-	Site

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
SITE ESTABLISHMENT	SETTING OUT THE BOUNDRIES FOR THE SITE CAMP	SNAKES, HAND TOOLS, UNEVEN TERRAIN	SNAKE BITES, BODILY INJURIES, SLIPS TRIPS AND FALLS	S H	4 4	3 3	2 2	9 9	ENCOUNTER WITH SNAKE PROCEDURE TO BE IN PLACE. HAND TOOLS INSPECTOR TO BE APPOINTED TO CARRY OUT INSPECTIONS. INDUCTION TO BE IN PLACE FOR EMPLOYEES. PPE TO BE MADE READILY AVAILABLE ON SITE.	THE PRINCIPAL CONTRACTOR TO ENSURE THAT ALL PERSONNEL ENTERING THE SITE ARE TRAINED ON THE ENCOUNTER WITH A SNAKE PROCEDURE AND INDUCTION PRIOR TO ENTERING THE SITE. THE LOCAL HOSPITAL AND SNAKE CATCHER'S DETAILS MUST BE READILY AVAILABLE TO ALL SITE PERSONNEL. HAND TOOLS INSPECTOR MUST ENSURE THAT ALL HAND TOOLS ARE INSPECTED REGULARLY, AND DEFECTIVE TOOLS ARE IMMEDIATELY REMOVED FROM SERVICE AND REPLACED. EMPLOYEES MUST BE INSTRUCTED TO WEAR APPROPRIATE PPE AND TO FOCUS ON TASK AND PATH.
	EXCAVATING HOLES FOR FENCE POSTS	HAND TOOLS & EXCAVATION WORK	BODILY INJURIES AND DAMAGE TO SERVICES WHICH MAY RESULT IN ELECTROCUTION OF THE EMPLOYEE.	S	3	2	1	6	HAND TOOLS INSPECTOR TO BE APPOINTED TO CARRY OUT INSPECTIONS. INDUCTION TO BE IN PLACE FOR EMPLOYEES. PPE TO BE READILY AVAILABLE ON SITE. SITE LAYOUT AND SERVICES DRAWINGS MUST BE MADE	HAND TOOLS INSPECTOR TO ENSURE THAT ALL HAND TOOLS ARE INSPECTED REGULARLY, AND DEFECTIVE TOOLS ARE IMMEDIATELY REMOVED FROM SERVICE AND REPLACED. EMPLOYEES INSTRUCTED WEAR APPROPRIATE PPE AND TO FOCUS ON TASK AND PATH. SITE LAYOUT &

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
									AVAILABLE FROM ENGINEERS AND CLIENT.	SERVICES DRAWINGS TO BE READILY AVAILABLE ON SITE FOR USE BY THE PRINCIPAL CONTRACTOR. SERVICES TO BE PROVED BEFORE EXCAVATION OF HOLES FOR THE FENCE POSTS.
	OFFLAODING & CARRYING PIPE MARKERS POSTS AND MESH WIRE.	HANDLING OF PIPE MARKERS POSTS AND MESH WIRE.	BACK INJURIES, SCRATCHES & BRUISES	S	3	2	1	6	EMPLOYEES TO BE AVAILABLE TO ASSIST WITH HEAVY ITEMS. CORRECT LIFTING PROCEDURE TO BE INCLUDED IN INDUCTION TRAINING. PPE TO BE READILY AVAILABLE ON SITE.	EMPLOYEES MUST ASK FOR ASSISTANCE WHEN CARRYING HEAVY ITEMS. EMPLOYEES MUST BE INSTRUCTED WEAR APPROPRIATE PPE. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL EMPLOYEES ARE INDUCTED BEFORE PROCEEDING TO SITE.
	ERECTING PIPE MARKERS	INSTALLING POLES & FIXING WIRE	BACK INJURIES, SCRATCHES & BRUISES	S	3	2	1	6	EMPLOYEES TO BE AVAILABLE TO ASSIST WITH HEAVY ITEMS. CORRECT LIFTING PROCEDURE TO BE INCLUDED IN INDUCTION TRAINING. PPE TO BE READILY AVAILABLE ON SITE.	EMPLOYEES TO ASK FOR ASSISTANCE WHEN CARRYING HEAVY ITEMS. EMPLOYEES INSTRUCTED WEAR APPROPRIATE PPE. THE PRINCIPAL CONTRACTOR TO ENSURE THAT ALL EMPLOYEES ARE INDUCTED BEFORE PROCEEDING TO SITE.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
SITE ESTABLISHMENT	PLACEMENT OF STORES & OFFICE CONTAINERS	UNTRAINED & UNAUTHORISED PERSONNEL OPERATING TRUCK MOUNTED CRANE	FATALITIES, BODILY INJURIES & DAMAGE TO PROPERTY	S	4	3	2	9	TRUCK MOUNTED CRANE OPERATOR TO BE TRAINED BY ACCREDITED TRAINING SERVICE PROVIDER ON SAFE USE OF TRUCK MOUNTED CRANE OPERATION AND APPOINTED IN WRITING BY THE EMPLOYER.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY TRAINED & AUTHORISED PERSONNEL OPERATE THE TRUCK MOUNTED CRANE.
		PHYSICALLY UNFIT PERSONNEL OPERATING TRUCK MOUNTED CRANE	FATALITIES, BODILY INJURIES & DAMAGE TO PROPERTY	S	4	3	2	9	ALL OPERATORS TO UNDERGO MEDICAL & PSYCHOLOGICAL EXAMINATION BY OCCUPATIONAL HEALTH PRACTITIONER PRIOR TO COMMENCING WORK ON SITE. MEDICALS ARE VALID FOR ONE YEAR FROM DATE OF EXAMINATION.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY PHYSICALLY FIT PERSONNEL OPERATE THE TRUCK MOUNTED CRANE.
		UNSAFE TRUCK MOUNTED CRANE AND LIFTING EQUIPMENT	FATALITIES, BODILY INJURIES & DAMAGE TO PROPERTY	S	4	3	2	9	PRE-START INSPECTIONS TO BE DONE ON EQUIPMENT AND RESULTS TO BE ENTERED IN THE REGISTERS PROVIDED.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT PRESTART CHECKS ARE DONE BY THE OPERATOR AND THAT DEVIATIONS ARE ADDRESSED PRIOR TO COMMENCEMENT WITH THE USE OF THE TRUCK MOUNTED CRANE AND LIFTING EQUIPMENT.
		UNSAFE LIFTING GEAR	INJURY, DAMAGE TO PROPERTY AND POSSIBLE FATALITIES.	S	4	3	2	9	ALL LIFTING GEAR ARE TO BE LOAD TESTED WITH SUPPORTING TEST CERTIFICATES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT INSPECTIONS ARE DONE AT LEAST EVERY THREE MONTHS BY A COMPETENT PERSON AND DEVIATIONS ARE ACTIONED WITHOUT DELAY.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
		LIFTING OPERATIONS	INJURY, DAMAGE TO PROPERTY AND POSSIBLE FATALITIES.	S	4	3	2	9	RIGGERS TO BE TRAINED BY ACCREDITED TRAINING SERVICE PROVIDER ON SLINGING & RIGGING.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY TRAINED PERSONNEL OPERATE LIFTING GEAR.
		RIGGING	INJURY, DAMAGE TO PROPERTY AND POSSIBLE FATALITIES.	S	4	3	2	9	RIGGERS TO BE TRAINED BY ACCREDITED TRAINING SERVICE PROVIDER ON SLINGING & RIGGING.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY TRAINED PERSONNEL OPERATE LIFTING GEAR.
		ELEVATED LOADS	FATALITY / FATALITIES	S	4	3	2	9	AREAS TO BE CORDONED OFF DURING LIFTING OPERATIONS AND MANNED BY FLAGMEN WITH WHISLES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT NO PERSONNEL WALK / STAND UNDER ELEVATED LOADS AND WHISTLES ARE MADE AVAILABLE FOR LIFTING AND EMERGENCY PURPOSES.
		IMPROPER POSITIONING OF	POOR HOUSEKEEPIN	S	3	2	1	6	OFFICE & STORES LAYOUT TO BE PLANNED AND DISCUSSED WITH THE	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE CONTAINERS ARE PLACED CORRECTLY BY THE
		CONTAINERS	G, CONJESTION & BLOCKED ACCESS						PRINCIPAL CONTRACTOR & CONTAINER HIRE COMPANY.	CONTAINER HIRE COMPANY.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
SITE ESTABLISHMENT	PLACEMENT OF TOILETS	IMPROPER LIFTING	BACK INJURIES, SCRATCHES & BRUISES	S	3	2	1	6	EMPLOYEES TO BE AVAILABLE TO ASSIST WITH HEAVY ITEMS. CORRECT LIFTING PROCEDURE TO BE DISCUSSED WITH SITE PERSONNEL.	EMPLOYEES MUST ASK FOR ASSISTANCE WHEN CARRYING HEAVY ITEMS. EMPLOYEES MUST BE INSTRUCTED WEAR APPROPRIATE PPE. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL SITE PERSONNEL ARE INDUCTED BEFORE PROCEEDING TO SITE.
		IMPROPER POSITIONING OF TOILETS	POOR SANITATION	S H E	3 3 3	2 2 2	1 1 1	6 6 6	TOILET LAYOUT TO BE PLANNED AND DISCUSSED WITH THE PRINCIPAL CONTRACTOR & TOILET HIRE COMPANY.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE TOILETS ARE PLACED CORRECTLY BY THE TOILET HIRE COMPANY.
		HEAVY WIND	SCRATCHES & BRUISES, DAMAGE TO TOILET & POOR SANITATION	S H E	3 3 3	2 2 2	1 1 1	6 6 6	TOILETS TO BE PLACED ON LEVEL GROUND AND TIED DOWN.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE TOILETS ARE PLACED ON LEVEL GROUND AND TIED DOWN USING WIRE/ROPES ATTACHED TO STEEL/WOODEN PEGS DRIVEN INTO THE GROUND.
		OPEN TOILETS	VISUAL NUISANCE	E	3	2	1	6	TOILETS TO BE CORDONED OFF TO ENSURE PRIVACY.	SHADE CLOTH OR SIMILAR MUST BE USED TO CORDON OFF TOILETS. SITE PERSONNEL USING THE TOILETS MUST ENSURE THAT THE TOILET DOORS REMAIN CLOSED.
		SEPARATE TOILETS	POOR SANITATION	H E	3 3	2 2	1 1	6 6	THERE NEEDS TO BE SEPARATE MALE AND FEMALE TOILETS ALL PROVIDED WITH TOILET PAPER AND SOAP FOR WASHING	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE ARE SEPARATE MALE & FEMALE TOILETS AND THAT THERE IS SUFFICIENT TOILET PAPER AND SOAP.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	STACKING & STORAGE	NO STACKING & STORAGE SUPERVISOR APPOINTED	STACKS COLLAPSE CAUSING INJURY AND POSSIBLE FATALITIES	S	4	3	2	9	A COMPETENT STACKING & STORAGE SUPERVISOR TO BE APPOINTED. ALL STACKING AND STORAGE TO BE CARRIED OUT IN ACCORDANCE WITH GSR 8 AND CR 28	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL STACKING & STORAGE ON SITE TAKES PLACE UNDER THE SUPERVISION OF A COMPETENT AND APOINTED STACKING & STORAGE SUPERVISOR.
	EMERGENCY PREPAREDNESS	NO FIRE EQUIPMENT AVAILABLE	FIRE	S H E	3 3 3	2 2 2	1 1 1	6 6 6	SUITABLE FIRE EQUIPMENT TO BE MADE AVAIALABLE ON SITE AND AT THE SITE CAMP.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE ARE SUITABLE AND SUFFICENT FIRE EXTINGUISHERS AT THE SITE AND SITE CAMP. FIRE FIGHTING EQUIPMENT MUST BE WITHIN 5 METRES OF ANY PLANT OR MACHINERY & FLAMMABLES.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
SITE ESTABLISHMENT	EMERGENCY PREPAREDNESS	NO FIRE TEAM OR FIRE EQUIPMENT INSPECTOR APPOINTED	FIRE	S H E	3 3 3	2 2 2	1 1 1	6 6 6	A TRAINED AND COMPETENT PERSON TO BE APPOINTED TO INSPECT THE FIRE FIGHTING EQUIPMENT ON SITE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE ARE SUFFICENT PEOPLE TRAINED ON THE USE AND INSPECTION OF FIRE EXTINGUISHERS.
		NO FIRST-AIDER OR EQUIPMENT AVAILABLE	MEDICAL NEGLIGENCE	S	4	3	2	9	A TRAINED AND COMPETENT PERSON TO BE APPOINTED TO INSPECT THE FIRST-AID EQUIPMENT AND TO TREAT ALL INJURIES ON SITE. FIRSTAID KITS TO BE MADE AVAILABLE ON SITE AND AT THE SITE CAMP.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE TRAINED FIRST-AIDER IS READILY AVAILABLE ON SITE AND THAT THERE IS SUFFICENT FIRST-AID EQUIPMENT READILY AVAILABLE TO TREAT INJURIES ON SITE.
		NO EMERGENCY HORN	INJURY OR EXPOSURE TO HAZARDS	S H E	3 3 3	2 2 2	1 1 1	6 6 6	A SUITABLE ALARM OR SIMILAR DEVICE TO BE KEPT ON SITE WHICH IS TO BE SOUNDED IN CASE OF AN EMERGENCY.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT A SUITABLE EMERGENCY DEVICE IS READILY AVAILABLE ON SITE.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
		NO EMERGENCY ASSEMBLY POINT / EMERGENCY PROCEDURES NOT KNOWN	INJURY DUE TO TRIPPING WHILE RUSHING OUT OF THE SITE	S	4	3	2	9	ALL SITE PERSONNEL TO BE TRAINED ON THE EMERGENCY PROCEDURES PRIOR TO PROCEEDING ONTO THE SITE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL SITE PERSONNEL ARE INDUCTED PRIOR TO PROCEEDING ONTO THE SITE.
SURVEYING	SETTING UP SURVEY EQUIPMENT	SNAKES, HAND TOOLS, UNEVEN TERRAIN	SNAKE BITES, BODILY INJURIES, SLIPS TRIPS AND FALLS	S H	4 4	3 3	2 2	9 9	ENCOUNTER WITH SNAKE PROCEDURE TO BE IN PLACE. HAND TOOLS INSPECTOR TO BE APPOINTED TO CARRY OUT INSPECTIONS. INDUCTION TO BE IN PLACE FOR EMPLOYEES. PPE TO BE MADE READILY AVAILABLE ON SITE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL PERSONNEL ENTERING THE SITE ARE TRAINED ON THE ENCOUNTER WITH A SNAKE PROCEDURE AND INDUCTION PRIOR TO ENTERING THE SITE. THE LOCAL HOSPITAL AND SNAKE CATCHER'S DETAILS MUST BE READILY AVAILABLE TO ALL SITE PERSONNEL. THE HAND TOOLS INSPECTOR MUST ENSURE THAT ALL HAND TOOLS ARE INSPECTED REGULARLY, AND DEFECTIVE TOOLS ARE IMMEDIATELY REMOVED FROM SERVICE AND REPLACED. EMPLOYEES MUST BE INSTRUCTED TO WEAR APPROPRIATE PPE AND TO FOCUS ON TASK AND PATH.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	MARKING OUT THE WORK AREA USING SURVEY EQUIPMENT	INCOMPETENT SURVEYOR AND USE OF OUTDATED DRAWINGS.	INCORRECT SURVEY, PRODUCTION LOSS.	E	3	2	1	6	ONLY TRAINED AND ASSESSED SURVEYOR TO CARRY OUT SURVEYING. SURVEY EQUIPMENT TO BE CALLIBRATED AT LEAST ANNUALLY. DRAWINGS TO BE CONFIRMED WITH ENGINEERS PRIOR	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE SURVEYOR IS COMPETENT TO CARRY OUT HIS TASKS. THE EQUIPMENT MUST BE CALIBRATED AT LEAST ANNUALLY BY AN ACCREDITED SERVICE PROVIDER. ALL DRAWING MUST BE SIGNED OFF BY THE ENGINEERS PRIOR TO SETTING OUT.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
									TO SETTING OUT.	
SURVEYING	ERECT WOODEN PEGS IN POSITION	HAND TOOLS & SPLINTERS	BODILY INJURIES AND DAMAGE TO SERVICES WHICH MAY INCLUDE ELECTROCUTION OF EMPLOYEE.	S	3	2	1	6	HAND TOOLS INSPECTOR TO BE APPOINTED TO CARRY OUT INSPECTIONS. INDUCTIONS TO BE IN PLACE FOR EMPLOYEES. PPE TO BE READILY AVAILABLE ON SITE. SITE LAYOUT AND SERVICES DRAWINGS TO BE MADE AVAILABLE FROM ENGINEERS AND CLIENT.	HAND TOOLS INSPECTOR MUST ENSURE THAT ALL HAND TOOLS ARE INSPECTED REGULARLY, AND DEFECTIVE TOOLS ARE IMMEDIATELY REMOVED FROM SERVICE AND REPLACED. EMPLOYEES MUST BE INSTRUCTED WEAR APPROPRIATE PPE AND TO FOCUS ON TASK AND PATH. SITE LAYOUT & SERVICES DRAWINGS MUST BE READILY AVAILABLE ON SITE FOR USE BY THE FOREMAN. SERVICES MUST BE PROVED BEFORE DRIVING PEGS INTO THE GROUND.
	WORKING ALONG ROADS	TRAFFIC	EMPLOYEES KNOCKED OVER BY MOTOR VEHICLES	S	4	3	2	9	ALL EMPLOYEES TO BE ISSUED WITH AND ISTRUCTED TO WEAR REFLECTIVE CLOTHING (BIBS/VESTS) SITE PERSONNEL TO BE INDUCTED PRIOR TO ENTERING THE SITE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT REFLECTIVE CLOTHING IS ISSUED TO EMPLOYEES PRIOR TO COMMENCEMENT WITH WORK ON SITE. EMPLOYEES MUST FACE ONCOMMING VEHICLES WHEN WORKING ALONG ROADS (DO NOT FACE YOUR BACK TOWARDS THE APPROACHING VEHICLES)

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	WORKING IN ISOLATION	ROBBERS	THEFT OF EQUIPMENT WITH POSSIBLE ASSAULT OF SURVEYOR	S	4	3	2	9	SURVEYOR TO BE ACCOMPANIED BY SECURITY WHEN WORKING IN ISOLATED OR HIGH CRIME AREAS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT SECURITY IS AVAILABLE ON REQUEST OF THE SURVEYOR.
	OBTAINING SERVICES LAYOUT DRAWINGS FROM THE RELEVANT DEPARTMENTS.	OUTDATED DRAWINGS	CONTACT WITH EXISTING SERVICES, I.E. ELECTROCUTION OR DAMAGE TO SERVICES, POLLUTION, RESPIRATORY PROBLEMS	S H E	4 3 3	3 2 2	2 1 1	9 6 6	DRAWINGS TO BE CONFIRMED WITH THE RESIDENT ENGINEERS PRIOR TO WORKING WITH THEM.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE DRAWINGS ARE APPROVED AND ISSUED FOR CONSTRUCTION.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
PROVING & RELOCATION OF EXISTING SERVICES	MARKING OUT SERVICES ALONG THE ROAD	TRAFFIC	PERSONNEL KNOCKED OVER BY MOTOR VEHICLES	S	4	3	2	9	ALL SITE PERSONNEL TO BE ISSUED WITH AND INSTRUCTED TO WEAR REFLECTIVE CLOTHING (BIBS/VESTS) SITE PERSONNEL TO BE INDUCTED PRIOR TO ENTERING THE SITE. CONES/DELINEATORS TO BE USED TO CORDON OFF WORK AREAS. FLAGSMEN TO BE POSTED TO WARN TRAFFIC OF WORKMEN AHEAD.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT REFLECTIVE CLOTHING IS ISSUED TO ALL SITE PERSONNEL PRIOR TO COMMENCEMENT WITH WORK ON SITE. EMPLOYEES MUST FACE ONCOMMING VEHICLES WHEN WORKING ALONG ROADS (DO NOT FACE YOUR BACK TOWARDS THE APPROACHING VEHICLES). THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ADEQUATE PRECAUTIONS ARE TAKEN TO PREVNT SITE PERSONNEL FROM BEING KNOCKED OVER WHICH INCLUDES THE POSTING OF FLAGSMEN AND ERECTING CONES/DELINEATORS AROUND THE IMMEDIATE WORK AREAS.
	EXCAVATING IDENTIFIED SERVICES	CONTACT WITH SERVICES	ELECTROCUTION OR DAMAGE TO SERVICES, POLLUTION, RESPIRATORY PROBLEMS	S H E	4 3 3	3 2 2	2 1 1	9 6 6	PICKS TO BE USED TO LOOSEN HARD INTERMEDIATE MATERIAL AND NOT TO BE USED WITH FORCE FOR DIGGING. NO FLAT DIGGING SPADES TO BE USED, ONLY ROUND NOSE SHOVELS TO BE USED TO SCOOP OUT MATERIAL.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE CORRECT TOOLS ARE BEING USED FOR THE TASK AND THAT THE TOOLS ARE BEING USED CORRECTLY.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	EXPOSING SERVICES	GENERAL PUBLIC	ELECTROCUTION	S	4	3	2	9	ALL EXCAVATIONS TO BE ADEQUATELY BARRICADED TO PREVENT PASSERSBY FROM FALLING IN OR TRIPPING. EXPOSED SERVICES ABOVE GROUND TO BE ADEQUATELY CORDONED OFF AND MADE SAFE BY INSULATING.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE EXPOSED SERVICES DO NOT COME INTO CONTACT WITH THE PUBLIC BY PROVIDING EFFECTIVE BARRICADING.
PROVING & RELOCATION OF	RELOCATION OF EXISTING	ELECTRICAL WORK	ELECTROCUTION	S	4	3	2	9	ALL ELECTRICAL WORK TO BE CARRIED BY A MUNICIPALITY APPROVED ELECTRICAL CONTRACTOR.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY APPOINTED CONTRACTORS CARRY OUT ANY ELECTRICAL WORK.
		WATER &	DAMAGE TO SERVICES, POLLUTION, RESPIRATORY PROBLEMS	S H E	4 3 3	3 2 2	2 1 1	9 6 6	ALL WATER AND SANITATION WORK TO BE CARRIED OUT BY COMPETENT PERSONS OR A NOMINATED CONTRACTOR WHO ARE FAMILIAR WITH THE SCOPE OF WORK.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT STEPS ARE TAKEN TO PREVENT ANY DAMAGES TO SERVICES AND THAT THEY ARE RELOCATED SAFELY AND CORRECTLY BY COMPETENT PERSONNEL OR THE NOMINATED CONTRACTOR.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
EXISTING SERVICES	SERVICES	SANITATION	FLOODING CAUSING POSSIBLE DROWING	S	3	2	1	6	VALVES & FITTINGS TO BE READILY AVAILABLE FOR DRAINAGE OF TRENCHES. WHERE POSSIBLE, TRENCHES TO BE DAYLIGHTED.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ADEQUATE STEPS ARE TAKEN TO PREVENT PERSONNEL FROM DROWNING DURING FLOODING OF PIPE TRENCHES WHICH MUST INCLUDE THE EASY ACCESS INTO AND OUT OF EXCAVATIONS, DAYLIGHTING TRENCHES AND THE PROVISION OF SUB-VALVE & FITTINGSS.
	TREE FELLING	USING A CHAINSAW	BODILY INJURIES, AMPUTATIONS WITH POSSIBLE FATALITIES, RESPIRATORY INFECTIONS AND AIR POLLUTION	S H E	4 3 3	3 2 2	2 1 1	9 6 6	ALL EQUIPMENT TO BE OF SOUND CONDITION AND OPERATED BY COMPETENT PERSONNEL. PERSONNEL OPERATING THE CHAINSAW MUST BE ISSUED AND INSTRUCTED TO WEAR SUITABLE PPE INCLUDING FORESTRY OVERALLS AND HELMETS WITH FACE SHIELDS AND EAR MUFFS IN ADDITION TO THE SAFETY GLASSES, EAR PLUGS, DUST MASKS, GLOVES AND SAFETY BOOTS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL EQUIPMENT IS INSPECTED PRIOR TO USE AND DEFECTIVE EQUIPMENT IS REMOVED FROM SERVICE AND REPLACED. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE CHAINSAW IS OPERATED BY TRAINED AND COMPETENT PERSONNEL. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT SUITABLE PPE IS READILY AVAILABLE FOR USE BY THE CHAINSAW OPERATORS.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
CLEARING & GRUBBING	TREE FELLING	WORKING IN CLOSE PROXIMITY OF OTHERS	BODILY INJURIES, AMPUTATIONS WITH POSSIBLE FATALITIES	S	4	3	2	9	THERE NEEDS TO BE A SUITABLE WORKING SPACE BETWEEN EMPLOYEES TO AVAID THE RISK OF INJURING EACH OTHER. A SAFE WORKING DISTANCE OF AT LEAST 1,5 METRES FROM THE END OF THE TOOL TO THE NEXT EMPLOYEE SHOULD BE OBSERVED.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE IS SUFFICIENT WORKSPACE FOR ALL EMPLOYEES WORKING IN THE AREA.
		FALLING BRANCHES	HEAD INJURIES, WITH POSSIBLE FATALITIES	S	4	3	2	9	NO PERSON TO STAND UNDER OR NEAR BRANCHES. GUIDE ROPES TO BE USED TO SAFELY LOWER BRANCHES TO THE GROUND. THE AREA TO BE CORDONED OFF WHERE NECESSARY.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE AREA IS CLEAR OF ALL PERSONNEL PRIOR TO COMMENCEMENT WITH THE USE OF CHAINSAWS. CHAINSAW OPERATORS MUST CUT BRANCHES IN SMALL MOVABLE SIZES.
		FLYING DEBRIS AND SAW DUST	EYE AND FACE INJURIES.	S	4	3	2	9	ALL OPERATORS PROVIDED AND INSTRUCTED TO WEAR APPROPRIATE PPE INCLUDING FACE SHIELDS, DUST MASKS AND SAFETY GLASSES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE AREA IS CLEAR OF ALL PERSONNEL PRIOR TO COMMENCEMENT WITH THE USE OF CHAINSAWS.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	REMOVAL OF TREE STUMPS	USE OF TLB / EXCAVATOR	INJURIES AND POSSIBLE FATALITIES	S	4	3	2	9	SAFE WORK PROCEDURE TO BE IN PLACE FOR USE OF CONSTRUCTION VEHICLES & MOBILE PLANT. PERSONNEL TO STAND CLEAR OF MOBILE PLANT AND CONSTRUCTION VEHICLES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT CONSTRUCTION VEHICLES AND MOBILE PLANT ARE OPERATED BY TRAINED, COMPETENT, AUTHORIZED AND MEDICALLY FIT OPERATORS PRIOR TO COMMENCEMENT WITH THE USE OF CONSTRUCTION VEHICLES AND MOBILE PLANT. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT NO PERSON WALKS BEHIND OR WITHIN THE SWING AREA OF THE TLB / EXCAVATOR.
	STRIPPING OF TOPSOIL	USE OF TLB / EXCAVATOR	INJURIES AND POSSIBLE FATALITIES	S	4	3	2	9	SAFE WORK PROCEDURE TO BE IN PLACE FOR USE OF CONSTRUCTION VEHICLES & MOBILE PLANT. PERSONNEL TO STAND CLEAR OF MOBILE PLANT AND CONSTRUCTION VEHICLES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT CONSTRUCTION VEHICLES AND MOBILE PLANT ARE OPERATED BY TRAINED, COMPETENT, AUTHORIZED AND MEDICALLY FIT OPERATORS PRIOR TO COMMENCEMENT WITH THE USE OF CONSTRUCTION VEHICLES AND MOBILE PLANT. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT NO PERSON WALKS BEHIND OR WITHIN THE SWING AREA OF THE TLB / EXCAVATOR.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
CLEARING & GRUBBING	USE OF CONSTRUCTION VEHICLES (TIPPERS)	TIPPERS REVESING ON SITE	SITE PERSONNEL / PUBLIC KNOCKED OVER BY TIPPER	S	4	3	2	9	A STAGING CLERK TO BE POSTED TO WARN PASSERSBY AND TO GUIDE TIPPERS SAFELY INTO POSITION.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE INTERACTION BETWEEN THE PUBLIC AND THE CONSTRUCTION ACTIVITIES ARE MINIMISED BY CREATING SAFE ACCESS ROUTES FOR PEDESTRIANS AND MOTORISTS.
	LOADING OF SOIL INTO TIPPERS	USE OF TLB / EXCAVATOR	INJURIES AND POSSIBLE FATALITIES	S	4	3	2	9	SAFE WORK PROCEDURE TO BE IN PLACE FOR USE OF CONSTRUCTION VEHICLES & MOBILE PLANT. PERSONNEL TO STAND CLEAR OF MOBILE PLANT AND CONSTRUCTION VEHICLES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT CONSTRUCTION VEHICLES AND MOBILE PLANT ARE OPERATED BY TRAINED, COMPETENT, AUTHORIZED AND MEDICALLY FIT OPERATORS PRIOR TO COMMENCEMENT WITH THE USE OF CONSTRUCTION VEHICLES AND MOBILE PLANT. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT NO PERSON WALKS BEHIND OR WITHIN THE SWING AREA OF THE TLB / EXCAVATOR.
	HAULING OF MATERIAL	OPERATING TIPPERS	PERSONNEL KNOCKED OVER	S	4	3	2	9	ALL DRIVERS TO BE APPOINTED IN WRITING, HAVE VALID DRIVER'S LICENCES AND PDP WITH VALID MEDICALS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY AUTHORISED DRIVERS OPERATE THE TIPPERS.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
		DUST	POOR VISIBILITY CAUSING ACCIDENTS, RESPIRATORY PROBLEMS AND AIR POLLUTION	S H E	4 3 3	3 2 2	2 1 1	9 6 6	A WATER TANKER TO BE MADE AVAILABLE FOR DUST SUPPRESSION ON HAUL ROUTES. SITE PERSONNEL TO BE ISSUED WITH DUST MASKS WHEN WORKING IN DUSTY CONDITIONS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT A WATER TANKER IS ON SITE DAILY FOR THE SUPPRESSION OF DUST ON HAUL ROUTES AND DUST MASKS ARE EASILY ACESSIBLE FOR SITE PERSONNEL.
EXCAVATION WORK	OPERATING CONSTRUCTION VEHICLES & MOBILE PLANT	UNTRAINED OPERATOR	INJURIES, FATALITIES & DAMAGE TO PROPERTY	S	4	3	2	9	CONSTRUCTION VEHICLES & MOBILE PLANT OPERATOR TRAINED BY ACCREDITED TRAINING SERVICE PROVIDER ON SAFE USE OF CONSTRUCTION VEHICLES & MOBILE PLANT OPERATION.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY TRAINED PERSONNEL OPERATE THE CONSTRUCTION VEHICLES & MOBILE PLANT.
		PHYSICALLY & OR MENTALLY UNFIT OPERATOR	INJURIES, FATALITIES & DAMAGE TO PROPERTY	S	4	3	2	9	ALL OPERATORS UNDERGO MEDICAL & PSYCHOLOGICAL EXAMINATION BY OCCUPATIONAL HEALTH PRACTITIONER PRIOR TO COMMENCING WORK ON SITE. MEDICALS VALID FOR ONE YEAR.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY MENTALLY AND PHYSICALLY FIT PERSONNEL OPERATE THE CONSTRUCTION VEHICLES & MOBILE PLANT.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
		UNSAFE EQUIPMENT	INJURIES, FATALITIES & DAMAGE TO PROPERTY	S	4	3	2	9	PRE-START INSPECTIONS DONE ON EQUIPMENT AND RESULTS ENTERED IN THE REGISTERS PROVIDED.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT PRESTART CHECKS ARE DONE BY THE OPERATOR AND THAT DEVIATIONS ARE ADDRESSED PRIOR TO COMMENCEMENT WITH THE USE OF THE CONSTRUCTION VEHICLES & MOBILE PLANT.
		CONSTRUCTION VEHICLES & MOBILE PLANT TOO CLOSE TO THE EDGE OF THE EXCAVATION	CONSTRUCTION VEHICLES & MOBILE PLANT FALLING INTO EXCAVATIONS CAUSING MAJOR INJURIES AND FATALITIES	S	4	3	2	9	SAFE WORK PROCEDURE TRAINING CARRIED OUT ON OPERATORS REGARDING SAFE WORKING DISTANCES. EMPLOYEES TO MOVE OUT OF EXCAVATIONS WHEN HEAVY PLANT APPROACHES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL OPERATORS ARE TRAINED ON THE SAFE USE OF THE CONSTRUCTION VEHICLES & MOBILE PLANT.
EXCAVATION WORK	APPOINTMENT OF EXCAVATION SUPERVISOR	COMPETENT EXCAVATION SUPERVISOR NOT APPOINTED	EMPLOYEES BURIED IN EXCAVATIONS WITH POSSIBLE FATALITIES	S	5	4	3	12	A COMPETENT EXCAVATION SUPERVISOR TO BE APPOINTED TO SUPERVISE AND INSPECT ALL EXCAVATION WORK. THE EXCAVATION SUPERVISOR MUST BE TRAINED BY AN ACCREDITED TRAINING SERVICE PROVIDER.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL EXCAVATION WORK IS CARRIED OUT UNDER THE CONSTANT SUPERVISION OF AN APPOINTED COMPETENT EXCAVATION SUPERVISOR.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	HSE	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	EXCAVATING LOOSE / WET MATERIAL	SIDES COLLAPSE	EMPLOYEES BURIED IN EXCAVATIONS WITH POSSIBLE FATALITIES	S	5	4	3	12	ALL EXCAVATIONS TO BE SHAPED TO THE MAXIMUM ANGLE OF REPOSE RELATIVE TO THE HORIZONTAL PLANE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL EXCAVATIONS ARE INSPECTED AND SAFE BEFORE ENTRY.
	PLACING OF EXCAVATED MATERIAL	MATERIAL PLACED TOO CLOSE TO THE EDGE CAUSING IT TO FALL BACK INTO THE EXCAVATION OR SIDES COLLAPSE.	EMPLOYEES BURIED IN EXCAVATIONS WITH POSSIBLE FATALITIES	S	5	4	3	12	ALL EXCAVATED MATERIAL TO BE PLACED AT LEAST 1 METRE AWAY FROM THE EDGE OF THE EXCAVATION.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL EXCAVATED MATERIAL IS PLACED AT A SAFE DISTANCE AWAY FROMM THE EDGE OF THE EXCAVATION WITH A MINIMUM DISTANCE OF 1 METRE FROM THE EDGE.
	ACESSING THE EXCAVATION	NO SAFE ACCESS INTO OR OUT OF THE EXCAVATION	TRIPS AND FALLS INTO THE EXCAVATIONS CAUSING MULTIPLE INJURIES	S	4	3	2	9	ALL EXCAVATIONS TO BE PROVIDED WITH SAFE MEANS OF ACCESS WITHIN 6 METRES OF THE EMPLOYEES WORKING INSIDE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT SUITABLE LADDERS ARE MADE AVAILABLE FOR USE BY EMPLOYEES WORKING INSIDE THE EXCAVATIONS. THE LADDERS MUST EXTEND AT LEAST 1 METRE ABOVE THE LANDING OR GROUND LEVEL.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
EXCAVATION WORK	USE OF LADDERS	UNSAFE LADDERS	TRIPS AND FALLS INTO THE EXCAVATIONS CAUSING MULTIPLE INJURIES	S	3	2	1	6	THE LADDERS TO BE CONSTRUCTED OF SOUND MATERIAL. WOODEN LADDERS MUST BE PAINT AND KNOT FREE WITH THE RUNGS LET INTO THE STYLES. LADDERS TO BE INSPECTED BY A COMPETENT PERSON PRIOR TO USE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL LADDERS ARE DESIGNED FOR THE PURPOSE FOR WHICH IT IS INTENDED TO BE USED. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL LADDERS COMPLY WITH AT LEAST THE MINIMUM STANDARDS SET OUT IN REGULATION 13A OF THE GENERAL SAFETY REGULATIONS OF 2003.
	RAIN	WATER ACCUMMULATION IN EXCAVATIONS	DROWNING	S	3	2	1	6	SUB-VALVE & FITTINGSS TO BE READILY AVAILABLE FOR DRAINAGE OF TRENCHES. WHERE POSSIBLE, TRENCHES TO BE DAYLIGHTED.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ADEQUATE STEPS ARE TAKEN TO PREVENT PERSONNEL FROM DROWNING DURING FLOODING OF PIPE TRENCHES WHICH MUST INCLUDE THE EASY ACCESS INTO AND OUT OF EXCAVATIONS, DAYLIGHTING TRENCHES AND THE PROVISION OF SUB-VALVE & FITTINGSS.
	OPEN EXCAVATIONS	FALLING INTO OPEN EXCAVATIONS	INJURY AND POSSIBLE FATALITY	S	4	3	2	9	CONSTRUCTION SITE TO BE BARRICADED FROM THE PUBLIC WITH PIPE MARKERS. BARRIER NEETING NEED TO BE AVAILABLE FOR BARRICADING IMMEDIATE SURROUNDINGS OF EXCAVATIONS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ADEQUATE STEPS ARE TAKEN TO PREVENT PERSONS FROM FALLING INTO EXCAVATIONS WHICH INCLUDES THE ERECTING OF PIPE MARKERS AND BARRIER NETTING.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	BACKFILLING OF PIPE TRENCH WITH SUITABLE MATERIAL	WORKING IN CLOSE PROXIMITY TO OTHERS	HEAD & BODILY INJURIES WITH POSSIBLE FATALITIES	S	4	3	2	9	THERE NEEDS TO BE A SUITABLE WORKING SPACE BETWEEN EMPLOYEES TO AVAID THE RISK OF INJURING EACH OTHER. A SAFE WORKING DISTANCE OF AT LEAST 1,5 METRES FROM THE END OF THE TOOL TO THE NEXT EMPLOYEE SHOULD BE OBSERVED.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE IS SUFFICIENT WORKSPACE FOR ALL EMPLOYEES WORKING IN THE AREA.
	COMPACTION OF BACKFILL WITH SMALL COMPACTION PLANT COMPACTION OF BACKFILL WITH SMALL COMPACTION PLANT	DEFECTIVE PLANT	HAND & BODILY INJURIES	S	3	2	1	6	ALL EQUIPMENT TO BE INSPECTED BY THE AUTHORISED USER AND SERIOUS DEVIATIONS TO BE ADDRESSED PRIOR TO USE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE PLANT IS OF SOUND CONDITION AND INSPECTED BY THE OPERATOR PRIOR TO USE.
		UNTRAINED OPERATOR	HAND & BODILY INJURIES	S	3	2	1	6	ALL EQUIPMENT TO BE OPERATED BY TRAINED AND COMPETENT PERSONNEL	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE PLANT IS OPERATED BY PERSONNEL WHO HAVE UNDERGONE TRAINING BY THE PLANT HIRE COMPANY AND ARE DEEMED COMPETENT TO OPERATE SUCH EQUIPMENT.
		VIBRATION	LOSS OF SENSITIVITY IN FINGERS AND ACING TENDONS & LIGAMENTS	H	3	2	1	6	GLOVES TO BE ISSUED TO ALL PERSONNEL HANDLING SMALL PLANT	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT GLOVES ARE WORN BY EMPLOYEES USING SMALL PLANT.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
		NOISE	NOISE INDUCED HEARING LOSS	H	3	2	1	6	EAR PLUGS TO BE ISSUED TO ALL PERSONNEL HANDLING SMALL PLANT	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT EAR PLUGS ARE WORN BY EMPLOYEES USING SMALL PLANT.
		DUST	RESPIRATORY PROBLEMS	H	3	2	1	6	DUST MASKS TO BE ISSUED TO ALL PERSONNEL HANDLING SMALL PLANT. WATER TO BE USED TO SUPPRESS THE DUST.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT DUST MASKS ARE WORN BY EMPLOYEES USING SMALL PLANT.
CONSTRUCTION OF FOUNDATIONS & FLOOR SLABS	CUTTTING STEEL MESH TO SIZE USING A BOLT CUTTER	USE OF BOLT CUTTER AND HANDLING STEEL MESH.	BRUISES AND SCRATCHES	S	3	2	1	6	HAND TOOLS INSPECTOR TO BE APPOINTED TO INSPECT ALL HAND TOOLS ON SITE. GLOVES TO BE ISSUED TO ALL PERSONNEL HANDLING STEEL MESH.	THE HAND TOOLS INSPECTOR TO ENSURE THAT ALL HAND TOOLS ARE INSPECTED REGULARLY, AND DEFECTIVE TOOLS ARE IMMEDIATELY REMOVED FROM SERVICE AND REPLACED. EMPLOYEES INSTRUCTED WEAR APPROPRIATE PPE AND TO FOCUS ON TASK AND PATH.
	PLACEMENT OF STEEL MESH	LOWERING STEEL MESH INTO POSITION.	BRUISES AND SCRATCHES	S	3	2	1	6	ROPES TO BE USED TO LOWER STEEL INTO POSITION. ALL EMPLOYEES TO BE ISSUED WITH AND INSTRUCTED TO WEAR GLOVES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT EMPLOYEES WEAR THEIR PPE.
	DELIVERY OF CONCRETE	REVERSING ON SITE	EMPLOYEES RUN OVER BY CONCRETE SPINNER TRUCKS.	S	4	3	2	9	A STAGING CLERK TO BE POSTED TO GUIDE CONCRETE TRUCKS SAFELY INTO POSITION.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE IS SAFE ACCESS FOR THE CONCRETE TRUCKS TO DELIVER CONCRETE.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	DISCHARGING OF CONCRETE INTO EXCAVATION FOR FOUNDATIONS	INCORRECT OPERATION OF SPINNER TANK	CONCRETE SPILLS	E	3	2	1	6	CONCRETE TO BE DISCHARGE THROUGH THE CHUTES AND OPERATED BY TRAINED PERSONNEL.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE DISCHARGE OF CONCRETE TAKES PLACE UNDER THE SUPERVISION OF TRAINED PERSONNEL.
	CASTING OF CONCRETE BASES	WORKING WITH CONCRETE	DERMATITUS	H	3	2	1	6	ALL EMPLOYEES WORKING WITH WET CONCRETE TO WEAR GLOVES AND GUM BOOTS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL PERSONNEL ARE ISSUED WITH AND INSTRUCTED TO WEAR APPROPRIATE PPE.
	FLOATING OF CONCRETE	POSITIONING OF EMPLOYEE	BACK INJURIES (ERGONOMICS)	S	3	2	1	6	EMPLYEES FLOATING CONCRETE MUST BEND THEIR KNEES AND NOT THEIR BACKS WHEN WORKING WITH CONCRETE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL PERSONNEL ARE TRAINED ON ERGONOMICS (POSITIONING) WHICH MUST BE COVERED IN THE INDUCTION.
		CONCRETE SPLASHES MAKING CONTACT WITH EYES.	EYE IRRITATIONS	S	3	2	1	6	ALL EMPLOYEES TO BE ISSUED WITH SAFETY GLASSES WHEN WORKING WITH CONCRETE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT EMPLOYEES WEAR THEIR SAFETY GLASSES WHEN WORKING WITH CONCRETE.

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BUILDING WORK		WORKING IN CLOSE PROXIMITY TO OTHERS	HEAD & BODILY INJURIES WITH POSSIBLE FATALITIES	S	4	3	2	9	THERE NEEDS TO BE A SUITABLE WORKING SPACE BETWEEN EMPLOYEES TO AVAID THE RISK OF INJURING EACH OTHER. A SAFE WORKING DISTANCE OF AT LEAST 1,5 METRES FROM THE END OF THE TOOL TO THE NEXT EMPLOYEE SHOULD BE OBSERVED.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE IS SUFFICIENT WORKSPACE FOR ALL EMPLOYEES WORKING IN THE AREA.
	DELIVERY OF BRICKS	IMPROPER STACKING & STORAGE	STACKS COLLAPSE CAUSING INJURY AND POSSIBLE FATALITIES	S	4	3	2	9	A COMPETENT STACKING & STORAGE SUPERVISOR TO BE APPOINTED. ALL STACKING AND STORAGE TO BE CARRIED OUT IN ACCORDANCE WITH GSR 8 AND CR 28	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL STACKING & STORAGE ON SITE TAKES PLACE UNDER THE SUPERVISION OF A COMPETENT AND APOINTED STACKING & STORAGE SUPERVISOR. ALL STACKS MUST BE CORDONED OFF AND PLACED ON LEVEL GROUND.

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	BROKEN BRICKS AND STRAPS	POOR HOUSEKEEPING	TRIPS AND FALLS	S	3	2	1	6	A HOUSEKEEPING SUPERVISOR TO BE APPOINTED TO ENSURE THAT THE SITE AND SITE CAMP IS KEPT CLEAN AT ALL TIMES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT HOUSEKEEPING BECOMES EVERYONES RESPONSIBILITY AND MUST BECOME PART OF THE DAILY TASKS.
	LAYING OF BRICKS	BRICKLAYER NOT FOCUSED ON TASK	hand and foot injuries	S	3	2	1	6	BRICKLAYERS TO FOCUS ON TASK AND PATH. ALL PERSONS HANDLING BRICKS MUST BE ISSUED WITH AND INSTRUCTED TO WEAR GLOVES & STEEL TOE CAP SAFETY BOOTS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL PERSONNEL WORKING WITH BRICKS ARE ISSUED WITH AND INSTRUCTED TO WEAR THE APPROPRATE PPE AND THEY FOCUS ON THEIR TASK AND PATH.
	ASSISTANTS PASSING BRICKS TO BRICKLAYERS	MISCOMMUNICATION BETWEEN BRICKLAYER & ASSISTANT.	HAND AND BODILY INJURIES	S	3	2	1	6	BRICKS TO BE PASSED HAND TO HAND AND NOT THROWN TO THE BRICKLAYERS. ALL PERSONS HANDLING BRICKS MUST BE ISSUED WITH AND INSTRUCTED TO WEAR GLOVES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL PERSONNEL WORKING WITH BRICKS ARE ISSUED WITH AND INSTRUCTED TO WEAR GLOVES AND BRICKS MUST BE PASSED HAND TO HAND TO EACH OTHER WITH EMPLOYEES FOCUSING ON TASK AND PATH.
	MIXING OF MORTAR	DRY CEMENT POWDER	EYE IRRITATIONS, RESPIRATORY PROBLEMS AND AIR POLLUTION	S H E	3 3 3	2 2 2	1 1 1	6 6 6	ALL EMPLOYEES TO BE ISSUED WITH AND INSTRUCTED TO WEAR DUST MASKS AND SAFETY GLASSES WHEN WORKING WITH DRY CEMENT POWDER. CEMENT POWDER IS NOT BE USED IN WINDY CONDITIONS	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL EMPLOYEES ARE TRAINED ON THE MSDS FOR CEMENT AND WEAR THE APPROPRIATE PPE. THE PRINCIPAL CONTRACTOR MUST ENSURE THAT DRY CEMENT POWDER IS NOT USED DURING WINDY CONDITIONS

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		MIXING ON BARE GROUND	GROUND CONTAMINATION	E	3	2	1	6	ALL MIXING OF MORTAR OR SIMILAR CEMENT PRODUCTS TO TAKE PLACE ON PLASTIC SHEETING OR MIXING BOARDS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL MIXING OF MORTAR OR SIMILAR PRODUCTS ARE DONE ON AN IMPERMEABLE SURFACE.
	RAISING HIGH WALLS	WORKING AT HEIGHTS	BRICKLAYERS FALLING FROM HEIGHTS	S	4	3	2	9	SCAFFOLDING TO BE USED TO GAIN ACCESS TO ELEVATED POSITIONS. ALL SCAFFOLDING TO BE ERECTED IN ACCORDANCE WITH SANS 10085 STANDARDS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE SCAFFOLDING IS ERECTED BY COMPETENT SCAFFOLD ERECTORS AND UNDER THE CONSTANT SUPERVISON OF A COMPETENT SCAFFOLD SUPERVISOR AND THEN FINALLY INSPECTED BY A COMPETENT SCAFFOLDING INSPECTOR.
	ERECTING ACCESS SCAFFOLDING	UNTRAINED PERSONNEL	SCAFFOLD COLLAPSE CAUSING INJURIES TO PERSONNEL WITH POSSIBLE FATALITIES AND DAMAGE TO PROPERTY	S	4	3	2	9	ALL SACFFOLDING TO BE ERECTED, SUPERVISED AND INSPECTED BY TRAINED, COMPETENT AND APPOINTED PERSONNEL. ALL SCAFFOLDING TO COMPLY WITH SANS 10085 STANDARD.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE ARE SUFFICIENT NUMBER OF EMPLOYEES TRAINED ON SCAFFOLD ERECTION AND THAT THE ERECTING OF SCAFFOLDING IS CONSTANTLY SUPERVISED BY THE SCAFFOLDING SUPERVISOR. ONCE THE SCAFFOLDING HAS BEEN ERECTED, IT MUST BE INSPECTED BY THE SCAFFOLDING INSPECTOR AND TAGGED SAFE / UNSAFE FOR USE. THE SCAFFOLDING CAN ONLY BE ACCESS WHEN IT IS SAFE TO DO SO.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	WORKING AT HEIGHTS	UNTRAINED PERSONNEL	FALL FROM HEIGHTYS CAUSING INJURIES AND POSSIBLE FATALITIES	S	5	4	3	12	A COMPETENT PERSON TO BE APPOINTED TO DRAW UP A FALL PROTECTION PLAN. ALL SITE PERSONNNEL TO BE TRAINED ON THE FALL PROTECTION PLAN.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL EMPLOYEES WORKING AT HEIGHTS ARE TRAINED ON THE FALL PROTECTION PLAN AS A MINIMUM REQUIREMENT. ADDITIONAL ACCREDITED TRAINING MAY BE REQUIRED IF NECESSARY, IN ACCORDANCE WITH UNIT STANDARD 22998 / 120362.
		UNPROTECTED EDGES	FALL FROM HEIGHTYS CAUSING INJURIES AND POSSIBLE FATALITIES	S	5	4	3	12	ALL EDGES TO BE PROTECTED IN THE FORM OF HAND RAILS & KNEE RAILS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ADEQUATE STEPS ARE TAKEN TO PREVENT PERSONNEL FROM FALLING OVER THE EDGE.
		NO FALL PROTECTION	FALL FROM HEIGHTS CAUSING INJURIES AND POSSIBLE FATALITIES	S	5	4	3	12	ALL EMPLOYEES WORKING AT HEIGHTS TO BE PROVIDED WITH, TRAINED AND INSTRUCTED TO WEAR DOUBLE LANYARD SAFETY HARNESSES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL EMPLOYEES WORKING AT HEIGHTS WEAR AND ATTACH THEIR SAFETY HARNESS WHEN WORKING OR MOVING FROM ONE POSITION TO ANOTHER.
		FALLING OBJECTS	ITEMS FALLING FROM HEIGHTS CAUSING HEAD INJURIES AND POSSIBLE FATALITIES	S	5	4	3	12	ALL SITE PERSONNEL TO BE INSSUED WITH AND INSTRUCTED TO WEAR HARD HATS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL SITE PERSONNEL WEAR HARD HATS WHILE ON SITE.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	FIXNG STEEL	UNTRAINED PERSONNEL	CUTS & BRUISES	S	3	2	1	6	ALL STEEL TO BE FIXED BY TRAINED AND COMPETENT PERSONNEL. PPE INCLUDING GLOVES TO BE MADE READILY AVAILABLE ON SITE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT STEEL FIXING IS CARRIED OUT BY TRAINED & COMPETENT PERSONNEL. EMPLOYEES MUST BE INSTRUCTED WEAR APPROPRIATE PPE AND TO FOCUS ON TASK AND PATH.
	ERECTING SHUTTERS	UNTRAINED PERSONNEL	HAND & FOOT INJURIES	S	3	2	1	6	A TEMPORARY WORKS SUPERVISOR TO BE APPOINTED TO SUPERVISE THE SHUTTER WORK. ALL SHUTTERS TO BE FIXED BY TRAINED AND COMPETENT PERSONNEL. PPE INCLUDING GLOVES TO BE MADE READILY AVAILABLE ON SITE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT FIXING OF SHUTTERS IS CARRIED OUT BY TRAINED & COMPETENT PERSONNEL AND UNDER THE SUPERVISON OF A COMPETENT AND APPOINTED TEMPORARY WORKS SUPERVISOR. EMPLOYEES MUST BE INSTRUCTED WEAR APPROPRIATE PPE AND TO FOCUS ON TASK AND PATH.
	ERECTING SHUTTERS	COLLAPSE OF ERECTED SHUTTERING	HEAD & BODILY INJURIES WITH POSSIBLE FATALITIES	S	4	3	2	9	A TEMPORARY WORKS DESIGNER & INSPECTOR TO BE APPOINTED TO DESIGN AND INSPECT THE SHUTTER WORK BEFORE POURING THE CONCRETE AND BEFORE STRIPPING AFTER THE CONCRETE IS CURED.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT A COMPETENT STRUCTURAL ENGINEER IS APPOINTED TO DESIGN AND INSPECT THE SHUTTER/FORM/TEMPORARY WORKS. A DRAWING OF THE TEMPORARY WORKS MUST BE MADE AVIALABLE ON SITE FOR USE BY THE CONTRACTOR, ENGINEERS AND INSPECTORS.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	DELIVERY OF CONCRETE	REVERSING ON SITE	EMPLOYEES RUN OVER BY CONCRETE SPINNER TRUCKS.	S	4	3	2	9	A STAGING CLERK TO BE POSTED TO GUIDE CONCRETE TRUCKS SAFELY INTO POSITION.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THERE IS SAFE ACCESS FOR THE CONCRETE TRUCKS TO DELIVER CONCRETE.
	DISCHARGING OF CONCRETE INTO SHUTTERING	INCORRECT OPERATION OF SPINNER TANK	CONCRETE SPILLS	E	3	2	1	6	CONCRETE TO BE DISCHARGE THROUGH THE CHUTES AND OPERATED BY TRAINED PERSONNEL.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE DISCHARGE OF CONCRETE TAKES PLACE UNDER THE SUPERVISION OF TRAINED PERSONNEL.
	SETTLING CONCRETE USING VIBRATING NEEDLE	USE OF DRIVE UNIT & VIBRATING NEEDLE	HAND AND BODILY INJURIES	S	3	2	1	6	THE VIBRATING NEEDLE TO BE OPERATED BY TRAINED AND COMPETENT PERSONNEL. PPE INCLUDING GLOVES TO BE MADE READILY AVAILABLE ON SITE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT VIBRATING OF CONCRETE IS CARRIED OUT BY TRAINED & COMPETENT PERSONNEL. EMPLOYEES MUST BE INSTRUCTED WEAR APPROPRIATE PPE AND TO FOCUS ON TASK
			FUEL / OIL SPILLS	E	3	2	1	6	ALL EQUIPMENT TO BE INSPECTED BY A COMPETENET PERSON AND SERIOUS DEVIATIONS TO BE ADDRESSED PRIOR TO USE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT THE EQUIPMENT IS IN SOUND CONDITION WITH NO OIL OR FUEL LEAKS.

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Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
			FIRE	S	3	2	1	6	SUITABLE AND SUFFICIENT FIRE EQUIPMENT TO BE MADE AVAILABLE WITHIN 5 METRES OF PETROL DRIVEN PLANT.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT AN ADEQUATE NUMBER OF EMPLOYEES ARE TRAINED ON THE SAFE USE OF FIRE EXTINGUISHERS. ALL FIRE EQUIPMENT MUST BE INSPECTED BY A COMPETENT PERSON APPOINTED IN WRITING FOR THAT PURPOSE.
	FLOATING OF CONCRETE	POSITIONING OF EMPLOYEE	BACK INJURIES (ERGONOMICS)	S	3	2	1	6	EMPLYEES FLOATING CONCRETE MUST BEND THEIR KNEES AND NOT THEIR BACKS WHEN WORKING WITH CONCRETE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL PERSONNEL ARE TRAINED ON ERGONOMICS (POSITIONING) WHICH MUST BE COVERED IN THE INDUCTION.
BUILDING WORK	APPLYING CONCRETE CURING COMPOUND	CONTACT WITH HAZARDOUS CHEMICAL	EYE & SKIN IRRITATION	S	3	2	1	6	ALL EMPLOYEES WORKING WITH HAZARDOUS CHEMICALS TO BE TRAINED ON THE RELEVANT MSDS PRIOR TO WORKING WITH IT. ALL EMPLOYEES TO BE ISSUED WITH AND INSTRUCTED TO WEAR APPROPRIATE PPE PRIOR TO THE USE OF HAZARDOUS CHEMICALS, INCLUDING DUST MASKS, SAFETY GLASSES AND PVC GLOVES.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL PERSONNEL ARE TRAINED ON THE RELEVANT MSDS AND PPE IS BEING WORN BY THE EMPLOYEES WORKING WITH HAZARDOUS CHEMICALS.

Baseline Risk Assessment

Primary Activity	Secondary Activity	Potential Hazard	Risk / Possible Result	H S E	Probability	Severity	Expose	Ranking / Rating	Preventative Measures	Control Measures
	STRIPPING OF FORMWORK (TEMPORARY WORKS)	PREMATURE COLLAPSE OF STRUCTURE	MULTIPLE INJURIES INCLUDING FATALITIES.	S	5	4	3	12	STRIPPING OF FORMWORK TO ONLY TAKE PLACE UPON THE WRITTEN APPROVAL OF THE TEMPORARY WORKS INSPECTOR.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT NO TEMPORARY WORKS ARE INTERERED WITH UNTIL AUTHORISED IN WRITING BY THE TEMPORARY WORKS INSPECTOR.
	ELECTRICAL INSTALLATION	ELECTRICAL WORK	ELECTROCUTION	S	5	4	3	12	ALL ELECTRICAL WORK TO BE CARRIED BY AN APPROVED ELECTRICAL CONTRACTOR.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY APPOINTED CONTRACTORS CARRY OUT ANY ELECTRICAL WORK. ALL ELECTRICAL INSTALLATIONS MUST BE CARRIED OUT IN ACCORDANCE WITH THE LECTRICAL INSTALLATIONS REGULATIONS OF 2009.
		UNTRAINED EMPLOYEES	ELECTROCUTION OR INJURY	S	5	4	3	12	ALL WELDING AND CUTTING TO BE DONE BY CERTIFIED WELDERS.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ONLY COMPETENT AND APPOINTED WELDERS CARRY OUT ANY FABRICATION WORK.
	STORAGE OF ACETELYNE GAS	IMPROPER STORAGE	FIRE OR EXPLOSIONS	S	5	4	3	12	ALL GAS TO BE STORED IN A WELL VENTILATED AND LOCKABLE STORE.	THE PRINCIPAL CONTRACTOR MUST ENSURE THAT ALL GAS IS STORED IN ACORDANCE WITH

Note:

This Baseline Risk Assessment serves as a guideline to assist the contractor in identifying hazards and risks on site and control measures that could be taken to reduce if not eliminate the risk. The contractor may choose to use other methods to mitigate the risks on site. It is the responsibility of the contractor to carry out their own site-specific risk assessment which could address risks not identified in the baseline risk assessment. The contractor must comply with Regulation 9 of the Construction Regulations of 2014 with regards to the risk assessments.

Compiled by:

_____ 09th September 2022

Signature Date

Ugu District Municipality

DR Safety Consultants

Covid-19 Health & Safety Specifications

for

The Construction of the Backwash Water Recovery Facility at the Bhobhoyi Waterworks.

Prepared By: DR Safety Consultants

COVID-19 Health & Safety Specifications

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1. Introduction

COVID-19 Health & Safety Specifications

Coronavirus Disease 2019 (COVID-19) is a respiratory disease caused by the SARS-CoV-2 virus. The symptoms of the COVID-19 are similar in nature to that of the common flu but are much more extreme. To reduce the impact of COVID-19 outbreak conditions on the organization, employees, clients, and the public, it is important to set out a strategy / plan to address the specific exposure risks, sources of exposure, routes of transmission, and other unique characteristics of SARS-CoV-2 (i.e., compared to influenza virus outbreaks). Lack of continuity planning may result in a cascade of failures as the organization attempts to address challenges of COVID-19 with insufficient resources and employees who might not be adequately trained for jobs they may have to perform under pandemic conditions.

It is the duty of the Principal Contractor to compile a health a safety plan based on the client's specifications. The COVID-19 pandemic has introduced a new hazard to the workplace and therefore the current health & safety specifications are not adequately designed to prevent persons from contracting or spreading the Coronavirus. Planning must include administrative changes or development of new policies, procedures, plans and risk assessments.

2. Scope

The addendum to the health & safety specifications covers the procedures that must be implemented by the principal contractor and contractors during government's intervention with the COVID-19 risk adjusted strategy for economic activity. The procedures set out below must be incorporated into the scope of work which must form part of the normal activities performed by the contractor. Construction work is labour intensive and is therefore regarded as high-risk due to the close contact between employees.

3. Administrative

Employment contracts need to be reviewed to include, where necessary, revised working hours, remuneration and health & safety precautions to be taken into consideration due to the Covid-19 pandemic.

Based on the Covid-19 pandemic, a Risk Assessment must be developed to include the following:

i. A List of Activities to be performed by the employees;
ii. Identification of the Hazards Associated with each activity;
iii. Analysing the Risk Associated with each Hazard;
iv. Implementation of Control Measures to Mitigate or Reduce the Risks;
v. Delegation of Responsible persons to address the Control Measures.

Risk Assessments must include, but not limited to:

i. Transportation of Employees (Public Transport / Transport provided by the employer);
ii. Access into the Workplace;
iii. Placement of workers into their workstations / work areas;
iv. Working Hours, Tea Breaks and Lunch Breaks;
v. Employee Welfare Facilities (Toilets, Showers, Changerooms, Eating Areas, etc);
vi. Emergency Procedures (Infected Employees, First-Aid, Evacuation, etc); and

vii. Communication with employees.

The following hierarchy of controls must be considered when compiling the risk assessment:

i. Engineering Controls (Isolating employees from work-related hazards by installing Physical Barriers / Shields, etc)
ii. Administrative Controls (Changes in work policy or procedures to reduce or minimize exposure to a hazard)
iii. Safe Work Practices / Procedures (Procedures used to reduce the duration, frequency, or intensity of exposure to a hazard, i.e. social distancing, etc.)
iv. Personal Protective Equipment – PPE (Last Resort should other controls be inadequate)

The new risk assessments must be submitted to the Client's Health & Safety Agent for approval. Once approved, the risk assessments must be communicated to the employees prior to commencing work on site.

Policies must be reviewed to incorporate the prevention of contact with and the spread of Coronavirus or similar diseases / viruses.

The Health & Safety Plans must be revised to incorporate these specifications and include a plan to prevent contact with and or contain the spread of the Covid-19 pandemic.

Evacuations plans must be updated to incorporate the COVID-19 pandemic and employees must be required to maintain social distancing while evacuating and assembling at emergency assembly points.

Employees who do not comply with the rules or those who contribute to the spread of the Coronavirus must be disciplined which may lead to dismissal and possible prosecution by authorities.

4. Responsibilities

In terms of Section 8 (1) of the Occupational Health & Safety Act, 85 of 1993:

8. General duties of employers to their employees

(1) Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees.

Client – Employer	: Compensate the contractor for any additional costs incurred due to the implementation of the prevention of contact with and spread of the COVID-19 pandemic. (This may include but not limited to the supply of additional PPE, Sanitizers, Physical Barriers, administrative costs, training, signage and loss of production due to new work practices and social distancing).

In light of the above, The Principal Contractor must delegate the responsibilities to the various competent appointed persons within the organization and should be as follows.

CEO – OHSA 16 (1)	: Set out the policies & procedures for addressing the prevention of contact with or spreading of the Coronavirus.

Contracts Manager – OHSA 16 (2) : Ensure that policies and procedures are implemented at the various sites allocated to him / her.

NB: The persons listed below must be on site full-time.

SHE Representative – OHSA 17 (1) : Assists employees in complying with the policies and procedures and is the Liaison between the employees and the employer.

Construction Manager – CR 8 (1) : Enforces the implementation of the policies and procedures on his / her site. Also appointed as the COVID-19 Manager in terms of Section 16 (5) of Disaster Management Act, 57 of 2002.

Assistant Construction Manager – CR 8 (2) : Assists the CR 8 (1) in enforcing the implementation of the policies and procedures.

Construction Health & Safety Officer – CR 8 (5) : Develops the procedures and assists the employer and employees in complying with the policies and procedures. Also appointed as the COVID-19 Compliance officer to monitor the controls set out by the principal contractor and co-ordinate emergencies.

Construction Supervisor – CR 8 (7) : Enforces the implementation of the policies in his / her work area.

Assistant Construction Supervisor – CR 8 (8): Assists the CR 8 (7) in enforcing the implementation of the policies in that work area.

Risk Assessor – CR 9 (1) : Compiles a COVID-19 Risk assessment with the assistance from management and employee representatives and ensure that it is communicated to the employees.

To prevent unnecessary appointment of new employees, the current employees on site must be appointed to monitor and maintain the implementation of policies, plans, procedures and risk assessments.

5. Procurement

The Principal Contractor must procure the following:

- Services of an Occupational Health & Safety Professional to compile the required documentation and conduct training of employees. The Principal Contractor can utilize his / her own resources provided that the appointed person is registered with the SACPCMP in the Health & Safety Profession and at least one other occupational health & safety statutory body established in terms of Section 2 of the Project and Construction Management Act, No. 48 of 2000 (SAIOSH, IOSH, IOSM, etc).
- 70 % Alcohol based hand sanitizers for all entrances, offices, workstations, plant and welfare facilities;
- Disinfectants for surfaces, tools, plant, etc;

- 3 Ply Washable cloth face masks (Minimum of 2 per employee);
- FFP2 type masks and additional latex gloves for first-aiders
- Safety glasses to prevent droplets making contact with the eyes;
- Face Shields where social distancing is inadequate;
- Infrared Thermometers (Non-contact) for temperature screening;
- COVID-19 Awareness Posters & Signage;
- Additional security, where justified, to secure site entrances;
- Provision of an area or room to isolate employees showing symptoms of COVID-19.
- Bio-Hazard waste bins and provisions for safely disposing of waste.

The Construction Manager must ensure that there is adequate additional PPE for the COVID-19 pandemic. First-aiders must be required to wear the FFP2 type masks in addition to the latex gloves when attending to patients.

A preventative team must be established to ensure that all tools and equipment used on site are disinfected accordingly (70% JIK with 30% water can be used) to prevent the potential spread of COVID-19 virus.

6. Who must report for duty?

a) The Principal Contractor must ensure that employees who are most vulnerable to the Coronavirus must be the last to resume work on site and only when permitted by government. The return of employees to work must be staggered to prevent the sudden influx of staff. The essential employees must be first orientated into the workplace thereafter followed by support staff.

The following must be considered when selecting employees:

- The need / urgency for the employee to return to work;
- The age of the employee (employees 60 years and older must not be allowed to immediately resume work);
- The employee's current health condition based on their most recent Occupational Health Medicals (employees with respiratory problems or have chronic illnesses such as TB, Cancer, Diabetes, etc, must not be allowed to immediately resume work);
- Employees who have, or been in contact with a person who has, the symptoms of the Coronavirus (High Fever - 38ºC or higher, persistent cough, sore throat, difficulty in breathing). Only employees who test negative for the COVID-19 must be allowed to resume work (Employees must need to first self-isolate then get tested).

7. Screening

Non-contact Thermometers must be used by security personnel at the site entrances to monitor employees body temperatures before entry and before exiting the construction site on a daily basis. A daily questionnaire regarding the person's movements and current health condition must be completed for each person entering the site. It must be compulsory for all employees and visitors to complete a health declaration form before access is granted onto site. Employees showing signs of the Coronavirus

must be immediately sent to the site isolation room / designated area and the necessary authorities must be contacted for instructions and further medical attention. **An area must be designated on site for isolation of employees who have the symptoms of COVID-19.**

If an employee develops a high temperature or a persistent cough while at work, they must be required to:

- Maintain a 2m distance from all other people and isolate until they are able to leave the workplace.
- Inform their manager and supervisor and get directive from them in terms of what to do.
- Not touch any surfaces (door handles, counter tops, tools, etc).
- Cough or sneeze into a tissue and put it in a bin, or if they do not have tissues, cough and sneeze into the crook of their elbow.

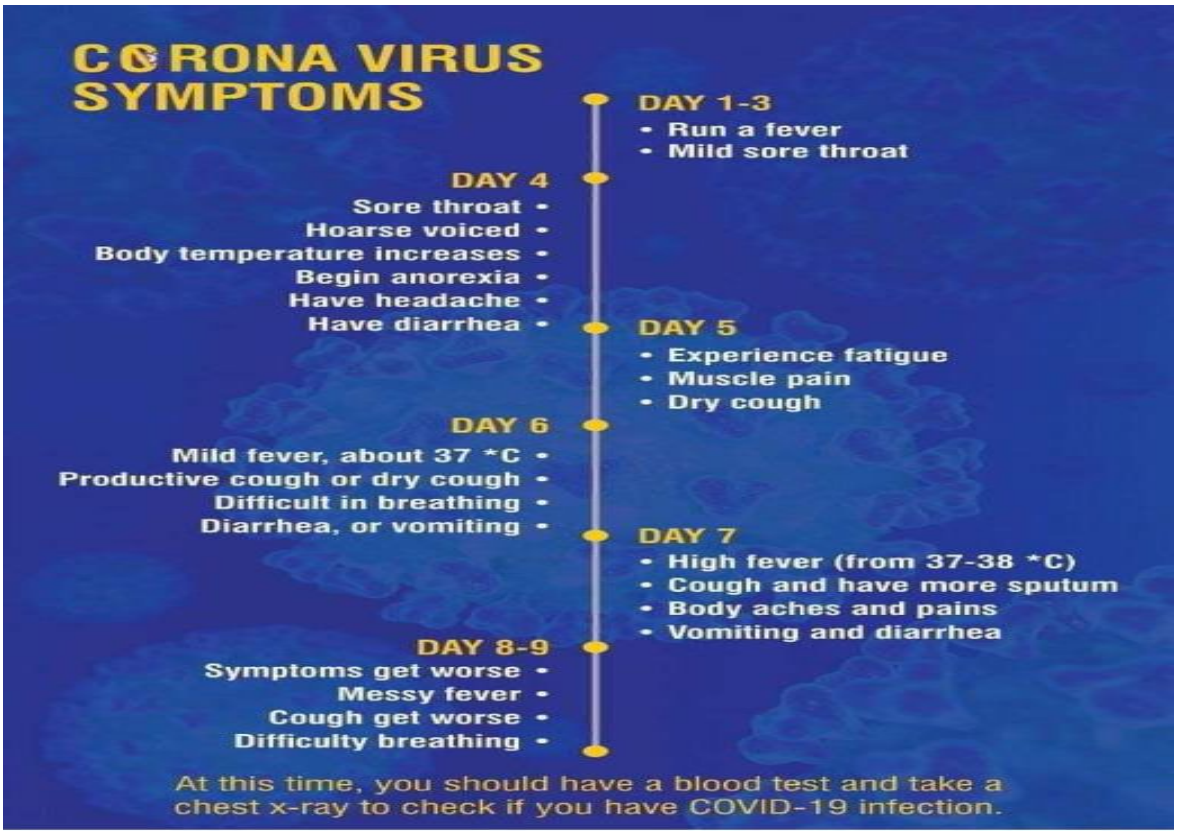
The Principal Contractor must keep on site all contact details (Cell Numbers, Physical Addresses, etc) of all employees or persons entering the site for the tracing by the Department of Health.

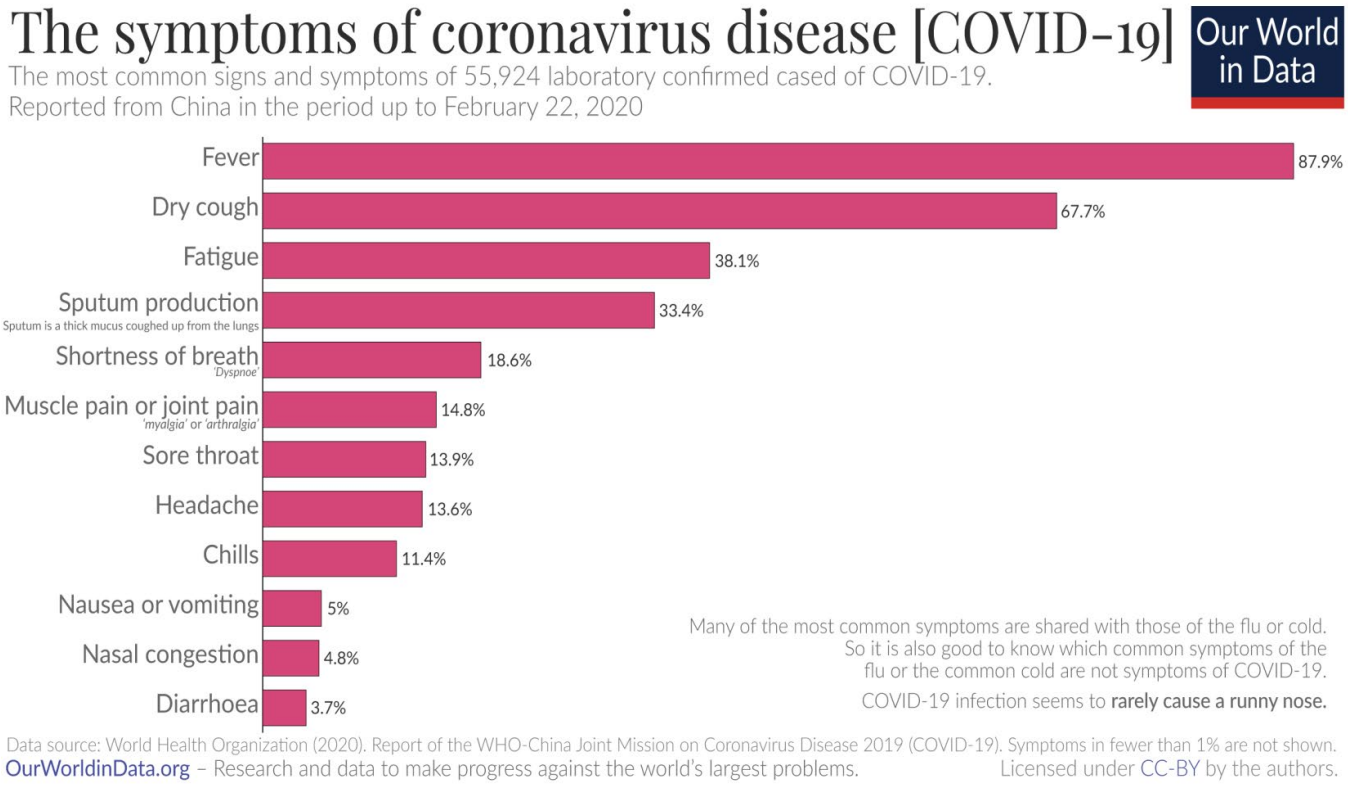
If a person has high fever and the symptoms of the COVID-19:

- The infected person must be safely escorted to and isolated or quarantined in a facility (room or area) provided on site for this purpose.
- This facility must be decontaminated on a regular basis or at least prior to the start of each shift.
- The facility must be well ventilated with adequate signage and controlled to prevent the unauthorised entrance of persons.
- Emergency contact details of the local health care facility and Department of Health to be on hand and must be contacted when a person displays symptoms of the Coronavirus.
- The person must be safely transported to the healthcare facility for further testing and treatment thereof.

The person may only return to work when he / she tests negative and is placed in quarantine for 14 days before returning to work. The Principal Contractor must continually monitor this person for symptoms of the Coronavirus.

If a person passes the screening process, i.e. no symptoms of COVID-19 and temperature below 37.5ºC must be required to sanitize their hands and enter the site while wearing a cloth face mask and maintaining social distancing.


CORONA VIRUS SYMPTOMS
DAY 1-3
• Run a fever
• Mild sore throat
DAY 4
Sore throat •
Hoarse voiced •
Body temperature increases •
Begin anorexia •
Have headache •
Have diarrhea •
DAY 5
• Experience fatigue
• Muscle pain
• Dry cough
DAY 6
Mild fever, about 37 *C •
Productive cough or dry cough •
Difficult in breathing •
Diarrhea, or vomiting •
DAY 7
• High fever (from 37-38 *C)
• Cough and have more sputum
• Body aches and pains
• Vomiting and diarrhea
DAY 8-9
Symptoms get worse •
Messy fever •
Cough get worse •
Difficulty breathing •
At this time, you should have a blood test and take a chest x-ray to check if you have COVID-19 infection.


The symptoms of coronavirus disease [COVID-19]
The most common signs and symptoms of 55,924 laboratory confirmed cased of COVID-19.
Reported from China in the period up to February 22, 2020
Our World in Data
Fever 87.9%
Dry cough 67.7%
Fatigue 38.1%
Sputum production 33.4%
Sputum is a thick mucus coughed up from the lungs
Shortness of breath 18.6%
'Dyspnoe'
Muscle pain or joint pain 14.8%
'myalgia' or 'arthralgia'
Sore throat 13.9%
Headache 13.6%
Chills 11.4%
Nausea or vomiting 5%
Nasal congestion 4.8%
Diarrhoea 3.7%
Many of the most common symptoms are shared with those of the flu or cold.
So it is also good to know which common symptoms of the flu or the common cold are not symptoms of COVID-19.
COVID-19 infection seems to rarely cause a runny nose.
Data source: World Health Organization (2020). Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19). Symptoms in fewer than 1% are not shown.
OurWorldinData.org – Research and data to make progress against the world's largest problems.
Licensed under CC-BY by the authors.

8. Site access

Notices must be placed at the site entry indicating that there will be “No Unauthorised Entry” Access to the site must be controlled by gates and manned guards which must be limited to one entry and exit point. These must be site specific, the number of entry and exit points for each site may vary however they must be controlled. All persons entering the site must wear and continue wearing a cloth face mask throughout the day while at work or in public. No person must be permitted on site without the relevant / required PPE. Access to the site must be limited to site personnel and deliveries, i.e. no visitors must be allowed unless part of the professional team. Suppliers must be informed on the requirements for entry to the site and the rules to be complied with prior to any deliveries taking place. Delivery vehicle operators must be instructed to follow the same protocol as that of the contractor’s employees. Employees must not be permitted to leave the site during the course of the day or during lunch & tea breaks and must limit contact with the general public. Employees must be encouraged to bring pre-prepared meals to work to avoid going to the local shops to buy food.



9. Washing Hands

Soap and water must be provided to employees and they must be encouraged to regularly wash their hands. Each person entering the site must be required to use hand sanitizers provided by the Principal Contractor at the entrances to the sites. The following process must be used when washing hands: arriving on site, before lunch, when leaving site; and when inadvertently touching another person or surface:



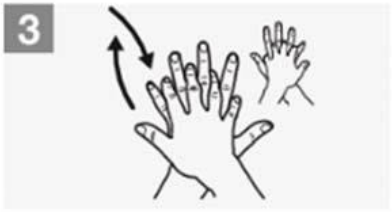
Wet hands with water;



Apply enough soap to cover all hand surfaces;



Rub hands palm to palm;



Right palm over left dorsum with interlaced fingers and vice versa;



Palm to palm with fingers interlaced;



Backs of fingers to opposing palms with fingers interlocked;



Rotational rubbing of left thumb clasped in right palm and vice versa;



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



Rinse hands with water;



Dry hands thoroughly with a single use towel;



Use towel to turn off faucet;



Your hands are now safe.



10. Sanitizing of the site

The Construction of the Backwash Water Recovery Facility at the Bhobhoyi Waterworks.

The Principal Contractor must ensure that all work surfaces, tools and machinery are sanitized using mist spray disinfectants. Where employees enter offices and enclosed workplaces, their shoes and hands must be sanitized. Hand sanitizers must be placed at strategic points around the site camp which must include the site office, storerooms, washing areas and eating areas. Soap must also be provided at all taps at the site camp. Hand sanitizers must also be placed inside all construction vehicles & mobile plant for use by the operators no other person must be permitted to enter the vehicle or plant unless carrying out services and repairs. The Principal Contractor must ensure that there is sufficient stock of 70 % Alcohol based hand sanitizers on site. Employees must be instructed to clean up their waste and eating areas immediately after they are done and not leave it for someone else to clear it which will reduce contact with contaminated surfaces. All cleaning material used to disinfect surfaces and used PPE must be disposed of into Bio-Hazard waste bins which must be clearly identifiable. These must be sent to a bio-hazard waste facility.



11. Social Distancing

All employees must be required to maintain a safe distance of at least 2 metres between each other. Tasks must be rearranged to incorporate social distancing in order to prevent the gathering of employees closer than two metres from each other and where gatherings are unavoidable, the period of contact must be reduced. Where social distancing is unavoidable, physical barriers must be put in place to prevent contact with other persons. The installation of physical barriers must first need to be discussed with the client as they must incur a major cost. The option of whether the task is necessary or not, must be determined by the practicality and cost of installing the barrier.

Delivery vehicle operators must be encouraged to remain in their vehicles and avoid contact with the contractor's employees except for receiving clerks who must sign off on the deliveries.

No unnecessary meetings must take place, either between managers or employees. Where meetings are unavoidable, only key participants must attend and attendees must maintain a safe distance of at least 2 metres between each other. Meetings must be held in open areas where possible.

Where possible, avoid professional meetings taking place at site offices. Conference calls or similar types of communication must be considered instead of holding site meetings.

12. Personal Protective Equipment (PPE)

a) All PPE must be issued free of charge to employees. All employees must be trained on the use, care and limitations of the PPE issued to them. In addition to the basic PPE issued to employees for construction work, they must also be issued with at least 2 washable cloth face masks. Wearing of the masks must be demonstrated to the employees. Where additional face protection is required, employees may be issued with and required to wear face shields. All employees must be required to wear suitable gloves for all tasks. The gloves must remain on the employees hands for the duration of each task and must only come off when the employee uses any welfare facilities and during tea & lunch breaks. Washing and sanitizing of hands must be required when gloves are removed and prior to putting them on again. The cloth/fabric face mask must comply with the recommended guidelines of fabric face masks for the Clothing and Textile Manufacturing Industry for General Public Use. (Refer to the attached)

The face mask does not substitute a dust mask which is used for the purpose of preventing contact with dust particles. SABS FFP 1 / FFP 2 type dust masks to be worn by employees when working in dusty conditions or must be worn by first aiders when attending to patients on site.

Employees must be required to sign acknowledgement on a register for each item of PPE issued to him or her.

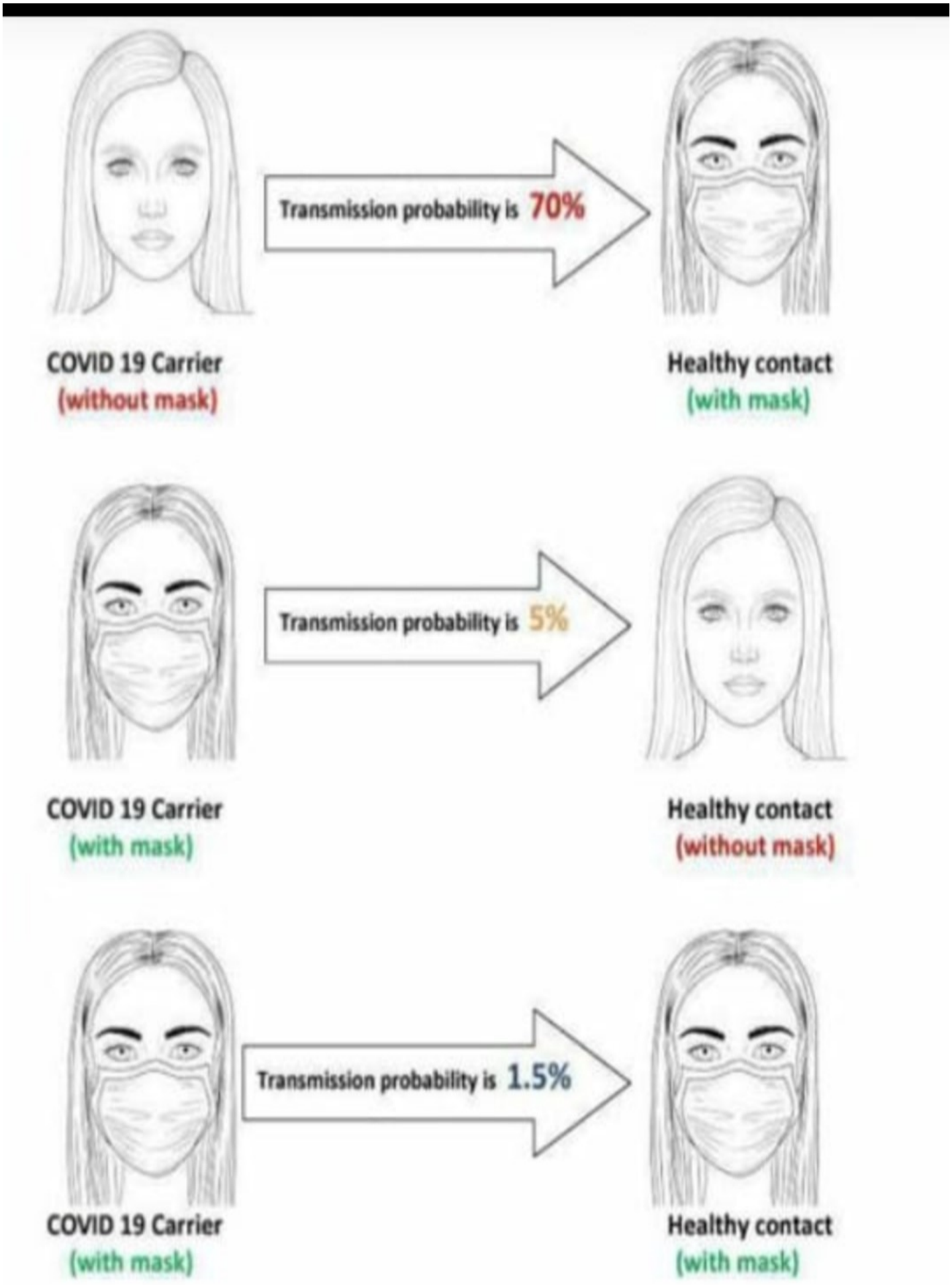
a) It is very important to note that in terms of Regulation 2 (2) of the General Safety Regulations of 1986, *"the employer or user of machinery, as the case may be, shall take steps to reduce the risk as much as is practicable, and* ***shall provide free of charge and maintain in a good and clean condition such safety equipment and facilities*** *as may be necessary to ensure that any person exposed to any such condition or situation at a workplace or in the course of his employment or on premises where machinery is used is rendered safe".* This basically states that it is the employer's duty and not that of the employee to maintain the PPE, i.e. the cloth/fabric face masks must be washed regularly and ironed before use.

b) Surgical masks are discouraged however it must be accepted only where cloth/fabric masks are unavailable. Where surgical masks are issued, they must be reissued when they become unhygienic.

c) Employees need to care for the masks to prevent the unnecessary re-issue of these masks.

13. Employee Welfare Facilities

Employees must be required to use facilities provided by the Principal Contractor. Employees must practise safe hygiene (Washing of hands regularly and sanitizing). Social distancing must also be observed when employees utilise these facilities. The use of welfare facilities must be controlled to prevent the unnecessary gathering of employees. This may include the possible staggering of work start and finish times and tea & lunch breaks. Portable toilets must be serviced more frequently by the service providers (at least twice a week). Eating areas must be reorganized such that a 2-metre distance can be maintained between each employee.


Transmission probability is 70%
COVID 19 Carrier
(without mask)
Healthy contact
(with mask)
Transmission probability is 5%
COVID 19 Carrier
(with mask)
Healthy contact
(without mask)
Transmission probability is 1.5%
COVID 19 Carrier
(with mask)
Healthy contact
(with mask)

14. Transportation of Employees

Where employees are transported to the site, the transportation of employees must be done from a designated area. The transportation of staff to site must be limited to only key personnel and the number of employees transported in a vehicle must be limited to 50% of the normal capacity. Note that the transportation of employees must be in accordance with Regulation 23 of the Construction Regulations of 2014 and the South African Roads Traffic Act.

Where staff use public transport to get to the site, employee awareness programs must be in place to inform employees of the precautions to be taken to avoid contact with and the spread of the Coronavirus while is public spaces.

15. Awareness

All employees must be contacted via cell-phone and requested to report for duty accordingly. They must be instructed to practice social distancing, sanitize and wear a cloth face mask when making their way to work. Staggered briefing sessions must be held regarding the resumption of work after or during the extended lockdown period.

Employees must be trained on the COVID-19 Policies, Plans, Safe Work Procedures and Risk Assessment. Additional Toolbox talks must be held at least once a week to discuss ways to prevent contact with or the spread of the Coronavirus. Toolbox talks to be held in small groups while maintaining social distancing.

Posters should be displayed on employee notice boards, wash areas and other employee facilities to create awareness about the prevention of contact with and the spread of the Coronavirus.

16. Reporting

The following reporting process must be followed.

- Employee reports to the immediate supervisor and Construction Health & Safety Officer;
- Supervisor reports to manager on site;
- Manager reports to the Department of Health



Note that the above are minimum requirements, and where the contractor intends on implementing stricter controls to contain / prevent the spread of the Coronavirus, it must be Risk Based and at the contractor's own discretion, provided that the minimum requirements are met.

COVID-19 Baseline Risk Assessment

Probability of Occurrence (P)	INJURY SEVERITY POTENTIAL (IS)	DAMAGE / LOSS SEVERITY (DS)	DURATION OF EXPOSURE (ED)	ERGONOMICS / ENVIRONMENT (E)	HEALTH (H)	Probability of Occurrence (P)	INJURY SEVERITY POTENTIAL (IS)	DAMAGE / LOSS SEVERITY (DS)	DURATION OF EXPOSURE (ED)	ERGONOMICS / ENVIRONMENT (E)	HEALTH (H)	Consequence (C)
Common Occurrence	Multiple Fatalities OR PERMANENT DISABILITIES	More than R 1 500 000	1<10> Days	Major	Major	5	5	5	5	5	5	21 - 30
Has Happened before	Fatal / Permanent Disability	R 500 000 to R 1 500 000	6<10> Hours	Serious	Serious	4	4	4	4	4	4	11 - 20
Could Occur	Moderate / Serious Injury	R 150 000 to R 500 000	3<6> Hours	Medium	Medium	3	3	3	3	3	3	
Not likely	Lost Time Injury	R 15 000 to R 150 000	1<3> Hour	Minor	Minor	2	2	2	2	2	2	6 - 10
Practically Impossible	Minor injury – No Lost Time	Less than R 15 000	< 1 Hour	None	None	1	1	1	1	1	1	

CURRENT RISK										REMEDIAL	RISIDUAL							ACTION	
Task Steps	HAZARD IDENTIFIED	RISK ASSOCIATED WITH HAZARD	P	IS	DS	ED	E	H	C	HOW IS HAZARD TO BE DEALT WITH	P	IS	DS	ED	E	H	C	BY WHOM	BY WHEN
Arrival at office / workshop to report for duty.	COVID-19 Infected Employee	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	All employees instructed by government to wear face masks and practice social distancing. Construction Manager instructs employees to wear face masks when arriving to work and monitors social distancing.	2	2	2	2	2	2	12	Construction Manager / Access Controller (Security)	On arrival at the office / workshop
Screening for COVID-19.	Tests not conducted / employees enter office / workshop without being screened. Employee has symptoms of COVID-19.	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	All access points controlled by security / Construction Manager personnel. Construction Manager procures non-contact thermometres to read all employees body temperatures prior to entry to the office / workshop. Designated area / room provided at the office / workshop to isolate employees and health department is contacted for further instructions.	2	2	2	2	2	2	12	Construction Manager / Access Controller (Security)	On arrival at the office

CURRENT RISK										REMEDIAL	RISIDUAL							ACTION	
Task Steps	HAZARD IDENTIFIED	RISK ASSOCIATED WITH HAZARD	P	IS	DS	ED	E	H	C	HOW IS HAZARD TO BE DEALT WITH	P	IS	DS	ED	E	H	C	BY WHOM	BY WHEN
Sanitization.	No hand sanitizers	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Construction Manager procurers 70% alcohol content hand sanitnitizers for use at entrance to office / workshop, restrooms and other frequently visited areas within the office / workshop. Employees made aware of sanitization through government and posters / notices displayed in the office / workshop.	2	2	2	2	2	2	12	Construction Manager / Access Controller (Security)	On arrival at the office
Briefing from Construction Manager regarding the site and scope of work as approved by the client.	Employee unaware of COVID-19 preparedness.	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Construction Manager procurers 70% alcohol content hand sanitnitizers for use at entrance to office / workshop, restrooms and other frequently visited areas within the office / workshop. Employees made aware of sanitization through government and posters / notices displayed in the office / workshop.	2	2	2	2	2	2	12	Construction Manager / Access Controller (Security)	On arrival at the office
Load tools & equipment required for the task into the vehicle.	Contaminated Surfaces	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Sharing of tools not allowed. All sufaces are continually disinfected using a 70% alcohol based mist sprayer. Social Distancing observed while carrying tools.	2	2	2	2	2	2	12	Construction Manager	Prior to starting work

CURRENT RISK										REMEDIAL	RISIDUAL							ACTION	
Task Steps	HAZARD IDENTIFIED	RISK ASSOCIATED WITH HAZARD	P	IS	DS	ED	E	H	C	HOW IS HAZARD TO BE DEALT WITH	P	IS	DS	ED	E	H	C	BY WHOM	BY WHEN
Travel to site	No social Distancing or PPE not worn	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Social Distancing explained comprehensively by government and discussed with employees during briefing. Only one person is seated in the front of the vehicle while others are transported at 50 % of the vehicle capacity while maintaining safe distances. All employees issued with and instructed to wear cloth face masks. PPE use demonstrated to employees.	2	2	2	2	2	2	12	Construction Manager	Prior to leaving the Office
Arrive at site and follow Principal Contractor's entry instruction.	Alternate entrance to work area used and instructions not communicated to employees.	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Construction Manager to discuss Point of Entry and Access rules with employees during morning briefings at the office.	2	2	2	2	2	2	12	Construction Manager	Prior to leaving the Office
Attend principal contractor briefings where required (Toolbox Talks, Risk Assessment Training, Induction, etc).	Employees not attending briefings and are therfore unaware of potential hazards on site.	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Importance of attanding principal contractor's training discussed with employees during morning briefings at the office. Construction Supervisor to ensure that all personnel attend the briefings.	2	2	2	2	2	2	12	Construction Manager & Construction Supervisor	Prior to Commencing Work on Site
Check site is safe, hygienic and ready for work.	Unhygienic or unsafe site conditions	Employees infected by contaminated surfaces	5	5	5	5	2	5	27	All unhygienic and unsafe site conditions reported to the Construction Manager. Construction Supervisor to ensure that work areas are in a hygienic and safe condition prior to commencement with work.	2	2	2	2	2	2	12	Construction Supervisor	Prior to Commencing Work on Site

CURRENT RISK										REMEDIAL	RISIDUAL							ACTION	
Task Steps	HAZARD IDENTIFIED	RISK ASSOCIATED WITH HAZARD	P	IS	DS	ED	E	H	C	HOW IS HAZARD TO BE DEALT WITH	P	IS	DS	ED	E	H	C	BY WHOM	BY WHEN
Unload equipment and tools from vehicle, moving them into position on site	Employees working in proximity to each others	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Sharing of tools not allowed. All sufaces are continually disinfected using a 70% alcohol based mist sprayer. Social Distancing observed while carrying tools.	2	2	2	2	2	2	12	Construction Supervisor	While Working on Site
Use tools and equipment to carry out tasks.	Employees working in proximity to each others	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Sharing of tools not allowed. Social Distancing observed while working. Sanitizing of hands before and after handling tools & equipment. All employees issued with and instructed to wear suitable gloves while working.	2	2	2	2	2	2	12	Construction Supervisor	While Working on Site
Clear area of dust or debris before moving to next location.	Work areas left untidy after completion of work.	Others infected by contaminated surfaces	3	3	2	2	2	2	14	All areas to be cleaned up prior to leaving the work area and waste to be disposed at the bins provided by the principal contractor for this purpose.	1	1	1	1	1	1	6	Construction Supervisor	After Working in an area on Site
Rest during tea and lunch breaks	No social Distancing or safe sanitizing being done. Contact with public.	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	All vehicles provided with 70 % alcohol based hand sanitizers to be used by staff on site. Staff will also use sanitizers provided by the principal contractor. Employees instructed not to leave the site during tea and lunch breaks. Employees are encouraged to bring pre-prepared meals to avoid going to the local shops to buy food.	1	1	1	1	1	1	6	Construction Supervisor	Before, during and after tea & lunch breaks
Clean and pack tools and equipment away safely.	Employees working in proximity to each others	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Sharing of tools not allowed. All sufaces are continually disinfected using a 70% alcohol based mist sprayer. Social Distancing observed while carrying tools.	2	2	2	2	2	2	12	Construction Supervisor	After completing work on Site

CURRENT RISK										REMEDIAL	RISIDUAL							ACTION	
Task Steps	HAZARD IDENTIFIED	RISK ASSOCIATED WITH HAZARD	P	IS	DS	ED	E	H	C	HOW IS HAZARD TO BE DEALT WITH	P	IS	DS	ED	E	H	C	BY WHOM	BY WHEN
Use welfare facilities provided by the Principal Contractor	No social Distancing or safe sanitizing being done.	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Staff will also use sanitizers provided by the principal contractor at various areas on site. Employees will maintain social distancing while approaching and leaving the toilets and other facilities. Facilities are serviced more frequently by service providers.	2	2	2	2	2	2	12	Construction Supervisor	Before, during and after tea & lunch breaks
Working on Site	Contact with members of the public	Tranfer of Coronavirus from public to Principal Contractor's employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Staff & signage will be posted at6 the entrances to the site to warn the public of work taking place. Employees instructed to maintain social distancing while approaching or being approached by members of the public.	2	2	2	2	2	2	12	Construction Supervisor / Employees	Before, during and after working on site.
Depart from site & travel to the office / workshop.	No social Distancing or PPE not worn	Tranfer of Coronavirus from public to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Only one person is seated in the front of the vehicle while others are transported at 50 % of the vehicle capacity while maintaining safe distances. All employees issued with and instructed to wear cloth face masks. PPE use demonstrated to employees.	2	2	2	2	2	2	12	Construction Supervisor	Prior to leaving the site
Screening for COVID-19.	Tests not conducted / employees enter office / workshop without being screened. Employee has symptoms of COVID-19.	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	All access points controlled by security / Construction Manager personnel. Construction Manager procures non-contact thermometres to read all employees body temperatures prior to entry to the office / workshop. Designated area provided at the office / workshop to isolate employees and health department is contacted for further instructions.	2	2	2	2	2	2	12	Construction Manager / Access Controller (Security)	On arrival at the office

CURRENT RISK										REMEDIAL	RISIDUAL							ACTION	
Task Steps	HAZARD IDENTIFIED	RISK ASSOCIATED WITH HAZARD	P	IS	DS	ED	E	H	C	HOW IS HAZARD TO BE DEALT WITH	P	IS	DS	ED	E	H	C	BY WHOM	BY WHEN
Sanitization	No hand sanitizers	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Construction Manager procurers 70% alcohol content hand sanitnitizers for use at entrance to office / workshop, restrooms and other frequently visited areas within the office / workshop. Employees made aware of sanitization through government and posters / notices displayed in the office / workshop.	2	2	2	2	2	2	12	Construction Manager / Access Controller (Security)	On arrival at the office / workshop
Offload tools and equipment from vehicle and store away.	Employees working in proximity to each others	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Sharing of tools not allowed. All sufaces are continually disinfected using a 70% alcohol based mist sprayer. Social Distancing observed while carrying tools.	2	2	2	2	2	2	12	Construction Manager / Construction Supervisor	While at the office / workshop
Briefing Construction Manager of work accomplished for the day and outstanding work still to be done.	Social Distancing not observed and PPE not worn	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Social Distancing of 2 metres observed and employees wear face masks while attending briefing.	2	2	2	2	2	2	12	Construction Manager / Employees	While at the office / workshop
Leave office / workshop to return home.	Social Distancing not observed and PPE not worn	Tranfer of Coronavirus to other employees causing respiratory and associated problems.	5	5	5	5	2	5	27	Social Distancing of 2 metres observed and employees wear face masks while travelling home.	2	2	2	2	2	2	12	Employees	From the office / workshop to home

C3.9: MECHANICAL STANDARD SPECIFICATIONS

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C3.9.1 SCOPE

This Mechanical Standard Specification gives a general description of the requirements to be met, and provides the basic quality, safety, design and materials requirements of all of the mechanical plant and equipment that is to be supplied and installed under the mechanical section(s) of the Contract. The specific requirements of the Contract are prescribed in document- Mechanical Project Specification.

Should there be any conflict between the Mechanical Project Specification(s) and this Mechanical Standard Specification, the Mechanical Project Specification takes precedence. In the event of there being a discrepancy between any specification, and/or the drawings and/or the Bills of Quantities, the discrepancy shall be drawn to the attention of, and resolved by, the Employer's Agent before the execution of any work associated with the discrepancy.

This Mechanical Standard Specification, when read together with the Mechanical Project Specification, indicates the minimum requirements. Where no specific requirement is indicated, it does not relieve the Contractor of any statutory or common law duty and the Contractor will still be required to comply with all relevant requirements and/or standards from any statutory body that is applicable to the plant and equipment being designed, supplied and installed.

References made hereinafter to specifications of the South African Bureau of Standard (SABS/SANS) or the British Standards Institute (BS) or the International Standards organisation (ISO) or the American Society of Mechanical Engineers (ASME) or the American Standard for

Testing and Materials (ASTM) shall be deemed to include all revisions of and/or additions to such specifications ruling four weeks prior to the closing date of tenders.

C3.9.2 QUALITY MANAGEMENT

Details regarding the Quality Assurance and Quality Control requirements are dealt with in their respective documents.

All enquiries made, and contracts placed by the Contractor for critical components, shall require suppliers and/or sub-contractors to comply with the requirements of the Contract. Responsibility for, and all associated costs of, compliance shall rest with the Contractor. In instances where SANS/ISO 9001 is not applicable, Tenderers must indicate what equivalent alternative Code of Practice is being implemented.

C3.9.3 SAFETY

C3.9.3.1 General

Safety shall be an important and overriding consideration and proper attention shall be paid by the Contractor to this aspect at the design, installation, and commissioning stages of the project.

All plant and equipment shall comply with the requirements of the Occupational Health and Safety Act (Act 85 of 1993 as amended) and the relevant Regulations thereto.

All potential hazards must be avoided or guarded. Nip points shall be guarded, sharp corners shall be rounded off, and operating handles, supports and protrusions shall be kept clear of access ways.

All accessible moving parts shall be properly guarded to protect injury to personnel.

In addition to the emergency stops specified elsewhere, trip wires which will stop the driving motor when pulled, shall be provided along the accessible side/s of moving conveyor belts, chains and the like irrespective of operating speed and irrespective of the safety guards provided.

C3.9.3.2 Guards

Guards are required to cover all moving or revolving components of machinery and shall:

- Be such as to adequately cover all moving protrusions such as couplings, keys, lock nuts, lock washers, sets crews, and the like.
- Be such as to prevent a person from touching any moving protrusion.
- Be neatly and rigidly constructed and fixed so as to not vibrate or cause noise during operation of the plant.
- Enable adjustments to be made where required such as on belt guards.
- Be fixed with M10 or larger hex head bolts.
- Be easily removable for maintenance purposes
- Be fabricated from Grade 304 stainless steel or mild steel (hot dip galvanised).

Mesh shall not be used for chain guards but, on belt drives, the side of the guard most conveniently sited for inspection, shall be constructed of expanded metal or similar. Mesh should similarly be used in other situations where inspection or ventilation is required. Where expanded metal or similar mesh is used, the mesh opening shall not permit a circular object 10 mm or larger to penetrate.

C3.9.4 BASIC REQUIREMENTS OF THE PLANT AND EQUIPMENT

C3.9.4.1 *General*

Robust construction, reliability, long life, operation, efficiency, ease of maintenance and operation, and neatness of all plant and equipment are essential requirements for all plant and equipment to be supplied and installed under this Contract.

C3.9.4.2 Design Requirements

The design of all plant and equipment shall be based on:

- The full range of duties which can be reasonably be anticipated.
- The power and torque transmitted by the driver system under full load under installed conditions.
- The maximum pressure or vacuum which can be produced by pumps under all conditions including blocked or closed inlet and outlet circuits and surge conditions.
- Conservative service and safety factors based on approved standards or recommended or laid down in the specifications of reputable and approved manufacturers.
- Suitable safety margins where relevant and specified in the specifications, in addition to any service or safety factors the original equipment manufacturer (OEM) deems necessary.
- Continuous twenty-four hour per day operation.

- A minimum life of 100 000 hours of wearing parts before repair or major part replacement.
- Prevention of serious damage from normal operational problems such as blockages, blinding, jamming, seizure, malfunction and, as far as is practical, maloperation.

Machines with non-overloading characteristics shall be selected wherever possible e.g, motors shall be sized so that they cannot be overloaded by the driven machines.

C3.9.4.3 Fail safe Operation and Protections

The Electrical and Instrumentation specification take precedence over this if specified.

Where damage can occur from normal operational or other foreseeable problems, plant, equipment and systems must be designed to be failsafe i.e, it must have built in redundant elements, or it must return to a safe condition where no further damage can be done in the event of a failure, malfunction, mal-operation, overload and, as far as practical, misuse. All reasonable and economically justifiable protections to prevent or limit damage to plant and equipment, particularly in high risk situations, must be incorporated. Protections shall:

- Be directed at the source of the problem, limit forces to safe levels, and act quickly enough to prevent damage and/or injury to personnel.
- Stop, or prevent from starting, all equipment at risk.
- Activate an alarm with a labelled indicator on the control panel / HMI whenever a protection operates.
- Be such as to prevent unauthorised tampering.
- Operate reliably after long inactive periods exposed to corrosive and dusty conditions.

C3.9.4.4 Moving Parts

The following general requirements shall apply to all equipment with moving parts such as headstocks, extension spindles, swivelling davits, heavy duty hinges, pivots and the like:

- All rotating or swivelling shafts, pins and the like, shall be adequately supported, guided, and restrained, by lubricated or self-lubricating bearings, collars and/or bushes.
- Swivelling joints on linkages and the like shall be of the "universal" or fork and rod type with bearings or bushes fitted to the eyes or forks.
- On abrasive applications, abrasion resistant materials and slow speed operation shall be utilised.
- Susceptibility to fatigue failure shall be minimised by proper design and manufacturing procedures. In particular, changes in section shall be radiused and care must be taken to avoid the use of welded components in areas of fluctuating stress.
- The methods of locking of nuts and pins in position shall be suitable for purpose
- Wearing parts shall be designed for inter-changeability and ease of removal and replacement.

C3.9.4.5 Arrangement and Mounting

The arrangement and general design shall take the following requirements into consideration:

- Lifting eyes, lugs, hooks, etc. shall be provided on heavy or large items to facilitate handling.
- Castings or fabrications shall have machined pads for seating and be mounted on either soleplates or base plates as appropriate.
- Where accurate alignment is required, positioning pins and/or jacking screws shall be provided.
- The needs of operation and maintenance including neatness, access, working space, safety, cleaning, adjustment, handling, assembly, alignment, disassembly, removal, etc.
- With plant and equipment to be mounted on or against concrete or brick structures, provision shall be made in the mechanical design for adjustment.
- Any special accuracy requirements that affect others responsible for constructing buildings, structures, supports and the like shall be specified on the Contractor's drawings that are submitted in advance to the Employer's Agent.

C3.9.4.6 Lubrication

Grease lubrication is preferred and all greasing points must be easily accessible. Equipment with multiple greasing points shall be provided with grease lines which are piped, separately, to a single easily accessible position.

In cases in which motorised lubrication is provided to more than one destination a distributor shall be provided. The distributor shall be a positive displacement device which ensures equal, successive lubrication to all destinations.

Pipework for grease distribution shall be of stainless steel or non-ferrous metal.

Oil level indicators shall be fitted for visual checking. Drain cocks, including Grade 316 stainless steel fittings where necessary to permit convenient draining, and plugged at the end, shall be provided for oil reservoirs exceeding 1,5 litre capacity.

All lubrication systems shall be designed so as to exclude dirt and moisture. Air vents on oil reservoirs shall contain an air filter.

C3.9.5 FABRICATION OF STEELWORK

C3.9.5.1 Welding

Procedures that comply with accepted Standards shall be followed. These standards are not limited to but include the following:

- BS EN 1011 Parts 1 to 8: Welding. Recommendations for welding of metallic materials
- BS EN 13480 Parts 1 to 6: Metallic industrial piping

Welding is to be continuous: All welding shall be continuous on all sides of any joint unless otherwise approved in writing by the Employer's Agent. No crevices will be permitted and, where stitch welding has been approved by the Employer's Agent, the crevices so left shall be sealed with an approved filling compound after priming but before further painting.

Weld appearance: Welding shall be free of blowholes and all welding flux shall be removed. All weld spatter and other sharp imperfections shall be removed prior to abrasive blasting. Prior to painting, weld beads with a surface irregularity exceeding 3 mm or with sharp crests and edges having a radius less than 2 mm shall be ground. However, weld grinding must not be performed on Grade 304, 304L, 316, or 316L stainless steel, unless unavoidable.

Site welding: Site welding shall be kept to a minimum and shall only be undertaken with the approval of the Employer's Agent.

Type of stainless steel: Austenitic stainless steels to be welded shall be of the higher carbon grade (i.e, 304, 316) unless otherwise stated.

Welding rods: The welding rods used shall be the most suitable for the metal and purpose. Type 309 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved by the Employer's Agent.

Welders: Only welders experienced with welding stainless materials shall be used.

General: All possible steps shall be taken to ensure maximum corrosion resistance, strength of the welds and welded material. Special care shall be taken to avoid prolonged heating. Discolouration and steel contamination must be removed by pickling or electro cleaning as approved by the Employer's Agent but should rather be avoided by taking the appropriate measures.

C3.9.5.2 Mild Steel Fabrication

The design of all structural steelwork shall comply with, inter alia, the requirements of The National Building Regulations (SANS 10400-B).

The Contractor shall ensure that the Employer's Agent is given due notice enable inspects of fabrications, including fabricated pipework, to be undertaken in the fabrication workshop.

All surfaces must be accessible for surface preparation and coating. Inaccessible pockets, open hollow sections or the like shall not be permitted except where hot-dip galvanizing (without painting) is called for. Surfaces which cannot be properly prepared after fabrication must be abrasive blasted and coated with a two-pack epoxy pre weld primer before fabrication.

C3.9.5.3 Stainless Steel Fabrication

The requirements regarding the fabrication of carbon steels also apply to the fabrication of stainless steels. In addition, the following requirements apply to the fabrication of stainless steels:

- Work shall be carried out in an area(s) demarcated for stainless steel fabrication.
- Surfaces which become contaminated with steel or otherwise stained or otherwise marked so as to be of uneven colour, shall be cleaned by pickling or electro-cleaning rather than by grinding.
- All welds shall be passivated.

C3.9.6 FLOORING, HANDRAILS AND LADDERS

C3.9.6.1 Open Grid Flooring

All grid flooring shall be of an approved type and of adequate strength with load bearing bearer bars across the shorter span. The depth of steel bearer bars shall not be less than 30 mm with a bearer bar pitch of not greater than 40 mm. All panels are to be banded and set level and fixed down with clips in angle frames so as to prevent rocking. All cut outs in grid flooring for pipes, valve spindles and the like are to be banded.

Mild steel grid floor panels and frames shall be hot dipped galvanised after fabrication. Painting shall be done to suit the relevant safety codes.

The fixing clip set (saddle clamp and locking plate) shall be of hot dip galvanised steel but all fasteners shall be of Grade 316 stainless steel.

C3.9.6.2 Handrails

Handrailing shall comply with inter alia, SANS 10104 and shall be in accordance with legislated requirements and shall be provided generally in positions where the vertical difference in level is 1 000 mm or greater.

All handrailing shall be of Grade 316 stainless steel and shall comprise hand and knee rails not less than 32 mm diameter and stanchions spaced at not more than

1,8 m except where specifically directed otherwise in writing by the Employer's Agent. All components shall be supplied in the pickled and passivated condition which may also be polished. All surfaces must be uncontaminated and unmarked to ensure maximum corrosion resistance.

Where kick plates are required by legislation, these shall extend to 150 mm above the walkway level.

Unless other materials are specified, all ladders and stairs shall be of mild steel and hot dip galvanised after all fabrication has been completed.

On platforms, walkways, landings or around dangerous areas, the vertical height, measured from the top of the hand rail to the floor or surface, shall be at least 1 000 mm.

On stairways and fixed ladders, the rails shall be parallel to the stringers, and the vertical height, measured from the top of the hand rail to the nosing of the tread, shall be at least 900 mm.

Stanchions and rails shall be smoothly finished and free from sharp corners, edges and projections which may injure persons or damage clothing. Stanchion bases shall have the corners rounded off.

The tubular rails shall be joined using the slip jointing method with separate and neatly fitting tubular inserts fitted into the railing bore. If stainless steel pins are used, they shall have their ends peened over and smoothed or, if taper pins are used, they shall be filed off flush with the rail. The joints shall withstand the required loads when situated in any position including centrally between two stanchions. Joints shall preferably be located inside the stanchion balls.

Railings shall be ended off with positively fixed (pinned) closure bends. At corners, short radius bends with stanchions on both ends shall be employed or, alternatively, stanchions specifically designed for such a position shall be employed. No sharp endings will be permitted.

Stanchions shall generally be base mounted but can be side mounted to suit the arrangement requirements and shall be of solid or welded construction. Welding shall be compatible with the material, shall not impair the strength or corrosion resistance of the material, shall be continuous and shall be smoothly finished and then passivated.

Stanchions shall be self-draining to suit the mounting arrangement.

Holes for the rails to go through the stanchions shall have a diametral clearance not exceeding 1 mm but preferably 0,5 mm. On stairways with stanchions vertically mounted, the hole shall be angled to suit and shall accurately fit the angled rail with the abovementioned clearances.

Stanchion bases which are attached to metallic surfaces shall have minimum dimensions of 150 mm x 60 mm. Two fasteners of minimum size M16, shall be used to attach the base which must have a material thickness shall be not less than 8 mm.

Stanchion bases which are attached to non-metallic surfaces shall have minimum dimensions of 150 mm X 150 mm. In instances where the horizontal surface to which the base is to be fastened is less than 150 mm wide, the base shall be designed to be seated on at least two surfaces. Four fasteners of minimum size M16, shall be used to attach the base to the concrete. Base material thickness shall be not less than 10 mm. Non shrink, cementitious grout shall be applied under the foot just prior to final tightening of nuts.

C3.9.6.3 Permanent Ladders

Permanent ladders shall be safe to use and shall comply with the following:

- Access points to the head of ladders from platforms and walkways shall be protected by self-closing gates or by chains.
- No part of a ladder may project into a passageway.
- The clear width between stringers shall be no less than 500 mm.
- A minimum clear space of 230 mm must be allowed behind the rungs.
- The diameter of the rungs shall be between 20 mm and 50 mm.
- Additional rungs shall be provided in the same horizontal plane as the top rung in order to close the gap between the platform and the ladder. Sufficient rungs shall be provided to ensure a maximum gap of 75 mm. These top rungs shall be at the same level as the floor or platform to which access is being provided.
- Stringers shall be formed from flat plate or channel sections. The vertical distance between the ladder support brackets shall not exceed 1 800 mm.
- The stringers shall extend to 1 100 mm above the floor or platform and shall be matched with any hand-rail protections at this level. Connections between hot dip galvanised steel ladders and stainless-steel hand railing shall be bolted. Unless laterally supported by the hand-rails, these stringers shall be supported by vertical structural sections (not flat bar) whose bases shall comply with this specification for hand-rail stanchion bases.
- All rises in a flight shall be uniform and the surface of the top rung shall be level with the top platform or landing. The height chosen for the rise shall be between 225 mm and 255 mm.
- Except on chimneys, the height of a ladder should not exceed 6 000 mm. Greater heights shall be provided with intermediate landings between each 6 000 mm ladder section.

- If the height between start and end levels is over 4 000 mm, the ladder shall be fitted with a safety cage. The safety cage shall extend at least 1 000 mm above the higher landing. The cage shall be no more than 700 mm away from the plane of the rungs and shall comprise no fewer than seven vertical elements.
- Anchor bolts shall be of Grade 316 stainless steel and shall be no smaller than M16.
- Stringers, rungs and anchor brackets shall be of solid structural sections (e.g, flat bar, round bar, square bar, angles, etc.) and no hollow sections may be used for any part of any ladder.

C3.9.7 MATERIALS FOR MANUFACTURE AND FABRICATION

C3.9.7.1 General

All materials and components used in the manufacture and fabrication of pump station and equipment to be supplied under this Contract shall be new and of the best quality and suitable for the purposes for which they are intended.

The Contractor shall ensure that materials are selected in accordance with the best engineering practice to suit the working conditions and, where applicable, the corrosive environment.

C3.9.7.2 Mild Steel

All structural steel shall comply with the requirements of SANS 50025 and be of a grade suitable for purpose and that is determined by the designer of the plant for structural (strength) reasons.

C3.9.7.3 Castings

Castings shall comply with the relevant South African Standards for the material used, including the following:

Grey Iron Castings	-	SANS 1034
Spheroidal Graphite Iron Castings	-	SANS 936 & 937
Steel Castings (General applications)	-	SANS 1465
Aluminium Castings	-	SANS 991 & 992
Copper and Copper Alloy Castings	-	SANS 200

Particular attention shall be paid to cleanliness, soundness and neat fettling and dressing of castings. Surfaces shall be smooth and irregularities caused by mould washaways, and the presence of porosity and sand and slag inclusions will not be tolerated. Areas under bolt heads, nuts and washers, shall be machined or spot faced to ensure a flat and smooth pressure bearing area, and sufficient space shall be provided for the use of ring or socket spanners.

All pressure retaining castings shall be hydrostatically tested to not less than 1,5 times the maximum working pressure after machining and shall be drop tight.

No repairs shall be undertaken to castings without the written permission of the Employer's Agent and welding will not be permitted on cast iron castings.

Castings shall be heat treated to provide optimum corrosion resistance and toughness combined with reasonable machinability. In particular stainless steel castings shall be heat treated so as to ensure that all carbides are in solution, to ensure optimum grain size and to provide maximum corrosion resistance.

The Contractor shall provide a test certificate for each casting or batch of castings, except for those made of grey cast iron, giving details of the material analysis, the heat treatment and any mechanical tests carried out.

C3.9.7.4 Plastics

Thermoplastics and fibre reinforced polymers shall be UV resistant, have adequate tensile strength, and high impact strength and generally suitable for the application. PVC is generally regarded as too brittle and shall not be used unless specified elsewhere or approved by the Employer's Agent.

C3.9.7.5 Fasteners

Bolts and nuts shall have hexagon heads complying with SANS 1700 with threads of the coarse pitch series. Allen head screws or bolts may not be used without the Employer's Agent's written consent.

The length of each bolt, other than jacking bolts, shall be such that, after the bolt has been tightened, the end of the bolt shall project beyond the outer face of the nut. In the case of bolted joints that will remain visible, the projection beyond the end of the nut shall not be more than two threads.

All fasteners in corrosive areas shall be Grade 316 stainless-steel. Corrosive areas shall be deemed to include any moist or wet area such as in close proximity to liquid, and where a continuous or intermittent spray can be expected and all internal and external areas in the vicinity of the inlet works of a wastewater treatment works. All fasteners embedded in brick, concrete or soil shall also be Grade 316 stainless-steel.

Fasteners which are in non-corrosive areas shall, except when specified otherwise, be electro galvanised mild steel.

Fastener material shall always be of equal or better corrosion resistance than the items being fastened, e.g, Grade 316 stainless-steel bolts must be used to fasten together Grade 316 stainless components.

Washers of similar material to the bolts shall be provided under each nut and setscrew head. Multiple washers or shims may not be used. Spring washers or other approved locking arrangements shall be installed on all fasteners subject to vibration.

Before assembly, threads shall be treated with an approved nickel based, anti-seize/corrosion protection compound. Compound on the exposed thread shall be cleaned off prior to painting.

Anchor fasteners for brickwork shall be of Grade 304 stainless-steel and shall be of the chemical anchor fastening type. Anchor fasteners for other applications may be either of the expanding type or chemical anchor type.

Grade 304 stainless-steel hook bolts shall be supplied and grouted into pockets which will be provided in the concrete structure by the civil contractor in accordance with the information to be supplied by the mechanical contractor. The grouting products shall be mixed and applied strictly in accordance with the manufacturer's instructions.

Where machinery is anchored by studs or bolts which extend through the supporting structure and fastened down with the use of nuts from both sides, these, together with associated washers and brackets, shall be of Grade 304 stainless-steel.

C3.9.8 LIFTING EQUIPMENT

All lifting equipment shall comply with the following requirements unless otherwise stated:

- Lifting equipment shall be designed and constructed in accordance with a generally accepted code of practice or standard.
- Fixings of crawl beams shall be through bolted by means of Grade 304 stainless steel threaded bar.
- High-tensile or alloy steel chains shall be hot dipped galvanised and shall have a factor of safety of at least four.
- Steel wire ropes shall have a factor of safety of at least six.
- Man-made fibre ropes or woven webbing shall have a factor of safety of at least six.
- Natural fibre ropes shall have a factor of safety of at least ten.
- The safe working load (SWL) shall be clearly and boldly marked on all lifting equipment.
- The complete installation shall be inspected and shall be tested on site by the Contractor over its complete lifting range using a load which shall be at least 125 % of the safe working load.

Chain block casings are to be fabricated from cast iron or high strength alloy steel. A slipping clutch or equivalent, is to be fitted to ensure that it is not possible to overload the chain block. A trolley, along with all ancillary equipment, is to be provided with the chain block for operation on the crawl beam.

Davits shall be manufactured from mild steel and shall be hot dipped galvanised after fabrication. All fasteners, pins, shafts, shackles, hooks, guide pulleys and shafts, shall be of Grade 304 stainless steel or other corrosion resistant material, with suitable non-metallic bearings which do not require regular lubrication. The swivelling arrangements shall be properly designed for easy operation, shall be accurately fitted and shall not be subject to corrosion problems. Bushes made of nylon, "Vesconite" or other suitable non-metallic material shall be used and any metallic rubbing mating face shall be of Grade 316 stainless steel. Wire ropes must be long enough to reach the lowest required position with at least 3 turns left on the drum. The drum size shall be sized to store the full rope length. The diameter of the drum shall suit the rope diameter in accordance with good practice and approved by the wire rope manufacturer.

C3.9.9 PIPEWORK

C3.9.9.1 Screwed and Socketed Steel Pipes and Malleable Cast Iron Fittings

Steel pipes larger than DN 50 and smaller than DN 150 shall be seamless Schedule 40 pipe. Steel pipes DN 200 and smaller shall be hot-dipped galvanised. Malleable cast iron fittings used in conjunction with screwed and socketed pipes shall comply with the requirements of SANS 14 and shall be galvanised.

C3.9.9.2 Hydraulic and Oil Pipework

Hydraulic pipework shall comply with the requirements of BS 778. All pipes and fittings shall be thoroughly degreased, descaled, and cleaned internally and externally after fabrication by abrasive blasting or pickling, thoroughly cleaned and rinsed, dipped in a hot iron phosphate solution and coated internally with a corrosion inhibiting, oil soluble preservative. After treatment and drying all openings shall be sealed until the pipes are installed.

C3.9.9.3 Copper Pipes

Copper pipes shall be of a class suitable for the plant operating conditions and conforming to SANS 460. Where bends are required they shall be formed with a proper tube bending machine. Joints shall be brass compression fittings conforming to SANS 1067. Holderbats shall comply with SANS 1209.

C3.9.9.4 Unplasticised Polyvinyl Chloride Pipes and Fittings

Unplasticised Polyvinyl Chloride (uPVC) pipes and fittings shall comply with the requirements of the following standards and shall be of the class(es) required for each application:

- SANS 791 - Unplasticised poly (vinyl chloride) (PVC-U) sewer and drainpipes and pipe fittings.
- SANS 966-1 - Components of pressure pipe systems Part 1: Unplasticised polyvinyl chloride (PVC-U) pressure pipe systems.
- SANS/ISO 967 - Unplasticised polyvinyl chloride (PVC-U) soil, waste and vent pipes and pipe fittings.
- SANS/ISO 21138 - Plastic piping systems of Unplasticised polyvinyl chloride (PVC-U) for non-pressure underground drainage and sewerage – structured wall piping systems etc.
- SANS/ISO 1601 - Structured wall pipes and fittings of Unplasticised polyvinyl chloride (PVC-U) for buried drainage and sewerage systems.

C3.9.9.5 Polyethylene Pipes and Fittings

Polyethylene pipes shall be of high density type complying with the requirements of the following standards and shall be of the class(es) required for each application:

- SANS/ISO 4427 - Plastics piping systems – Polyethylene (PE) pipes and fittings for water supply.
- SANS/ISO 4437 Metric Series - Buried polyethylene pipes (PE) for the supply of gaseous fuels.
- SANS/ISO 8772 - Plastics piping systems for non-pressure underground drainage and sewerage – Polyethylene (PE).
- SANS/ISO 21307 - Plastics pipes and fittings – butt fusion jointing procedures for polyethylene (PE) pipes and fittings.
- PR EN 13476-1 & ISO 9969 - PE Structured Wall Sewer Pipes (Note that all pipes must be spigotted and socketed with a rubber seal).

C3.9.9.6 Stainless Steel Pipes and Fittings

All stainless steel pipework is to be Grade 304 welded austenitic pipe in accordance with the American Standard ASTM A312. Schedule 10 pipes and fittings shall be used unless otherwise specified and/or required for higher pressures.

If prescribed in the Project Specification, mild steel flanges may be used on stainless steel pipes and joined with mild steel bolts and nuts and, in cases where stainless steel and mild steel flanges are joined together, nylon or plastic washers shall be used to prevent galvanic corrosion.

All welds on stainless steel are to be passivated.

C3.9.9.7 Mild Steel Pipes and Fittings

Steel pipes DN 150 and smaller, other than screwed and socketed pipes, shall be API seamless Schedule 40 pipe.

Unless otherwise specified in Project Specification, all pipes and fittings shall have a minimum wall thickness of 6 mm.

Steel pipes DN 200 and larger shall be manufactured in accordance with SANS 719 with the following specific requirements being applicable:

SANS 719 Clause 4.4 - Certification: Add the following:

"The manufacturer shall, on completion of the Contract, furnish the Employer's Agent with certified copies of the steel manufacturer's certificates pertaining to the steel plate/coils used. All information relevant to pipe fabrication shall be made available to the Employer's Agent, during the course of the pipe manufacturing process."

Unless otherwise required for structural (pressure) reasons, all pipes shall be manufactured from Grade X42 mild steel plate.

C3.9.9.8 Epoxy Lining and Coating of Steel Pipes and Fittings

Before leaving the pipe mill or the fabrication shop as applicable, all mild steel pipes greater than DN 150, fittings and other steelwork shall be abrasive blast-cleaned internally and externally to Grade Sa 2,5 of the Swedish Standard SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter given the following treatment:

Internally (including ends of fittings):	Pipes and fittings DN 200 and less are to be hot dipped galvanised (heavy duty coating). Pipes and fittings greater than DN 200 are to be lined with solvent free epoxy complying with SANS 1217 1B with DFT of at least 300 microns.
Externally:	Pipes and fittings DN 200 and less are to be hot dipped galvanised (heavy duty coatings). Pipes and fittings greater than DN 200 are to be coated with solvent free epoxy complying with SANS 1217 1B with DFT of at least 300 microns. In addition, all external surfaces of all pipes that are to remain exposed are to be painted with an appropriate primer if required and an approved gloss paint after erection.

The solvent free epoxy to be used shall be subject to the approval of the Employer's Agent.

Plain ends of pipes and fittings shall be covered and protected against damage whilst being transported from the factory/fabrication shop to the site.

C3.9.9.9 Nozzles & Tees for Fittings & Instruments

Nozzles on pipework for installation of gauges, transmitters, drain pipes, cooling water take offs, air valves, etc. shall be designed so that the pipework corrosion prevention system is not affected.

Nozzles shall consist of a flanged, welded tee off of at least DN 50, painted internally and provided with a non-corrosive blank flange, e.g, Grade 316 stainless steel. The blank flange shall be provided with tapped holes suitable for the equipment installation.

A nozzle on cement lined, mild steel pipework shall consist of a flanged, cement lined tee off (of at least 100 mm diameter) and a non-corrosive blank flange.

Internally painted, small diameter mild steel nozzles and screwed mild steel tee offs are both unacceptable as nozzles. Mild steel pipework may be provided with small diameter, Grade 316 stainless steel nozzles which are welded into the pipework if the Employer's Agent considers this to be acceptable of the particular application.

C3.9.9.10 Pipe Ends

Pipe ends shall either be prepared for welding or in accordance with the coupling manufacturer's recommendations. Where machining is required, as in the case of cast iron pipes, the length of machining on each pipe shall be in excess of the overall length of the coupling to ensure that the coupling can be separated for pipe removal purposes.

C3.9.9.11 Flanges and Gaskets

The dimensions and drilling of standard flanges shall comply with the requirements of SANS 1123, Table 1000 unless otherwise stated in the Project Specification. Flanges shall be machined flat, i.e, without a raised joint face unless otherwise stated in the Project Specification.

Puddle flanges shall have the same dimensions as standard flanges but shall be undrilled.

Faces of flanges which will be in contact with jointing gaskets shall receive a protective coating of such thickness and consistency as will not impair the air/gas/water tightness of the joint. Where flanged pipes and fittings are rubber lined the rubber lining is to be wrapped around from the barrel onto the face of the flange and that rubber will form the gasket.

Flanges are to be drilled "off-centre" i.e, off horizontal and vertical centrelines.

Gaskets for flanged joints shall be of aramid and glass fibre with nitrile rubber binder to BS 7531, suitable for the specified pressures, and with a minimum thickness of 3 mm. Full face gaskets shall be used for flat face flange connections and ring gaskets for raised face flange connections.

Properly designed O-ring seals are also acceptable.

Notwithstanding the foregoing, the responsibility for the selection of gaskets suitable for each particular installation and for the prescribed test pressures will rest with the Contractor.

C3.9.9.12 Flanged Joints

Where required, suitably rated insulating flanged kits shall be supplied, installed and tested such that the flanged joints will be electrically discontinuous and will withstand the hydraulic field tests without leaking.

The flange insulating sets shall be supplied complete. Each set must include an insulating gasket, insulating sleeves, two insulating washers and two machined steel washers per bolt, and an explosion proof spark gap. The entire insulating flanged joint shall be proved to be electrically discontinuous on completion of the project.

After the assembly of the joint and successful hydraulic pressure testing, the entire insulating flange shall be wrapped circumferentially with a white PVC backed polymer modified bituminous tape 1,5 to 2,0 mm thick with a minimum 25 mm overlap.

An insulating flange consists of an insulating gasket, bolt sleeves and washers, appropriated sized steel bolts and washers and a voltage-limiting device for protection of the insulating materials.

The insulating gasket located between flanges is to be in accordance with the following table. The internal diameter of the pipe and the gasket shall be equal in all instances.

Field Test Pressure (MPa)	**Nominal Pipe Diameter (mm)**	**Insulating Gasket Material**
< 2,5	All Diameters	3,2 mm thick High Density Polyethylene to PEH Hostalen GM 5010 Specification, full face gasket in one piece
=> 2,5 < 4,6	All Diameters	3,2 mm thick High Density Polyethylene to PEH Hostalen GM 5020 SA Specification, full face gasket in one piece
=> 2,5 < 4,6	< 1 200	3,2 mm thick Fabric Reinforced Phenolic (Tested to BS 5102 Appendices A-M Type III) full faced gasket in one piece with neoprene or nitrile rubber faces 0,8mm thick
> 4,6	=< 1 200	3,2 mm thick Fabric Reinforced Phenolic (Tested to BS 5102 Appendices A-M Type III) full faced gasket with not more than 2 only factory made lap joints, with neoprene or nitrile rubber faces 0,8 mm thick
=> 4,6	> 1 200	3,2 mm thick Fabric Reinforced Phenolic (Tested to BS 5102 Appendices A-M Type III) full faced gasket in one piece with a aramid and glass fibre with nitrile rubber binder full faced gasket to BS 7531 on each side.

Notwithstanding the gasket types tabulated above the Contractor will be responsible for ensuring watertight joints shall therefore ensure that the gaskets used are suitable for the specified pressures.

The insulating sleeves for each bolt shall be a minimum 1 mm thick glass fibre reinforced polyester or heat shrink insulation type ITCS Polyolefin sleeving with sealant. The total length of sleeves is to be 2 to 3 mm less than the length between inside faces of steel washers. The insulating sleeves shall fit completely inside the insulating washers and extend partially inside the steel washers.

Two insulating washers for each bolt shall be 3 mm thick fabric reinforced phenolic resin with outer diameter the same as that of machined steel washer. The internal diameter to be a sliding fit over outer diameter of insulating sleeve.

The diameter and thickness of the steel washers are to be machined in accordance with the tolerances for Grade A in SANS 1700-4-3.

Bolts and nuts shall comply with the requirements of SANS 1700-5-1. Stud bolts may only be used where it is not possible to through bolt. Tolerances shall be in accordance with Grade A in SANS 1700-4-1. The next smaller size bolt diameter shall be selected for installation in standard drilled flanges to accommodate the insulating sleeves and the “property class” shall be 8.8 as per SANS1700-5-1 i.e, the material of the bolts and nuts material shall be high tensile steel with a tensile strength of 800 MPa.

An explosion proof spark gap, type Dehn EX-FS (120kA) or similar approved shall be installed across the flange faces. The mild steel mounting brackets holding the spark gap are to be hot dip galvanised and of suitable dimensions to suit the flange bolt.

C3.9.10 VALVES

C3.9.10.1 General

All valves shall be double flanged unless otherwise specified in Bill of quantities and/ Technical datasheets and/ Applicable drawings.

Handwheels shall be of cast iron.

The handwheel, lever, etc. on valves, valve actuators, and valve gearboxes, shall be clockwise closing when viewed from above end of the handwheel/lever shaft unless otherwise specified in the Project Specification.

Valves and their method of actuation shall be designed to provide operation under the full pressure rating of the valve.

Each gate valve shall be capable of being opened and closed by one person when the unbalanced head on the gate is equal to the specified maximum working pressure of the valve. If the design of the valve(s) is such that gearing is necessary to achieve this, then the valve(s) shall be equipped with machine-cut gearing and differential gear indicators. Gearboxes shall be grease filled.

All valves with gearboxes/gearing and valves with actuators, shall be provided with indication of current position as well as indication of the closing and/or opening direction.

Extensions spindles, if required, shall be manufactured from Grade 304 stainless steel. Headstocks shall be manufactured from Grade 304 stainless steel, 3CR12 steel, or cast iron, and to a pattern that is subject to the approval of the Employer’s Agent.

The back of each flange shall be spot faced over areas large enough to accommodate every washer and nut. All flanges are to be drilled with the holes off horizontal and vertical centrelines.

The factory body and open end test pressure required on the valves shall be as stated in the Bills of Quantities and/or on the drawings.

The Employer's Agent reserves the right to send a representative/inspector to inspect all or some of the valves and/or to witness the hydraulic tests on all or some of the valves. A test certificate shall be provided by the manufacturer for each individual valve. The tendered rates for the valves shall include for making arrangements for the independent inspections. The inspectors' fee and recoverable expenses will be for the account of the Employer, but fees and other expenses arising from abortive or repeat visits due to non-compliance with the specified requirements will be for the Contractor's account and will be deducted from amounts due to the Contractor.

C3.9.10.2 Local Content

The Department of Trade and Industry has, in terms of Regulation 9 (2) of the Procurement Regulations 2011, stipulated the "minimum threshold for valves products and actuators for local production and content" the details of which are set out in the National Treasury instruction that became effective from 3 March 2014. Compliance with these requirements is mandatory.

C3.9.10.3 Wedge Gate Valves

Gate valves shall comply with requirements of SANS 664 -1, -2, and -3 as applicable, except where otherwise specified. The factory body and open end test pressure required on the valves shall be 2,0 MPa unless otherwise stated in the Project Specification and/or on the drawings.

Valves shall be drop tight under working conditions and shall have non-rising spindle, wedge closure, and suitable for repacking under pressure. Bodies, gates and glands shall be cast iron or cast steel, spindles bronze, and seal rings on gate and body gunmetal or stainless steel.

All valves shall be fitted with square caps or hand wheels as appropriate. The direction of opening or closing of each valve, and the appropriate words shall be embossed on the cap and superfluous arrow heads shall be completely ground off the castings.

The valves shall be subjected to both the "closed end" test and the "open end" test in both directions. There shall be no leakage under the body test pressure but minor dripping/weeping will be acceptable under open end test pressure.

Guides and shoes, if required, shall be of copper alloy or stainless steel and shall guide the gate along the complete travel distance. Spindle seals shall be of the nitrite rubber 'O' ring type with bush insert and provided with an external scraper ring. Replacement of the seals shall be possible with the valve under pressure.

All gate valves shall be double flanged with flanges drilled off-centre and with drillings to match adjoining flanges where applicable and/or to suit the pressure ratings of the valves. The spindles shall be bronze or stainless steel and the spindle nut either bronze or gun metal.

C3.9.10.4 Resilient Seal Valves

Resilient seal valves shall comply with requirements of SANS 664-3 except where otherwise specified. The factory body and open end test pressure required on the valves shall be 2,0 MPa unless otherwise stated in the Project Specification and/or the Bills of Quantities and/or on the drawings.

Spindles shall be manufactured from stainless steel or EN57 or equal approved material according to the duty requirements. At least two spindle seals of the nitrile rubber "O" sealing rings in a corrosion resistant housing shall be provided, along with one nitrile rubber wiper ring to prevent the ingress of dirt. Replacement of the seals shall be possible with the valve under pressure.

C3.9.10.5 Gate Valves

Knife gate valves are to be used to control the flow of liquids with high solids concentrations such as water treatment sludge, primary, waste activated sludge and digested sludge.

Valves shall have cast iron bodies, stainless steel blades, and cast iron handwheels.

Valves shall have chamfered blade edges and resilient body seals. Gate position indication shall be provided if the overall design does not make this apparent. The blade shall be loaded through its central plane during opening and closing and this shall be achieved by the use of a clevis link or similar.

Blade scrapers shall be incorporated to protect the body seal and valve chest. As the valve is opened, the scrapers shall clean the blade surfaces before these make contact the body seal. The scrapers shall be of a non-elastomeric, non-metallic material and shall be designed to cause minimal damage to the blade.

Valves shall be droptight with flow in either flow direction. Suitable sealing shall be provided to prevent leakage from the valve and it shall be possible to adjust these seals while the valve is in line under pressure.

C3.9.10.6 Air Valves

The design and performance characteristics of the air release and intake valves must have been tested and approved by the Council for Scientific and Industrial Research (CSIR) or other similar testing authority.

Valves shall be capable of discharging high volumes of air through the large orifice under positive line pressure filling conditions and shall be capable of letting in high volumes of air under negative pressure conditions. In addition, the valve shall be capable of releasing small quantities of dis-entrained air at all line pressures up to the rated working pressure of the valve.

Air valves shall not exhibit the characteristics of dynamic closure in both the exhaust and vacuum mode. The valves shall be dual acting and suitably sized to enable the following without creating shock or pressure surges in the pipeline:

- Unrestricted intake of air under negative (sub atmospheric) pressure,
- Unrestricted discharge of air under pressurized air pressure conditions and,
- Slow discharge of air that may come out of solution when the space beneath the air valve is full of water under pressure.

The primary intake/discharge orifice shall be equivalent in cross-sectional area to the nominal diameter of the air valve. The discharge/intake port shall be protected by a non-corrosive screen or shield that shall not impair the discharge characteristics of the valve.

Discharge of pressurised air shall be controlled by the seating and unseating of a small orifice nozzle which shall only open in the presence of air and shall not leak under normal operating conditions.

The valve construction shall be proportioned with regard to the inherent material strengths such that excessive deformation or damage of any kind or leaks do not occur when the air valve is subjected to twice its rated pressure.

Valves shall react immediately to negative pipeline pressure in order to prevent the formation of unacceptably high negative pressure conditions.

During air discharge conditions, the large orifice shall close at a differential pressure across the large orifice of between 4 and 6 kPa in order to minimize transient pressure effects. The design shall enable air to continue to be released once the large orifice has closed under such conditions. This may be achieved by means of a secondary orifice or other approved manner. A slow closing characteristic is an important feature so as to sudden rate of change of velocity which will result in a pressure spine and concomitant surges in the pipeline

The valve shall seal drop tight, without the use of a mechanical spring device, at all line pressures from 10 kPa up to 1,5 times the rated working pressure of the valve.

The valve floats and seals shall require minimal maintenance and it shall be possible to carry out such maintenance without removing the valve.

Provision shall be made for the installation of a 6 mm stainless nipple and ball valve for the fitting of pressure gauges for testing purposes. The stainless steel nipple shall extend through the body to cover all the threads.

All air valves shall be supplied with a copy of the relevant factory test certificates that reflect the test pressure and valve serial number. Original factory test certificates together with a copy of the QCP shall be issued for each valve.

C3.9.10.7 Check Valves

Check valves shall comply with the requirements of SANS 1551-2.

Unless otherwise stated, each valve shall be double flanged and shall have:

- An access cover.
- An extended shaft to which is attached an adjustable lever arm and counterweight.
- A suitably sized arrow indicating the flow direction through the valve cast onto the body of the valve.
- Door seat rings fixed with non-corrosive fixing screws.
- Bronze bushes at each end of the shaft which are capable of being maintained via a removable flange.

If stated in the Project Specification, the valves shall have a manually operated bypass valve noting that it would not be part of the valve if it were to be part of the upstream and downstream pipework.

Valves greater than DN 600 shall be of the double door or multi-door type and unless otherwise stated. In other respects, they must be in accordance with the specifications for the single door type.

Except where otherwise specified, single door swing type and shall be fitted with gun metal seats and bronze hinge and clack pins with bronze bushes. In the case of check valves to be mounted horizontally, the design shall be such that the gate rests against the seat in the absence of flow or of differential pressure, without the aid of springs or external counterweights.

The body and door materials shall be suitable for purpose and shall be agreed and documented in a QCP.

Valve trim materials shall be suitable for purpose and shall be agreed and documented in a QCP.

Door return springs are not permitted.

Bronze swing type check valves may be used for pipework up to DN 50.

C3.9.10.8 Corrosion Protection of Valves

All valves shall be coated externally and lined internally as specified hereunder.

All cast iron and steel surfaces of every valve shall be prepared for painting to a thoroughly clean condition, free of all grease and deleterious matter.

Surfaces shall be degreased by the use of a water-free solvent degreaser such as that complies with SANS 1344 or, for use in enclosed systems, with SANS 1365.

After complete removal of oil or grease contamination, the valve shall be thoroughly washed with clean potable water to remove all residues. The surface shall be water break free. The valve shall then be allowed to dry.

Abrasive materials used for blast cleaning shall be free from oil or grease, as shall be the compressed air used in air blast cleaning.

Surfaces shall be blast cleaned by air blast cleaning methods, then vacuum cleaned or blown off to achieve a standard equal to Sa3 of Swedish Standard SIS 05-5900 when tested in accordance with SANS 5768.

The profile produced by blast cleaning shall be angular and shall have an average peak to valley height of 60 to 100 microns, when tested in accordance with SANS 5772. Hackles shall be removed with coarse abrasive paper.

Residual dust and debris shall not exceed 0,2% when tested in accordance with SANS 5769.

Water soluble salts shall not exceed 100 mg/m^2 at any point when tested with the Weber-Reilly Reagent.

Any laminations revealed by blast cleaning shall be ground out and re-blasted. If grinding penetrates the body to a depth greater than 8% of the nominal wall thickness the valve shall be rejected.

The materials shall comply with SANS 1217 Type 1A for solvent borne chemically cured epoxies. The epoxy to be used shall be subject to the approval of the Employer's Agent.

A total minimum dry film thickness of 250 microns that is to be pinhole free over the entire painted surface shall be achieved.

Coating and lining repairs shall be carried out using repair systems that comply with the specified performance requirements and shall be compatible with the coating and lining materials. The Contractor shall submit proof to the Employer's Agent from the suppliers of the lining and coating suppliers to this effect. Coating and lining materials shall be suitable for use on potable water systems. The cured materials shall be chemically unaffected by free chlorine or chloramine in water in concentrations up to 10 mg/ℓ and to ozone concentration up to 5 mg/ℓ in water and by fluids with a pH ranging from 4 to 10.

The mating face of flanges shall be masked and left uncoated. All runs or drips of epoxy shall be removed from the mating faces of the flanges and the flange profiling shall be clearly visible over the entire flange face.

The mating face shall receive one coat of an approved polymer based, waterborne rust inhibitor.

Care shall be exercised to ensure that after application of all coatings there are no runs or drips and that the flange profiling is clearly visible over the entire flange face.

Excessive coating build up in flange bolt holes that could snag bolts will not be permitted.

In the case of valves with resilient seals, attention shall be given to the thickness and integrity of the coating in the areas where the gate is to operate.

The coating and lining of valves shall be carried out at the factory prior to the dispatch of the valves.

Non-ferrous metal or stainless steel surfaces must not be painted.

After installation, valves shall be further treated with one coat of undercoat and one coat of approved gloss finish.

C3.9.11 FLUID CONTROL EQUIPMENT

C3.9.11.1 General

All equipment is to be designed such that, under full unbalanced hydraulic load, the stress shall not exceed 50% of the minimum yield strength of the parent materials and the rate of leakage shall be minimal. Unless otherwise stated, all equipment shall be fabricated from Grade 316 stainless steel.

Unless otherwise stated, an unbalanced head of 3 m for seating and a head of 2 m for unseating shall be applicable.

Each item, other than hand stops and stop logs, shall be equipped with a solid rising spindle with mounting brackets and a headstock with an appropriately sized handwheel. Where necessary to enable operation by one person, bevel gears shall be provided. Gate lifting spindles shall be of adequate diameter to open and close the gate against resistance without excessive deflection. The lifting nuts shall be of bronze or gun metal with thread length equal to at least twice spindle diameter and cut with mating thread. In cases where the spindle is excessively long due to a deep channel or higher than usual head frame, the spindle is to be supported by guides to prevent buckling. Twin lifting spindles with interconnected gears are to be used for very wide gates. The spindles covers must accommodate the full range of travel of the spindles and shall include external brass position indicators and be manufactured from robust polycarbonate material and provided with mounting flanges bonded to the covers.

Gates shall move freely and smoothly in the frames and sealing shall be achieved by the use of replaceable bulb section neoprene strips of the “music note” or “J” types. Seals manufactured from a similar ultra violet resistance material shall be provided on the upstream face of all moving faces.

C3.9.11.2 Wall Mounted Sluice Gates

The frame sealing for all sides of the wall mounted sluice gates shall be arranged with the use of replaceable bulb section neoprene seals of the “music note” or “J” types.

C3.9.11.3 Twistlock Gates

Gates shall be similar to wall mounted sluice gates and shall be capable of being locked in any partially opened position by a cam mechanism forcing the gate against the frame. The same action is to be used for closing the gate. The gates and frames may be fabricated from cast iron, cast stainless steel or mild steel with corrosion protection. Bronze seating faces are to be used.

C3.9.11.4 Channel Gates

The gate guides on channel gates/penstocks shall extend upwards to fully accommodate the gate when fully opened. The frame of the channel gate is to be embedded into the wall and floor of the channel. Suitably sized grooves will be provided and, once the channel frame has been installed it shall be grouted in.

C3.9.11.5 Hand Stops and Stop Logs

Hand stops and stop logs are to be suitable for manual installation and removal by two operators and the mass of each section may not exceed 20 kg and the maximum width is to be no more than 1 500 mm.

Provision shall be made for the easy attachment of two lifting hooks to each hand stop/stop log eyes under submerged conditions.

Sealing will be achieved through ultra violet resistant neoprene seals between sections and the installed arrangement shall provide an effective seal under all depths of immersion.

The Contractor shall design and supply a permanent frame manufactured from aluminium sections to enable the storage and locking of hand stops to prevent theft.

C3.9.12 ELECTRIC VALVE ACTUATORS

Each actuator assembly shall include the motor, gear train, torque and gear limit switches, hand wheel, de-clutching mechanism, valve position indicator, and all other appurtenances required to rigidly mount and operate the actuator.

Actuators shall be fixed to valves by means of stainless steel studs, nuts and washers and the drive shall be transmitted through a splined sleeve to the spindle. All joints shall be O-ring protected and both the motor and gear-box are to be weatherproof to IP 66 unless otherwise stated in Specifications.

Actuators shall be capable of transmitting sufficient torque or load to the shaft of the valve to unseat it at the maximum working pressure for which the valve is rated and to operate the valve from the fully open to fully closed state.

All torque transmitting housing parts shall be of cast iron. Aluminium die cast is only allowed for covers. The gearing shall be totally enclosed and oil-lubricated. All cover screws, which must be opened for commissioning or setting, must be captive so that they cannot be lost.

The speed of operation of the valve shall be uniform. The stroke travel speed shall be limited by the gearbox and not by way of interrupt timers. Valve travel shall be limited by torque limit switches. If the speed/time of opening and closing of a valve(s) is a requirement, it must be stated in the Specification.

The actuator gearing must be self-locking so that the actuator stays in its last position with zero deviation from the required position. The self-lock feature must stay active if the actuator is changed into hand wheel (manual operation) mode. The actuator must be capable of being installed in all mounting orientations.

A geared hand wheel of suitable size shall be provided for safe and efficient manual operation. The manual control shall be independent of the motor drive. The changeover from motor operation to hand wheel operation shall be accomplished by a declutching device which must be without load during the change into the hand wheel mode. The changing from hand wheel operation into motor operation shall be automatic. The force of the hand wheel shall be in accordance with DIN 3210 Sheet 2.

Actuators shall be fitted with indicators showing the valve opening position. The scale of the position indicator shall be marked "open" and "closed" and shall show the actual degree of opening of the valves. The design shall provide for the installation of a contact-less transmitter to give 4 to 20 mA analogue signal for remote indication and control corresponding to valve travel. An electronic current feedback (4 to 20 mA) facility must also be available. The feedback drive must be fully assembled by the actuator manufacturer. The position indicator shall be able to be powered by a backup battery to provide remote indication in the event of a mains power failure. Changeover between the backup battery and the mains power shall be fully automatic with no human intervention.

Output drives shall be in accordance with the requirements of ISO 5210. In the case of drive Form A, to ISO 5210 they should be separate from the main actuator housing in order to remove the complete actuator from the valve, while the valve stem is kept in position by the output drive of the actuator.

Position control shall use a 4 to 20 mA input signal.

Open / close control shall be effected by potentially free contacts using a low voltage from the actuator.

Torque faults and limits shall have external relay outputs.

Terminals for power supplies and control circuits shall be provided in a separate terminal enclosure. Entries shall be plugged and sealed until site wiring commences. Each terminal shall be separately marked with numbers corresponding to the schematic and wiring diagrams.

Local open/close/remote push buttons and lockable selector switches are to be provided integral with the actuator. The selector switch shall give the following facilities:

- Remote only
- Remote and local stop
- Stop locked (electrical operation not possible)

A geared hand wheel is to be provided as an integral part of the actuator and it shall:

- Not add friction to the actuator.
- Allow for impact effect, if any, in both the opening and closing directions.
- Be automatically de-clutched when the motor is started.
- The actuator assembly is to be provided with a mechanical valve position indicator.

The valve/actuator assembly shall be designed to prevent overheating of the actuator above its design limits.

Actuator motors shall be sized for to operate the valves with adequate safety margins with due regard to the impact effect, if any, in both the opening and closing operations and shall be:

- 3-phase squirrel cage motors to IP 65 unless otherwise stated in the Specification.
- Flange mounted directly on to the gearbox
- Specially designed for valve application providing high torque and low inertia
- Totally enclosed, with the housing being one casting, non-ventilated
- Insulating Class F,
- Thermally protected by 2 thermostats embedded in the motor windings, one for each phase,
- Time rated 52-15 min to IEC 34 at nominal motor load and at least 33% of maximum valve torque for 15 min rated with cyclic duration factor of 25% at 33% of actuator output rated torque giving a temperature rise of not exceeding that permitted for Class B insulation at standard nominal voltage,
- Rated for 20 starts per hour,
- Equipped with a self-regulated anti-condensation heater of less than 15 W rating which shall be energised from the internal control transformer,
- Protected by a motor protection unit integrated into the actuator.

The motor wiring shall be connected to the main actuator housing by a plug and socket for easy removal.

The integral motor protection shall de-energise the motor in the event of:

- Single phasing
- Overheating as sensed by 2 No thermostats in the stator windings
- Overloading
- Stalling as a result of a jammed valve
- Output torque exceeding torque setting

The following valve status signals shall be wired to terminals for remote indication:

- Valve fully closed
- Valve partly open
- Valve opening/closing
- Collective fault signal containing power failure, wrong phasing, motor thermostat tripped, control voltage failure and torque switch operation in intermediate position of the valve. This is considered as the actuator electrical availability signal
- Remote selected

The valve position shall be determined from a 4-20 mA signal representing the valve percentage open and shall be wired to terminals for remote indication.

The above signals shall be from potential free/dry change over contacts rated 5 amp 240 volt AC inductive and 5 amp 24 volt DC. A 24 volt DC supply shall be made available for remote control and indication.

Local indication at the actuator shall include:

- Valve fully closed
- Valve partly open
- Collective fault signal containing power failure, wrong phasing, motor thermostat tripped, control voltage failure and torque switch operation in intermediate position of the valve. This is considered as the actuator electrical availability signal

Local control at the actuator shall include a LOCAL-OFF-REMOTE selector switch, padlockable in any position, and OPEN, CLOSE and STOP controls.

Switches must be encapsulated to IP66 to IEC 144 to protect them against getting wet during setting work on the actuators and allow for setting while power is on. They shall be rated at 5 Amps at 240 V DC. Switches shall be bounce-free. A minimum load of 20 mA at 24 V AC must be operated by a standard switch.

Each actuator:

- Shall incorporate two, independent from each other, electronically settable torque switches, one for fully closed and one for fully open. Infra-red setting of torque is preferable.
- Shall be supplied with one limit switch for open end position and one limit switch for closed end position. The limit switches shall be set electronically, preferably by infra-red control. The limit switches must function independently of the torque switches. Over travel of the set point, e.g, by hand operation shall not change the set position.

The reversing contactors shall be electrically and mechanically interlocked, rated appropriate to the motor size and shall be of the extreme switch duty AC-4 type.

The controls should be a part of the actuator design, suitably housed to prevent breathing and condensation build-up. All connections between the actuator and the control housing should be made by one plug and socket connection for easy removal of the complete control.

In remote control mode the actuator shall be controlled by open, close and stop contacts in the control panel. The contacts for this control in the control panel are voltage-free and are energised from the actuator. The inputs of these signals must be separated from the control by optocouplers in the actuator.

Within the control it must be possible to program the function of the end position switching i.e, torque switch or limit switch dependent. It must also be programmable for both opening and closing direction independent of each other whether the actuator runs after getting a control signal by self-retaining contacts into the end position or runs only as long as the control signal is coming.

All internal connections within the integral control and between the different boards should be made by plug and socket connections except for motor power cables. All plug and sockets shall be clearly marked to prevent incorrect connections.

Provision must be made for three cable entries, one for the motor cable, one for the control cable and one for possible feedback signals. All terminations shall be clearly marked.

C3.9.13 PUMPS

C3.9.13.1 General

The pumps offered shall be pumps of proven performance and of manufacturers' standard designs, except that the pumps must be located to suit the layout(s) shown on the relevant drawing issued with the tender documents by the Employer's Agent

All parts are to be properly designed with ample margin of safety and are to be suitable for their pumping duties.

Pump speeds should be such as to permit direct drive by a squirrel cage induction motor except in those cases where the drive is to be adapted to suit future changes in duty or where the required speed for the specified duty is incompatible with that of the motor.

Where V-belt or wedge belt drives are required they shall comply with, and be selected in accordance with, the requirements of BS 3790 with the type being subject to the Employer's Agent's approval. The service factor on the design of the belt system shall be selected for continuous operation at heavy duty and be not less than 1,6 based on the installed motor power. All belts shall be in matched sets. Motor and pump pulleys shall be manufactured from cast iron with metric dimensions to ISO 4183. The pulleys shall be fitted to the pump and motor shafts using taper-lock bushes. The shafts and pulleys shall be accurately machined and provided with a keyway. The minimum overall efficiency of the whole motor and drive assembly shall not be less than 80 %.

Adjustment of belt tension shall be accommodated using accurately machined parallel action slide rails, securely affixed to the baseplate, manufactured from cast iron and incorporating robust adjustment bolts with locking nuts and guides. Adjustment bolts and guides shall be manufactured from Grade 304 stainless steel.

Pumps shall:

- Be capable of doing the duty required at speeds preferably less than 1 500 rpm but never in excess of 3 000 rpm.
- Be so balanced that there will be no end thrust when the pump is new or after wear has taken place, or alternatively, suitable heavy duty thrust bearings must be provided.
- Have shafts of high tensile steel with protecting sleeves of bronze or other suitable metal, the diameter being sufficient to withstand and transmit without whip and with ample margin of safety all torsional and bending stresses to which it may be subjected.
- Have pump casings of high-grade close-grained cast iron or cast steel of grade suitable to withstand the field and/or factory test pressure specified , rigidly secured to a neat, properly designed bedplate or base.

The pump manufacturer shall utilise suitable materials for all moving and static parts in contact with the fluid to be pumped so as to enable them to resist all corrosion and erosion damage.

Bearings shall have no less than a L_{10} 100 000 hour life and are to be of ample bearing area, dustproof with suitable provision for continuous lubrication.

Performance particulars and characteristic curves for each type of pump shall be submitted at the time of tendering. Efficiencies should be as high as possible in the normal indicated operating range.

Wherever possible, axial thrusts should be counteracted by hydraulic balancing rather than by thrust bearings. The rotating elements shall be statically and dynamically balanced.

Components of the pumps should be so fitted and fixed that neither normal nor contra rotation can give rise to torques which will set them free to move out of their proper position.

The arrangements for bearing lubrication, water seals, air bleeding and priming of all pumps and pipework shall be such as to permit unattended stopping, starting and operation of the pumping plant by means of automatic remote control for the longest possible period under the control and operating conditions specified and in accordance with the general duty requirements.

The pump casing from the suction inlet flange to the delivery outlet flange shall be capable of withstanding the internal hydraulic pressures specified.

C3.9.13.2 Centrifugal Pumps

Centrifugal pumps shall:

- Comply with the requirements of ISO 9908.
- Be of the self-regulating type with a "stable" characteristic i.e, for any selected manometric head each pump shall be capable of pumping at only one rate.
- Be capable of doing the duty required at speeds preferably less than 1 500 rpm but never in excess of 3 000 rpm
- Have impellers and guides of cast iron for sewage pumps and stainless steel or phosphor bronze for potable water pumps.

C3.9.13.3 Dosing Pumps

Dosing pumps shall comply with the following:

- Each pump shall be capable of dosing up to the maximum rate stated in corresponding documents.
- Pumps, which feature diaphragms, shall be configured or protected so that diaphragm breakage will not lead to damage of the internal part of the pump. A pressure relief valve and diaphragm protection (burst disc) system shall be installed.
- The pump installation shall, only if specifically stated in the specification incorporate a pulsation damper (with separating diaphragm) facility to ensure a constant dosing flow of chemical solution to the application point.
- All components such as dosing heads, suction and delivery valves, diaphragm and pulsation dampers, isolating valves, pressure sustaining valves, suction and delivery lines in contact with the chemical solution shall be compatible with, and resistant to, chemical attack by lime solutions used in water treatment plants.
- Pumps shall be either simplex or duplex pumps.

- The electric motors shall be 240 V unless otherwise specified in the Specification.
- Pumps shall either be mounted on a wall or other rigid vertical mounting surface on stainless steel supports or shall be mounted on plinths above the floor level.
- The pipework on the inlet and outlet of pumps shall be provided with isolating valves and couplers to allow removal of the pumps without dismantling of the surrounding pipework.
- Strainers shall be provided upstream of each pump inlet. The strainers shall be designed and installed in a manner which will allow cleaning of the strainer element without uncontrolled spillage. Strainers shall be provided with inlet and outlet isolating valves.
- A facility for the connection of a flushing water pipe shall be provided. The chemical solution feed pipe and the treated water flushing pipes that are to be connected to the suctions of the dosing pumps are to be equipped with a solenoid valve(s) to ensure that regular flushing of the dosing pumps and discharge pipe can be achieved. The solenoid valve is to be controlled via adjustable timers to enable flushing cycles (both open and closed valve periods) to be selected. These timers are to be housed in the panels supplied under the electrical section of the Contract.
- All mounting fasteners and mounting brackets shall be of Grade 316 stainless steel.

C3.9.13.4 Bedplates, Couplings and Guards

With the exception of submersible pumps, each pump and its corresponding motor and drive shall be mounted on a rigid steel baseplate manufactured from carbon steel channel and plate section with holding down bolts and nuts for fixing the pump and motor to the bedplate and the bedplate to a concrete base. In each case the bottom of the bedplate shall be set 25 mm above the concrete base, and in erecting the plant, the Contractor shall set each unit to precise line and level by means of brass shims and steel wedges and shall grout up the holding down bolts and carry out all grouting and finishing below, inside and round each bedplate.

Separate pads shall be provided for mounting the pump and motor which shall be machined after completion of manufacture and galvanising. The baseplate shall be supported from the concrete foundation by anchor bolts into pockets. Provision shall be made for accurate alignment of all components after installation and prior to grouting. Each bedplate shall be provided with suitable openings for pouring in grout.

Except in cases where special drives are required for future duty changes, in which cases the drive shall be arranged by the Contractor to suit his plant, each pump shall be direct coupled to its corresponding motor by means of an approved, flexible coupling of robust design. Coupling halves shall be precisely machined and securely fitted so that the rims and faces of the two halves of any coupling may be used for checking alignment errors of parallelism and angularity of motor and pump shafts using laser alignment equipment. The accuracies of ± 0,025 mm and ± 0,025 mm on 100 mm, respectively, or less if recommended by the pump manufacturer, shall be achieved.

The coupling shall be of the type which can tolerate slight misalignments.

Clearance between the two halves of the flexible couplings shall be adequate to avoid interference between the metal halves. Sufficient clearance is to be provided between the halves of the coupling to allow unhampered end-wise movement of the shaft of the motor to the limit of its bearing clearance and taking the magnetic centre of the motor into account.

The running position of the motor-half of the coupling is to be checked by the Contractor by running the motor alone and the couplings halves set on the shafts accordingly.

Alignment errors shall be measured by the Contractor using laser type equipment after final grouting and final tightening of holding down bolts and warming up of the motors by running for at least half an hour and the Contractor shall furnish the Employer's Agent with a certificate stating that the positions of the coupling halves have been checked in accordance with the foregoing paragraphs and also stating the measurements of errors of angularity and parallelism of coupled shafts and that they comply with the pump and motor manufacturers' recommendations.

The importance of ensuring that the suction and/or delivery pipework does not impose any forces onto the pump casing(s) is recognised. The Employer's Agent will therefore require the Contractor to complete carry out the following after completion of the installation of the pump sets and pipework but before hydraulic testing:

- Remove all of the bolts and nuts in the pump suction/suction pipework connecting flange.
- Remove all of the bolts and nuts in the pump delivery/delivery pipework connecting flange.

There shall be no apparent movement of either the pump flanges or the pipe flanges and each bolt shall not require excessive force to insert it back into its hole in the abutting flanges. In the event of it not being possible to easily (without force) insert every bolt, the Contractor shall rectify the matter. Thereafter the hydraulic pressure test shall be carried out.

Rigid steel guards shall be provided and bolted to the bedplate in such a way as to ensure protection of operators from moving parts.

Submersible pumps are to be mounted on a vertical guiderail arrangement and fixed by to a rigidly mounted duckfoot bend by means of a flanged claw arrangement unless otherwise stated in the Project Specification.

C3.9.13.5 Pump Accessories and Gauges

The tendered prices for all pump accessories and gauges shall include allowances to cover the cost of everything, such as brackets and fixings, necessary for setting up this part of the plant in a neat and workmanlike fashion, all so arranged to facilitate reading of gauges and clearing of drainage tubing without dismantling.

The pumps are to be fitted with all the necessary air cocks and drains, which shall discharge into drains on the base plate of the pumps, and hence to the drainage ducts. All drains shall be of stainless steel. They shall be properly supported along their entire length and generally shall be located under the suction pipework. Pipe runs shall be straight where possible. At all changes of direction, plugged tees or crosses shall be provided to permit rodding. Stainless steel tubes to pressure gauges, etc, shall be properly fitted, securely cleated in position. Bends shall be uniformly made, free of wrinkles or flattening.

Each pump is to be provided with two highest quality glycerine filled 150 mm dial pressure gauges calibrated in kPa and to register the suction and delivery pressures. Such gauges shall be in accordance with DIN Specification, with bottom connection for wall mounting and glycerine filled. The case and movement shall be of stainless steel. A three-way bronze isolating cock is to be provided for each gauge. A snubbing screw is to be provided.

The gauges shall cover the range given and be so designed that they will not be liable to damage if the delivery head is exerted on them. Calibration certificates for each gauge must be supplied by the Contractor.

The suction and delivery pressure gauges shall be rigidly mounted near the pump in a position agreed with the Employer's Agent with all dials at the same elevation and if possible, so arranged that all are visible by an operator standing at the pump starter.

An isolating cock shall be provided at each point of connection to the pump or pipework. Each gauge shall be equipped with a bronze isolating cock and connected to the pipework by means of suitable stainless steel tubing neatly laid and securely fixed. A tee and extra isolating cock shall be provided at each gauge point so arranged that when required for testing purposes two gauges can be fitted side by side at each point.

On all raw water/sewage/effluent/chemical/viscous fluid installations, each pressure gauge is to be equipped with a diaphragm seal to prevent the ingress of solids into the gauge.

The non-return valve on the delivery of each pump shall be fitted with an extended shaft with an adjustable counterweight and a limit switch and timers to stop the pump automatically if flow ceases for more than one minute, or such shorter period recommended by the pump supplier.

C3.9.13.6 Factory Tests on Pumps

Unless otherwise stated in the Project Specification, the prices tendered for all pump sets will be held to cover all factory testing of pumps in compliance with this clause. The following tests shall be carried out in the manufacturer's works or in approved testing premises:

- Prior to the performance tests being carried out, each new pump shall be subjected to the internal static hydraulic test pressure as stated in the Project Specification with suction and delivery flanges blanked off. The pumps shall be watertight (except at packed glands if mechanical seals are not installed) under this test.
- Each new pump to be supplied under the Contract shall be tested in the manufacturer's Works, or in other approved premises. The Employer's Agent reserves the right to send a representative/inspector to witness all or some of the tests. The tendered rates for the pumps shall include for making arrangements for the independent inspections. The inspectors' fee and recoverable expenses will be for the account of the Employer, but fees and other expenses arising from abortive or repeat visits due to non-compliance with the specified requirements will be for the Contractor's account and will be deducted from amounts due to the Contractor.
- All centrifugal pumps are to be tested in accordance with BS EN ISO 9906 Rotodynamic pumps – Hydraulic performance acceptance tests – Grades 1, 2 and 3. Unless otherwise stated in the Project Specification, Table 9 shall be applicable.
- The range of the performance tests shall be sufficient to enable the Employer's Agent to compare the actual test performance of each pump with the performance figures entered on the data sheets and/or otherwise presented by the Tenderer at the time of tendering.

- The results of the tests on each pump shall be prepared in triplicate in the form of pump test sheets and signed by the manufacturer and by the Employer's Agent's representative/inspector in the event of that person being present and having witnessed the test. Each such sheet or copy thereof shall be accompanied by curves accurately plotted and depicting the following characteristics:
  - Test Curve: Total Pumping Head (metres of water) vs Discharge (l/s)
  - Tender Curve for comparison with above
  - Test Curve: Pump Efficiency vs Discharge
  - Tender Curve for comparison with above
  - Test Curve: Input power (kW absorbed by pump) vs Discharge
  - Tender Curve for comparison with above
  - Test Curve: Amps per phase of motor vs Pumping Head (metres)
  - Tender Curve for comparison with above; calculated from tendered data relating to pump and motor.

Note: The above-mentioned test curve shall be calculated on the basis of the results of the aforementioned pump tests in conjunction with the results of simultaneous or separate tests on the appropriate motor, without allowance for the operating effect of power factor correction capacitors and assuming it is operating at the altitude of the site as specified elsewhere.

The triplicate copies of pump test sheets certified by the Manufacturer or his/her Agent's together with the above-mentioned curves shall be sent timeously to the Employer's Agent so as to reach him/her at least two weeks before erection of the appropriate pump is completed on site so that the last listed curves above may be used for the purpose of re-checking the performance of the appropriate pump-motor-combination set at the time of commissioning.

C3.9.13.7 Site Acceptance Tests

Each pumpset shall be subject to a commissioning run to ensure that it is operating in accordance with its specified conditions and that there is no undue noise, vibration or excessive heating of any components.

C3.9.14 BLOWERS

Unless otherwise stated in the specification blowers are to be of the air cooled, positive displacement, rotor type Roots blower and shall deliver oil free air. The blower housing and rotor shall be of high quality spherodial graphite or cast iron.

As far as possible, sound reduction is to be achieved by pulsation dampening. The pressure fluctuations in the air supply shall not exceed 2% of the operating pressure.

Standard operation conditions are to be assumed for the design and selection of the blowers to suit the site conditions.

Measures are to be taken to reduce damage to the blowers as a result of the blowers being started against a closed valve or a valve being closed under operating conditions.

The rotors are to be of the three lobe rotor type for quiet operation, and reduced vibration and downstream pulse. They are to be designed with an involute profile for maximum efficiency and are to be statically and dynamically balanced. The rotors are to be mounted on high tensile steel shafts and shall be linked by accurately machined and hardened timing gears mounted on the shafts and secured with a lock nut. Cylindrical roller bearings are to be used for the shafts and shall be rated for no less than a L10 100 000 hour life.

The rotor housing (compression chamber) is to be a one piece housing with the inlet and discharge flanges cast in. The rotors are to run without any lubrication within the housing. Each end cover is to effectively seal the compression chamber from the ingress of oil, water and air. Piston rings are to be used to reduce air leakage through the shaft openings in the end covers. Hydrostatic oil seals are to be used to prevent lubricant from entering the compression chamber.

Blowers shall be of the air cooled type. The intake filter is to be a combination of intake filter and intake silencer. The parts are to be housed in weather proof housing and mounted on the intake flange of the blower housing. Intake is to be from the atmosphere. A discharge silencer is to be supplied with the unit.

The end covers shall cover the gears and form oil reservoirs for lubricating. An oil sight glass is to be provided on each oil reservoir. The bearings and timing gears may be splash lubricated.

A direction of rotation arrow shall be permanently embossed on the blower casing.

Should an air bypass facility for surge control during blower start up and shut down or other operating conditions be required due to the characteristics of the air blowers offered, provision shall be made for this equipment.

Pressure gauges are to be mounted on the suction and delivery sides of the blowers. They are to be glycerine filled and have a minimum diameter of 100 mm. They are to be able to read twice the blower operating pressure. Stop cocks are to be provided to isolate the pressure gauges. The air blowers are to shut down if the inlet pressure is negative.

Inlet and outlet silencers shall be of the absorption type with inner pipe sleeve or filler boxes of Grade 304 stainless steel. The filling shall be of mineral wool. The design of the filler boxes or sleeves shall prevent any loss of the filling material. The silencers shall be capable of reducing the blower and suction noise levels to the prescribed limits.

The blowers are to be supplied with acoustics enclosures which reduce the noise generated to below 75 dB when measured one metre away from the enclosure in accordance with ISO 3746. Each acoustic enclosure panel is to be lined with self-extinguishing, sound absorbing, polyurethane material. An air extraction fan is to be fitted in the enclosure. The pressure gauges are to be mounted in the enclosure for easy access and readability.

C3.9.15 GEARBOXES

Gearboxes shall be of the parallel shaft type, specifically designed for the intended application either horizontal or vertical and, where applicable, for operation at an inclined angle. They shall be selected for continuous operation in exposed conditions at 95% humidity and direct sunlight with an ambient air temperature range between 0° and 45°C.

The power transmission rating of gearboxes shall be calculated in accordance with the method laid down by the American Gear Manufacturers Standard 6010-F97 for continuous operation and shall not be less than 2,0 x absorbed power or 1,75 x installed power whichever is the greater. Strength and durability calculations in accordance with AGMA 2001-D04 shall be submitted by the Contractor within 4 weeks of award of the Contract.

Gearboxes shall be of the double or triple reduction type and all gearing is to be helical. Worm gears will not be considered. All gears and pinions shall be manufactured by an approved process to AGMA 2009-B01 or ISO 1328-1.

All bearings shall have a L10 100 000 hour life and proof of such rating shall be submitted by Tenderers. In addition, the bearings on the output shaft shall be capable of withstanding the resultant forces caused by a combination of radial and axial loads imposed simultaneously due consideration being given to out of balance liquid loads. Selection shall be such that the following condition is complied with where the permissible loads are the manufacturer's figures for L10 5 000 hour life.

$$\frac{\text{Actual radial load}}{\text{Permissible radial load}} + \frac{\text{Actual axial load}}{\text{Permissible axial load}} \leq 1$$

Gearbox housings shall be of the best quality close grained grey cast iron to ISO 185 or equal, and suitable breathers shall be supplied to prevent the ingress of moisture. Provision shall be made for easy draining of the gearbox by extending the drain to a point outside the base plate. A stainless steel lever operated ball valve and plug shall be fitted to the drainpipe.

Each gearbox shall be mounted on machined sole plates fitted with jacking screws to assist with alignment.

Bearing housings on gearboxes and motors shall be provided with a ground hemispherical indentation at a common location to permit vibration and bearing analysis.

Each gearbox shall be provided with:

- A dip stick so arranged as to prevent the ingress of water or a robust oil level gauge consisting of a toughened glass sight tube with brass or stainless-steel shroud and fixing and sight glass, together with maximum and minimum oil level indication
- A stainless-steel drain cock extension plug fitted to facilitate easy draining of the gearbox oil.
- A dry well for the output shaft lower bearing to avoid total loss of oil in the event of a seal failure. This bearing shall be grease lubricated with the grease nipple being located in an easily accessible position

C3.9.16 ELECTRIC MOTORS

The detailed specifications for the electric motors are included in the electrical specifications that form part of this document. All motors shall be IP 55 unless otherwise stated in the Project Specification.

The following motor margins shall be applicable:

Maximum Power Absorbed by the Driven Machine Under All Operating Conditions	%age to be Added to the Absorbed Power Under the Operating Condition of Maximum Power Absorbed
Up to 4 kW	50%
> 4 kW & up to 30 kW	25%
> 30 & up to 100 kW	15%
> 100 kW	10%

Each electric motor that is mounted vertically in an exposed position shall be equipped with a non-corrosive GRP weatherproof cover/cowl mounted above the fan housing in order to prevent the sun's rays from damaging the plastic fan and in order to prevent rain from falling on the fan and hence on the end of the motor shaft. The cover shall be easily removable by loosening no more than four small diameter stainless steel bolts.

C3.9.17 INSTALLATION OF PLANT AND EQUIPMENT

C3.9.17.1 General

When installed, the plant and equipment shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb, and in proper working order.

The Contractor shall provide all foundation bolts, supports, hangers, brackets, etc. required for the support and fixing of all equipment.

All pumps, pipework, valves and fittings shall be securely fixed and supported so as to impose no undue stress on any pump casing and the prices tendered shall include for the supply and installation of all supports and fixings in this regard.

The Contractor will be responsible for grouting puddle pipes which pass through concrete walls and/or slabs and for all other grouting necessary for the correct installation of all plant and equipment supplied and installed under this Contract.

C3.9.17.2 Alignment of Shafts

Shafts for drives, such as motors, shall be accurately aligned using laser aligning equipment.

Final alignment shall be carried out after installation and an alignment certificate shall be submitted to the Employer’s Agent before commissioning. Alignment shall comply with the manufacturer's recommendations and be sufficiently accurate to ensure that there are no adverse effects as a result of the out of alignment tolerances.

C3.9.18 Installation of Pipework

C3.9.18.1 General

Pipes and fittings shall be selected to suit the application and shall be neatly installed, straight to line and level, and adequately supported and shall operate without vibration. Adequate provision shall be made for expansion and contraction due to variations in temperature or pressure.

All pipework shall fit perfectly and be so arranged and supported that it shall not impart stresses to the pumps or other plant due to misalignment.

All pipe fittings at pump inlet and outlet ports shall be detachable without moving pumps or other pipework and so arranged and supported such that, after closing its delivery and suction sluice valves any pump may be conveniently removed for overhauling while others continue to operate.

Unless otherwise stated in the Project Specification, all pipework to be built into or in contact with concrete structures shall be 6 mm thick Grade 304 stainless steel.

All pipework shall be suitably equipped with the requisite tapped bosses, isolating cocks, supports, fixings and everything necessary for attaching site pressure testing apparatus and controls and for satisfactory operation of the plant.

Isolating valves shall be mounted with their spindles vertical. On sludge and raw sewage installations, check valves shall be mounted horizontally. All valve handwheels shall be easily accessible to the operators.

The prices tendered for pipework shall include allowances to cover the cost of all jointing, in situ welding, supporting, support brackets, tie rods, drilling, grouting in and supplying support bolts, painting and everything necessary in terms of this specification.

C3.9.18.2 Supports

Pipe supports shall be so located that when an item of mechanical equipment is removed, the associated valves and pipework will still be adequately supported.

Supports shall be provided under or close to heavy items such as valves.

All supports shall be robust and, in particular, horizontal support brackets such as those on pipework and fixed to walls shall be fabricated from suitably sized channel or box sections to prevent deflection and to resist and completely dampen any vibration that may occur in the pipework.

Where vibration is not possible, 3 mm thick neoprene strips shall be placed between pipes and supports or clamps to protect the paintwork and limit corrosion. Where roller or sliding supports are used to accommodate movement, suitable wear blocks shall be fixed to the pipe to prevent damage.

C3.9.18.3 Flexible Joints

Where movement or misalignment must be allowed for, or if necessary for ease of removal, flexible couplings and flange adaptors shall be used and these shall not have central registers. Where flexible couplings are used they shall be arranged with extra lugs and bolts as necessary, so as to transmit the full tensile forces developed at the joints by the applied hydraulic pressures.

Flexible couplings shall comprise a centre sleeve/body and endings manufactured from hot rolled Grade X42 steel. The sleeve/body and endings shall be abrasive blast-cleaned internally and externally to Grade Sa 2,5 of the Swedish Standard SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter shall be abrasive blast-cleaned internally and externally to Grade Sa 2,5 of the Swedish Standard SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter coated with solvent free epoxy complying with SANS 1217 1B with a DFT of at least 300 microns.

Rubber expansion joints (bellows) may be used if approved by the Employer's Agent. These flexible rubber expansion joints shall be rated in excess of the maximum surge pressure.

C3.9.18.4 Draining, Venting and Purging

On liquid lines, provision shall be made for draining and venting where necessary. Vents shall be provided at all vertical down bends on gravity lines.

C3.9.18.5 Condensate Drains

Automatic condensate traps with isolating valves and valved by-passes shall be provided at all necessary points including ahead of any globe type valve, orifice plate or concentric reducer in a horizontal line, at each change of level and immediately ahead of the user equipment.

A suitable well of a diameter equal to the pipe diameter with a bottom drain shall be provided at each condensate removal point. Condensate traps and valves shall be accessible and condensate shall be piped to the nearest drain. Pipework shall be sloped in the direction of flow towards a drain point with a slope of 1 in 150 and care shall be taken to avoid sagging at any point.

C3.9.18.6 By-passes

Isolating valves and valved by-passes shall be provided around condensate traps, pressure reducing valves and valves with solenoid or other actuation which do not have provision for manual operation.

C3.9.18.7 Pressure Testing

All pipelines shall be pressure tested to 1,5 times maximum working pressure or such higher pressure as may be prescribed in the Project Specification.

C3.9.19 CORROSION PROTECTION

C3.9.19.1 General

Where corrosion of metal may be expected, the Contractor shall supply materials which are resistant to corrosion. Any material showing signs of corrosion, tuberculation or pitting before expiry of the Defects Liability Period must be replaced by the Contractor at no cost to the Employer.

Corrosion protection requirements shall be carefully attended to as outlined below.

All epoxies and paints are to be applied strictly in accordance with the manufacturer's recommendations. Particular care is to be taken with surfaces which will be inaccessible after assembly. Surfaces of welded connections must be painted before welding is carried out and painted surfaces damaged by welding must be suitably prepared and repainted without delay. In the case of bolted connections, edges of bolt holes must also be painted, and bolts, nuts and washers must be similarly treated. Washers must be used under all nuts to prevent damage to the treated surfaces of the plate.

The final colour scheme(s) is to suit the Employer's requirements.

The tendered prices will be held to include the cost of all painting or other surface treatment which is not separately specified or scheduled but which is nevertheless necessary for the protection of surfaces against corrosion and for the final appearance of the installations.

C3.9.19.2 Galvanising

Unless an alternative coating is called for in the Project Specification, all fabricated mild steel components shall be hot dipped galvanised strictly in accordance with the requirements of SANS 121 (hot-dip zinc coatings) for heavy duty applications.

After galvanising, the equipment shall be carefully stored and loaded, making ample use of wooden spacers to prevent damage to the galvanised surfaces. Equipment with damage to the galvanised surface will be accepted only after satisfactory re-galvanising.

Unless stated otherwise in the Project Specification, or otherwise agreed on site with the Employer’s Agent, galvanised steelwork shall receive a suitable primer and two coats of gloss enamel after installation.

C3.9.19.3 Fabricated Mild Steel

If specifically stated in the Project Specification that hot dipped galvanising is not required, the fabricated mild steel components shall be abrasive blast-cleaned internally and externally to Grade Sa2,5 of the Swedish Standard

SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter coated with solvent borne epoxy complying with SANS 1217 Type 1A with a DFT of at least 300 microns.

After installation, all surfaces are to be painted with an appropriate primer (if necessary) and two coats of gloss enamel.

C3.9.19.4 Fabricated 3CR12

Unless otherwise specified in the Project Specification, 3CR12 components are not to be coated.

C3.9.19.5 Mild Steel Pipework

All pipework shall be lined and coated as specified above.

Only if stated in the Project Specification, certain pipes are to be rubber lined as specified above instead of being epoxy lined.

After installation, all coated pipes that are to remain exposed are to be primed (if required) and then given two coats of gloss enamel.

C3.9.19.6 Valves

All valves shall be coated as specified in above.

After installation the valves are to be primed (if required) and then given two coats of enamel, with the colour scheme to suit the Employer's requirements.

C3.9.19.7 Stainless Steel

Unless otherwise stated in the Project Specification, stainless steel components and pipes shall not be painted but shall be buffed to a clean shiny finish.

C3.9.19.8 Buried Joints

Where flanges and couplings are part of buried pipework, the joints shall be enclosed with "Denso mastic" or similar approved to a smooth finish, wrapped with "Denso tape" or similar approved and then wrapped with a polythene sheet which is strapped in place. If the operating temperature is likely to exceed 70ºC a suitable grease or sealer shall be used.

C3.9.20 MACHINE VIBRATION

All rotating elements shall be statically and dynamically balanced according to ISO 1940-1:2003 to a balance quality grade of G2.5. Balancing certificates shall be submitted in an approved format.

The mechanical vibration of machines measured at all important points such as at bearings shall be lower than that indicated in ISO 10816.

Pumps shall comply with the vibration standards for Category II pumps as indicated in BS ISO 10816-7.

C3.9.21 NOISE EMISSION

The noise level of the completed installation shall not exceed the following:

- A maximum noise level at the site boundary not exceeding an equivalent continuous sound level of 55 dB(A) when all equipment installed is being operated.
- A maximum noise level at a distance of 1 m of each sound producing mechanical and/or electrical equipment of 80 dB(A).

Where the Contractor is unable to restrict the noise level of the machines to the maximum specified, by the appropriate selection of suitable equipment e.g, by selecting slow speed or silent type machines, quiet type cooling fans, suitable silencers, etc. then an alternative solution, such as an acoustic hood or similar shall be included in the tendered amounts.

Notices and signs complying with the regulations to the OHSA shall be supplied and installed in all "noise zones".

C3.9.22 CONDITION MONITORING

Unless otherwise stated, all pumps, motors, and gearboxes with ratings equal to or greater than 15 kW shall have provision for the installation of temperature and vibration sensors on all bearings. In the event of temperature and/or vibration sensors being required. Refer to bill of quantities and/ applicable drawings.

All condition monitoring equipment that is supplied and installed shall be such that it can function satisfactorily and be repaired or replaced without the need for the use of proprietary equipment.

C3.9.23 NAMEPLATES

A corrosion resistant nameplate that is clearly engraved or hard stamped displaying the following information is to be provided on each item of plant:

- Manufacturer’s name
- Type and Model
- Serial number
- Date of manufacture
- Rated duty
- Rated operating speed
- Maximum permissible operating speed
- Drive motor size (kW)
- In the case of pumps, the impeller diameter and maximum impeller diameter

C3.9.24 SIGNAGE OF THE MAJOR COMPONENTS

For the benefit of the Employer's operating and maintenance staff, each major component of plant is to be permanently identified by means of a robust plastic sign no less than 100 mm high with 75 mm high embossed lettering in a contrasting colour, permanently fixed to galvanised steel supports or to concrete or plastered brick surfaces with stainless steel or brass screws into wall anchors. The signs are to be installed in conspicuous positions. For example, in a pump station with three pumpsets, three plastic signs marked Pump 1, Pump 2 and Pump 3 would be required and would be wall mounted in positions visible from the HMI and/or MCC. The Contractor's proposal in this regard will be subject to the approval of the Employer's Agent prior to the ordering and subsequent erection of the signs.

C3.9.25 SPARES, TOOLS AND LUBRICANTS

Tenderers must submit in the appropriate Technical data Sheet, a priced list of spare parts which it is recommended should be kept by the Employer for maintenance of the plant for a 3 year period. All spares that may be ordered must be packed separately and the cases appropriately marked.

Tenderers must also submit a price for any special spanners, keys and tools required for the operation, adjustment and overhaul of the plant supplied.

In addition to the lubricating oil to be provided for commissioning the plant (where applicable) an additional quantity of oil adequate for at least two complete refills of such plant must also be provided and will be deemed to be included in the tendered rates for the plant.

The spare parts to be listed and priced shall not be limited to, but shall include the following:

Centrifugal Pumps:

Impeller	Shaft sleeves
Spacers	Keys
Bearings	Seals
Races	Glands
Wearing rings	
Shaft	
Two complete sets of gland packing if applicable	
Vee-belt Drives: Belts	

All spares that are ordered shall be supplied and handed over to the Employer.

Each part shall be hermetically sealed and labelled by means of a metal label firmly affixed to it by wire. On each label shall be stated:

- The manufacturer's name and address.
- The manufacturer's catalogue or part number.
- A description of the spare part.
- A description of the particular equipment for which the spare is supplied and the Contract number under which the particular equipment was supplied.
- The date of supply of the spare part.

C3.9.26 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

Operating and maintenance instructions manuals are required for all new plant and equipment supplied and/or installed under this Contract. Such instructions shall be prepared by the Contractor and shall be supplied as part of his/her contractual obligations.

The operating and instruction manuals shall be made up in the form of one or more hard cover files suitable for A4 pages with rear pockets for enclosing paper prints of the relevant drawings.

C3.9.27 COMMISSIONING

The commissioning process that is to be followed is set out in Commissioning Plan Standard Specification.

C3.10: MECHANICAL GENERAL SPECIFICATIONS

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C3.10.1 Scope

This Mechanical Standard Specification gives a general description of the requirements to be met, and provides the basic quality, safety, design and materials requirements of all of the mechanical plant and equipment that is to be supplied and installed under the mechanical section(s) of the Contract. The specific requirements of the Contract are prescribed in Section C3.10 Mechanical Project Specification.

Should there be any conflict between the Mechanical Project Specification(s) and this Mechanical Standard Specification, the Mechanical Project Specification takes precedence. In the event of there being a discrepancy between any specification, including those specifications dealing with civil and building works, and/or the drawings and/or the Bills of Quantities, the discrepancy shall be drawn to the attention of, and resolved by, the Employer's Agent before the execution of any work associated with the discrepancy

This Mechanical Standard Specification, when read together with the Mechanical Project Specification, indicates the minimum requirements. Where no specific requirement is indicated, it does not relieve the Contractor of any statutory or common law duty and the Contractor will still be required to comply with all relevant requirements and/or standards from any statutory body that is applicable to the plant and equipment being designed, supplied and installed.

References made hereinafter to specifications of the South African Bureau of Standard (SABS/SANS) or the British Standards Institute (BS) or the International Standards organisation (ISO) or the American Society of Mechanical Engineers (ASME) or the American Standard for

Testing and Materials (ASTM) shall be deemed to include all revisions of and/or additions to such specifications ruling four weeks prior to the closing date of tenders.

C3.10.2 Quality Management

Details regarding the Quality Assurance and Quality Control requirements are dealt with in Clause C3.5.4.

All enquiries made, and contracts placed by the Contractor for critical components, shall require suppliers and/or sub-contractors to comply with the requirements of the Contract. Responsibility for, and all associated costs of, compliance shall rest with the Contractor. In instances where SANS/ISO 9001 is not applicable, Tenderers must indicate what equivalent alternative Code of Practice is being implemented.

C3.10.3 Safety

C3.10.3.1 General

Safety shall be an important and overriding consideration and proper attention shall be paid by the Contractor to this aspect at the design, installation, and commissioning stages of the project.

All plant and equipment shall comply with the requirements of the Occupational Health and Safety Act (Act 85 of 1993 as amended) and the relevant Regulations thereto.

All potential hazards must be avoided or guarded. Nip points shall be guarded, sharp corners shall be rounded off, and operating handles, supports and protrusions shall be kept clear of access ways.

All accessible moving parts shall be properly guarded to protect injury to personnel.

In addition to the emergency stops specified elsewhere, trip wires which will stop the driving motor when pulled, shall be provided along the accessible side/s of moving conveyor belts, chains and the like irrespective of operating speed and irrespective of the safety guards provided.

C3.10.3.2 Guards

Guards are required to cover all moving or revolving components of machinery and shall:

- Be such as to adequately cover all moving protrusions such as couplings, keys, lock nuts, lock washers, sets crews, and the like.
- Be such as to prevent a person from touching any moving protrusion.
- Be neatly and rigidly constructed and fixed so as to not vibrate or cause noise during operation of the plant.
- Enable adjustments to be made where required such as on belt guards.
- Be fixed with M10 or larger hex head bolts.
- Be easily removable for maintenance purposes
- Be fabricated from Grade 304 stainless steel or mild steel (hot dip galvanised).

Mesh shall not be used for chain guards but, on belt drives, the side of the guard most conveniently sited for inspection, shall be constructed of expanded metal or similar. Mesh should similarly be used in other situations where inspection or ventilation is required. Where expanded metal or similar mesh is used, the mesh opening shall not permit a circular object 10 mm or larger to penetrate.

C3.10.4 Basic Requirements Of The Plant And Equipment

C3.10.4.1 General

Robust construction, reliability, long life, operation, efficiency, ease of maintenance and operation, and neatness of all plant and equipment are essential requirements for all plant and equipment to be supplied and installed under this Contract.

C3.10.4.2 Design Requirements

The design of all plant and equipment shall be based on:

- The full range of duties which can be reasonably be anticipated.
- The power and torque transmitted by the driver system under full load under installed conditions.
- The maximum pressure or vacuum which can be produced by pumps, blowers and compressors under all conditions including blocked or closed inlet and outlet circuits and surge conditions.
- Conservative service and safety factors based on approved standards or recommended or laid down in the specifications of reputable and approved manufacturers.
- Suitable safety margins where relevant and specified in the specifications, in addition to any service or safety factors the original equipment manufacturer (OEM) deems necessary.
- Continuous twenty-four hour per day operation.
- A minimum life of 100 000 hours of wearing parts before repair or major part replacement.
- Prevention of serious damage from normal operational problems such as blockages, blinding, jamming, seizure, malfunction and, as far as is practical, maloperation.

Machines with non-overloading characteristics shall be selected wherever possible e.g, motors shall be sized so that they cannot be overloaded by the driven machines.

C3.10.4.2 Fail safe Operation and Protections

Where damage can occur from normal operational or other foreseeable problems, plant, equipment and systems must be designed to be failsafe i.e, it must have built in redundant elements, or it must return to a safe condition where no further damage can be done in the event of a failure, malfunction, mal-operation, overload and, as far as practical, misuse. All reasonable and economically justifiable protections to prevent or limit damage to plant and equipment, particularly in high risk situations, must be incorporated. Protections shall:

- Be directed at the source of the problem, limit forces to safe levels, and act quickly enough to prevent damage and/or injury to personnel.
- Stop, or prevent from starting, all equipment at risk.
- Activate an alarm with a labelled indicator on the control panel / HMI whenever a protection operates.
- Be such as to prevent unauthorised tampering.
- Operate reliably after long inactive periods exposed to corrosive and dusty conditions.

C3.10.4.3 Moving Parts

The following general requirements shall apply to all equipment with moving parts such as headstocks, extension spindles, swivelling davits, heavy duty hinges, pivots and the like:

- All rotating or swivelling shafts, pins and the like, shall be adequately supported, guided, and restrained, by lubricated or self-lubricating bearings, collars and/or bushes.
- Swivelling joints on linkages and the like shall be of the "universal" or fork and rod type with bearings or bushes fitted to the eyes or forks.
- On abrasive applications, abrasion resistant materials and slow speed operation shall be utilised.
- Susceptibility to fatigue failure shall be minimised by proper design and manufacturing procedures. In particular, changes in section shall be radiused and care must be taken to avoid the use of welded components in areas of fluctuating stress.
- The methods of locking of nuts and pins in position shall be suitable for purpose
- Wearing parts shall be designed for inter-changeability and ease of removal and replacement.

C3.10.4.4 Arrangement and Mounting

The arrangement and general design shall take the following requirements into consideration:

- Lifting eyes, lugs, hooks, etc. shall be provided on heavy or large items to facilitate handling.
- Castings or fabrications shall have machined pads for seating and be mounted on either soleplates or base plates as appropriate.
- Where accurate alignment is required, positioning pins and/or jacking screws shall be provided.
- The needs of operation and maintenance including neatness, access, working space, safety, cleaning, adjustment, handling, assembly, alignment, disassembly, removal, etc.

- With plant and equipment to be mounted on or against concrete or brick structures, provision shall be made in the mechanical design for adjustment.
- Any special accuracy requirements that affect others responsible for constructing buildings, structures, supports and the like shall be specified on the Contractor's drawings that are submitted in advance to the Employer's Agent.

C3.10.4.5 Lubrication

Grease lubrication is preferred and all greasing points must be easily accessible. Equipment with multiple greasing points shall be provided with grease lines which are piped, separately, to a single easily accessible position.

In cases in which motorised lubrication is provided to more than one destination a distributor shall be provided. The distributor shall be a positive displacement device which ensures equal, successive lubrication to all destinations.

Pipework for grease distribution shall be of stainless steel or non-ferrous metal.

Oil level indicators shall be fitted for visual checking. Drain cocks, including Grade 316 stainless steel fittings where necessary to permit convenient draining, and plugged at the end, shall be provided for oil reservoirs exceeding 1,5 litre capacity.

All lubrication systems shall be designed so as to exclude dirt and moisture. Air vents on oil reservoirs shall contain an air filter.

C3.10.5 Materials For Manufacture And Fabrication

C3.10.5.1 General

All materials and components used in the manufacture and fabrication of plant and equipment to be supplied under this Contract shall be new and of the best quality and suitable for the purposes for which they are intended.

The Contractor shall ensure that materials are selected in accordance with the best engineering practice to suit the working conditions and, where applicable, the corrosive environment.

C3.10.5.2 Mild Steel

All structural steel shall comply with the requirements of SANS 50025 and be of a grade suitable for purpose and that is determined by the designer of the plant for structural (strength) reasons.

C3.10.5.3 Castings

Castings shall comply with the relevant South African Standards for the material used, including the following:

Grey Iron Castings	-	SANS 1034
Spheroidal Graphite Iron Castings	-	SANS 936 & 937
Steel Castings (General applications)	-	SANS 1465
Aluminium Castings	-	SANS 991 & 992
Copper and Copper Alloy Castings	-	SANS 200

Particular attention shall be paid to cleanliness, soundness and neat fettling and dressing of castings. Surfaces shall be smooth and irregularities caused by mould washaways, and the presence of porosity and sand and slag inclusions will not be tolerated. Areas under bolt heads, nuts and washers, shall be machined or spot faced to ensure a flat and smooth pressure bearing area, and sufficient space shall be provided for the use of ring or socket spanners.

All pressure retaining castings shall be hydrostatically tested to not less than 1,5 times the maximum working pressure after machining and shall be drop tight.

No repairs shall be undertaken to castings without the written permission of the Employer's Agent and welding will not be permitted on cast iron castings.

Castings shall be heat treated to provide optimum corrosion resistance and toughness combined with reasonable machinability. In particular stainless steel castings shall be heat treated so as to ensure that all carbides are in solution, to ensure optimum grain size and to provide maximum corrosion resistance.

The Contractor shall provide a test certificate for each casting or batch of castings, except for those made of grey cast iron, giving details of the material analysis, the heat treatment and any mechanical tests carried out.

C3.10.5.4 Plastics

Thermoplastics and fibre reinforced polymers shall be UV resistant, have adequate tensile strength, and high impact strength and generally suitable for the application. PVC is generally regarded as too brittle and shall not be used unless specified elsewhere or approved by the Employer's Agent.

C3.10.5.5 Fasteners

Bolts and nuts shall have hexagon heads complying with SANS 1700 with threads of the coarse pitch series. Allen head screws or bolts may not be used without the Employer's Agent's written consent.

The length of each bolt, other than jacking bolts, shall be such that, after the bolt has been tightened, the end of the bolt shall project beyond the outer face of the nut. In the case of bolted joints that will remain visible, the projection beyond the end of the nut shall not be more than two threads.

All fasteners in corrosive areas shall be Grade 316 stainless steel. Corrosive areas shall be deemed to include any moist or wet area such as in close proximity to liquid, and where a continuous or intermittent spray can be expected and all internal and external areas in the vicinity of the inlet works of a wastewater treatment works. All fasteners embedded in brick, concrete or soil shall also be Grade 316 stainless steel.

Fasteners which are in non-corrosive areas shall, except when specified otherwise, be electro galvanised mild steel.

Fastener material shall always be of equal or better corrosion resistance than the items being fastened, e.g, Grade 316 stainless steel bolts must be used to fasten together Grade 316 stainless components.

Washers of similar material to the bolts shall be provided under each nut and setscrew head. Multiple washers or shims may not be used. Spring washers or other approved locking arrangements shall be installed on all fasteners subject to vibration.

Before assembly, threads shall be treated with an approved nickel based, anti-seize/corrosion protection compound. Compound on the exposed thread shall be cleaned off prior to painting.

Anchor fasteners for brickwork shall be of Grade 304 stainless steel and shall be of the chemical anchor fastening type. Anchor fasteners for other applications may be either of the expanding type or chemical anchor type.

Grade 304 stainless steel hook bolts shall be supplied and grouted into pockets which will be provided in the concrete structure by the civil contractor in accordance with the information to be supplied by the mechanical contractor. The grouting products shall be mixed and applied strictly in accordance with the manufacturer's instructions.

Where machinery is anchored by studs or bolts which extend through the supporting structure and fastened down with the use of nuts from both sides, these, together with associated washers and brackets, shall be of Grade 304 stainless steel.

C3.10.6 Fabrication of Steelwork

C3.10.6.1 Welding

Procedures that comply with accepted Standards shall be followed. These standards are not limited to but include the following:

- BS EN 1011 Parts 1 to 8: Welding. Recommendations for welding of metallic materials
- BS EN 13480 Parts 1 to 6: Metallic industrial piping

Welding is to be continuous: All welding shall be continuous on all sides of any joint unless otherwise approved in writing by the Employer's Agent. No crevices will be permitted and, where stitch welding has been approved by the Employer's Agent, the crevices so left shall be sealed with an approved filling compound after priming but before further painting.

Weld appearance: Welding shall be free of blowholes and all welding flux shall be removed. All weld spatter and other sharp imperfections shall be removed prior to abrasive blasting. Prior to painting, weld beads with a surface irregularity exceeding 3 mm or with sharp crests and edges having a radius less than 2 mm shall be ground. However, weld grinding must not be performed on Grade 304, 304L, 316, or 316L stainless steel, unless unavoidable.

Site welding: Site welding shall be kept to a minimum and shall only be undertaken with the approval of the Employer's Agent.

Type of stainless steel: Austenitic stainless steels to be welded shall be of the higher carbon grade (i.e, 304, 316) unless otherwise stated as Grade 304L, 316L.

Welding rods: The welding rods used shall be the most suitable for the metal and purpose. Type 309 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved by the Employer's Agent.

Welders: Only welders experienced with welding stainless materials shall be used.

General: All possible steps shall be taken to ensure maximum corrosion resistance, strength of the welds and welded material. Special care shall be taken to avoid prolonged heating. Discolouration and steel contamination must be removed by pickling or electro cleaning as approved by the Employer's Agent but should rather be avoided by taking the appropriate measures.

C3.10.6.2 Mild Steel Fabrication

The design of all structural steelwork shall comply with, inter alia, the requirements of The National Building Regulations (SANS 10400-B).

The Contractor shall ensure that the Employer's Agent is given due notice enable inspects of fabrications, including fabricated pipework, to be undertaken in the fabrication workshop.

All surfaces must be accessible for surface preparation and coating. Inaccessible pockets, open hollow sections or the like shall not be permitted except where hot-dip galvanizing (without painting) is called for. Surfaces which cannot be properly prepared after fabrication must be abrasive blasted and coated with a two-pack epoxy pre weld primer before fabrication.

C3.10.6.3 Stainless Steel Fabrication

The requirements regarding the fabrication of carbon steels also apply to the fabrication of stainless steels. In addition, the following requirements apply to the fabrication of stainless steels:

- Work shall be carried out in an area(s) demarcated for stainless steel fabrication.
- Surfaces which become contaminated with steel or otherwise stained or otherwise marked so as to be of uneven colour, shall be cleaned by pickling or electro-cleaning rather than by grinding.
- All welds shall be passivated.

C3.10.7 Flooring, Handrails And Ladders

C3.10.7.1 Open Grid Flooring

All grid flooring shall be of an approved type and of adequate strength with load bearing bearer bars across the shorter span. The depth of steel bearer bars shall not be less than 30 mm with a bearer bar pitch of not greater than 40 mm. All panels are to be banded and set level and fixed down with clips in angle frames so as to prevent rocking. All cut outs in grid flooring for pipes, valve spindles and the like are to be banded.

Mild steel grid floor panels and frames shall be hot dipped galvanised after fabrication. Painting shall be done to suit the relevant safety codes.

The fixing clip set (saddle clamp and locking plate) shall be of hot dip galvanised steel but all fasteners shall be of Grade 316 stainless steel.

If stated in the Project Specification, the panels shall be of a moulded GRP proprietary type grating manufactured with continuous glass fibre strands and resin and adequately rated for the required spans and loads.

C3.10.7.3 Handrails

Handrailing shall comply with inter alia, SANS 10104 and shall be in accordance with legislated requirements and shall be provided generally in positions where the vertical difference in level is 1 000 mm or greater.

All handrailing shall be of Grade 316 stainless steel and shall comprise hand and knee rails not less than 32 mm diameter and stanchions spaced at not more than

1,8 m except where specifically directed otherwise in writing by the Employer's Agent. All components shall be supplied in the pickled and passivated condition which may also be polished. All surfaces must be uncontaminated and unmarked to ensure maximum corrosion resistance.

Where kick plates are required by legislation, these shall extend to 150 mm above the walkway level.

Unless other materials are specified, all ladders and stairs shall be of mild steel and hot dip galvanised after all fabrication has been completed.

On platforms, walkways, landings or around dangerous areas, the vertical height, measured from the top of the hand rail to the floor or surface, shall be at least 1 000 mm.

On stairways and fixed ladders, the rails shall be parallel to the stringers, and the vertical height, measured from the top of the hand rail to the nosing of the tread, shall be at least 900 mm.

Stanchions and rails shall be smoothly finished and free from sharp corners, edges and projections which may injure persons or damage clothing. Stanchion bases shall have the corners rounded off.

The tubular rails shall be joined using the slip jointing method with separate and neatly fitting tubular inserts fitted into the railing bore. If stainless steel pins are used, they shall have their ends peened over and smoothed or, if taper pins are used, they shall be filed off flush with the rail. The joints shall withstand the required loads when situated in any position including centrally between two stanchions. Joints shall preferably be located inside the stanchion balls.

Railings shall be ended off with positively fixed (pinned) closure bends. At corners, short radius bends with stanchions on both ends shall be employed or, alternatively, stanchions specifically designed for such a position shall be employed. No sharp endings will be permitted.

Stanchions shall generally be base mounted but can be side mounted to suit the arrangement requirements and shall be of solid or welded construction. Welding shall be compatible with the material, shall not impair the strength or corrosion resistance of the material, shall be continuous and shall be smoothly finished and then passivated.

Stanchions shall be self-draining to suit the mounting arrangement.

Holes for the rails to go through the stanchions shall have a diametral clearance not exceeding 1 mm but preferably 0,5 mm. On stairways with stanchions vertically mounted, the hole shall be angled to suit and shall accurately fit the angled rail with the abovementioned clearances.

Stanchion bases which are attached to metallic surfaces shall have minimum dimensions of 150 mm x 60 mm. Two fasteners of minimum size M16, shall be used to attach the base which must have a material thickness shall be not less than 8 mm.

Stanchion bases which are attached to non-metallic surfaces shall have minimum dimensions of 150 mm X 150 mm. In instances where the horizontal surface to which the base is to be fastened is less than 150 mm wide, the base shall be designed to be seated on at least two surfaces. Four fasteners of minimum size M16, shall be used to attach the base to the concrete. Base material thickness shall be not less than 10 mm. Non-shrink, cementitious grout shall be applied under the foot just prior to final tightening of nuts.

C3.10.7.4 Permanent Ladders

Permanent ladders shall be safe to use and shall comply with the following:

- Access points to the head of ladders from platforms and walkways shall be protected by self-closing gates or by chains.
- No part of a ladder may project into a passageway.
- The clear width between stringers shall be no less than 500 mm.
- A minimum clear space of 230 mm must be allowed behind the rungs.
- The diameter of the rungs shall be between 20 mm and 50 mm.
- Additional rungs shall be provided in the same horizontal plane as the top rung in order to close the gap between the platform and the ladder. Sufficient rungs shall be provided to ensure a maximum gap of 75 mm. These top rungs shall be at the same level as the floor or platform to which access is being provided.
- Stringers shall be formed from flat plate or channel sections. The vertical distance between the ladder support brackets shall not exceed 1 800 mm.
- The stringers shall extend to 1 100 mm above the floor or platform and shall be matched with any hand rail protections at this level. Connections between hot dip galvanised steel ladders and stainless-steel hand railing shall be bolted. Unless laterally supported by the handrails, these stringers shall be supported by vertical structural sections (not flat bar) whose bases shall comply with this specification for handrail stanchion bases.
- All rises in a flight shall be uniform and the surface of the top rung shall be level with the top platform or landing. The height chosen for the rise shall be between 225 mm and 255 mm.
- Except on chimneys, the height of a ladder should not exceed 6 000 mm. Greater heights shall be provided with intermediate landings between each 6 000 mm ladder section.
- If the height between start and end levels is over 4 000 mm, the ladder shall be fitted with a safety cage. The safety cage shall extend at least 1 000 mm above the higher landing. The cage shall be no more than 700 mm away from the plane of the rungs and shall comprise no fewer than seven vertical elements.
- Anchor bolts shall be of Grade 316 stainless steel and shall be no smaller than M16.
- Stringers, rungs and anchor brackets shall be of solid structural sections (e.g, flat bar, round bar, square bar, angles, etc.) and no hollow sections may be used for any part of any ladder.

C3.10.8 Lifting Equipment

All lifting equipment shall comply with the following requirements unless otherwise stated:

- Lifting equipment shall be designed and constructed in accordance with a generally accepted code of practice or standard.
- Fixings of crawl beams shall be through bolted by means of Grade 304 stainless steel threaded bar.
- High-tensile or alloy steel chains shall be hot dipped galvanised and shall have a factor of safety of at least four.
- Steel wire ropes shall have a factor of safety of at least six.
- Man-made fibre ropes or woven webbing shall have a factor of safety of at least six.
- Natural fibre ropes shall have a factor of safety of at least ten.
- The safe working load (SWL) shall be clearly and boldly marked on all lifting equipment.
- The complete installation shall be inspected and shall be tested on site by the Contractor over its complete lifting range using a load which shall be at least 125% of the safe working load.

Chain block casings are to be fabricated from cast iron or high strength alloy steel. A slipping clutch or equivalent, is to be fitted to ensure that it is not possible to overload the chain block. A trolley, along with all ancillary equipment, is to be provided with the chain block for operation on the crawl beam.

Davits shall be manufactured from mild steel and shall be hot dipped galvanised after fabrication. All fasteners, pins, shafts, shackles, hooks, guide pulleys and shafts, shall be of Grade 304 stainless steel or other corrosion resistant material, with suitable non-metallic bearings which do not require regular lubrication. The swivelling arrangements shall be properly designed for easy operation, shall be accurately fitted and shall not be subject to corrosion problems. Bushes made of nylon, "Vesconite" or other suitable non-metallic material shall be used and any metallic rubbing mating face shall be of Grade 316 stainless steel. Wire ropes must be long enough to reach the lowest required position with at least 3 turns left on the drum. The drum size shall be sized to store the full rope length. The diameter of the drum shall suit the rope diameter in accordance with good practice and approved by the wire rope manufacturer.

C3.10.9 Pipework

C3.10.9.1 Screwed and Socketed Steel Pipes and Malleable Cast Iron Fittings

Steel pipes larger than DN 50 and smaller than DN 150 shall be seamless Schedule 40 pipe. Steel pipes DN 200 and smaller shall be hot-dipped galvanised. Malleable cast iron fittings used in conjunction with screwed and socketed pipes shall comply with the requirements of SANS 14 and shall be galvanised.

C3.10.9.2 Steam, Gas and Compressed Air Pipework

Pipework for conveying steam, gas and compressed air in sizes up to and including DN 150 shall comply with the requirements of ANSI B36.10 STD/Schedule 40. The pipes shall be of heavy quality and either continuously welded or flanged save that gas all gas pipework shall be continuously welded. If used, flanges shall be rated for the operating temperature and the specified field test pressure.

C3.10.9.3 Hydraulic and Oil Pipework

Hydraulic pipework shall comply with the requirements of BS 778. All pipes and fittings shall be thoroughly degreased, descaled, and cleaned internally and externally after fabrication by abrasive blasting or pickling, thoroughly cleaned and rinsed, dipped in a hot iron phosphate solution and coated internally with a corrosion inhibiting, oil soluble preservative. After treatment and drying all openings shall be sealed until the pipes are installed.

C3.10.9.4 Copper Pipes

Copper pipes shall be of a class suitable for the plant operating conditions and conforming to SANS 460. Where bends are required they shall be formed with a proper tube bending machine. Joints shall be brass compression fittings conforming to SANS 1067. Holderbats shall comply with SANS 1209.

C3.10.9.5 Unplasticised Polyvinyl Chloride Pipes and Fittings

Unplasticised Polyvinyl Chloride (uPVC) pipes and fittings shall comply with the requirements of the following standards and shall be of the class(es) required for each application:

- SANS 791 - Unplasticised poly(vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings
- SANS 966-1 - Components of pressure pipe systems Part 1: Unplasticised polyvinyl chloride (PVC-U) pressure pipe systems
- SANS/ISO 967 - Unplasticised polyvinyl chloride (PVC-U) soil, waste and vent pipes and pipe fittings
- SANS/ISO 21138 - Plastic piping systems of Unplasticised polyvinyl chloride (PVC-U) for non-pressure underground drainage and sewerage – structured wall piping systems etc.
- SANS/ISO 1601 - Structured wall pipes and fittings of Unplasticised polyvinyl chloride (PVC-U) for buried drainage and sewerage systems:

C3.10.9.6 Polyethylene Pipes and Fittings

Polyethylene pipes shall be of high density type complying with the requirements of the following standards and shall be of the class(es) required for each application:

- SANS/ISO 4427 - Plastics piping systems – Polyethylene (PE) pipes and fittings for water supply:
- SANS/ISO 4437 Metric Series - Buried polyethylene pipes (PE) for the supply of gaseous fuels.
- SANS/ISO 8772 - Plastics piping systems for non-pressure underground drainage and sewerage – Polyethylene (PE).
- SANS/ISO 21307 - Plastics pipes and fittings – butt fusion jointing procedures for polyethylene (PE) pipes and fittings.
- PR EN 13476-1 & ISO 9969 - PE Structured Wall Sewer Pipes (Note that all pipes must be spigotted and socketed with a rubber seal):

C3.10.9.7 Stainless Steel Pipes and Fittings

All stainless steel pipework is to be Grade 304 welded austenitic pipe in accordance with the American Standard ASTM A312. Schedule 10 pipes and fittings shall be used unless otherwise specified and/or required for higher pressures.

If prescribed in the Project Specification, mild steel flanges may be used on stainless steel pipes and joined with mild steel bolts and nuts and, in cases where stainless steel and mild steel flanges are joined together, nylon or plastic washers shall be used to prevent galvanic corrosion.

All welds on stainless steel are to be passivated.

C3.10.9.8 Mild Steel Pipes and Fittings

Steel pipes DN 150 and smaller, other than screwed and socketed pipes, shall be API seamless Schedule 40 pipe.

Unless otherwise specified, all pipes and fittings shall have a minimum wall thickness of 6 mm.

Steel pipes DN 200 and larger shall be manufactured in accordance with SANS 719 with the following specific requirements being applicable:

SANS 719 Clause 4.4 - Certification: Add the following:

"The manufacturer shall, on completion of the Contract, furnish the Employer's Agent with certified copies of the steel manufacturer's certificates pertaining to the steel plate/coils used. All information relevant to pipe fabrication shall be made available to the Employer's Agent, during the course of the pipe manufacturing process."

Unless otherwise required for structural (pressure) reasons, all pipes shall be manufactured from Grade X42 mild steel plate.

C3.10.9.9 Epoxy Lining and Coating of Steel Pipes and Fittings

Before leaving the pipe mill or the fabrication shop as applicable, all mild steel pipes greater than DN 150, fittings and other steelwork shall be abrasive blast-cleaned internally and externally to Grade Sa 2,5 of the Swedish Standard SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter given the following treatment:

Internally (including ends of fittings):	Pipes and fittings DN 200 and less are to be hot dipped galvanised (heavy duty coating). Pipes and fittings greater than DN 200 are to be lined with solvent free epoxy complying with SANS 1217 1B with DFT of at least 300 microns.
Externally:	Pipes and fittings DN 200 and less are to be hot dipped galvanised (heavy duty coatings). Pipes and fittings greater than DN 200 are to be coated with solvent free epoxy complying with SANS 1217 1B with DFT of at least 300 microns. In addition, all external surfaces of all pipes that are to remain exposed are to be painted with an appropriate primer if required and an approved gloss paint after erection.

The solvent free epoxy to be used shall be subject to the approval of the Employer's Agent.

Plain ends of pipes and fittings shall be covered and protected against damage whilst being transported from the factory/fabrication shop to the site.

C3.10.9.10 Rubber Lining of Pipes and Fittings

If stated in the Project Specification, mild steel pipes and fittings are to be rubber lined as described below, and not epoxy lined as described above.

The material to be used shall be a Type 1, Grade A, Class 60 natural rubber compound to SANS 1198 such as Natural Rubber - 153", having the following minimum physical properties:

Hardness Shore "A"	: 50 deg
Tensile strength	: 18 MPa
Elongation at break	: 600
Specific gravity	: 1,08

and with a maximum service temperature of 90° C.

The internal surfaces to be lined shall be prepared as follows:

- Clean by grit blasting to Sa 2,5 as per Swedish Standard SIS 05-5900 to provide an anchor profile of between 80 and 100 microns, with a minimum of 65 microns.
- All dust and debris shall be removed, and the surfaces solvent wiped.

The cleaned and prepared surfaces are to receive the primer and tie coats associated with the application of the requisite rubber bonding system where such a process forms part of the lining procedure.

The bonding and rubber lining shall be applied by specialists to a minimum thickness of 10 mm unless otherwise stated in the Project Specification, and cured as necessary, all in accordance with the requirements of BS 6374 Part 5.

All lined surfaces shall be visually inspected and shall undergo a holiday detection spark test using a pulse holiday detection unit set at 3 000 volts per mm thickness of the lining.

Repairs to defective or damaged areas of coating shall be carried out in strict accordance with the specialist applicator's instructions and under the supervision of their accredited representative.

Notwithstanding the foregoing specification, the rubber lining applicator shall meet with representatives of the Employer's Agent prior to commencement of any rubber lining and agree the materials and application specifications and methodology to be used.

C3.10.9.11 Nozzles & Tees for Fittings & Instruments

Nozzles on pipework for installation of gauges, transmitters, drain pipes, cooling water take offs, air valves, etc. shall be designed so that the pipework corrosion prevention system is not affected.

Nozzles shall consist of a flanged, welded tee off of at least DN 50, painted internally and provided with a non-corrosive blank flange, e.g, Grade 316 stainless steel. The blank flange shall be provided with tapped holes suitable for the equipment installation.

A nozzle on cement lined, mild steel pipework shall consist of a flanged, cement lined tee off (of at least 100 mm diameter) and a non-corrosive blank flange.

Internally painted, small diameter mild steel nozzles and screwed mild steel tee offs are both unacceptable as nozzles. Mild steel pipework may be provided with small diameter, Grade 316 stainless steel nozzles which are welded into the pipework if the Employer's Agent considers this to be acceptable of the particular application.

C3.10.9.12 Pipe Ends

Pipe ends shall either be prepared for welding or in accordance with the coupling manufacturer's recommendations. Where machining is required, as in the case of cast iron pipes, the length of machining on each pipe shall be in excess of the overall length of the coupling to ensure that the coupling can be separated for pipe removal purposes.

C3.10.9.13 Flanges and Gaskets

The dimensions and drilling of standard flanges shall comply with the requirements of SANS 1123, Table 1000 unless otherwise stated in the Project Specification.

Flanges shall be machined flat, i.e, without a raised joint face unless otherwise stated in the Project Specification

Puddle flanges shall have the same dimensions as standard flanges but shall be undrilled.

Faces of flanges which will be in contact with jointing gaskets shall receive a protective coating of such thickness and consistency as will not impair the air/gas/water tightness of the joint. Where flanged pipes and fittings are rubber lined the rubber lining is to be wrapped around from the barrel onto the face of the flange and that rubber will form the gasket.

Flanges are to be drilled "off-centre" i.e, off horizontal and vertical centrelines.

Gaskets for flanged joints shall be of aramid and glass fibre with nitrile rubber binder to BS 7531, suitable for the specified pressures, and with a minimum thickness of 3 mm. Full face gaskets shall be used for flat face flange connections and ring gaskets for raised face flange connections.

Properly designed O-ring seals are also acceptable.

Notwithstanding the foregoing, the responsibility for the selection of gaskets suitable for each particular installation and for the prescribed test pressures will rest with the Contractor.

C3.10.9.14 Flanged Joints

Where required, suitably rated insulating flanged kits shall be supplied, installed and tested such that the flanged joints will be electrically discontinuous and will withstand the hydraulic field tests without leaking.

The flange insulating sets shall be supplied complete. Each set must include an insulating gasket, insulating sleeves, two insulating washers and two machined steel washers per bolt, and an explosion proof spark gap. The entire insulating flanged joint shall be proved to be electrically discontinuous on completion of the project.

After the assembly of the joint and successful hydraulic pressure testing, the entire insulating flange shall be wrapped circumferentially with a white PVC backed polymer modified bituminous tape 1,5 to 2,0 mm thick with a minimum 25 mm overlap.

The insulating sets must be suitable for use with standard flat or raised face flanges as stated in the Project Specification.

An insulating flange consists of an insulating gasket, bolt sleeves and washers, appropriated sized steel bolts and washers and a voltage-limiting device for protection of the insulating materials.

The insulating gasket located between flanges is to be in accordance with the following table. The internal diameter of the pipe and the gasket shall be equal in all instances.

Field Test Pressure (MPa)	**Nominal Pipe Diameter (mm)**	**Insulating Gasket Material**
< 2,5	All Diameters	3,2 mm thick High Density Polyethylene to PEH Hostalen GM 5010 Specification, full face gasket in one piece
=> 2,5 < 4,6	All Diameters	3,2 mm thick High Density Polyethylene to PEH Hostalen GM 5020 SA Specification, full face gasket in one piece
=> 2,5 < 4,6	< 1 200	3,2 mm thick Fabric Reinforced Phenolic (Tested to BS 5102 Appendices A-M Type III) full faced gasket in one piece with neoprene or nitrile rubber faces 0,8mm thick
> 4,6	=< 1 200	3,2 mm thick Fabric Reinforced Phenolic (Tested to BS 5102 Appendices A-M Type III) full faced gasket with not more than 2 only factory made lap joints, with neoprene or nitrile rubber faces 0,8 mm thick
=> 4,6	> 1 200	3,2 mm thick Fabric Reinforced Phenolic (Tested to BS 5102 Appendices A-M Type III) full faced gasket in one piece with a aramid and glass fibre with nitrile rubber binder full faced gasket to BS 7531 on each side.

Notwithstanding the gasket types tabulated above the Contractor will be responsible for ensuring watertight joints shall therefore ensure that the gaskets used are suitable for the specified pressures.

The insulating sleeves for each bolt shall be a minimum 1 mm thick glass fibre reinforced polyester or heat shrink insulation type ITCS Polyolefin sleeving with sealant. The total length of sleeves is to be 2 to 3 mm less than the length between inside faces of steel washers. The insulating sleeves shall fit completely inside the insulating washers and extend partially inside the steel washers.

Two insulating washers for each bolt shall be 3 mm thick fabric reinforced phenolic resin with outer diameter the same as that of machined steel washer. The internal diameter to be a sliding fit over outer diameter of insulating sleeve.

The diameter and thickness of the steel washers are to be machined in accordance with the tolerances for Grade A in SANS 1700-4-3.

Bolts and nuts shall comply with the requirements of SANS 1700-5-1. Stud bolts may only be used where it is not possible to through bolt. Tolerances shall be in accordance with Grade A in SANS 1700-4-1. The next smaller size bolt diameter shall be selected for installation in standard drilled flanges to accommodate the insulating sleeves and the “property class” shall be 8.8 as per SANS1700-5-1 i.e, the material of the bolts and nuts material shall be high tensile steel with a tensile strength of 800 MPa.

An explosion proof spark gap, type Dehn EX-FS (120kA) or similar approved shall be installed across the flange faces. The mild steel mounting brackets holding the spark gap are to be hot dip galvanised and of suitable dimensions to suit the flange bolt.

C3.10.10 Fluid Control Equipment

C3.10.10.1 General

All equipment is to be designed such that, under full unbalanced hydraulic load, the stress shall not exceed 50 % of the minimum yield strength of the parent materials and the rate of leakage shall be minimal. Unless otherwise stated, all equipment shall be fabricated from Grade 316 stainless steel.

Unless otherwise stated, an unbalanced head of 3 m for seating and a head of 2 m for unseating shall be applicable.

Each item, other than hand stops and stop logs, shall be equipped with a solid rising spindle with mounting brackets and a headstock with an appropriately sized handwheel. Where necessary to enable operation by one person, bevel gears shall be provided. Gate lifting spindles shall be of adequate diameter to open and close the gate against resistance without excessive deflection. The lifting nuts shall be of bronze or gun metal with thread length equal to at least twice spindle diameter and cut with mating thread. In cases where the spindle is excessively long due to a deep channel or higher than usual head frame, the spindle is to be supported by guides to prevent buckling. Twin lifting spindles with interconnected gears are to be used for very wide gates. The spindles covers must accommodate the full range of travel of the spindles and shall include external brass position indicators and be manufactured from robust polycarbonate material and provided with mounting flanges bonded to the covers.

Gates shall move freely and smoothly in the frames and sealing shall be achieved by the use of replaceable bulb section neoprene strips of the “music note” or “J” types. Seals manufactured from a similar ultra violet resistance material shall be provided on the upstream face of all moving faces.

C3.10.10.2 Wall Mounted Sluice Gates

The frame sealing for all sides of the wall mounted sluice gates shall be arranged with the use of replaceable bulb section neoprene seals of the “music note” or “J” types.

C3.10.10.3 Twistlock Gates

Gates shall be similar to wall mounted sluice gates and shall be capable of being locked in any partially opened position by a cam mechanism forcing the gate against the frame. The same action is to be used for closing the gate. The gates and frames may be fabricated from cast iron, cast stainless steel or mild steel with corrosion protection. Bronze seating faces are to be used.

C3.10.10.4 Channel Gates

The gate guides on channel gates/penstocks shall extend upwards to fully accommodate the gate when fully opened. The frame of the channel gate is to be embedded into the wall and floor of the channel. Suitably sized grooves will be provided and, once the channel frame has been installed it shall be grouted in.

C3.10.10.5 Weir Gates (Downward Opening Weir Gates and Tilting Weirs)

Sealing shall be achieved through ultra violet resistant neoprene seals of the “triangular” or “J” types between sections and the installed arrangement shall provide an effective seal under all depths of immersion.

If the head is greater than the height of the opening, four sided seals are to be used if the flow is to be completely shut off. Otherwise, three sided sealing is to be used.

If the width of the gate is to be significantly greater than height of the gate, side extensions may be added to increase the effective height of the gate. In the case of not being able to add extensions to the gate, double lifting spindles with synchronized gearboxes are to be used.

Tilting weir gates are to be designed for minimum leakage and shall be provided with head stock, rising spindles and wall mounts. The weir gates are to be hand-wheel operated. Bevel gearboxes shall be provided. Along the hinged section, flat neoprene seals are to be fitted the installed arrangement shall provide an effective seal under all depths of immersion. Vertical travel shall not be more than 500 mm. A centrally mounted spindle is to raise and lower the tilting weir gate and it is to be hinged at the bottom.

Downward opening and tilting weir gates lifting spindles shall be of adequate diameter to open and close the gate against resistance without excessive deflection. The lifting nut shall be of bronze or gun metal with thread length equal to at least twice spindle diameter and cut with mating thread.

Covers shall be provided for the spindles on all downward opening and tilting weir gates. The covers shall accommodate the full range of travel of the spindle and shall include external brass position indicators and be manufactured from robust polycarbonate material and provided with mounting flanges bonded to the covers.

C3.10.10.6 Hand Stops and Stop Logs

Hand stops and stop logs are to be suitable for manual installation and removal by two operators and the mass of each section may not exceed 20 kg and the maximum width is to be no more than 1 500 mm.

Provision shall be made for the easy attachment of two lifting hooks to each hand stop/stop log eyes under submerged conditions.

Sealing will be achieved through ultra violet resistant neoprene seals between sections and the installed arrangement shall provide an effective seal under all depths of immersion.

The Contractor shall design and supply a permanent frame manufactured from aluminium sections to enable the storage and locking of hand stops to prevent theft.

The frame of the channel gate is to be embedded into the wall and floor of the channel. Suitably sized grooves will be provided and, once the channel frame has been installed it shall be grouted in.

C3.10.10.7 Flap Gates

Flap gates that are to be used to prevent reversal of flow at the end of pipes or walls shall be double hung by stainless steel pins in bronze bushes. Counterweights shall be provided to ensure a positive seal is achieved.

Flap gates smaller than 0,2 m^2 are to be fabricated in cast iron or cast stainless steel and to have bronze or stainless steel sealing faces. Flaps 0,2 m^2 and larger shall be fabricated from stainless steel, and shall have neoprene seals.

C3.10.11 Pumps

C3.10.11.1 General

The pumps offered shall be pumps of proven performance and of manufacturers' standard designs, except that the pumps must be located to suit the layout(s) shown on the relevant drawing issued with the tender documents by the Employer's Agent.

All parts are to be properly designed with ample margin of safety and are to be suitable for their pumping duties.

Pump speeds should be such as to permit direct drive by a squirrel cage induction motor except in those cases where the drive is to be adapted to suit future changes in duty or where the required speed for the specified duty is incompatible with that of the motor.

Where V-belt or wedge belt drives are required they shall comply with, and be selected in accordance with, the requirements of BS 3790 with the type being subject to the Employer's Agent's approval. The service factor on the design of the belt system shall be selected for continuous operation at heavy duty and be not less than 1,6 based on the installed motor power. All belts shall be in matched sets. Motor and pump pulleys shall be manufactured from cast iron with metric dimensions to ISO 4183. The pulleys shall be fitted to the pump and motor shafts using taper-lock bushes. The shafts and pulleys shall be accurately machined and provided with a keyway. The minimum overall efficiency of the whole motor and drive assembly shall not be less than 80%.

Adjustment of belt tension shall be accommodated using accurately machined parallel action slide rails, securely affixed to the baseplate, manufactured from cast iron and incorporating robust adjustment bolts with locking nuts and guides. Adjustment bolts and guides shall be manufactured from Grade 304 stainless steel.

Pumps shall:

- Be capable of doing the duty required at speeds preferably less than 1 500 rpm but never in excess of 3 000 rpm.
- Be so balanced that there will be no end thrust when the pump is new or after wear has taken place, or alternatively, suitable heavy duty thrust bearings must be provided.
- Have shafts of high tensile steel with protecting sleeves of bronze or other suitable metal, the diameter being sufficient to withstand and transmit without whip and with ample margin of safety all torsional and bending stresses to which it may be subjected.
- Have pump casings of high-grade close-grained cast iron or cast steel of grade suitable to withstand the field and/or factory test pressure specified elsewhere, rigidly secured to a neat, properly designed bedplate or base.

The pump manufacturer shall utilise suitable materials for all moving and static parts in contact with the fluid to be pumped so as to enable them to resist all corrosion and erosion damage.

Bearings shall have no less than a L_{10} 100 000 hour life and are to be of ample bearing area, dustproof with suitable provision for continuous lubrication.

Performance particulars and characteristic curves for each type of pump shall be submitted at the time of tendering. Efficiencies should be as high as possible in the normal indicated operating range.

Wherever possible, axial thrusts should be counteracted by hydraulic balancing rather than by thrust bearings. The rotating elements shall be statically and dynamically balanced.

Components of the pumps should be so fitted and fixed that neither normal nor contra rotation can give rise to torques which will set them free to move out of their proper position.

The arrangements for bearing lubrication, water seals, air bleeding and priming of all pumps and pipework shall be such as to permit unattended stopping, starting and operation of the pumping plant by means of automatic remote control for the longest possible period under the control and operating conditions specified and in accordance with the general duty requirements.

The pump casing from the suction inlet flange to the delivery outlet flange shall be capable of withstanding the internal hydraulic pressures specified elsewhere.

C3.10.11.2 Centrifugal Pumps

Centrifugal pumps shall:

- Comply with the requirements of ISO 9908 – Technical Specification for Centrifugal Pumps - Class III unless otherwise stated.
- Be of the self-regulating type with a "stable" characteristic i.e, for any selected manometric head each pump shall be capable of pumping at only one rate.
- Be capable of doing the duty required at speeds preferably less than 1 500 rpm but never in excess of 3 000 rpm
- Have impellers and guides of cast iron for sewage pumps and stainless steel or phosphor bronze for potable water pumps.

C3.10.11.3 Progressive Cavity Pumps

The pumps are to be constructed of materials that will resist wear by all suspended matter in the fluid so as to maintain pump performance within 5 % of the specified discharge at the duty head for at least 10 000 running hours and preferably double that time without requiring replacement of wearing parts. A period of 20 000 to

30 000 hours is preferable in this regard if it can be achieved without the introduction of exotic and exorbitantly expensive materials of pump construction. The Tenderer is to exercise his judgment in this regard and offer alternative materials and prices and state the expected life hours in a covering letter if he is in doubt about preferences in the cost benefit of superior materials.

Pump shafts shall be fitted with a single internally mounted mechanical seal arrangement or a packed gland as stated in the Project Specification. Bearings shall be of the sealed type with provision for external lubrication or fully enclosed in an oil bath.

The pumps shall be driven by IP65 rated 400 V electric motors.

The pumps shall be either direct coupled or driven by a Vee or Wedge belt drive selected in accordance with the requirements of BS 3790 and with a service factor for continuous operation at heavy duty of not less than 1,6.

The operating speed of the pumps shall not exceed 400 rpm.

C3.10.11.4 Dosing Pumps

Dosing pumps shall comply with the following:

- Each pump shall be capable of dosing up to the maximum rate stated in the Project Specification.
- Pumps, which feature diaphragms, shall be configured or protected so that diaphragm breakage will not lead to damage of the internal part of the pump. A pressure relief valve and diaphragm protection (burst disc) system shall be installed.
- The pump installation shall, only if specifically stated in the Project Specification, incorporate a pulsation damper (with separating diaphragm) facility to ensure a constant dosing flow of chemical solution to the application point.
- All components such as dosing heads, suction and delivery valves, diaphragm and pulsation dampers, isolating valves, pressure sustaining valves, suction and delivery lines in contact with the chemical solution shall be compatible with, and resistant to, chemical attack by lime solutions used in water treatment plants.
- Pumps shall be either simplex or duplex pumps.
- The electric motors shall be 240 V unless otherwise specified in the Project Specification.
- Pumps shall either be mounted on a wall or other rigid vertical mounting surface on stainless steel supports or shall be mounted on plinths above the floor level.
- The pipework on the inlet and outlet of pumps shall be provided with isolating valves and couplers to allow removal of the pumps without dismantling of the surrounding pipework.
- Strainers shall be provided upstream of each pump inlet. The strainers shall be designed and installed in a manner which will allow cleaning of the strainer element without uncontrolled spillage. Strainers shall be provided with inlet and outlet isolating valves.
- A facility for the connection of a flushing water pipe shall be provided. The chemical solution feed pipe and the treated water flushing pipes that are to be connected to the suctions of the dosing pumps are to be equipped with a solenoid valve(s) to ensure that regular flushing of the dosing pumps and discharge pipe can be achieved. The solenoid valve is to be controlled via adjustable timers to enable flushing cycles (both open and closed valve periods) to be selected. These timers are to be housed in the panels supplied under the electrical section of the Contract.
- All mounting fasteners and mounting brackets shall be of Grade 316 stainless steel.

C3.10.11.5 Bedplates, Couplings and Guards

With the exception of submersible pumps, each pump and its corresponding motor and drive shall be mounted on a rigid steel baseplate manufactured from carbon steel channel and plate section with holding down bolts and nuts for fixing the pump and motor to the bedplate and the bedplate to a concrete base. In each case the bottom of the bedplate shall be set 25 mm above the concrete base, and in erecting the plant, the Contractor shall set each unit to precise line and level by means of brass shims and steel wedges and shall grout up the holding down bolts and carry out all grouting and finishing below, inside and round each bedplate.

Separate pads shall be provided for mounting the pump and motor which shall be machined after completion of manufacture and galvanising. The baseplate shall be supported from the concrete foundation by anchor bolts into pockets. Provision shall be made for accurate alignment of all components after installation and prior to grouting. Each bedplate shall be provided with suitable openings for pouring in grout.

Except in cases where special drives are required for future duty changes, in which cases the drive shall be arranged by the Contractor to suit his plant, each pump shall be direct coupled to its corresponding motor by means of an approved, flexible coupling of robust design. Coupling halves shall be precisely machined and securely fitted so that the rims and faces of the two halves of any coupling may be used for checking alignment errors of parallelism and angularity of motor and pump shafts using laser alignment equipment. The accuracies of ± 0,025 mm and ± 0,025 mm on 100 mm, respectively, or less if recommended by the pump manufacturer, shall be achieved.

The coupling shall be of the type which can tolerate slight misalignments.

Clearance between the two halves of the flexible couplings shall be adequate to avoid interference between the metal halves. Sufficient clearance is to be provided between the halves of the coupling to allow unhampered end-wise movement of the shaft of the motor to the limit of its bearing clearance and taking the magnetic centre of the motor into account. The running position of the motor-half of the coupling is to be checked by the Contractor by running the motor alone and the couplings halves set on the shafts accordingly.

Alignment errors shall be measured by the Contractor using laser type equipment after final grouting and final tightening of holding down bolts and warming up of the motors by running for at least half an hour and the Contractor shall furnish the Employer’s Agent with a certificate stating that the positions of the coupling halves have been checked in accordance with the foregoing paragraphs and also stating the measurements of errors of angularity and parallelism of coupled shafts and that they comply with the pump and motor manufacturers' recommendations.

The importance of ensuring that the suction and/or delivery pipework does not impose any forces onto the pump casing(s) is recognised. The Employer’s Agent will therefore require the Contractor to complete carry out the following after completion of the installation of the pump sets and pipework but before hydraulic testing:

- Remove all of the bolts and nuts in the pump suction/suction pipework connecting flange.
- Remove all of the bolts and nuts in the pump delivery/delivery pipework connecting flange.

There shall be no apparent movement of either the pump flanges or the pipe flanges and each bolt shall not require excessive force to insert it back into its hole in the abutting flanges. In the event of it not being possible to easily (without force) insert every bolt, the Contractor shall rectify the matter. Thereafter the hydraulic pressure test shall be carried out.

Rigid steel guards shall be provided and bolted to the bedplate in such a way as to ensure protection of operators from moving parts.

Submersible pumps are to be mounted on a vertical guiderail arrangement and fixed by to a rigidly mounted duckfoot bend by means of a flanged claw arrangement unless otherwise stated in the Project Specification.

C3.10.11.6 Pump Accessories and Gauges

The tendered prices for all pump accessories and gauges shall include allowances to cover the cost of everything, such as brackets and fixings, necessary for setting up this part of the plant in a neat and workmanlike fashion, all so arranged to facilitate reading of gauges and clearing of drainage tubing without dismantling.

The pumps are to be fitted with all the necessary air cocks and drains, which shall discharge into drains on the base plate of the pumps, and hence to the drainage ducts. All drains shall be of stainless steel. They shall be properly supported along their entire length and generally shall be located under the suction pipework. Pipe runs shall be straight where possible. At all changes of direction, plugged tees or crosses shall be provided to permit rodding. Stainless steel tubes to pressure gauges, etc, shall be properly fitted, securely cleated in position. Bends shall be uniformly made, free of wrinkles or flattening.

Each pump is to be provided with two highest quality glycerine filled 150 mm dial pressure gauges calibrated in kPa and to register the suction and delivery pressures. Such gauges shall be in accordance with DIN Specification, with bottom connection for wall mounting and glycerine filled. The case and movement shall be of stainless steel. A three-way bronze isolating cock is to be provided for each gauge. A snubbing screw is to be provided. The gauges shall cover the range given in the Project Specification and be so designed that they will not be liable to damage if the delivery head is exerted on them. Calibration certificates for each gauge must be supplied by the Contractor.

The suction and delivery pressure gauges shall be rigidly mounted near the pump in a position agreed with the Employer's Agent with all dials at the same elevation and if possible, so arranged that all are visible by an operator standing at the pump starter.

An isolating cock shall be provided at each point of connection to the pump or pipework. Each gauge shall be equipped with a bronze isolating cock and connected to the pipework by means of suitable stainless steel tubing neatly laid and securely fixed. A tee and extra isolating cock shall be provided at each gauge point so arranged that when required for testing purposes two gauges can be fitted side by side at each point.

On all raw water/sewage/effluent/chemical/viscous fluid installations, each pressure gauge is to be equipped with a diaphragm seal to prevent the ingress of solids into the gauge.

The non-return valve on the delivery of each pump shall be fitted with an extended shaft with an adjustable counterweight and a limit switch and timers to stop the pump automatically if flow ceases for more than one minute, or such shorter period recommended by the pump supplier.

C3.10.11.7 Factory Tests on Pumps

Unless otherwise stated in the Project Specification, the prices tendered for all pump sets will be held to cover all factory testing of pumps in compliance with this clause. The following tests shall be carried out in the manufacturer's works or in approved testing premises:

- Prior to the performance tests being carried out, each new pump shall be subjected to the internal static hydraulic test pressure as stated in the Project Specification with suction and delivery flanges blanked off. The pumps shall be watertight (except at packed glands if mechanical seals are not installed) under this test.
- Each new pump to be supplied under the Contract shall be tested in the manufacturer's Works, or in other approved premises. The Employer's Agent reserves the right to send a representative/inspector to witness all or some of the tests. The tendered rates for the pumps shall include for making arrangements for the independent inspections. The inspectors' fee and recoverable expenses will be for the account of the Employer, but fees and other expenses arising from abortive or repeat visits due to non-compliance with the specified requirements will be for the Contractor's account and will be deducted from amounts due to the Contractor.
- All centrifugal pumps are to be tested in accordance with BS EN ISO 9906 Rotodynamic pumps – Hydraulic performance acceptance tests – Grades 1, 2 and 3. Unless otherwise stated in the Project Specification, Table 9 shall be applicable.
- The range of the performance tests shall be sufficient to enable the Employer's Agent to compare the actual test performance of each pump with the performance figures entered on the data sheets and/or otherwise presented by the Tenderer at the time of tendering.
- The results of the tests on each pump shall be prepared in triplicate in the form of pump test sheets and signed by the manufacturer and by the Employer's Agent's representative/inspector in the event of that person being present and having witnessed the test. Each such sheet or copy thereof shall be accompanied by curves accurately plotted and depicting the following characteristics:
- Test Curve: Total Pumping Head (metres of water) vs Discharge (l/s)
- Tender Curve for comparison with above
- Test Curve: Pump Efficiency vs Discharge
- Tender Curve for comparison with above
- Test Curve: Input power (kW absorbed by pump) vs Discharge
- Tender Curve for comparison with above
- Test Curve: Amps per phase of motor vs Pumping Head (metres)
- Tender Curve for comparison with above; calculated from tendered data relating to pump and motor.

Note: The above-mentioned test curve shall be calculated on the basis of the results of the aforementioned pump tests in conjunction with the results of simultaneous or separate tests on the appropriate motor, without allowance for the operating effect of power factor correction capacitors and assuming it is operating at the altitude of the site as specified elsewhere.

The triplicate copies of pump test sheets certified by the Manufacturer or his/her Agent's together with the above-mentioned curves shall be sent timeously to the Employer's Agent so as to reach him/her at least two weeks before erection of the appropriate pump is completed on site so that the last listed curves above may be used for the purpose of re-checking the performance of the appropriate pump-motor-combination set at the time of commissioning.

C3.10.11.8 Site Acceptance Tests

Each pumpset shall be subject to a commissioning run to ensure that it is operating in accordance with its specified conditions and that there is no undue noise, vibration or excessive heating of any components.

C3.10.12 Blowers

Unless otherwise stated in the Project Specification, blowers are to be of the air cooled, positive displacement, rotor type Roots blower and shall deliver oil free air. The blower housing and rotor shall be of high quality spherodial graphite or cast iron.

As far as possible, sound reduction is to be achieved by pulsation dampening. The pressure fluctuations in the air supply shall not exceed 2% of the operating pressure.

Standard operation conditions are to be assumed for the design and selection of the blowers to suit the site conditions.

Measures are to be taken to reduce damage to the blowers as a result of the blowers being started against a closed valve or a valve being closed under operating conditions.

The rotors are to be of the three lobe rotor type for quiet operation, and reduced vibration and downstream pulse. They are to be designed with an involute profile for maximum efficiency and are to be statically and dynamically balanced. The rotors are to be mounted on high tensile steel shafts and shall be linked by accurately machined and hardened timing gears mounted on the shafts and secured with a lock nut. Cylindrical roller bearings are to be used for the shafts and shall be rated for no less than a L_{10} 100 000 hour life.

The rotor housing (compression chamber) is to be a one piece housing with the inlet and discharge flanges cast in. The rotors are to run without any lubrication within the housing. Each end cover is to effectively seal the compression chamber from the ingress of oil, water and air. Piston rings are to be used to reduce air leakage through the shaft openings in the end covers. Hydrostatic oil seals are to be used to prevent lubricant from entering the compression chamber.

Blowers shall be of the air cooled type. The intake filter is to be a combination of intake filter and intake silencer. The parts are to be housed in weather proof housing and mounted on the intake flange of the blower housing. Intake is to be from the atmosphere. A discharge silencer is to be supplied with the unit.

The end covers shall cover the gears and form oil reservoirs for lubricating. An oil sight glass is to be provided on each oil reservoir. The bearings and timing gears may be splash lubricated.

A direction of rotation arrow shall be permanently embossed on the blower casing.

Should an air bypass facility for surge control during blower start up and shut down or other operating conditions be required due to the characteristics of the air blowers offered, provision shall be made for this equipment.

Pressure gauges are to be mounted on the suction and delivery sides of the blowers. They are to be glycerine filled and have a minimum diameter of 100 mm. They are to be able to read twice the blower operating pressure. Stop cocks are to be provided to isolate the pressure gauges. The air blowers are to shut down if the inlet pressure is negative.

Inlet and outlet silencers shall be of the absorption type with inner pipe sleeve or filler boxes of Grade 304 stainless steel. The filling shall be of mineral wool. The design of the filler boxes or sleeves shall prevent any loss of the filling material. The silencers shall be capable of reducing the blower and suction noise levels to the prescribed limits.

The blowers are to be supplied with acoustics enclosures which reduce the noise generated to below 75 dB when measured one metre away from the enclosure in accordance with ISO 3746. Each acoustic enclosure panel is to be lined with self-extinguishing, sound absorbing, polyurethane material. An air extraction fan is to be fitted in the enclosure. The pressure gauges are to be mounted in the enclosure for easy access and readability.

C3.10.13 Air Compressors

Unless otherwise stated in the Project Specification, compressors shall be air cooled, oil-less (oil free) rotary type, either directly coupled to, or V belt driven by an electric motor, and shall be mounted on a rigid fabricated steel base plate and fitted with anti-vibration mountings and suitable guards. Preference will be given to low speed units, and the size of unit shall therefore be conservatively selected. Note that compressors can be piston type or rotary type with the latter requiring less maintenance.

The following ancillaries shall be provided for each compressor:

- An efficient heavy duty dry type air intake filter incorporating a centrifugal pre-cleaner with automatic dust ejector and a renewable filter element or cartridge. A servicing indicator is to be fitted.
- A silencer on the outlet.
- A discharge pressure gauge.
- A pressure relief valve.
- An adjustable governor to ensure that a fairly constant delivery pressure is maintained.
- Suction and delivery pipework and valves sized for low air velocities.

When operating in parallel with other compressor(s), an isolating valve, check valve, and lockable pressure relief valve complete with bronze lock and keys shall be fitted to each unit. (The pressure relief valve is in addition to those fitted to the air receivers).

The volume of air delivered shall modulate to match the demand. Provision shall, however, be made for the compressor to shut down should there be no air demand for a predetermined period, and to restart when demand is re-established. During the period before the compressor stops, the compressor shall be arranged to operate in a low power demand idling mode.

The sound level at a distance of 1 metre from the compressor at any operating point, shall not exceed 80 dBA

C3.10.14 Air Receivers and Hydropneumatic Tanks

Air receivers and hydropneumatic tanks shall be sized to allow for long cycling times of the compressor and allow "fail-safe" operations to take place after a power failure. They shall be of welded steel construction and be circular in cross section with convex ends and manufactured in accordance with an acceptable code of practice for pressure vessels. An elliptical handhole shall be provided at each end of the cylindrical section with the handhole covers being spigotted to facilitate accurate positioning. Screwed inspection plugs will not be acceptable. The covers and clamps shall be stamped and certified and the manufacturer's test certificate shall be endorsed accordingly.

Each vessel shall:

- Comply with the requirements of the Occupational Health and Safety Act and the Regulations pertaining thereto.
- Have a 100 mm diameter pressure gauge, calibrated in kPa and red-lined at the maximum safe working pressure. The calibration scale shall not exceed twice the safe working pressure of the vessel nor be less than the hydraulic test pressure of the vessel.
- Have lockable safety valves complete with bronze padlocks and two keys.
- Have a drain valve cock at the lowest point of the receiver with a pipe to a drain.
- An isolating valve in each air supply line as close as possible to the air receiver which it controls.
- It shall be abrasive blast-cleaned internally and externally to Grade Sa2,5 of the Swedish Standard SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter coated with solvent borne epoxy complying with SANS 1217 Type 1A with a DFT of at least 300 microns.

A manufacturer's factory test certificate for the air receivers as required in terms of the legislation must be supplied. This test certificate must be countersigned signed by a State authorised inspection authority. The Contractor shall also arrange for the receivers to be tested and inspected in accordance with the legislation after installation and before being put into use for the first time. The Employer's Agent reserves the right to appoint a competent person to witness the tests. The tendered rates for the receivers shall include for making arrangements for the independent inspections. The inspectors' fee and recoverable expenses will be for the account of the Employer, but fees and other expenses arising from abortive or repeat visits due to non-compliance with the specified requirements will be for the Contractor's account and will be deducted from amounts due to the Contractor.

C3.10.15 Gearboxes

Gearboxes shall be of the parallel shaft type, specifically designed for the intended application either horizontal or vertical and, where applicable, for operation at an inclined angle. They shall be selected for continuous operation in exposed conditions at 95% humidity and direct sunlight with an ambient air temperature range between 0° and 45°C.

The power transmission rating of gearboxes shall be calculated in accordance with the method laid down by the American Gear Manufacturers Standard 6010-F97 for continuous operation and shall not be less than 2,0 x absorbed power or 1,75 x installed power whichever is the greater. Strength and durability calculations in accordance with AGMA 2001-D04 shall be submitted by the Contractor within 4 weeks of award of the Contract.

Gearboxes shall be of the double or triple reduction type and all gearing is to be helical. Worm gears will not be considered. All gears and pinions shall be manufactured by an approved process to AGMA 2009-B01 or ISO 1328-1.

All bearings shall have a L10 100 000 hour life and proof of such rating shall be submitted by Tenderers. In addition, the bearings on the output shaft shall be capable of withstanding the resultant forces caused by a combination of radial and axial loads imposed simultaneously due consideration being given to out of balance liquid loads. Selection shall be such that the following condition is complied with where the permissible loads are the manufacturer's figures for L10 5 000 hour life.

$$\frac{\text{Actual radial load}}{\text{Permissible radial load}} + \frac{\text{Actual axial load}}{\text{Permissible axial load}} \leq 1$$

Gearbox housings shall be of the best quality close grained grey cast iron to ISO 185 or equal, and suitable breathers shall be supplied to prevent the ingress of moisture. Provision shall be made for easy draining of the gearbox by extending the drain to a point outside the base plate. A stainless steel lever operated ball valve and plug shall be fitted to the drainpipe.

Each gearbox shall be mounted on machined sole plates fitted with jacking screws to assist with alignment.

Bearing housings on gearboxes and motors shall be provided with a ground hemispherical indentation at a common location to permit vibration and bearing analysis.

Each gearbox shall be provided with:

- A dip stick so arranged as to prevent the ingress of water or a robust oil level gauge consisting of a toughened glass sight tube with brass or stainless-steel shroud and fixing and sight glass, together with maximum and minimum oil level indication
- A stainless-steel drain cock extension plug fitted to facilitate easy draining of the gearbox oil.
- A dry well for the output shaft lower bearing to avoid total loss of oil in the event of a seal failure. This bearing shall be grease lubricated with the grease nipple being located in an easily accessible position

C3.10.16 Electric Motors

The detailed specifications for the electric motors are included in the electrical specifications that form part of this document. All motors shall be IP 55 unless otherwise stated in the Project Specification.

The following motor margins shall be applicable:

Maximum Power Absorbed by the Driven Machine Under All Operating Conditions	%age to be Added to the Absorbed Power Under the Operating Condition of Maximum Power Absorbed
Up to 4 kW	50%
> 4 kW & up to 30 kW	25%
> 30 & up to 100 kW	15%
> 100 kW	10%

Each electric motor that is mounted vertically in an exposed position shall be equipped with a non-corrosive GRP weatherproof cover/cowl mounted above the fan housing in order to prevent the sun's rays from damaging the plastic fan and in order to prevent rain from falling on the fan and hence on the end of the motor shaft. The cover shall be easily removable by loosening no more than four small diameter stainless steel bolts.

C3.10.17 Installation Of Plant And Equipment

C3.10.17.1 General

When installed, the plant and equipment shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb, and in proper working order.

The Contractor shall provide all foundation bolts, supports, hangers, brackets, etc. required for the support and fixing of all equipment.

All pumps, pipework, valves and fittings shall be securely fixed and supported so as to impose no undue stress on any pump casing and the prices tendered shall include for the supply and installation of all supports and fixings in this regard.

The Contractor will be responsible for grouting puddle pipes which pass through concrete walls and/or slabs and for all other grouting necessary for the correct installation of all plant and equipment supplied and installed under this Contract.

C3.10.17.2 Machine Mountings

Each direct coupled and belt driven machine and its driver shall be mounted on a common fabricated steel base plate of rigid construction.

All base plates shall incorporate machined mounting pads at the support and fixing positions of each item of plant and equipment to be mounted on the base plate. On fabricated base plates this machining shall be done after fabrication, stress relieving (if applicable) and, where applicable, hot dip galvanising is complete. The thickness of the solid pads shall be not less than 1,25 times the diameter of the holding down bolts. The pads shall not be provided with threaded holes for machine screws but shall be drilled for inserting through bolts and adequate provision shall made for reaching the nut with a suitable spanner. In the period between machining and installation of the equipment, the machined surface shall be protected against corrosion by a removable coating. After installation, a non-hardening rust preventative compound shall be applied to exposed machined surfaces and to the crevice formed at the foot of the equipment.

Preliminary alignment shall be done at the factory to ensure that the base plate has been correctly manufactured, but final alignment must be done on site after installation and grouting has been completed. Alignment shall be accurate and a certificate of compliance showing the variances shall be submitted to the Employer's Agent.

Machined spacers shall be prepared where necessary. Shims and spacers shall be of a corrosion resistant material such as stainless steel. No more than three shims may be used at any point.

At least two diagonally opposed jacking screws shall be provided for belt tensioning in the case of belt driven units. Direct coupled motors above 10 kW shall be provided with jacking screws for horizontal alignment and direct coupled motors above 30 kW shall be provided with jacking screws for vertical alignment as well. Jacking screws shall be of mild steel.

Base plates shall be designed and grouted so as to eliminate collection points for water or dirt. Except where otherwise approved in writing by the Employer's Agent, all base plates on concrete plinths shall be fully grouted in. Grouting holes must be provided on base plates having a continuous top plate. Tapped holes and fixing setscrew protrusions shall be suitably protected.

The material used for grouting shall be a non-shrink, cementitious grout. The initial grouting shall be overseen by the plant supplier's technical representative.

In applications where base plates are not practical, machined soleplates, suitably fixed and grouted to the concrete plinths, shall be provided. No machine may be mounted directly onto a concrete base without the use of either a base plate or soleplate.

C3.10.17.3 Alignment of Shafts

Shafts for drives, such as motors, shall be accurately aligned using laser aligning equipment.

Final alignment shall be carried out after installation and an alignment certificate shall be submitted to the Employer's Agent before commissioning. Alignment shall comply with the manufacturer's recommendations and be sufficiently accurate to ensure that there are no adverse effects as a result of the out of alignment tolerances.

C3.10.18 Installation of Pipework

C3.10.18.1 General

Pipes and fittings shall be selected to suit the application and shall be neatly installed, straight to line and level, and adequately supported and shall operate without vibration. Adequate provision shall be made for expansion and contraction due to variations in temperature or pressure.

All pipework shall fit perfectly and be so arranged and supported that it shall not impart stresses to the pumps or other plant due to misalignment.

All pipe fittings at pump inlet and outlet ports shall be detachable without moving pumps or other pipework and so arranged and supported such that, after closing its delivery and suction sluice valves any pump may be conveniently removed for overhauling while others continue to operate.

Unless otherwise stated in the Project Specification, all pipework to be built into or in contact with concrete structures shall be 6 mm thick Grade 304 stainless steel.

All pipework shall be suitably equipped with the requisite tapped bosses, isolating cocks, supports, fixings and everything necessary for attaching site pressure testing apparatus and controls and for satisfactory operation of the plant.

Isolating valves shall be mounted with their spindles vertical. On sludge and raw sewage installations, check valves shall be mounted horizontally. All valve handwheels shall be easily accessible to the operators.

The prices tendered for pipework shall include allowances to cover the cost of all jointing, in situ welding, supporting, support brackets, tie rods, drilling, grouting in and supplying support bolts, painting and everything necessary in terms of this specification.

C3.10.18.2 Supports

Pipe supports shall be so located that when an item of mechanical equipment is removed, the associated valves and pipework will still be adequately supported.

Supports shall be provided under or close to heavy items such as valves.

All supports shall be robust and, in particular, horizontal support brackets such as those on pipework and fixed to walls shall be fabricated from suitably sized channel or box sections to prevent deflection and to resist and completely dampen any vibration that may occur in the pipework.

Where vibration is not possible, 3 mm thick neoprene strips shall be placed between pipes and supports or clamps to protect the paintwork and limit corrosion. Where roller or sliding supports are used to accommodate movement, suitable wear blocks shall be fixed to the pipe to prevent damage.

C3.10.18.3 Flexible Joints

Where movement or misalignment must be allowed for, or if necessary for ease of removal, flexible couplings and flange adaptors shall be used and these shall not have central registers. Where flexible couplings are used they shall be arranged with extra lugs and bolts as necessary, so as to transmit the full tensile forces developed at the joints by the applied hydraulic pressures.

Flexible couplings shall comprise a centre sleeve/body and endings manufactured from hot rolled Grade X42 steel. The sleeve/body and endings shall be abrasive blast-cleaned internally and externally to Grade Sa 2,5 of the Swedish Standard SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter shall be abrasive blast-cleaned internally and externally to Grade Sa 2,5 of the Swedish Standard SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter coated with solvent free epoxy complying with SANS 1217 1B with a DFT of at least 300 microns.

Rubber expansion joints (bellows) may be used if approved by the Employer's Agent. These flexible rubber expansion joints shall be rated in excess of the maximum surge pressure.

C3.10.18.4 Draining, Venting and Purging

On liquid lines, provision shall be made for draining and venting where necessary. Vents shall be provided at all vertical down bends on gravity lines.

On gas lines, provision shall be made for purging.

C3.10.18.5 Condensate Drains

Automatic condensate traps with isolating valves and valved by-passes shall be provided at all necessary points including ahead of any globe type valve, orifice plate or concentric reducer in a horizontal line, at each change of level and immediately ahead of the user equipment.

A suitable well of a diameter equal to the pipe diameter with a bottom drain shall be provided at each condensate removal point. Condensate traps and valves shall be accessible and condensate shall be piped to the nearest drain. Pipework shall be sloped in the direction of flow towards a drain point with a slope of 1 in 150 and care shall be taken to avoid sagging at any point.

C3.10.18.6 By-passes

Isolating valves and valved by-passes shall be provided around condensate traps, pressure reducing valves and valves with solenoid or other actuation which do not have provision for manual operation.

C3.10.18.7 Pressure Testing

All pipelines shall be pressure tested to 1,5 times maximum working pressure or such higher pressure as may be prescribed in the Project Specification.

C3.10.19 Corrosion Protection

C3.10.19.1 General

Where corrosion of metal may be expected, the Contractor shall supply materials which are resistant to corrosion. Any material showing signs of corrosion, tuberculation or pitting before expiry of the Defects Liability Period must be replaced by the Contractor at no cost to the Employer.

Corrosion protection requirements shall be carefully attended to as outlined below.

All epoxies and paints are to be applied strictly in accordance with the manufacturer's recommendations. Particular care is to be taken with surfaces which will be inaccessible after assembly. Surfaces of welded connections must be painted before welding is carried out and painted surfaces damaged by welding must be suitably prepared and repainted without delay. In the case of bolted connections, edges of bolt holes must also be painted, and bolts, nuts and washers must be similarly treated. Washers must be used under all nuts to prevent damage to the treated surfaces of the plate.

The final colour scheme(s) is to suit the Employer's requirements.

The tendered prices will be held to include the cost of all painting or other surface treatment which is not separately specified or scheduled but which is nevertheless necessary for the protection of surfaces against corrosion and for the final appearance of the installations.

C3.10.19.2 Galvanising

Unless an alternative coating is called for in the Project Specification, all fabricated mild steel components shall be hot dipped galvanised strictly in accordance with the requirements of SANS 121 (hot-dip zinc coatings) for heavy duty applications.

After galvanising, the equipment shall be carefully stored and loaded, making ample use of wooden spacers to prevent damage to the galvanised surfaces. Equipment with damage to the galvanised surface will be accepted only after satisfactory re-galvanising.

Unless stated otherwise in the Project Specification, or otherwise agreed on site with the Employer's Agent, galvanised steelwork shall receive a suitable primer and two coats of gloss enamel after installation.

C3.10.19.3 Fabricated Mild Steel

If specifically stated in the Project Specification that hot dipped galvanising is not required, the fabricated mild steel components shall be abrasive blast-cleaned internally and externally to Grade Sa2,5 of the Swedish Standard

SIS 05-5900 to an angular surface profile within the limits of 30-50 microns and immediately thereafter coated with solvent borne epoxy complying with SANS 1217 Type 1A with a DFT of at least 300 microns.

After installation, all surfaces are to be painted with an appropriate primer (if necessary) and two coats of gloss enamel.

C3.10.19.4 Fabricated 3CR12

Unless otherwise specified in the Project Specification, 3CR12 components are not to be coated.

C3.10.19.5 Mild Steel Pipework

All pipework shall be lined and coated as specified in C3.9.9.9 above.

Only if stated in the Project Specification, certain pipes are to be rubber lined as specified in C3.9.9.10 above instead of being epoxy lined.

After installation, all coated pipes that are to remain exposed are to be primed (if required) and then given two coats of gloss enamel.

C3.10.19.6 Valves

All valves shall be coated as specified in C3.9.10.16 above.

After installation the valves are to be primed (if required) and then given two coats of enamel, with the colour scheme to suit the Employer's requirements.

C3.10.19.7 Stainless Steel

Unless otherwise stated in the Project Specification, stainless steel components and pipes shall not be painted but shall be buffed to a clean shiny finish.

C3.10.19.8 Buried Joints

Where flanges and couplings are part of buried pipework, the joints shall be enclosed with "Denso mastic" or similar approved to a smooth finish, wrapped with "Denso tape" or similar approved and then wrapped with a polythene sheet which is strapped in place. If the operating temperature is likely to exceed 70ºC a suitable grease or sealer shall be used.

C3.10.20 Machine Vibration

All rotating elements shall be statically and dynamically balanced according to ISO 1940-1:2003 to a balance quality grade of G2.5. Balancing certificates shall be submitted in an approved format.

The mechanical vibration of machines measured at all important points such as at bearings shall be lower than that indicated in ISO 10816.

Pumps shall comply with the vibration standards for Category II pumps as indicated in BS ISO 10816-7.

C3.10.21 Noise Emission

The noise level of the completed installation shall not exceed the following:

- A maximum noise level at the site boundary not exceeding an equivalent continuous sound level of 55 dB(A) when all equipment installed is being operated
- A maximum noise level at a distance of 1 m of each sound producing mechanical and/or electrical equipment of 80 dB(A).

Where the Contractor is unable to restrict the noise level of the machines to the maximum specified, by the appropriate selection of suitable equipment e.g, by selecting slow speed or silent type machines, quiet type cooling fans, suitable silencers, etc. then an alternative solution, such as an acoustic hood or similar shall be included in the tendered amounts.

Notices and signs complying with the regulations to the OHSA shall be supplied and installed in all "noise zones".

C3.10.22 Condition Monitoring

Unless otherwise stated, all pumps, motors, and gearboxes with ratings equal to or greater than 15 kW shall have provision for the installation of temperature and vibration sensors on all bearings. In the event of temperature and/or vibration sensors being required, these will be prescribed in the Project Specification.

All condition monitoring equipment that is supplied and installed shall be such that it can function satisfactorily and be repaired or replaced without the need for the use of proprietary equipment.

C3.10.23 Nameplates

A corrosion resistant nameplate that is clearly engraved or hard stamped displaying the following information is to be provided on each item of plant:

- Manufacturer's name
- Type and Model
- Serial number
- Date of manufacture
- Rated duty
- Rated operating speed
- Maximum permissible operating speed
- Drive motor size (kW)
- In the case of pumps, the impeller diameter and maximum impeller diameter

C3.10.24 Signage of The Major Components

For the benefit of the Employer's operating and maintenance staff, each major component of plant is to be permanently identified by means of a robust plastic sign no less than 100 mm high with 75 mm high embossed lettering in a contrasting colour, permanently fixed to galvanised steel supports or to concrete or plastered brick surfaces with stainless steel or brass screws into wall anchors. The signs are to be installed in conspicuous positions. For example, in a pump station with three pumpsets, three plastic signs marked Pump 1, Pump 2 and Pump 3 would be required and would be wall mounted in positions visible from the HMI and/or MCC. The Contractor's proposal in this regard will be subject to the approval of the Employer's Agent prior to the ordering and subsequent erection of the signs.

C3.10.25 Spares, Tools And Lubricants

Tenderers must submit in the appropriate Technical data Sheet, a priced list of spare parts which it is recommended should be kept by the Employer for maintenance of the plant for a 3 year period. All spares that may be ordered must be packed separately and the cases appropriately marked.

Tenderers must also submit a price for any special spanners, keys and tools required for the operation, adjustment and overhaul of the plant supplied.

In addition to the lubricating oil to be provided for commissioning the plant (where applicable) an additional quantity of oil adequate for at least two complete refills of such plant must also be provided and will be deemed to be included in the tendered rates for the plant.

The spare parts to be listed and priced shall not be limited to, but shall include the following:

Centrifugal Pumps:

Impeller	Shaft sleeves
Spacers	Keys
Bearings	Seals
Races	Glands
Wearing rings	
Shaft	

Two complete sets of gland packing if applicable
Vee-belt Drives: Belts

All spares that are ordered shall be supplied and handed over to the Employer.

Each part shall be hermetically sealed and labelled by means of a metal label firmly affixed to it by wire. On each label shall be stated:

- The manufacturer's name and address.
- The manufacturer's catalogue or part number.
- A description of the spare part.
- A description of the particular equipment for which the spare is supplied and the Contract number under which the particular equipment was supplied.
- The date of supply of the spare part.

C3.10.26 Operating And Maintenance Instruction Manuals

The Compiler is to advise the Project Manager and all of the Project Engineers that Clients are now demanding comprehensive O&M Manuals and it is therefore necessary for the Manuals to be diligently prepared by the Contractor and carefully checked by RHDHV before submission to the Client. Failure to do so can have consequences for RHDHV.

Operating and maintenance instructions manuals are required for all new plant and equipment supplied and/or installed under this Contract. Such instructions shall be prepared by the Contractor and shall be supplied as part of his/her contractual obligations.

The operating and instruction manuals shall be made up in the form of one or more hard cover files suitable for A4 pages with rear pockets for enclosing paper prints of the relevant drawings.

The following information shall be printed in bold lettering on the cover of each File:

EMPLOYER'S NAME

PROJECT NAME

CONTRACT No

OPERATING AND INSTRUCTION MANUAL

FILE No ….. of …..

(Plant & equipment included in this file)

NAME OF MAIN CONTRACTOR

(Name, physical and e-mail address, and telephone number of Main Contractor)

NAME OF MECHANICAL SUB-CONTRACTOR

(Name, physical and e-mail address, and telephone number of Sub-Contractor)

MAIN ELECTRICAL SUB-CONTRACTOR

(Name, physical and e-mail address, and telephone number of Sub-contractor)

MAIN INSTRUMENTATION SUB-CONTRACTOR

(Name, physical and e-mail address, and telephone number of Sub-contractor)

The first page of each File shall be an index to all of the Operating and Maintenance Instruction Files for the whole project e.g.

File No 1 – Scope of Work, Operating Philosophy and Wastewater Pumps

File No 2 – Inlet Works, Primary Settling Tanks, Aeration Plant

File No 3 – Secondary Clarifiers, Chlorination Plant, Sludge Dewatering Plant

File No 4 - etc

Note: File No 1 shall commence with an outline of the scope of work carried out under the Contract followed by the overall Operating Philosophy of the installation.

The second page of each File shall be an index to the contents of the File and shall include:

The equipment manufacturer’s name and the title and number of pages of each pamphlet and/or catalogue in the file.

A list of the drawing numbers and titles of the Employer’s Agent's drawings relating to the sections of the Contract that are dealt with in the File and,

A list of the drawing numbers and titles of all of the Contractor’s and Sub-Contractor’s drawings that are included in the rear pockets of the File.

The third page of the File shall be a list and contact details of contractors and/or specialists, if any, that the Contractor, and/or a Sub Contractor, had engaged to work on the section of the project dealt with in this file

The instructions shall be carefully prepared so as to provide in detail, and with clarity, a complete description of all components of the plant and equipment, and all information and drawings required to give a complete record of the factory and site performance tests, and complete guidance to operators and maintenance staff on all matters relating to the proper and safe operation and maintenance of the plant and equipment, and on all matters relating to the future ordering of spare parts which may be required for maintenance purposes and relating to the use of testing equipment and conduct of regular testing required to establish and maintain the quality and economy of operation of the plant.

The instructions for each component supplied and installed under the Contract shall include, inter alia, the following:

- An outline of the scope of work carried out under the Contract.
- The Operating Philosophy of the whole installation.
- List of spares, tools and testing equipment supplied under the Contract. This list shall include the full details referred to in the Contract and relating to spares and testing equipment for mechanical, electrical and instrumentation plant. The manufacturer's part number for each spare part shall be given.
- List of spare parts and testing equipment which are not supplied under the Contract, but which may be required for future major overhaul and/or testing of mechanical or electrical plant and equipment. The manufacturer's part number for each spare part that is listed shall be given.
- Maintenance schedules for each item of plant and equipment including, but not limited to, a list of points requiring lubrication, stating for each point the type and grade of lubricant recommended and full details as to quantity, timing and renewing of lubricant. Before preparing the instructions, the Contractor shall contact the Employer's maintenance engineer responsible for the new works to obtain the name and brand of lubricants generally in use by the Employer and, wherever possible, suitable grades of lubricant of that particular brand shall be prescribed by the Contractor in the instructions but with alternatives also given.
- Particulars of bearings, contacts and other moving parts with instructions relating to any special attention which may be required.
- Adjustment and calibration instructions and fault-finding procedures.
- Precautions to be taken in starting, running and stopping the plant or equipment, by automatic or manual control.
- Routine tests and frequencies thereof which the supplier recommends must be carried out on the plant to ensure that it is kept in good repair.
- The Contractor's drawings depicting all mechanical plant including pumps, motors, couplings, guards, bedplates and pipework and valves.
- Dimensions and wiring diagrams of all switchgear, MCC's and switchboards and all other electrical equipment.
- Copies of all test records signed by the manufacturer or agent's engineer in the case of factory testing which shall include, but is not limited to, pumps and all other rotating equipment, pipework, valves, lifting equipment, electrical equipment (FATs) and instrumentation equipment.
- Cable schedules giving the description and length and tag number of every power and instrumentation cable.
- Electrical load list.

- Instrument list
- Functional design specification
- Tag numbering
- PLC I/O list
- Process and Instrumentation diagrams (P&ID)
- Control Philosophy
- PLC configuration
- PLC software details
- PLC analogue scale function block
- PLC analogue alarm function
- System back-up and storage
- HMI screen shots
- Certificate of Compliance for each electrical installation.
- Manufacturer's pamphlets and catalogues edited and clearly marked so as to describe the particular equipment and plant supplied. (Pamphlets and printed catalogue data shall be bound into the instructions rather than pocketed with the drawings, and all information in such pamphlets and catalogues which is relevant to this contract shall be clearly marked.) Information shown in 'general' catalogues and brochures that is not applicable to plant and equipment supplied and installed under this Contract is to be neatly deleted.
- Records of the site performance testing of all plant and equipment.
- Commissioning documentation prepared by the Contractor in accordance with the Commissioning Plan Standard Specification and signed off as completed and correct.

The manuals shall include schedules giving details of every item of mechanical, electrical and instrumentation plant and equipment that has been installed including the manufacturer, model/type, "name plate data", full particulars of serial numbers and other descriptive data. As this data and information will be used by the Employer to create an Asset Register, the format must be discussed and agreed with the Employer's representative.

The Operating and Instruction Manual shall first be prepared in draft form and one copy shall be submitted to the Employer's Agent for comment at least four weeks prior to the scheduled date for Pre-commissioning (Stage 1 of the Commissioning Plan). Upon receipt of the Employer's Agent's comments, the Contractor shall update the File(s) as and where required and then submit four identical copies of the operating and instruction manual to the Employer's Agent at least 14 days before the scheduled date for Pre-commissioning (Stage 1 of the Commissioning Plan). The Contractor's program shall clearly show this as a discrete event.

Within 7 days of the successful completion of Stages 1 to 5 of the Commissioning Plan, the Contractor shall submit copies all of his/her performance testing records and all of the commissioning documents, duly signed off as completed and correct by the Contractor, to the Employer's Agent who will insert them into relevant operating and Instruction Files together with his/her own records of the commissioning and performance testing.

The prices and rates tendered for the supply of plant and equipment will be deemed to include allowances for the supply of instructions in terms of this clause. However, an item(s) has been included in the Bills of Quantities to cover the preparation and supply of instructions.

C3.10.27 Commissioning

The commissioning process that is to be followed is set out in C3.13 Commissioning Plan Standard Specification.

C3.10.28 Instructing Operators During Initial Period Of Operation

Experienced representatives of the Contractor and, where applicable, of the electrical, instrumentation, and other sub-contractors shall attend the commissioning and performance testing of all equipment and shall explain in detail and demonstrate to at least one mechanical and one electrical and on instrumentation operator employed by the Employer, the contents of the instructions referred to above and the correct methods of operating and maintaining the plant and equipment. The prices tendered in the Bills of Quantities will be deemed to include allowances for such explanations and demonstrations as may be required to be provided by the Contractor and sub-contractors to ensure that the Employer's operating staff is fully informed as to how the plant and equipment is to be cared for, operated, maintained and safeguarded.

C3.10.29 Scheduled Visits During Defects Liability Period

During the Defects Liability Period, the Contractor shall visit the site (over and above such visits as may become necessary due to system breakdowns) at quarterly intervals to ascertain that the system is functioning correctly.

Within 14 days of each such visit the Contractor shall submit a short report to the Employer's Agent which shall include details of all faults that were found as well as a statement that such faults were rectified. At the end of the Defects Liability Period, the Contractor must analyse these findings in a "Close out report" submitted to the Employer's Agent, in which he/she shall include any recommendations with regard to the augmenting of the system, procuring of additional facilities/equipment, suggested modifications, etc. Items have been included in the Bill of Quantities to enable the costs of these scheduled visits and reports to be priced.

C3.10.30 Scheduled Items

Payment will be made based on the items in the Bills of Quantities which have been subdivided as follows:

<u>Preliminary and General</u>

a) Fixed Charge Items - lump sum items are scheduled

b) Time Related Items - lump sum items are scheduled

c) Health and Safety - lump sum items are scheduled

d) Preparation and submission of Operating and Maintenance manuals.

e) Tuition and training of the Employer's staff - lump sum items are scheduled delete if it is included in the individual sections of the B of Q

f) Inspections and reporting during the Defects Liability Period- lump sum items are scheduled delete if it is included in the individual sections of the B of Q

g) Provisional Sums - lump sum items are scheduled and include provision for third party inspections.

Mechanical Plant and Equipment

a) Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s) of plant and is deemed to include all ancillaries.

b) Taking delivery, handling, erection, installation and painting of the plant and equipment - a separate item is schedule for each of the foregoing items.

c) Site performance testing and adjusting the plant and equipment.

d) Commissioning the plant and equipment.

e) Tuition and training of the Employer's staff - lump sum items are scheduled. Delete if it is included in the P&G

Electrical Equipment

- Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s) and is deemed to include all ancillaries.
- Taking delivery, handling, erection, and installation of the plant and equipment - a separate item is schedule for each of the foregoing items.
- Site performance testing and adjusting the plant and equipment
- Commissioning the plant and equipment
- Tuition and training of the Employer's staff - lump sum items are scheduled. Delete if it is included in the P&G
- Inspections and reporting during the Defects Liability Period- lump sum items are scheduled delete if it is included in the individual sections of the B of Q

Instrumentation

- Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s) and is deemed to include all ancillaries.
- Taking delivery, handling, erection, and installation of the plant and equipment - a separate item is schedule for each of the foregoing items.
- Site performance testing and adjusting the plant and equipment
- Commissioning the plant and equipment

C3.11: MECHANICAL PROJECT SPECIFICATIONS

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C3.11 MECHANICAL PROJECT SPECIFICATION

1) Scope

The scope of the Contract is described in general terms under the appropriate headings.

Mechanical Standard Specification document gives a general description of the requirements to be met, and provides the basic quality, safety, design and materials requirements of all the mechanical equipment that is to be supplied and installed under this Contract. The specific requirements of the Contract are prescribed in this Project Specification which takes precedence over the Standard Specification.

The prices tendered shall be deemed to cover everything necessary for the equipping testing and commissioning of the proposed sludge treatment plant and equipment which includes but not limited to pumps, pipework, valves, degritters, mixers and centrifuge.

The work to be carried out under the Contract shall include, inter alia, design and preparation of drawings of the proposed plant and equipment showing full details of the required equipment, couplings and guards, holding down arrangements, pipework and valves, flexible couplings, et al, manufacture and factory testing of the required plant and equipment, pipework and valves, and all accessories, delivery, handling and installation, testing, commissioning, and upholding during the defects liability period and everything necessary for the satisfactory operation of the installations and all control equipment to the satisfaction of the Employer's Agent.

2) Subdivision of the Project Specification

For convenience, this Mechanical Project Specification has been sub-divided into nine separate sections namely:

M1: Vortex Degritters

M2: Balancing Tank Vertical Mixers

M3: Poly Dosing System

M4: Thickener Bridge

M5: Thickened Sludge Centrifuge Feed Pumps

M6: Centrifuge

M7: Return Flow Pumps

M8: Air Blower

M9: Flash Mixer

M10: Centrifuge Lifting Equipment

M11: Return Flow Pump Hoist

M12: Thickened Sludge Centrifuge Feed Pump Hoist

M13: Thickened Sludge Mixer

M14: Centrifuge Wash Water Pumps and Tank

M1 VORTEX DEGRITTERS

M1.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the layout of the sludge treatment and associated equipment. The drawings applicable to this equipment are drawing number MD5775-RHD-BR-VD-DR-C-1101.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer's Agent, installation, and testing.

M1.2 Scope

This section of the Contract covers the design, supply, installation, and commissioning of vortex degritters proposed for the plant.

- Two identical vortex degritters (two duty) are to be installed before the balancing tank and receive the combined waste from the gravity filters and clarifiers.

M1.3 Vortex Degritters

The vortex degritters shall be designed with a capacity to process 67.5 l/s as a minimum and achieve at least 90% of grit removal. The minimum flow velocity shall be 1.2 m/s.

The operating speed of the paddles shall be suit for sludge

The vortex degritters shall have the capability of processing varying quantity, size, density, and structure of the suspended material.

The vortex degritters shall have the ability to accommodate fluctuating feed volumes and continuous operation.

The grit chamber shall be of diameter 2 m.

M1.4 Material of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of vortex degritter selection.

M1.5 Vortex Degritter Paddle Mixer

The paddles shall be fully in contact with the water to ensure that a vortex is induced in the wastewater inside the de-gritting chamber.

The paddles shall be fixed on the paddle side shafts with a rotational coupling allowing the paddles to rotate to prevent damage to the machine in the case of debris in the de-gritting chamber.

M1.6 Motor and Gearbox

Each vortex degritter shall comprise of electrical motor and gearbox which are used to rotate the paddles through the fluid.

A vertically mounted electrical motor mounted in the top of the vortex de-gritter to transfer the power through the gearbox and shaft to the impeller.

The motor and gearbox selection are based on the specific de-gritting chamber size.

The driveshaft shall be used to transfer the rotation from the gearbox to the paddles.

The motor size of 1.1 kW is indicative only and Tenderers shall offer motors to suit the degritters offered in the tender. The motors shall be continuously rated to run the degritters and sized to meet the specified maximum power requirement of the unit with the requisite motor power margin rating at that rate of paddle rotation. The motors shall comply with the electrical specifications forming part of this document.

M1.7 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M1.8 Operation

The electrical controls and electronic instruments which are to be supplied and installed under this Contract are specified in the Electrical and Instrumentation section of this document and include the following for the operator:

- PLC & HMI
- Auto/Off/Manual selector
- Start/stop for "Manual" mode
- Running/Stopped indication
- Supply voltage per phase
- Amps drawn by each motor
- A serial interface between the PLC and the Employer's Telemetry Base Station if the Client wants telemetry.

M1.9 Testing

Performance testing will be carried out on the equipment and shall comprise:

- Efficient operation of paddles under all operating conditions.
- Simulated resistance to rotation and tripping of the overload device.
- Effective operation of sludge draw off valve/ mechanism.
- Checking for leaks.

M1.10 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M2 BALANCING TANK VERTICAL MIXERS

M2.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the layout of the sludge treatment and associated equipment. The drawings applicable to this equipment are drawing number numbers MD5775-RHD-BR-BT-DR-C-1201 and MD5775-RHD-BR-BT-DR-C-1202.

All the necessary controls for the mixers are to be housed in the panels to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for the complete installations including all necessary power and control cabling between the panels and the mixers all of which electrical and electronic requirements are specified and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer's Agent, factory testing, installation, commissioning and site testing.

M2.2 Scope

This section of the Contract covers the design, supply, installation in the proposed plant, testing, and commissioning of three vertical mixers in the balancing tank, each with gearboxes and electric motors mounted on platforms.

M2.3 Mixers

The fluid to be mixed is degritted waste. The mixers shall gently mix the contents without introducing oxygen through surface agitation and shall maintain all solids in suspension. The horizontal zones of maximum turbulence shall be as close to the floor as possible. Scour velocities shall be such that solids which may have settled during a power failure will be lifted and brought back into suspension.

The mixers shall be sized to maintain an effectively constant suspended solids concentration with not more than 200 mg/l variation from the average at any point in the tank. The discharge flow rate of the mixing tank shall be 67.5 l/s.

The mixer shaft shall be manufactured from AISI 431 or equivalent material or as required for structural reasons.

The impeller blades shall be fabricated from 3 CR12 and shall be designed to maximise mixing efficiency as well as preventing rags and other material lodging onto the blades. The blades are to be welded to a central hub which is to be attached to the shaft using a keyway and locking retainer.

The mixer impeller shall be fixed to, and supported by, a vertical shaft from the underside of the gearbox.

M2.4 Dimensions

The dimensions of tank shown on the drawings may be summarised as follows:

	Tank 1	Tank 2	Tank 3
Width x length x water depth	8.6 m x 5.8 m x 4.55 m	8.6 m x 5.8 m x 4.55 m	8.6 m x 6 m x 4.55 m
Total volume of fluid	227 cubic metres	227 cubic metres	235 cubic metres
Distance from top of concrete platform to floor of the tank	6.25 m	6.25 m	6.25 m
Distance from top of concrete platform to top water level in the tank	1.7 m	1.7 m	1.7 m
Number of mixers	One	One	One

M2.5 Motors for the Mixers

Each mixer shall be driven by a fully enclosed, IP 65, weatherproof electric motor. The motor shall be mounted on the gearbox.

A motor size shall be 2.2 kW for mixers this is indicative and Tenderers shall offer motors to suit the mixers offered in the tender. The motors shall be continuously rated to run the mixer and sized to meet the specified maximum power requirement of the mixer with the requisite motor power margin rating.

The motors shall comply with the electrical specifications forming part of this document.

A non-corrosive GRP weatherproof cover as shall be supplied and installed over the motor.

M2.6 Base Plates

The mixer gearbox shall be mounted on a robust base plate manufactured from 3CR12/Grade 304 stainless steel or equivalent . Suitable stiffening of the base plate shall be provided where necessary. The base plates shall be supported on the concrete platform by Grade 304 stainless steel jacking bolts. Pockets will be provided for grouting in of the jacking bolts after final alignment and levelling by the Contractor. A minimum of 50 mm vertical adjustment in either direction from mean level must be provided.

M2.7 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M2.8 Testing of the Mixers

Performance testing shall be carried out by the Contractor after commissioning and adjustment and once the plant has been commissioned and the tank is full of liquid.

The tests shall comprise:

- Smooth and efficient operation of the mixers.
- Vibration analysis using calibrated portable equipment complying with ISO 10816 standard specification for general mechanical engineering.
- Measurement of absorbed power by each mixer impeller using a calibrated kW/hour meter and calculation of efficiency.
- Mixing tests shall consist of taking a minimum of six samples at random points close to the surface and from the bottom of the tank within five minutes. Analyses of these samples for suspended solids concentration shall be carried out by a suitable laboratory and the average concentration calculated. The suspended solids concentration of any one sample may not differ from this average by more than 200 mg/l.

If the equipment does not pass the mixing tests, two retests will be permitted and if the equipment still does not perform correctly, the faulty mixers shall be replaced, and the testing procedure repeated until the equipment performs correctly.

M2.9 Control of the Mixers

This clause describes the manner in which the mixers will operate and details the required control and protection functions of the plant. The Tenderer shall study this Clause in conjunction with the whole specification and the tender drawings and shall be deemed to have included allowance in his tender price to cover the provision of everything necessary for the proper functioning of the plant whether such things are specifically scheduled as separate items in the Bill of Quantities or not.

All the necessary controls for the mixers are to be housed in the proposed switchboard to be supplied under this Contract and more fully described elsewhere. The prices tendered are to include for all the necessary cabling between the switchboard and the mixers and for a local isolator at each motor.

M2.10 Operator Facilities

The electrical controls and electronic instruments which are to be supplied and installed under this Contract are specified in the Electrical and Instrumentation section of this document. The following is the minimum requirements that must be provided for each mixer:

- PLC & HMI
- Auto/Off/Manual selector
- Method of setting and changing the Auto run parameters e.g, on/off timers and/or speed
- Start/Stop for Manual mode
- Running/Stopped indication
- Cumulative hours run of each mixer
- Supply voltage per phase
- Amps per phase drawn by each motor
- Temperature sensing devices for motor windings
- Motor winding overheated trip with reset facility
- Motor anti-condensation heater on/off.
- A serial interface between the PLC and the Employer's Telemetry Base Station if the Client wants telemetry.

M2.11 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M3 POLY DOSING SYSTEM

M3.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the layout of the sludge treatment and associated equipment. The drawings applicable to this equipment are drawing number MD5775-RHD-BR-FB-DR-C-1302

All the necessary controls for the poly dosing system are to be housed in the panels to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for the complete installations including all necessary power and control cabling between the panels and the poly dosing system all of which electrical and electronic requirements are specified and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, factory testing, installation, commissioning and site testing.

M3.2 Scope

This section of the Contract covers the design, supply, installation, and commissioning of poly dosing system proposed for the plant.

The poly dosing system comprises of:

- Poly transfer tank.
- Poly make-up tank.
- Poly dilution tank.
- Poly maturing tank.
- Four (4) off Poly dosing pumps.

M3.3 Poly Dosing System

The poly dosing system shall be used to dose the waste from the balancing tank in order to increase the sedimentation rate and thicken the sludge. The maximum dosing rate shall be 5 mg/l.

The poly dosing system shall comprise of all equipment and ancillaries listed in M3.2. The pump configurations shall be (1 duty 1 standby).

The system shall allow for preparation of solutions from dry or concentrated liquid polymers. It shall mix the polymer proportionally with intake water to achieve the desired concentration of the final solution.

The total overall load of the system is 0.16 KW.

M3.4 Poly Transfer Tank

The tank shall be robust in design and be capable of housing the concentrate volume.

It shall prevent the penetration of impurities from the outside environment into the solution.

M3.5 Poly Makeup Dilution Dosing System

The tank shall be capable of storing the mixed solution and allow for maturing. It shall allow for accurate maturation time.

M3.6 Poly Dosing Pumps

The dosing pumps shall be able to draws measured amounts of liquid into its chamber and injects the chemical into a tank or pipe that contains the fluid that is being dosed.

The pumps shall be powered by a motor and shall have a control system that accurately turns the pump on and off and manages the flow rate.

M3.7 Materials of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of poly dosing system selection.

M3.8 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M3.9 Control of Poly Dosing System

This clause describes the manner in which the poly dosing system will operate and details the required control and protection functions of the plant. The Tenderer shall study this Clause in conjunction with the whole specification and the tender drawings and shall be deemed to have included allowance in his tender price to cover the provision of everything necessary for the proper functioning of the plant whether such things are specifically scheduled as separate items in the Bill of Quantities or not.

All the necessary controls for the poly dosing system are to be housed in the proposed switchboard to be supplied under this Contract and more fully described elsewhere.

The prices tendered are to include for all the necessary cabling between the switchboard and the poly dosing system and for a local isolator at each motor.

The electronic controls specified elsewhere which are to be supplied and installed under this Contract may be briefly summarized as follows:

i. Motor failure device
ii. Circuit breaker failure
iii. Low of high-water flow
iv. Dry run

M3.10 Testing

Performance testing will be carried out on the equipment and shall comprise:

- Smooth and efficient operation of system
- Leak detection
- Full operation of sensors
- Factory hydraulic testing and factory performance testing of the pumps.

M3.11 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M4 THICKENER BRIDGE

M4.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the layout of the sludge treatment and associated equipment. The drawings applicable to this equipment are drawing number MD5775-RHD-BR-GT-DR-C-1401.

All the necessary controls for the thickener bridge are to be housed in the panels to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for the complete installations including all necessary power and control cabling between the panels and the thickener bridge all of which electrical and electronic requirements are specified and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, factory testing, installation, commissioning and site testing.

M4.2 Scope

This section of the Contract covers the design, supply, installation in the proposed plant, testing, and commissioning of one thickener bridge in the clarifier.

The thickener bridge comprises of:

- Drive
- Platform and walkway
- Feed well.
- Rake mechanism

M4.3 Thickener Bridge

The rotating bridge half bridge shall be no less than 750 mm wide and shall be fabricated from suitably sized steel sections, securely gusseted and braced. It shall be capable of supporting at least 3 kN/m^2 uniformly distributed load and an additional 1,5 kN point load at centre span as a minimum. The deflection when loaded shall be less than 1/385 of the span.

The bridge shall be designed to have sufficient camber to fully counteract the deflection which will be produced by the dead load of the complete bridge. Furthermore, it shall be capable of resisting the torsion imposed by the scraper / rake mechanism without excessive deflection.

The centre pivot shall comprise a turntable bearing designed to cater for all axial and radial loads. Lubrication pipe/s shall be extended up to the bridge walkway level

M4.4 Materials of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of the thickener bridge selection.

M4.5 Drive

The drive assembly shall provide the force to move the rakes through the thickened sludge and to move settled solids to the point of discharge

The drive shall have adequate reserve capacity to withstand upsets and temporary overloads.

The drive shall have a reliable control which protects the mechanism from damage when a major overload occurs.

M4.6 Platform and Walkway

All steelwork shall be in accordance with SABS 0162 'The Structural Use Of Steel'.

The walkway shall be equipped with galvanized mild steel/GRP open grid flooring panels fixed in position with clips.

A stainless-steel tubular stanchion handrail with two horizontal rails is required on both sides of the bridge walkway and both rails shall be continuous at the pivot end of the bridge. Access steps shall be provided at the outer end of the bridge.

M4.7 Feed Well

The feed well shall be designed to allow the feed to enter the thickener with minimum turbulence and uniform distribution while dissipating most of its kinetic energy.

The feed well shall allow easy entrance of waste through a pipe or launder suspended from the bridge.

The feed well system shall be able to minimize the excess velocity of fluid entering the feed well.

M4.8 Rake Mechanism

The rake mechanism shall be designed to move the settled solids to the point of discharge and assist in promoting the thickening of the sludge.

The rake shall be able to thicken the sludge by creating paths in a compressed zone, which allows for trapped liquids to escape upwards.

M4.9 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M4.10 Controls

This clause describes the manner in which the bridge will operate and details the required control and protection functions of the plant. The Tenderer shall study this Clause in conjunction with the whole specification and the tender drawings and shall be deemed to have included allowance in his tender price to cover the provision of everything necessary for the proper functioning of the plant whether such things are specifically scheduled as separate items in the Bill of Quantities or not.

A sensitive overload trip is to be provided which is to operate in the event of an external force of 100 N being applied at the external end of the rotating bridge.

An emergency stop shall be provided at the drive end of the rotating bridge.

The rotating bridge may be started and stopped manually but, when switched to “Auto” mode it shall run continuously. Following a power outage, a bridge that is on "Auto" shall start and run.

All the necessary controls for the rotating bridge are to be housed in the pump station switchboard to be supplied under this Contract and more fully described elsewhere.

The prices tendered are to include for all the necessary cabling between the switchboard and the bridge central columns and for an emergency stop at the drive/outer end of the rotating bridge.

M4.10 Testing

Performance testing will be carried out on the equipment and shall comprise but not limited to:

- Efficient operation of the bridges under all operating conditions
- Simulated resistance to rotation of the bridges and tripping of the overload device.

M4.11 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M5 THICKENED SLUDGE CENTRIFUGE FEED PUMPS

M5.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the position of the proposed pumps. The drawings applicable to this pumping installation are drawing number MD5775-RHD-BR-FB-DR-C-1302.

All the necessary controls for the pumps are to be housed in the panels to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for the complete installations including all necessary power and control cabling between the panels and the pumps and motors all of which are described and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer's Agent, factory testing, installation, commissioning and site testing.

M5.2 Scope

This section of the Contract covers the following:

Design, supply, installation of the centrifuge feed pumps, testing, and commissioning of the pumps and delivery pipework and valves which may be briefly described as follows:

- Two off progressive cavity pumps with the configuration of (one duty, and one standby) each pump shall be driven by 15 kW motor at a duty point of 6.55 l/s x 18 m. These centrifuge pumps primary function will be to feed the centrifuges with thickened sludge, and also be used to circulate the sludge back to the thickener should the sludge not meet the centrifuge feed requirements..

M5.3 Pumping Plant

The fluid to be pumped is thickened centrifuge sludge. The pump shall be able to transfer viscous and abrasive fluids with ease.

The pumps are to comprise of a specific motor, reducer and pump head designed to perform at the desired flow rates and pressure.

The pumps shall have positive displacement with no backflow

The pumps shall also be self- priming and low NPSHr for optimal suction capability.

The pumps shall have non-clogging design such that they can accommodate solids up to 6 %.

M5.4 Materials

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of pump selection.

M5.5 Duty Point of the Pumps

The pumps shall be capable of continuous operation alone pumping out of the sludge sump and into their respective centrifuge.

M5.6 Cooling Requirement of the Pumps

From the above clause, the pumps will be required to operate for protracted periods under varying conditions. Tenderers are to make provision for cooling mechanisms on the motors if deemed necessary and are to confirm that the pumps offered are suitable for use under those conditions.

M5.7 Method of Installation

Each of the pumps are mounted on their own base frames and tightly bolted. The motors driving the pumps shall be directly coupled to the pump. The pump components, cooling and lubrication units and all other ancillaries shall be mounted on the common base frames of the pump.

The pump casings shall be as per the manufacturer's standard supply and shall be selected to accommodate the required working pressure and pump life expectancy.

M5.8 Factory Testing of the Pumps

Items have been included in the Bills of Quantities to enable Tenderers to submit separate prices for factory hydraulic testing and factory performance testing of the pumps.

M5.9 Motors for the Pumps

Each pump shall be driven by an electric motor of such rating that the motor will not be overloaded by the pump no matter how great its discharge and no matter how low the total pumping head.

The tenderers shall offer motors to suit the pumps offered in the tender. The motors shall be continuously rated to run the pumps and sized to meet the specified maximum power requirement of the pump with the requisite motor power margin rating at that rate of pumping. The motors shall comply with the electrical specifications forming part of this document.

M5.10 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M5.11 Hydraulic Pressure Testing & Painting

On completion of the installation, the pumps' shall be tested as per manufactures standards to depict worst case scenario of the system.

All pipework shall receive two coats of gloss enamel after commissioning and prior to handing over.

M5.12 Pressure Gauges

The range of the gauges shall be as specified in the Bill of quantities and/ applicable drawings. Each pressure gauge is to be equipped with a diaphragm to prevent the ingress of solids into the gauge.

M5.13 Control of the Pumps

The control system for the pumps shall be reliable and provide appropriate protection also in the event of power failure. Precise level meters shall be installed on every sump to control the sequence of operation of the pumps. Details thereof are given in the instrumentation section.

M5.14 Operator Facilities

The electrical controls and electronic instruments which are to be supplied and installed under this Contract are specified in the Electrical and Instrumentation section of this document and include the following for the operator:

- PLC & HMI
- Duty pump selection
- Auto/Off/Manual selector
- Start/stop for Manual mode for each pump
- Running/Stopped indication for each pump
- Number of starts counter for each pump - resettable
- Number of starts counter for each pump - non-resettable
- Cumulative hours run of each pump
- No-flow trip with reset facility
- Supply voltage per phase
- Amps drawn by each motor
- A serial interface between the pump station PLC and the Employer's Telemetry Base Station.

M5.15 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M6 CENTRIFUGE

M6.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the layout of the proposed plant and the required position of the centrifuge which is to dewater sludge. The drawings applicable to this centrifuge are MD5775-RHD-BR-FB-DR-C-1303 and MD5775-RHD-BR-FB-DR-C-1304.

Nothing contained in this specification restricts Tenderers from offering proprietary centrifuge that may differ in configuration or type from that described below. However, all variance from this specification must be stated in the tender that is submitted.

All the necessary controls and power for the centrifuge are to be housed in a dedicated panel for each centrifuge as part of this Contract according to the supplier recommendations and requirements for the full function of the centrifuge.

The prices tendered are to include for all necessary power and control cabling between the centrifuge panel and the motors including all electrical and instrumentation requirements as per supplier recommendations and requirements. A feeder power cable will be supplied from the main MCC to each of the centrifuge panels.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, installation, and testing.

M6.2 Scope

This section of the Contract covers the design, supply, installation in the proposed plant, testing, and commissioning of two centrifuge equipment, complete with all accessories (including, but not limited to, motors, adjustable speed drives, control panels, speed reducers, safety guards and feed, polymer, centrate and cake solids sampling provisions).

M6.3 Centrifuge

The centrifuges shall be of the high-speed, dry solids, solid bowl horizontal, continuous feed, conveyor type specifically configured for dewatering and intended to produce a dewatered cake with a higher solid content.

The centrifuge feed flow shall be 6.55 l/s and a recovery percentage of 95 %.

The centrifuges shall be designed to limit air leakage into or from the body of the centrifuges.

The centrifuge equipment shall be designed for continuous operation. A main drive system shall be provided to drive each centrifuge rotating assembly and shall have speed variation.

The centrifuges shall be designed to be mounted on a steel frame allowing discharge into a discharge chute directly beneath the centrifuge bowl.

M6.4 Material of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of the centrifuge selection.

M6.5 Bowl

The bowl shall be designed to withstand all forces encountered during operation, with an adequate safety factor. The bowl shall be supported on each end.

M6.6 Conveyor

The centrifuges shall comprise of horizontal cylindrical-conical / screw type conveyor supported by anti-friction bearings.

The conveyor shall have the feed chambers, edges and face protected against abrasion.

M6.7 Case

The centrifuges shall be enclosed in fabricated cases, which shall have the capability to contain and direct the solids and liquid discharge from the centrifuge, and to act as a protective guard, and provide complete enclosure for noise reduction and odour control.

M6.8 Frame

The frame shall provide structure for mounting and positioning of the centrifuge and shall have the ability to reduce any vibration generated.

M6.9 Drive System

Each centrifuge shall comprise of electrical motor 165 KW and gearbox.

The system shall have capability for differential speed between the conveyor and bowl and a reducer.

The drive size of 165 kW is indicative only and Tenderers shall offer drives to suit the centrifuges offered in the tender. The drives shall be continuously rated to run the centrifuges and sized to meet the specified maximum power requirement of the unit with the requisite motor power margin rating at that rate of conveyor rotation. The drives shall comply with the electrical standard specifications forming part of this document.

M6.10 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M6.11 Controls

The controls for all components of each centrifuge shall be provided by a dedicated programmable logic controller (PLC), mounted in each of the respective control panels. The PLC shall provide all control and monitoring functions as required for the operation and monitoring of the centrifuge including, but not limited to, timing, interlocks, startup sequencing, normal and emergency shutdowns, and permissive functions required for safe operation of each centrifuge. Industrial ethernet protocol connections shall be installed for telemetry and SCADA information to be communicated between the centrifuge control panels and the main PLC in the main MCC.

M6.12 Testing

Performance testing will be carried out on the equipment and shall comprise but not limited to:

- Centrifuge functional tests
- Drive
- Noise and vibration

M6.13 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M7 RETURN FLOW PUMPS

M7.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the position of the proposed pump station. The drawings applicable to this pumping installation are drawing number MD5775-RHD-BR-FB-DR-C-1302.
All the necessary controls for the pumps are to be housed in the panels to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for the complete installations including all necessary power and control cabling between the panels and the pumps and motors all of which are described and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, factory testing, installation, commissioning and site testing.

M7.2 Scope

This section of the Contract covers the following:

Design, supply, installation of the return flow pumps, testing, and commissioning of the pumps and delivery pipework and valves which may be briefly described as follows:

Two identical pumps with a configuration (one duty, one standby) in parallel each driven by a 30 kW (estimated rating) induction electric motor and with a duty point of 66.5 l/s x 25.65 m.

M7.3 Pumping Plant

The fluid to be pumped is return water,

The pumpsets shall be of single stage centrifugal type suitable for pumping the above-mentioned fluid. Each pump shall be direct coupled motor running at a speed not exceeding 2960 rpm.

The pumps shall have non-clogging impellers capable of passing return water.

OR

The pumps shall have non-clogging, fully recessed, impellers and shall be capable of passing return water.

The pump and motor unit are to be installed below water and must therefore be designed and constructed specifically for that purpose.

The pumps must have suitably rated mechanical seals to seal the motor. The seals shall be located in an oil chamber and the pump shall have a seal monitoring system to give warning of any malfunction.

Bearings shall be of the grease lubricated, sealed-for-life type and shall be capable of taking the static weight of the rotating parts and any other loads produced by the operation of the pump.

M7.4 Materials

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of pump selection.

M7.5 Duty Point of the Pumps

The pumps shall be capable of continuous operation alone pumping out of the return flow sump to head of works.

M7.6 NPSH Requirements of the Pumps

The NPSH requirement at duty point shall be 9.16 m.

Each pump is to operate satisfactorily under these conditions with an adequate margin of safety on the pump manufacturer's "3% Decay NPSH Required" curve.

The "NPSH Required" by the pump offered will be deemed to be 30% above that of the pump manufacturer's 3% decay curve and that value shall be less than the NPSH Available as calculated above. The adequacy or otherwise of the NPSH safety margin will be carefully considered when the tenders are adjudicated.

M7.7 Cooling Requirement of the Pumps

From the above clause, the pumps will be required to operate for protracted periods under varying conditions. Tenderers are to make provision for cooling mechanisms on the motors if deemed necessary and are to confirm that the pumps offered are suitable for use under those conditions.

M7.8 Method of Installation

Each of the pumps are mounted on their own base frames. The motors driving the pumps shall be directly coupled to the pump drive shafts. The drive motors, gearboxes, cooling and lubrication units and all other ancillaries shall be mounted on the common base frames of the pump.

The pump casings shall be as per the manufacturer's standard supply and shall be selected to accommodate the required working pressure and pump life expectancy.

An integrally cast or permanently attached metal plate with a direction of rotation arrow.

M7.9 Factory Testing of the Pumps

Items have been included in the Bills of Quantities to enable Tenderers to submit separate prices for factory hydraulic testing and factory performance testing of the pumps.

M7.10 Motors for the Pumps

Each pump shall be driven by an electric motor of such rating that the motor will not be overloaded by the pump no matter how great its discharge and no matter how low the total pumping head.

Pumps 30 kW close coupled induction electric motors running at no more than 2960 rpm are to be provided under the electrical section of the Contract.

The motor size of 30 kW is indicative only and Tenderers shall offer motors to suit the pumps offered in the tender. The motors shall be continuously rated to run the pumps and sized to meet the specified maximum power requirement of the pump with the requisite motor power margin rating at that rate of pumping. The motors shall comply with the electrical specifications forming part of this document.

M7.11 Delivery Pipework and Valves

No responsibility is accepted for any dimensions shown on the drawings as the Contractor will be required to design suitable pipework and valve configurations for verification by the Employer's Agent prior to fabrication. Notwithstanding that the pipework that is required is shown on the drawings and is briefly described below, the Contractor will be required to design and supply and install all pipes, valves, and fittings required for the complete installation.

The diameters and extent of the delivery pipework that is to be supplied and installed under this Contract to serve all the pumps with suction flange DN 125 to discharge flange DN 100. All pipework is to be mild steel unless otherwise stated below.

The factory test pressures required on the valves shall be 1,5 x PN for the gate (open end) and 2,0 x PN for the body. The valves shall be capable of being opened and closed by one person against an unbalanced head of no less than 1000 kPa.

M7.12 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M7.13 Hydraulic Pressure Testing & Painting

On completion of the installation, the pumps' delivery pipework, valves and fittings shall be hydrostatically tested to 1 500 kPa.

All pipework and valves shall receive two coats of gloss enamel after commissioning and prior to handing over.

M7.14 Pressure Gauges

The range of the gauges shall be as specified in the Bill of quantities and/ applicable drawings. Each pressure gauge is to be equipped with a diaphragm to prevent the ingress of solids into the gauge.

M7.15 Control of the Pumps

The control system for the pumps shall be reliable and provide appropriate protection also in the event of power failure. Precise level meters shall be installed on every sump to control the sequence of operation of the pumps. Details thereof are given in the instrumentation section.

The pumps are to be electrically interlocked (both in "Manual" mode and in "Auto" mode to prevent pumps from starting simultaneously.

M7.16 Operator Facilities

The electrical controls and electronic instruments which are to be supplied and installed under this Contract are specified in the Electrical and Instrumentation section of this document and include the following for the operator:

PLC & HMI

i. Duty pump selection
ii. Auto/Off/Manual selector
iii. Start/stop for Manual mode for each pump
iv. Running/Stopped indication for each pump
v. Number of starts counter for each pump - resettable
vi. Number of starts counter for each pump - non-resettable
vii. Cumulative hours run of each pump
viii. No-flow trip with reset facility
ix. Supply voltage per phase
x. Amps drawn by each motor
xi. A serial interface between the pump station PLC and the Employer's Telemetry Base Station.

M7.17 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M8 AIR BLOWER

M8.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the layout of the proposed plant and the required position of the air blowers. The drawings applicable to this centrifuge are MD5775-RHD-BR-VD-DR-C-1101.

Nothing contained in this specification restricts Tenderers from offering proprietary blowers that may differ in configuration or type from that described below. However, all variance from this specification must be stated in the tender that is submitted.

All the necessary controls for the blowers are to be housed in the panel to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for all necessary power and control cabling between the panel and the motors all of which electrical and instrumentation requirements are specified and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer's Agent, installation, and testing.

M8.2 Scope

This section of the Contract covers the design, supply, installation in the proposed plant, testing, and commissioning of two air blower equipment, complete with all ancillaries.

M8.3 Air Blower

The air blower shall be capable of creating an efficient airflow to provide air in the process of aeration and agitation in the plant. This air is required for the naturally occurring bacteria or microorganisms to develop and treat wastewater.

The air blower design shall incorporate a cooling mechanism, with the air blower housing being of high-quality material.

The pressure fluctuations in the air supply shall not exceed 2% of the operating pressure.

The air blowers shall be capable of reducing the noise generated to below 75 dB when measured one metre away from the enclosure in accordance with ISO 3746.

M8.4 Unit

Each air blower shall be enclosed, with the appropriate IP rating for outdoor.

The drive system shall be designed to provide 22 kW.

A drive size shall be 22 kW for air blowers this is indicative, and Tenderers shall offer drives to suit the air blower offered in the tender. The motors shall be continuously rated to run the air blower and sized to meet the specified maximum power requirement of the air blower with the requisite motor power margin rating.

The motors shall comply with the electrical specifications forming part of this document.

M8.5 Material of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of the air blower selection.

M8.6 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M8.7 Testing

Performance testing will be carried out on the equipment and shall comprise but not limited to:

- Air blower functional tests
- Drive
- Noise and vibration

M8.8 Control of the Air Blowers

This clause describes the manner in which the air blowers will operate and details the required control and protection functions of the plant. The Tenderer shall study this Clause in conjunction with the whole specification and the tender drawings and shall be deemed to have included allowance in his tender price to cover the provision of everything necessary for the proper functioning of the plant whether such things are specifically scheduled as separate items in the Bill of Quantities or not.

All the necessary controls for the air blowers are to be housed in the proposed switchboard to be supplied under this Contract and more fully described elsewhere. The prices tendered are to include for all the necessary cabling between the switchboard and the air blowers.

M8.9 Operator Facilities

The electrical controls and electronic instruments which are to be supplied and installed under this Contract are specified in the Electrical and Instrumentation section of this document. The following is the minimum requirements that must be provided for each air blower:

- PLC & HMI
- Auto/Off/Manual selector
- Method of setting and changing the Auto run parameters e.g, on/off timers and/or speed
- Start/Stop for Manual mode
- Running/Stopped indication
- Cumulative hours run of each motor
- Supply voltage per phase
- Amps per phase drawn by each motor
- Temperature sensing devices for motor windings
- Motor winding overheated trip with reset facility
- A serial interface between the PLC and the Employer's Telemetry Base Station

M8.10 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M9 FLASH MIXERS

M9.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the layout of the sludge treatment and associated equipment. The drawings applicable to this equipment are drawing number MD5775-RHD-BR-FB-DR-C-1302.

All the necessary controls for the flash mixers are to be housed in the panels to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for the complete installations including all necessary power and control cabling between the panels and the flash mixers all of which electrical and electronic requirements are specified and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, factory testing, installation, commissioning and site testing.

M9.2 Scope

This section of the Contract covers the design, supply, installation in the proposed plant, testing, and commissioning of two flash mixers for dosing system, each with motors and associated ancillaries.

M9.3 Flash Mixers

The flash mixers will form part of the poly mixing system. The flash mixers shall mix the contents without introducing oxygen through surface agitation, and shall be designed to disperse polymers so that they enhance flocculation by optimizing the strength, size and weight of the flocculant.

The flash mixers shall be designed to ensure duration of the flash mix chamber is carefully controlled. If the duration of the flash mix is not long enough, the chemicals will not be properly distributed throughout the liquid. If too long, and the newly formed flocculant will be damaged by impeller shear. The discharge flow rate of the system shall be 67.5 l/s.

The flash mixer shaft shall be manufactured from AISI 431 or equivalent material or as required for structural reasons.

The impeller blades shall be fabricated from 3 CR12 or equivalent and shall be designed to maximise mixing efficiency.

The mixer impeller shall be fixed to, and supported by, a vertical shaft from the underside of the gearbox.

M9.4 Motors for the Flash Mixers

Each mixer shall be driven by a fully enclosed, IP 65, weatherproof electric motor. The motor shall be mounted on the gearbox.

A motor size shall be 1.1 kW for flash mixers this is indicative and Tenderers shall offer motors to suit the flash mixers offered in the tender. The motors shall be continuously rated to run the flash mixers and sized to meet the specified maximum power requirement of the flash mixers with the requisite motor power margin rating.

The motors shall comply with the electrical specifications forming part of this document.

A non-corrosive GRP weatherproof cover as shall be supplied and installed over the motor.

M9.5 Material of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of the flash mixer selection.

M9.6 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M9.7 Testing of the Flash Mixers

Performance testing shall be carried out by the Contractor after commissioning and adjustment and once the plant has been commissioned and the tank is full of liquid.

The tests shall comprise but not limited to:

- Smooth and efficient operation of the flash mixers.
- Vibration analysis using calibrated portable equipment complying with ISO 10816 standard specification for general mechanical engineering.
- Measurement of absorbed power by each flash mixer impeller using a calibrated kW/hour meter and calculation of efficiency.
- Mixing tests shall consist of taking samples at random points close to the surface and from the bottom of the tank at different time frames. The concentration of the samples shall not have a large deviation

If the equipment does not pass the mixing tests, retests will be permitted and if the equipment still does not perform correctly, the faulty flash mixers shall be replaced, and the testing procedure repeated until the equipment performs correctly.

M9.8 Control of the Flash Mixers

This clause describes the manner in which the flash mixers will operate and details the required control and protection functions of the plant. The Tenderer shall study this Clause in conjunction with the whole specification and the tender drawings and shall be deemed to have included allowance in his tender price to cover the provision of everything necessary for the proper functioning of the plant whether such things are specifically scheduled as separate items in the Bill of Quantities or not.

All the necessary controls for the flash mixers are to be housed in the proposed switchboard to be supplied under this Contract and more fully described elsewhere. The prices tendered are to include for all the necessary cabling between the switchboard and the flash mixers and for a local isolator at each motor.

M9.9 Operator Facilities

The electrical controls and electronic instruments which are to be supplied and installed under this Contract are specified in the Electrical and Instrumentation section of this document. The following is the minimum requirements that must be provided for each flash mixer:

- PLC & HMI
- Auto/Off/Manual selector
- Method of setting and changing the Auto run parameters e.g, on/off timers and/or speed
- Start/Stop for Manual mode
- Running/Stopped indication
- Cumulative hours run of each flash mixer
- Supply voltage per phase
- Amps per phase drawn by each motor
- Temperature sensing devices for motor windings
- Motor winding overheated trip with reset facility
- Motor anti-condensation heater on/off.
- A serial interface between the PLC and the Employer's Telemetry Base Station if the Client wants telemetry.

M9.10 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M10 CENTRIFUGE LIFTING EQUIPMENT

M10.1 General

This specification must be read in conjunction with the Mechanical Standard Specification. The drawings accompanying this document show the layout of the sludge treatment and associated equipment.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, installation, and testing.

M10.2 Scope

This section of the Contract covers the design, supply, installation, and commissioning of the centrifuge lifting equipment proposed for the plant.

- One Electrical Overhead Travelling crane to service both centrifuges.

M10.3 Electrical Overhead Travelling Crane

The crane shall have the following as minimum requirements.

- Bearings
    - All bearings shall be of heavy-duty, anti-friction type.
    - End carriage and crab axle bearings shall be mounted in such a manner as to facilitate in-situ replacement.
- End carriage and crab
    - Cellular buffers shall be provided on both sides of each end carriage, and rubber buffers on both sides of the crab. The buffers shall be capable of arresting movement under full load conditions at rated maximum speed without damage to crane or buffers.
- Loading hook block
    - The load hook block shall be of the enclosed type. Guards shall be provided at pinch points where the lifting ropes pass over the sheaves in the load block. The hook shall be constructed to facilitate wire rope replacement when necessary.
    - Each hook is to be fitted with a spring-loaded safety catch.
- Hoist units and ropes
    - All hoist units as a minimum shall be manufactured strictly in accordance with the FEM standards.
    - All hoist units shall be supplied with the correct type of hoisting ropes to prevent rope spin and the twisting of hook blocks during lifting/lowering operations.
- Lubrication
    - Provision shall be made to easily lubricate all moving parts of the crane from walkways next to the end carriages of from the walkway next to the girder beam.
    - Seals shall be provided where necessary to prevent leakage from containers or with appropriate sealed-for-life bearings.
    - Lubrication schedule are to be supplied clearly showing quantities, frequency, and type of lubricant with position/s of grease points, fill plugs, draw plugs, etc.
- Mains isolator
    - The Electrical Overhead Travelling Crane installed shall be provided with a pad lockable manually operated main isolator and panel mounted in an easily accessible position at ground level.
    - This isolator is required to isolate the incoming power supply to the whole Electrical Overhead Travelling Crane when maintenance is being undertaken.
    - Its enclosure shall afford the degree of protection IP55 or any better equivalent.
- Brakes
    - Hoisting mechanism shall be equipped with “thruster” type brakes, or approved equivalent, for automatically maintaining hoisting and lowering speeds without variation at each point, regardless of load.

- Gearboxes
    - All gearboxes shall be of rigid construction, totally enclosed, dust proof, splash proof, horizontally or vertically split, and equipped with inspection covers, drain and filler plugs, oil seals and gaskets, breather holes, level indicators and lifting lugs, as required. The boxes shall be stress relieved and guaranteed against distortion, when in service. All gear shafts except where they extend outside the box, shall be sealed off completely from the outside, by separate caps, or separate total enclosures.

M10.4 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M10.5 Control of the Crane

- Pendant or Radio control
    - The crane shall be pendant, or radio controlled as indicated on data sheet.
    - The operating height of the pendant control is to be advised by supplier. The pendant shall have a moulded shock resistant, dust proof and splash proof non-metallic casing which is completely insulated. The control functions shall be by shrouded push buttons which shall return to the “OFF” position on release.
    - There shall be a means of “locking out” the pendant control, and operation of the main contactor shall be possible from the pendant.
    - The mass of the pendant will be supported completely and independently of the electrical control cable.
- Controls
    - All operations shall be controlled by pendant or radio control.
    - Controls shall be such that all functions are fully reversible.
    - The crane operation will be with two speed ranges controlled from the pendant push button or radio control.
- Limit Switches
    - Each hoisting motion shall be protected by an over wind limit switch of the automatic reset type actuated by the bottom block, to limit travel to the highest safe position.
    - Further, an automatic reset type adjustable over lower limit switch shall also be incorporated in each hoisting motion.
    - The hoist motion shall be fitted with raise and lower limit switches of the rotary cam, screw or hunting teeth type directly driven by substantial gears, coupling or chain and sprockets from the hoist barrel shafts. A further separate “over hoist” limit switch shall be provided to operate in the event of failure of the hoist raise limit switch. This limit switch shall trip the main contractor, apply all brakes and shall be weight biased to the normal position and tripped by mechanical linkage from the hoist block.
    - Load cell limit to be installed for overloading conditions.
    - The interiors of gearboxes shall be thoroughly cleaned, (in the case of castings, they shall be cleaned by shot blasting, or other approved method). Gearboxes shall be

subjected to paraffin testing for oil tightness, prior to being painted on the inside with oil resisting enamel paint of light colour.

- All output shafts and bearings shall be designed to accommodate any torsion and bending loads expected to be encountered in service.
- Drive trains and gearboxes shall be correctly adjusted and free from any lubrication oil leaks whatsoever.

- Electrical
  - All electrical switch gear and control gear shall be mounted in panels which shall be mounted as to afford safe and easy access for maintenance. Enclosures shall provide protection against high humidity and dust. Incoming moulded case circuit breakers shall be fitted to each cubicle with mechanically interlocked operating handles so arranged that the cubicle door can only be opened with the isolator in the “OFF” position. Even with this facility, the relevant IP standard requirement shall be maintained.

M10.6 Material of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of the centrifuge selection

M10.7 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M10.8 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M11 RETURN FLOW PUMP HOIST

M11.1 General

This specification must be read in conjunction with the Mechanical Standard Specification. The drawings accompanying this document show the layout of the sludge treatment and associated equipment.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, installation, and testing.

M11.2 Scope

This section of the Contract covers the design, supply, installation, and commissioning of the return flow pump hoist proposed for the plant.

- One Manual lifting hoist for return flow pumps and all associated ancillaries.

M11.3 Hoist

- The equipment shall be designed and constructed in accordance with a generally accepted code of practice or standard.
- Fixings of crawl beams shall be through bolted by means of Grade 304 stainless steel threaded bar.

- High-tensile or alloy steel chains shall be hot dipped galvanised and shall have a factor of safety of at least four.
- The safe working load (SWL) shall be clearly and boldly marked on all lifting equipment.
- The complete installation shall be inspected and shall be tested on site by the Contractor over its complete lifting range using a load which shall be at least 125% of the safe working load.
- Chain block casings are to be fabricated from cast iron or high strength alloy steel. A slipping clutch or equivalent, is to be fitted to ensure that it is not possible to overload the chain block. A trolley, along with all ancillary equipment, is to be provided with the chain block for operation on the crawl beam.

M11.4 Material of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of the flash mixer selection.

M11.5 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M11.6 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M12 THICKENED SLUDGE CENTRIFUGE FEED PUMP HOIST

M12.1 General

This specification must be read in conjunction with the Mechanical Standard Specification. The drawings accompanying this document show the layout of the sludge treatment and associated equipment.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, installation, and testing.

M12.2 Scope

This section of the Contract covers the design, supply, installation, and commissioning of the thickened sludge centrifuge feed pump hoist proposed for the plant.

- One Manual lifting hoist for thickened sludge centrifuge feed pumps and all associated ancillaries.

M12.3 Hoist

- The equipment shall be designed and constructed in accordance with a generally accepted code of practice or standard.
- Fixings of crawl beams shall be through bolted by means of Grade 304 stainless steel threaded bar.
- High-tensile or alloy steel chains shall be hot dipped galvanised and shall have a factor of safety of at least four.
- The safe working load (SWL) shall be clearly and boldly marked on all lifting equipment.
- The complete installation shall be inspected and shall be tested on site by the Contractor over its complete lifting range using a load which shall be at least 125% of the safe working load.

- Chain block casings are to be fabricated from cast iron or high strength alloy steel. A slipping clutch or equivalent, is to be fitted to ensure that it is not possible to overload the chain block. A trolley, along with all ancillary equipment, is to be provided with the chain block for operation on the crawl beam.

M12.4 Material of Manufacture

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of the flash mixer selection.

M12.5 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M12.6 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M13 THICKENED SLUDGE MIXER

M13.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the layout of the sludge treatment and associated equipment. The drawings applicable to this equipment are drawing numbers MD5775-RHD-BR-FB-DR-C-1302 and MD5775-RHD-BR-FB-DR-C-1304.

All the necessary controls for the mixer are to be housed in the panels to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for the complete installations including all necessary power and control cabling between the panels and the mixers all of which electrical and electronic requirements are specified and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer’s Agent, factory testing, installation, commissioning and site testing.

M13.2 Scope

This section of the Contract covers the design, supply, installation in the proposed plant, testing, and commissioning of the thickened sludge mixer in the thickened sludge sump, each with gearboxes and electric motors mounted on support structures.

M13.3 Mixers

The fluid to be mixed is thickened sludge. The mixer shall gently mix the contents without introducing oxyge0n through surface agitation and shall maintain all solids in suspension. The horizontal zones of maximum turbulence shall be as close to the floor as possible. Scour velocities shall be such that solids which may have settled during a power failure will be lifted and brought back into suspension.

The mixers shall be sized to maintain an effectively constant suspended solids concentration with not more than 200 mg/l variation from the average at any point in the sump. The discharge flow rate of the sump shall be 6.55 l/s.

The mixer shaft shall be manufactured from AISI 431 or equivalent material or as required for structural reasons.

The impeller blades shall be fabricated from 3 CR12 and shall be designed to maximise mixing efficiency as well as preventing rags and other material lodging onto the blades. The blades are to be welded to a central hub which is to be attached to the shaft using a keyway and locking retainer.

The mixer impeller shall be fixed to, and supported by, a vertical shaft from the underside of the gearbox.

M13.4 Dimensions

The dimensions of s0ump shown on the drawings may be summarised as follows:

Sump	
Width x length x depth	3 m x 3.85 m x 2.8 m
Approx. volume of fluid	32.34 cubic metres
Number of mixers	One

M13.5 Motors for the Mixers

Each mixer shall be driven by a fully enclosed, IP 65, weatherproof electric motor. The motor shall be mounted on the gearbox.

A motor size shall be 1.1 kW for mixers this is indicative and Tenderers shall offer motors to suit the mixers offered in the tender. The motors shall be continuously rated to run the mixer and sized to meet the specified maximum power requirement of the mixer with the requisite motor power margin rating.

The motors shall comply with the electrical specifications forming part of this document.

A non-corrosive GRP weatherproof cover as shall be supplied and installed over the motor.

M13.6 Base Plates

The mixer gearbox shall be mounted on a robust base plate manufactured from 3CR12/Grade 304 stainless steel or equivalent . Suitable stiffening of the base plate shall be provided where necessary. The base plates shall be supported on the concrete platform by Grade 304 stainless steel jacking bolts. Pockets will be provided for grouting in of the jacking bolts after final alignment and levelling by the Contractor. A minimum of 50 mm vertical adjustment in either direction from mean level must be provided.

M13.7 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M13.8 Testing of the Mixers

Performance testing shall be carried out by the Contractor after commissioning and adjustment and once the plant has been commissioned and the tank is full of liquid.

The tests shall comprise but not limited to:

- Smooth and efficient operation of the mixers.
- Vibration analysis using calibrated portable equipment complying with ISO 10816 standard specification for general mechanical engineering.

- Measurement of absorbed power by each mixer impeller using a calibrated kW/hour meter and calculation of efficiency.
- Mixing tests shall consist of taking a minimum of six samples at random points close to the surface and from the bottom of the tank within five minutes. Analyses of these samples for suspended solids concentration shall be carried out by a suitable laboratory and the average concentration calculated. The suspended solids concentration of any one sample may not differ from this average by more than 200 mg/l.

If the equipment does not pass the mixing tests, two retests will be permitted and if the equipment still does not perform correctly, the faulty mixers shall be replaced, and the testing procedure repeated until the equipment performs correctly.

M13.9 Control of the Mixers

This clause describes the manner in which the mixers will operate and details the required control and protection functions of the plant. The Tenderer shall study this Clause in conjunction with the whole specification and the tender drawings and shall be deemed to have included allowance in his tender price to cover the provision of everything necessary for the proper functioning of the plant whether such things are specifically scheduled as separate items in the Bill of Quantities or not.

All the necessary controls for the mixers are to be housed in the proposed switchboard to be supplied under this Contract and more fully described elsewhere. The prices tendered are to include for all the necessary cabling between the switchboard and the mixers and for a local isolator at each motor.

M13.10 Operator Facilities

The electrical controls and electronic instruments which are to be supplied and installed under this Contract are specified in the Electrical and Instrumentation section of this document. The following is the minimum requirements that must be provided for each mixer:

- PLC & HMI
- Auto/Off/Manual selector
- Method of setting and changing the Auto run parameters e.g. on/off timers and/or speed
- Start/Stop for Manual mode
- Running/Stopped indication
- Cumulative hours run of each mixer
- Supply voltage per phase
- Amps per phase drawn by each motor
- Temperature sensing devices for motor windings
- Motor winding overheated trip with reset facility
- Motor anti-condensation heater on/off.
- A serial interface between the PLC and the Employer's Telemetry Base Station if the Client wants telemetry.

M13.11 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

M14 CENTRIFUGE WASH WATER PUMPS AND TANK

M14.1 General

This specification must be read in conjunction with the Mechanical Standard Specification.

The drawings accompanying this document show the position of the proposed equipment. The drawings applicable to this pump and tank installation are drawing number MD5775-RHD-BR-FB-DR-C-1303 and MD5775-RHD-BR-FB-DR-C-1304.

All the necessary controls for the pumps are to be housed in the panels to be supplied and installed under other sections of this Contract and are fully described elsewhere. The prices tendered are to include for the complete installations including all necessary power and control cabling between the panels and the pumps and motors all of which are described and scheduled elsewhere.

The prices tendered are to include for the complete installation and shall include for the detailed designs and preparation of drawings for verification by the Employer's Agent, factory testing, installation, commissioning and site testing.

M14.2 Scope

This section of the Contract covers the following:

Design, supply, installation of wash water pumps and tank, testing, and commissioning of the pumps, tank and delivery pipework and valves which may be briefly described as follows:

- Two identical pumps with electric motor and with a duty point of 66.19 l/s x 25.65 m.
- One 5000 L tank (Jojo).

M14.3 Pumping Plant

The fluid to be pumped is wash water,

The pumps shall be of single stage centrifugal type suitable for pumping the above-mentioned fluid. Each pump shall be direct coupled motor running at a speed not exceeding 2960 rpm.

The pumps shall have non-clogging impellers capable of passing wash water.

OR

The pumps shall have non-clogging, fully recessed, impellers and shall be capable of passing return water.

The pumps must have suitably rated mechanical seals to seal the motor. The seals shall be located in an oil chamber and the pump shall have a seal monitoring system to give warning of any malfunction.

Bearings shall be of the grease lubricated, sealed-for-life type and shall be capable of taking the static weight of the rotating parts and any other loads produced by the operation of the pump.

M14.4 Materials

The Tenderer is to provide details in a covering letter accompanying his/her tender of various alternative materials, estimated running hour life and prices relevant to this aspect of pump selection.

M14.5 Duty Point of the Pumps

The pumps shall be capable of continuous operation pumping water from tank to centrifuges.

M14.6 Cooling Requirement of the Pumps

From the above clause, the pumps will be required to operate for protracted periods under varying conditions. Tenderers are to make provision for cooling mechanisms on the motors if deemed necessary and are to confirm that the pumps offered are suitable for use under those conditions.

M14.7 Method of Installation

Each of the pumps are mounted on their own base frames. The motors driving the pumps shall be directly coupled to the pump drive shafts. The drive motors, gearboxes, cooling and lubrication units and all other ancillaries shall be mounted on the common base frames of the pump.

The pump casings shall be as per the manufacturer's standard supply and shall be selected to accommodate the required working pressure and pump life expectancy.

An integrally cast or permanently attached metal plate with a direction of rotation arrow.

M14.8 Factory Testing of the Pumps

Items have been included in the Bills of Quantities to enable Tenderers to submit separate prices for factory hydraulic testing and factory performance testing of the pumps.

M14.9 Motors for the Pumps

The supplier to size the suitable motor that will be capable of supplying suitable wash water to centrifuge.

M14.10 Delivery Pipework and Valves

No responsibility is accepted for any dimensions shown on the drawings as the Contractor will be required to design suitable pipework and valve configurations for verification by the Employer's Agent prior to fabrication. Notwithstanding that the pipework that is required is shown on the drawings and is briefly described below, the Contractor will be required to design and supply and install all pipes, valves, and fittings required for the complete installation.

The factory test pressures required on the valves shall be 1,5 x PN for the gate (open end) and 2,0 x PN for the body. The valves shall be capable of being opened and closed by one person against an unbalanced head of no less than 1000 kPa.

M14.11 Corrosion Protection

All components shall be protected against corrosion as specified in the Mechanical Standard Specification.

M14.12 Hydraulic Pressure Testing & Painting

On completion of the installation, the pumps' delivery pipework, valves and fittings shall be hydrostatically tested to 1 500 kPa.

All pipework and valves shall receive two coats of gloss enamel after commissioning and prior to handing over.

M14.13 Pressure Gauges

The range of the gauges shall be as specified in the Bill of quantities and/ applicable drawings. Each pressure gauge is to be equipped with a diaphragm to prevent the ingress of solids into the gauge.

M14.13 Control of the Pumps

The control system for the pumps shall be reliable and provide appropriate protection also in the event of power failure. Precise level meters shall be installed on tank to control the sequence of operation of the pumps. Details thereof are given in the instrumentation section.

The pumps are to be electrically interlocked (both in "Manual" mode and in "Auto" mode to prevent pumps from starting simultaneously.

M14.14 Operator Facilities

The electrical controls and electronic instruments which are to be supplied and installed under this Contract are specified in the Electrical and Instrumentation section of this document and include the following for the operator:

- PLC & HMI
- Duty pump selection
- Auto/Off/Manual selector
- Start/stop for Manual mode for each pump
- Running/Stopped indication for each pump
- Number of starts counter for each pump - resettable
- Number of starts counter for each pump - non-resettable
- Cumulative hours run of each pump
- No-flow trip with reset facility
- Supply voltage per phase
- Amps drawn by each motor
- A serial interface between the pump PLC and the Employer's Telemetry Base Station.

M14.15 Spares

A list of the manufacturer's recommended spares and consumables for a maintenance period of three years is to be provided in the technical data sheet.

TECHNICAL DATA SHEET No 1: M1 – VORTEX DEGRITTER

Item		Tenderer to Complete
Location	Before Balancing tank	
Feed type	Wastewater	
Number of degritters required	2	
Operation Arrangement	Duty/standby	
Total incoming flow	67.5 l/s	
Grit separation efficiency	90 %	
Grit concentration	2 %	
Minimum flow velocity	1.2 m/s	
Particle size (max)	0.8 mm	
Manufacturer	*	
Place of manufacture	*	
Type/model No	*	
Material	*	
Number of paddles required on each	*	
Vertical shaft material	*	
Vertical shaft diameter	*	
Rotational speed	*	
Motor:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Rated output power - indicative rating given but a different rating may be offered to suit the mixers offered	1 kW	
Frame size	*	
Weatherproof rating	IP 65	
Motor efficiency class	*	
Rated maximum speed	*	
Direct on line starting current	*	
Full load current	*	
Power factor	*	
Gearbox:	*	
Manufacturer	*	
Place of Manufacture	*	
Type/model No	*	
AGMA Rating	*	
Thermal rating	*	
Output speed	*	

Item		Tenderer to Complete
Maximum torque capacity	*	
Efficiency at motor rating	*	
Service factor on max power absorbed	2,00	
Service factor on installed power	1,75	
Method of lubrication	*	
Overall Degritter Assembly:	*	
Will degritters fit into allocated space shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	Yes/No	
Drawing Nos of the drawings supplied by Tenderer with the tender		
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

*** Tenderer to provide**

The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.

SIGNATURE: ..... **DATE:** .....….....
(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No 2: M2 – BALANCING TANK VERTICAL MIXERS

Item		Tenderer to Complete
Location	Balancing tank	
Number of mixers required	3	
Volume of fluid to be mixed per tank 1, 2 &3	235 m^3	
Incoming flow	67.5 l/s	
Height of mixer platform from floor of tank	6.25 m	
Height of mixer platform from top water level in tank	1.7 m	
Depth of water in tank	4.57m	
Manufacturer	*	
Place of manufacture	*	
Type/model No	*	
Base plate material	*	
Vertical shaft material	*	
Impeller material	*	
Impeller diameter	*	
Vertical shaft diameter	*	
Rotational speed	*	
Power absorbed by mixer impeller	*	
Motor:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Rated output power - indicative rating given but a different rating may be offered to suit the mixers offered	2.2 kW	
Frame size	*	
Weatherproof rating	*	
Motor efficiency class	*	
Rated maximum speed	*	
Direct on line starting current	*	
Full load current	*	
Power factor	*	
Gearbox:		
Manufacturer	*	
Place of Manufacture	*	
Type/model No	*	
AGMA Rating	*	
Thermal rating	*	
Output speed	*	
Maximum torque capacity	*	
Efficiency at motor rating	*	

Item		Tenderer to Complete
Service factor on max power absorbed	*	
Service factor on installed power	*	
Method of lubrication	*	
Overall Mixer Assembly:		
Will mixers fit into the balancing tank shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	Yes/No	
Drawing Nos of the drawings supplied by Tenderer with the tender		
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

***Tenderer to provide**

The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.

SIGNATURE: ..... **DATE:** .....…….....
(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No 3: M3 – POLY DOSING SYSTEM

Item		Tenderer to Complete
Location	Polymer system	
Thickener feed flow	67.5 l/s	
Centrifuge feed flow	6.55 l/s	
Dosing rate (maximum)	5 mg/l	
Poly Dosing System:	*	
Manufacturer	*	
Place of manufacture	*	
Type/model No	*	
Material	*	
Poly Dosing Pumps:	*	
Contractual duty points	*	
Number of pumps required	4	
Fluid to be pumped	Polymer	
Type of pump	*	
Manufacturer	*	
Place of manufacture	*	
Make /type/model No	*	
Operating speed of pump	*	
Flow Rate	*	
Head	*	
Pump efficiency at duty Point	*	
NPSH requirement at duty point	*	
Maximum size of solids which can pass through the pump in normal operation:	*	
Suction inlet	*	
Delivery outlet	*	
Material	*	
Motors:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Rated output power - indicative rating given but a different rating may be offered to suit the system offered	0.08 kW	
Frame size	*	
Weatherproof rating	*	
Motor efficiency class	*	
Rated maximum speed	*	
Direct on line starting current	*	
Full load current	*	
Power factor	*	

Item		Tenderer to Complete
Drawings:		
Will dosing system fit into allocated space shown on the tender Drawings	Yes/No	
Overall system assembly	Yes/No	
Pump characteristics (Efficiency & Power drawn versus Q)	*	
Drawing Nos of the drawings supplied by Tenderer with the tender	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

***Tenderer to provide**

The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.

SIGNATURE: ..... **DATE:** .....….....

(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No 4: M4 – THICKENER BRIDGE

Item		Tenderer to Complete
Location	Thickener	
No of Gravity Thickeners	1	
Incoming flow	67.5 l/s	
Diameter	15. m	
Design upflow Rate	1.4 m/hr	
Area	191.1 m^2	
Water depth at outer wall - floor to overflow	4m	
Slope of floor	7 degs	
Influent Baffle diameter (m)	*	
Influent baffle depth (m)	*	
Influent bafle material	*	
Thickener Bridge:		
Manufacturer	*	
Place of manufacture	*	
Bridge Length	*	
Material of bridge		
Scrapper and picket fence Material (under water)	Stainless	
Number of scrapper arms		
Floor scrapper material		
Picket fence rotational speed (rpm)		
Overflow weir material	304 stainless Steel	
Drive Unit :		
Manufacturer	*	
Place of Manufacture	*	
Drive Unit Rated output power -	*	
Drive unit gearbox and manufacture and model	*	
Weatherproof rating (IP)	*	
Rated maximum speed	*	

Item		**Tenderer to Complete**
Drawing Nos of the drawings supplied by Tenderer with the tender	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

*** Tenderer to provide**

The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.

SIGNATURE: ..... **DATE:** .....….....
(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No 5: M5 – THICKENED SLUDGE CENTRIFUGE FEED PUMPS

Item		Tenderer To Complete
Location	Sludge Sump	
Pumps:		
Average Pumping rate	23.6m^3/hr	
Maximum Pumping Rate	40.47m^3/hr	
Static head	9m	
Number of pumps required	2	
Offered Duty	*	
Fluid to be pumped	Thickened waterworks Sludge	
Type of pump	Progressive cavity	
Manufacturer	*	
Place of manufacture	*	
Make /type/model No	*	
Operating speed of pump	To no more than 2960 rpm	
Pump efficiency at duty Point	*	
NPSH requirement at duty point	*	
Maximum size of solids which can pass through the pump in normal operation:	*	
Sludge solids concentration	4 % to maximum 6%	
Suction inlet	*	
Discharge outlet	*	
Materials of construction		
Pump casting	*	
Rotor	*	
Stator	*	
Motor:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Rated output power	*	
Frame size	*	

Item		Tenderer To Complete
Mass of fully assembled motor	*	
Confirm integrally cooled	State Yes/No	
Maximum allowable ambient temperature to prevent overheating	*	
Weatherproof rating (IP)	*	
Motor efficiency class	*	
Rated maximum speed	*	
Direct on line starting current	*	
Full load current	*	
At full load	*	
At 3/4 load	*	
At 1/2 load	*	
Slip at full load % of synchronous speed.	*	
Starting torque in star as a % full load torque.	*	
Starting current in star as % of full load current.	*	
Power drawn from electricity supply at pump duty point	*	
Drawings:		
Drawing Nos of the drawings supplied by Tenderer with the tender:	*	
Pump assembly	*	
Pump characteristics (Efficiency & Power drawn versus Q)		

SIGNATURE: ..... **DATE:** .....….....
(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No 6: M6 - CENTRIFUGE

Item		Tenderer to Complete
Location		
	Waterworks thickened Sludge	
Number of centrifuges required	2	
Operational Arrangement	Duty/ Assist	
Centrifuge feed flow range	23 to 41 m^3/hr	
Feed solids concentration	4 to 6 %	
Recovery percentage	95 %	
Centrifuge velocity	*	
Manufacturer	*	
Place of manufacture	*	
Type/model No	*	
Length	*	
Width	*	
Height	*	
Maximum Weight	*	
Manufacture Materials		
Bowl Material	Stainless Steel	
Case material	Stainless Steel	
Frame Material	*	
Conveyor Material	Stainless Steel	
Inlet tube	Stainless Steel	
Outlets	Stainless Steel	
Rotational speed	*	
Drive Motors:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Main drive size	*	
Back Drive Size	*	
Main Drive Control	*	
Back Drive Control	*	
Weatherproof rating	*	
Motor efficiency class	*	
Rated maximum speed	*	

Item		Tenderer to Complete
Gearbox:		
Manufacturer	*	
Place of Manufacture	*	
Type/model No	*	
AGMA Rating	*	
Thermal rating	*	
Output speed	*	
Maximum torque capacity	*	
Efficiency at motor rating	*	
Service factor on max power absorbed	*	
Service factor on installed power	*	
Method of lubrication	*	
Overall Centrifuge Assembly:		
Will centrifuge fit into allocated space shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	Yes/No	
Drawing Nos of the drawings supplied by Tenderer with the tender		
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

*** Tenderer to provide**

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(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No 7: M7 – RETURN FLOW PUMPS

Item		Tenderer To Complete
Location	Return flow sump	
Pumps:		
Contractual duty point	66.19l /s x 25.65m head	
Number of pumps required	2	
Operational Arrangement	Duty and standby	
Fluid to be pumped	Raw water	
Manufacturer	*	
Place of manufacture	*	
Make /type/model No	*	
Motor Operating speed	1500 rpm	
Pump efficiency at duty Point	*	
Maximum size of solids which can pass through the pump in normal operation:	*	
Suction inlet	*	
Delivery outlet	*	
Materials of construction		
Pump housing	Cast iron EN-GJL-250 ASTM class 35	
Impeller	Cast iron EN-GJL-200 ASTM class 3	
shaft	Stainless steel EN 1.4301 AISI 304	
Fasteners	*	
Motor:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Rated output power (indicative rating given as 30 kW but a different rating may be offered provided there is always the specified minimum margin at the run out point	30 KW	
Frame size	*	
Mass of fully assembled motor	*	

Item		Tenderer To Complete
Confirm integrally cooled	State Yes/No	
Maximum allowable ambient temperature to prevent overheating	*	
Weatherproof rating (IP)	*	
Motor efficiency class		
Rated maximum speed	2960 rpm	
Power drawn from electricity supply at pump duty point	*	
Drawings:		
Drawing Nos of the drawings supplied by Tenderer with the tender:	*	
Pump assembly	*	
Pump characteristics (Efficiency & Power drawn versus Q)	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

***Tenderer to provide**

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TECHNICAL DATA SHEET No 8: M8 – AIR BLOWER

Item		Tenderer To Complete
Location		
Number of air blowers required	2	
Flow rate per air blower	*	
Manufacturer	*	
Place of manufacture	*	
Type/model No	*	
Air blower unit material	*	
Impeller material	*	
Impeller diameter	*	
Rotational speed	*	
Motor:		
Manufacturer	*	
Place of Manufacture	*	
Rated output power - indicative rating given but a different rating may be offered to suit the air blowers offered	22 kW	
Frame size	*	
Weatherproof rating	*	
Motor efficiency class	*	
Rated maximum speed	*	
Direct on line starting current	*	
Full load current	*	
Power factor	*	
Gearbox:		
Manufacturer	*	
Place of Manufacture	*	
Type/model No	*	
AGMA Rating	*	
Thermal rating	*	
Output speed	*	
Maximum torque capacity	*	
Efficiency at motor rating	*	
Service factor on max power absorbed	*	
Service factor on installed power	*	
Method of lubrication	*	

Item		Tenderer To Complete
Air blower assembly:		
Will blower fit into the system shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	*	
Drawing Nos of the drawings supplied by Tenderer with the tender	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:		
	Qty	Cost (not to be included in tender price)

***Tenderer to provide**

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TECHNICAL DATA SHEET No 9: M9 – FLASH MIXERS

Item		Tenderer To Complete
Location		
Number of mixers required	2	
Total volume of fluid to be mixed	*	
Distance from top to floor of tank	*	
Manufacturer	*	
Place of manufacture	*	
Type/model No	*	
Vertical shaft material	*	
Impeller material	*	
Impeller diameter	*	
Vertical shaft diameter	*	
Rotational speed	*	
Power absorbed by mixer impeller	*	
Motor:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Rated output power - indicative rating given but a different rating may be offered to suit the mixers offered	1.1 kW	
Frame size	*	
Weatherproof rating	*	
Motor efficiency class	*	
Rated maximum speed	*	
Direct on line starting current	*	
Full load current	*	
Power factor	*	
Gearbox:		
Manufacturer	*	
Place of Manufacture	*	
Type/model No	*	
AGMA Rating	*	
Thermal rating	*	
Output speed	*	
Maximum torque capacity	*	
Efficiency at motor rating	*	
Service factor on max power absorbed	*	
Service factor on installed power	*	
Method of lubrication	*	

Item		Tenderer To Complete
Overall Flash Mixer Assembly:		
Will Flash mixers fit into the tank shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	Yes/No	
Drawing Nos of the drawings supplied by Tenderer with the tender	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

***Tenderer to provide**

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TECHNICAL DATA SHEET No 10: M10 – CENTRIFUGE LIFTING EQUIPMENT

Item		Tenderer to Complete
Location of Equipment		
Manufacturer	*	
Place of manufacture	*	
Quantity No.	1	
Equipment to be lifted	Centrifuges	
Technical		
Type	EOT Crane	
Lifting capacity (safe working load)	*	
Lifting height required	*	
Crane span	*	
Travel	*	
Hoist speed	*	
Cross travel speed	*	
Hook type	*	
Rope /Chain	*	
Long travel speed	*	
Main hoist power	*	
Cross travel	*	
Long travel	*	
IP protection	*	
Materials of construction		
Hoist	*	
Chain	*	
Overall Assembly:		
Overall dimensions L x W x H	*	
Will structure fit into allocated space shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	Yes/No	
Drawing Nos of the drawings supplied by Tenderer with the tender	*	

Item		Tenderer to Complete
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

***Tenderer to provide**

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TECHNICAL DATA SHEET No 11: M11 – RETURN WATER PUMP HOIST

Item		Tenderer To Complete
Location of Equipment	Return Water Pumps	
Manufacturer	*	
Place of manufacture	*	
Quantity No.	1	
Equipment to be lifted	Pumps	
Technical		
Type	Manual lifting hoist	
Lifting Capacity	*	
Rope /Chain	Chain	
Chain Reach	*	
Materials of construction		
Hoist	*	
Chain	*	
Overall Assembly:		
Will structure fit into allocated space shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	Yes/No	
Drawing Nos of the drawings supplied by Tenderer with the tender	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)
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TECHNICAL DATA SHEET No 12: M12 – THICKENED SLUDGE CENTRIFUGE FEED PUMP HOIST

Item		Tenderer To Complete
Location of Equipment		
Manufacturer	*	
Place of manufacture	*	
Quantity No.	1	
Equipment to be lifted	Pumps	
Technical		
Type	Manual lifting hoist	
Lifting Capacity	TBA	
Rope /Chain	Chain	
Chain Reach	TBA	
Materials of construction		
Hoist	*	
Chain	*	
Overall Assembly:		
Will structure fit into allocated space shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	Yes/No	
Drawing Nos of the drawings supplied by Tenderer with the tender	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

Tenderer to provide

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TECHNICAL DATA SHEET No 13: M13 – THICKENED SLUDGE MIXER

Item		Tenderer to Complete
Location	Thickened Sludge sump	
Number of mixers required	One	
Total volume of fluid to be mixed	32.3 m^3	
Incoming flow	6.55 l/s	
Distance from top to floor of sump	2.8 m	
Manufacturer	*	
Place of manufacture	*	
Type/model No	*	
Base plate material	*	
Vertical shaft material	*	
Impeller material	*	
Impeller diameter	*	
Vertical shaft diameter	*	
Rotational speed	*	
Power absorbed by mixer impeller	*	
Motor:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Rated output power - indicative rating given but a different rating may be offered to suit the mixers offered	1.1 kW	
Frame size	*	
Weatherproof rating	*	
Motor efficiency class	*	
Rated maximum speed	*	
Direct on line starting current	*	
Full load current	*	
Power factor	*	
Gearbox:		
Manufacturer	*	
Place of Manufacture	*	
Type/model No	*	
AGMA Rating	*	
Thermal rating	*	
Output speed	*	
Maximum torque capacity	*	
Efficiency at motor rating	*	
Service factor on max power absorbed	*	

Item		Tenderer to Complete
Service factor on installed power	*	
Method of lubrication	*	
Overall Mixer Assembly:		
Will mixers fit into the balancing tank shown on the tender Drawings	Yes/No	
If not, details of required changes are to be shown on drawings submitted with the tender – are drawings included with the tender	Yes/No	
Drawing Nos of the drawings supplied by Tenderer with the tender	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

***Tenderer to provide**

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TECHNICAL DATA SHEET No 14: M14 – CENTRIFUGE WASH WATER PUMPS AND TANK

Item		Tenderer To Complete
Location		
Tank :		
Capacity	5000 l	
Material	Polyethylene	
Pumps:		
Contractual duty point	*	
Number of pumps required	2	
Fluid to be pumped	water	
Type of pump	*	
Manufacturer	*	
Place of manufacture	*	
Make /type/model No	*	
Operating speed of pump	*	
Pump efficiency at duty Point	*	
NPSH requirement at duty point	*	
Maximum size of solids which can pass through the pump in normal operation:	*	
Suction inlet	*	
Delivery outlet	*	
Materials of construction		
Pump housing	*	
Impeller	*	
shaft	*	
Fasteners	*	
Motor:		
Manufacturer	*	
Place of Manufacture	*	
Type Insulation (Class) and temperature Rise Class	*	
Rated output power (indicative rating given as 30 kW but a different rating may be offered provided there is always the specified minimum margin at the run out point	*	

Item		Tenderer To Complete
Frame size	*	
Mass of fully assembled motor	*	
Confirm integrally cooled	State Yes/No	
Maximum allowable ambient temperature to prevent overheating	*	
Weatherproof rating (IP)	*	
Motor efficiency class	*	
Rated maximum speed	2960 rpm	
Direct on line starting current	*	
Full load current	*	
At full load	*	
At 3/4 load	*	
At 1/2 load	*	
Slip at full load % of synchronous speed.	*	
Starting torque in star as a % full load torque.	*	
Starting current in star as % of full load current.	*	
Power drawn from electricity supply at pump duty point	*	
Drawings:		
Drawing Nos of the drawings supplied by Tenderer with the tender:	*	
Pump assembly	*	
Pump characteristics (Efficiency & Power drawn versus Q)	*	
List of spares and consumables recommended by the manufacturer for maintenance for a 3 year period:	Qty	Cost (not to be included in tender price)

***Tenderer to provide**

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C3.12: ELECTRICAL PROJECT SPECIFICATIONS

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ELECTRICAL PROJECT SPECIFICATION

C3.12.1 SCOPE

The electrical work to be carried out by the Contractor under the Contract includes the design, manufacture, supply, temporary storage if necessary, delivery, installation, testing, commissioning and handing over in proper working order complete installation as described in all the constituent parts of this document.

The Contractor will be responsible for repairing any existing equipment damaged by his/her employees or sub-contractors at his/her own cost.

This standard technical specification prescribes the standard of workmanship and quality of material required for the services installations as described in the Project Specification, and Schedules and/or shown on the Drawings.

Should there be any conflict between the electrical Project Specification(s) and this standard specification, the electrical Project Specification takes precedence. In the event of there being a discrepancy between any specification and/or a drawing(s) and/or the Bills of Quantities, the discrepancy must be drawn to the attention of, and resolved by, the Employer's Agent before the execution of any work associated with the discrepancy.

C3.12.2 ELECTRICAL CONNECTION

The existing WTW is supplied with electricity from an existing Eskom installation. Provision for the new MCC 3 has been made in the existing DB in the recent expansion of the WTW.

C3.12.3 ALTERNATIVE POWER SUPPLIES

C3.12.3.1 Standby Generator

An existing 800kVa outdoor standby diesel generator is provided at the WTW. This generator serves the entire WTW.

C3.12.3.2 Low Voltage System

Motor Control Centre

A new MCC 3 will be provided for the operation and control of the pumps and equipment within the scope of works of this project.

A PLC will be provided for the automation and control of the equipment where required and the information will be relayed to and integrated with the Existing SCADA system in the central control room.

C3.12.3.3 Field Control Stations

Field control stations will be provided locally at the pumps and equipment for local manual starting and stopping and for maintenance purposes, however it is envisioned that the normal operation will be from the new MCC 3.

C3.12.3.4 LV, Control and Instrumentation Cabling

LV, control and instrumentation cabling will be installed from the new MCC 3 to the associated equipment on the WTW and will be buried underground in coordination with the other services. Buried cable routes will be clearly marked by means of concrete cable markers

C3.12.3.5 Harmonic Filtering

Harmonic filters will be installed for all VSD's.

C3.12.3.6 Control and Instrumentation

Instrumentation and control equipment shall be supplied as required by the operation and control philosophy.

C3.12.4 DEFINITIONS

"Extra low voltage" means voltages of 50 V or less.
"Low voltage" means voltages not exceeding 1 000 V.
"Medium voltage" means voltages exceeding 1 000 V.
"Isolator" means "switch-disconnector".
"Main Switch" means *"main disconnector"* or *"local disconnector"*, as applicable.
"Supply" means purchase, procure, acquire, store off site as necessary, deliver to site, and off load, position, stack and store on site.
"Install" means set out, erect, mount, align, fix, connect, adjust, test and commission and hand over in proper working order.
"Provide" means supply and install.
"Installation" means the electrical installation covered by this this contract.
"Approved" means acceptable to the Employer in the sole opinion of the Employer's Agent.
"Relevant Codes and Specifications" refers to those listed in the below and the normative references listed in SANS 10142, as applicable.

C3.12.5 COMPLIANCE WITH REGULATIONS AND STANDARDS

The electrical installation shall comply with the latest revisions and amendments of the South African Bureau of Standards Code of Practice for the Wiring of Premises, SANS 10142, referred to herein as the "Wiring Code".

The Contractor shall comply with the requirements of the Occupational Health and Safety Act (Act No 85 of 1993 as amended) and the Regulations pertaining thereto and will be required to ensure the safe operation and the safety of all people on site and proper management of the works.

The Contractor shall be registered with the Electrical Contracting Association of South Africa (ECASA) and shall comply with:

- The Local Authority's By-laws and Regulations and any regulations of the Power Supply Authority.
- The Local Authority's fire codes and regulations if and where applicable.
- The relevant codes and specifications.
- The regulations of the gas supplier if and where applicable.
- The standard regulations of any Government Department or other statutory body where applicable.

All the equipment and materials shall conform to the relevant SANS, NRS, or IEC Specifications and the latest revisions thereof, where applicable. For equipment and materials not covered by the following table, reference shall be made to the list of normative references in SANS 10142.

Description		SANS
1.	**SWITCHGEAR AND CONTROL GEAR**	
1.1	High-voltage switchgear and control gear Part 102: Alternating current disconnectors and earthing switches	62271-102
1.2	A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV	62271-200
1.3	HV a.c. switch-fuse combinations	62271-105
1.4	HV a.c. contactors and contactor-based motor starters	62271-106
1.5	Common specifications for HV switchgear and controlgear standards	62271-1
1.6	A.C. insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	62271-201
1.7	HV a.c. circuit breakers	62271-100
1.8	Metal-clad switchgear for rated voltages above 1 kV and up to and including 36 kV	1885
1.9	Moulded-case circuit breakers	156
1.10	Low-voltage switchgear and controlgear assemblies Part 0: Guidance to specifying assemblies	61439-0
1.11	Low-voltage switchgear and controlgear assemblies Part 1: General rules	61439-1
	Low-voltage switchgear and controlgear assemblies Part 2: Power switchgear and controlgear assemblies	61439-1
1.12	Low-voltage switchgear and controlgear assemblies - Part 3: Distribution boards intended to be operated by ordinary persons (DBO)	61439-3
1.13	Low-voltage switchgear and controlgear assemblies - Part 4: Particular requirements for assemblies for construction sites (ACS)	61439-4
1.14	Low-voltage switchgear and controlgear assemblies - Part 5: Assemblies for power distribution in public networks	61439-5
1.15	Low-voltage switchgear and controlgear assemblies Part 6: Busbar trunking systems (busways)	61439-6
1.16	Low-voltage switchgear and controlgear assemblies - Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations	61439-7
1.17	LV switchgear and controlgear - Part 1 : General Rules	60947-2

Description		SANS
1.18	LV switchgear and controlgear - Part 2 : Circuit breakers	60947-2
1.19	LV switchgear and controlgear - Part 3 : Switches, disconnectors, switch-disconnectors and fuse-combination units	60947-3
1.20	LV switchgear and controlgear:	
	Part 4 - 1 : Contactors and motor starters (electro-mechanical)	60947-4-1
	Part 4 - 2 : Contactors and motor starters (semi-conductor)	60947-4-2
	Part 5-1 : Electromechanical control circuit devices	60947-5-1
	Part 5 - 2 : Proximity switches	60947-5-2
	Part 5 - 5 : Electrical emergency stop device with mechanical latching function	60947-5-5
	Part 6 - 1 : Automatic transfer switching equipment	60947-6-1
1.21	Earth-leakage protection units - Part 1 : Fixed earth-leakage protection circuit breakers	767-1
1.22	RCCBs without integral overcurrent protection for household and similar use - Part 1 : General rules	61008-1
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C3.12.6 BUILDING AND CASTING IN

The Contractor will be responsible for placing in position all wireways, conduits, conduit boxes, etc., for the civil / building contractor to build in or cast in, attend to the that contractor during building-in or casting-in, and ensure firm fixings accurate positioning.

The Contractor may chase only where it is impractical to build or cast-in. No face-brick or finished surface may be chased without the permission of the Employer's Agent and the civil / building contractor. No structural concrete may be chased without the permission of the Employer's Agent and the civil / building contractor.

C3.12.7 DRAWINGS, MANUALS, LITERATURE, TUITION, SPARES AND TOOLS

The Employer's Agent's drawings covering the various sections of the installation are listed elsewhere. The working drawings shall, however, consist of the following, where applicable:

- The Employer's Agent's drawings
- The Architect's drawings
- The Structural Engineer's drawings
- The drawings of other services installations that are relevant for co-ordination and installation

Unless otherwise specified, three sets of the Employer's Agent's drawings will be issued to the Contractor for construction purposes. If required, additional copies may be purchased from the Employer's Agent.

The Contractor shall submit two copies of each shop drawings to the Employer's Agent for examination and to demonstrate compliance with the Contract. Shop drawings shall include drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, manufacturer, supplier or distributor and which illustrate some portion of the work.

The Employer's Agent's examination of shop drawings or samples shall not relieve the Contractor of responsibility for compliance with the requirements of this Contract unless the Contractor has informed the Employer's Agent in writing of such deviations at the time of submission of shop drawings or samples and the Employer's Agent has given written approval for the specific deviation. Furthermore, the Employer's Agent's examination of the shop drawings will not relieve the Contractor of responsibility for errors or omissions in the shop drawings or samples or for responsibility for erection or installation fit.

The Contractor shall submit to the Employer's Agent two copies of marked-up structural drawings, or other drawings, showing changes and/or additional requirements to be made in the structure in order to accommodate equipment that is to be installed under this Contract.

The Contractor will not be allowed to rely on the Employer's Agent for as-installed information which he/she may have compiled, to produce record drawings.

Drawings to be entitled "Record Drawing" shall bear the signature of the Contractor, or his authorised representative, and the date.

The Contractor shall obtain from the Employer's Agent, electronic copies of the drawings for the preparation of record drawings that are to be provided by the Contractor on completion of the Works. One set of the record drawings shall be submitted for verification by the Employer's Agent.

A set of final layout and schematic record drawings shall be provided in a purpose made holder inside the door of each distribution board and motor control centre, or where no doors are fitted, to the front plate of the cabinet. The frame shall be adequately sized to receive the equivalent of two A1 size drawings folded to a nominal size of A4.

For main boards, supply schematic drawings in aluminium picture frame with glass and sealed rear backing suitable for mounting against the substation wall shall be provided by the Contractor.

The Contractor shall submit to the Employer's Agent four manuals bound between hard covers which shall include the following:

- Dimensioned drawings of the layout of the equipment and systems.
- Wiring diagrams cross referred to the drawings described above, and to the Employer's Agent's layout and schematic drawings.
- All Test Certificates for tests done at the factories and on the site.
- System and equipment descriptions.
- Operating instructions.
- Maintenance, adjustment and calibration instructions with preventive maintenance schedule and fault-finding procedures.
- Spare parts list with names and address of component suppliers and price list of all components and a list of recommended spare components to be kept in stock.

The Contractor shall submit a preliminary copy of the manual to the Employer's Agent for scrutiny.

The Contractor shall provide thorough tuition of the Employer's staff in the operating and maintenance of the Works.

The Contractor shall allow in his price for the provision a set of digital photographs to be taken on monthly basis, for the duration of the Contract, of all the areas and equipment where the Contractor is involved. The photographs shall be properly dated with comments e.g, access to substation not possible etc. The set of the photographs shall be submitted to the Employer's Agent's Representative at the site meetings.

The Contractor shall provide a complete set of tools associated with equipment for each installation.

The Works will not be accepted until the manuals have been subject to the approval of the Employer's Agent and handed over to the Employer.

C3.12.8 TESTS AND INSPECTION

C3.12.8.1 Factory Tests and Inspections

The manufacturers shall perform all routine tests in their factory as described by SANS, IEC and/or BSS as well as the manufacturers' own standard routine tests on all materials, equipment and auxiliary equipment. Type tests shall be performed as described in the relevant equipment specifications.

The Contractor shall submit a list of tests and inspections to be performed on the equipment for approval.

The Contractor shall perform any additional standard tests that may be required by the Employer's Agent.

The Employer's Agent will indicate which tests are to be witnessed by a representative of the Employer and/or the Employer's Agent.

The Contractor shall submit four copies of the test certificates with the test results of all the tests performed to the Employer's Agent prior to the delivery of the equipment.

C3.12.8.2 Site Tests

The Contractor shall inspect and check the installations for compliance with the Wiring Code, the Regulations of the Supplier of Electricity and the Occupational Health and Safety Act and the Regulations pertaining thereto. Record of these checks shall be submitted to the Employer's Agent.

On completion of erection and installation on site, the Contractor shall perform all the tests that may be required to ensure that the Works are ready for handing over and putting into regular use.

Contractors shall provide their own test equipment which shall be of accepted standards.

The Contractor shall submit a list of tests and inspections to be performed on the equipment for approval.

The Contractor shall perform any additional standard test that may be required by the Employer's Agent.

All the tests shall be witnessed by a representative of the Employer's Agent and/or the Employer.

Four copies of site test certificates shall be submitted to the Employer's Agent within 7 days after completion of each test.

Testing of the electrical installations shall include the following and any other specific requirements specified elsewhere:

- Ensure correct polarity, phase rotation and load balance between the phases.
- Verify polarity and phase identification.
- Continuity and resistance of earth conductor including all bonding conductors.
- Continuity of ring circuit.
- Earth electrode resistance.
- Insulating resistance.
- Earth fault loop impedance test.
- Operation of earth leakage protection devices and circuit breakers.

After inspection and testing, timeously arrange for any inspection and test required by the Power Supply Authority to be carried out and provide assistance as necessary to the inspector by providing access, tools, instruments and attendance.

The Contractor shall:

- Submit a "Certificate of Compliance by an accredited person" Annexure 1 in terms of the Occupational Health and Safety Act 85/1993, Electrical Installation Regulation 1992, to the Employer and forward a copy to the Employer's Agent.
- Carry out additional special tests as required by the Employer's Agent and provide the required test equipment.
- Timeously advise the Employer's Agent of all inspections and tests as the Employer's Agent reserves the right to witness such inspections and tests.
- Provide access, tools, instruments and attendance, to assist the Employer's Agent who may perform verification tests at any time.

The Employer's Agent reserves the right to examine any part of the Works or materials intended for use in or on the Works at any time either on site, or at the place of manufacture or storage.

On completion of the works, the Contractor shall submit four indexed volumes of all test certificates to the Employer's Agent for tests done at factories and on site – these are to be included in the O&M manuals.

The Contractor will be responsible for calculating all relay settings and for submitting them to the Employer's Agent for approval at least 2 weeks before the commissioning of the works commences. The settings shall be substantiated by calculation sheets and graphs where applicable.

The Contractor shall check that all protection relays and overload devices are properly set to protect equipment such as motors, cables and capacitors etc., before the system is energised or any motors are switched on. Where overload devices are overrated or the ranges of relays insufficient to protect equipment, the Employer's Agent shall be informed and the equipment shall not be energised.

C3.12.8.3 Arrangements for Witnessing Tests

The Contractor shall make arrangements at least two weeks in advance with the Employer's Agent for factory and site tests to be witnessed.

C3.12.9 FIRE EXTINGUISHERS. FIRST AID KITS, DANGER AND INSTRUCTION SIGNS FOR SUBSTATIONS

C3.12.9.1 Fire Extinguishers

Unless otherwise specified, 5 kg type fire extinguishers or nearest standard sizes offered by manufacturers, shall be supplied.

Fire extinguishers shall be of the CO2 type or of a type suitable for the fighting of fires where electrical apparatus and oil fires are involved.

Unless otherwise specified, fire extinguishers shall be provided as follows:

- Medium voltage switch rooms: One extinguisher per 30 m² of floor area.
- Low voltage rooms: One per room.
- Transformer rooms: One per transformer.

Fire extinguishers shall be mounted on suitable wall mounted brackets and shall be installed next to exit doors wherever possible.

C3.12.9.2 First Aid Kits

Industrial type first aid kits as supplied by St John Ambulance or the Red Cross or the South African First Aid League, shall be provided for substation buildings.

The first aid kits shall be housed in suitable metal boxes with internal trays and metal lids.

The first aid kits shall be mounted on suitable wall mounted shelfs next to the substation main exit doors.

One first aid kit shall be provided for every substation building.

C3.12.9.3 Danger Signs and Notices

All outside doors of all substations and all substation yard entrance gates shall be provided with a sign showing a lightning strike.

Suitable notices prohibiting unauthorised persons from entering premises shall be provided on all doors and gates of substation buildings and yards.

The following notices shall be provided and mounted against walls inside substation buildings:

- A notice prohibiting unauthorised persons from handling or interfering with electrical apparatus.
- A notice containing directions as to resuscitation of persons suffering from the effects of electrical shock.
- A notice containing directions as to procedure in case of fire.

One set of notices called for above shall be provided and installed for each substation building

The notices shall be made from suitable plastic with engraved lettering and shall be displayed at a prominent position inside the buildings.

C3.12.10 MATERIALS

Materials and equipment shall, where possible, be of South African manufacture and shall comply with this specification and relevant SANS, BSI and IEC Specifications and shall be subject to the approval of the Employer's Agent.

The Contractor shall submit samples of all materials and equipment for examination by the Employer's Agent before installation, unless prior consent to the contrary has been obtained in writing from the Employer's Agent. Such samples will be held for comparison with equipment and materials installed and will be released on satisfactory completion of the Contract. Similar equipment and material shall be of the same manufacture and interchangeable and be standard products from established manufacturers.

Where a certain manufacturer's material or equipment is specified, listed in the Schedules or noted on the drawings, such materials or equipment shall be provided as specified, except where an alternative is allowed.

Where certain products of a specified manufacturer are unobtainable, substitutes may be offered, but may only be supplied after written consent by the Employer's Agent.

Where the words 'or approved alternative' follow a manufacturer's name and catalogue reference, the materials shall be of the specified manufacture and reference, or, if Contractor wishes to use a substitute the onus shall be on the Contractor to prove such substitute is equivalent to the specified manufacture and reference. The decision, as to the acceptance of such substitute, shall rest solely with the Employer's Agent, whose decision shall be final. If the Employer's Agent instructs the Contractor to

install the materials of the specified manufacture and reference, then no alteration to the Contract Sum or rates shall be permissible.

The Employer's Agent may instruct the Contractor to supply material or equipment and/or install any other make or manufacture of equipment than that specified and will issue variation orders where such change has cost implications.

Where a detailed specification for material or equipment is not provided, the Contractor shall select such material or equipment to comply with normal practice and to suit the particular application in all respects.

C3.12.11 FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT

C3.12.11.1 General

The Contractor shall select materials and their finishing to avoid corrosion.

Exterior applications within 50 km of the coast shall be deemed to be corrosive environments.

Aluminium shall be anodised to SANS 999 - 1986 Grade A for exterior and Grade B for interior applications.

Unless otherwise specified, the finish to steel shall be as follows:

C3.12.11.2 Interior Applications, and Non-Corrosive Exterior Applications

- Galvanise to SANS 121, or paint by preparing the surfaces to SANS 10064 and
- Prime with an approved primer of dry film thickness of 25 microns (minimum) and
- Apply two final coats of high gloss enamel paint to SANS 630 Grade 1, each coat of dry film thickness of 25 microns (minimum).

C3.12.11.3 Exterior Corrosive Applications

- Hot dip galvanise to SANS 121 and,
- Prime with an approved galvanised iron primer with a dry film thickness of 25 microns (minimum) and,
- Apply an undercoat to SANS 681 Type 2 and,
- Apply two final coats of high gloss enamel paint to SANS 630 Grade 1, each coat of dry film thickness of 25 microns (minimum).

Hot dip galvanising must be carried out after all fabrication. Damaged areas of hot dip galvanised surfaced shall be repaired by cleaning and abrading and applying zinc rich paint.

All unpainted steel shall be chromium-plated or similarly plated to approval.

Where required, aluminium surfaces are to be painted as follows:

- Thoroughly clean and apply a self-etch primer and
- Apply two final coats of high gloss enamel paint to SANS 630 Grade 1, each coat with a dry film thickness of 25 microns (minimum).

C3.12.11.4 Fixing of Materials

Luminaires, metal draw boxes on surface, industrial surface mounted switches and plugs, metal channels, wiring troughs or trays, cable trays, saddles, conduit accessories, brackets, braces, trunking and all other surface-mounted material and equipment shall be fixed as described below:

- Concrete (in situ) - expanding cast-in, or gun-bolted, metal screw-fasteners.
- Precast concrete - only with permission of the Employer's Agent.
- Brickwork - expanding, or built-in metal screw fasteners.
- Ash brick - "J bolts" or approved alternative.
- Steelwork - drilled, gun-bolted, or tapped and screwed metal screw fasteners; or steel gun-bolt nails or, where permitted by the Employer's Agent, welding.
- Woodwork - woodscrews, not nails.
- Hollow tiles - spring toggles of not less than 6 mm diameter, but only with permission from the Employer's Agent.
- Exposed to weather - solid brass or stainless-steel screw-fasteners.

Where any equipment or material is to be mounted on the surface of ceilings, false ceilings, dry wall partitions, gas-beton or other specialised surfaces, such equipment or material shall be fixed only as specified.

Where sizes of fasteners etc. are not specified, samples and proposals shall be submitted and will be subject to the Employer's Agent's approval.

Gun bolts into ash bricks, brickwork, gas-beton or precast concrete, may not be used except as may be authorised by the Employer's Agent.

Plastic plugs, wooden plugs or any other soft substance type plugs may not be used.

"Fischer", or approved alternative hard nylon plugs of not less than 6 mm diameter may be used for fixing light materials to suitable surfaces.

Plugs shall not be installed in mortar joints between bricks.

Suitable washers shall be provided under all screw heads and nuts.

All materials shall be installed in accordance with manufacturer's instructions and recommendations in all respects including type, size and spacing of fixings.

C3.12.12 ENCLOSURES FOR DISTRIBUTION BOARDS, MOTOR CONTROL CENTRES AND OTHER BUILDING SERVICES PANELS

C3.12.12.1 General

This specification covers sheet metal enclosures for distribution boards (DBs), motor control centres (MCCs) and panels for other building services such as telephone, fire detection and intruder alarm systems.

This specification must be read in conjunction with the following standard specifications to provide a complete specification for LV DBs and MCCs:

- LV switchgear and control gear
- Busbars
- Current transformers
- LV motor protection
- Wiring in DBs, MCCs and panels
- Wiring and cable terminations
- Glands and gland plates
- Switchboard accessories
- Nameplates and labels
- Metering and indication equipment

For MV MCCs, the following specifications must also be read in conjunction with this specification:

- MV disconnectors and earth switches
- MV contactors
- Voltage transformers
    - MV protection and relays

The Project Specification sets out which DBs, MCCs and panels are to be provided under the Contract.

MCCs and floor-standing distribution boards shall be Form 4A to SANS 61439.

Enclosures shall be completely vermin-proof and indoor enclosures shall have the following ingress protection:

- IP44 with doors closed
- IP2X with doors open
- IP2X between compartments.

Outdoor enclosures shall have IP65 ingress protection with doors closed.

Enclosures containing heat-generating equipment shall be ventilated to prevent thermal damage to any equipment, and to prevent the temperature within the cabinet from exceeding the maximum allowable temperatures of the equipment and materials in the enclosure.

Wood or artificial wood products shall not be used inside enclosures as mounting panels or for partitions, except where such a back panel for telephone and electronic building services is required.

Sufficient space shall be provided in enclosures for internal wiring, incoming and outgoing cabling, and cabling for any future circuits.

Whilst certain equipment may be installed abutting other equipment, undue cramping of wiring and equipment is not permitted. A minimum clearance of 75 mm shall be maintained between rows of equipment, and between equipment and the top, bottom and sides of compartments.

DIN rails shall be installed at least 125 mm apart between horizontal centres.

For the purposes of evaluating clearances and creepage distances, and hence the size of the enclosure and its compartments, the environment shall be taken as Pollution Degree 3.

C3.12.12.2 Construction of Floor-Mounted Enclosures

Material and Fabrication

The enclosure shall be fabricated from 3Cr12 sheet metal. Outer panels and doors shall be 2 mm thick and internal partitions 1,6 mm thick.

The sheet metal shall be suitably bent, braced and welded where necessary to form a rigid structure. Holes, doors, covers, rails, framework, etc. shall be accurately formed to provide a true and plumb structure when completed. Where welding is necessary the excess material shall be ground to the parent surfaces to present a smooth and blemish-free surface for painting.

All screws employed in the manufacture of the enclosures shall be Grade 316 stainless steel with machined threads. No self-threading screws or self-setting rivets (pop rivets) will be permitted. Where the thickness of material for screw tapping is less than 5 x screw pitch, an externally knurled, threaded insert shall be installed to accept the machine screw. The insert shall be fitted with a hydraulically operated tool, and properly clinched, to ensure it will not rotate in the sheet steel. The inserts shall also be manufactured from Grade 316 stainless steel.

Alternative methods of providing suitable screw anchorages in sheet steel may be considered, such as captured or welded nuts, but the detailed alternatives shall be submitted for consideration at the time of tendering.

Enclosures shall be made up of vertically separated sections which shall be divided into compartments to accommodate equipment for motor drives, instrumentation, switchgear for main and sub-main feeder switches, etc.

Each compartment shall be a minimum of 600 x 380 mm totally separated from the adjacent compartments with sheet steel barriers welded or bolted into position and where wiring is required to pass through these barriers, brass crushed holes shall be provided.

A complete enclosure shall be mounted on and bolted to a hot-dipped galvanised 100 x 50 x 6 mm channel steel base with mitred external corners. The fixing bolts shall be 316 stainless steel M10 bolts.

The height of an enclosure shall not exceed 2 100 mm when mounted on its base.

Doors

All doors shall be arranged to stand off from the face/rear of the enclosure. Each door shall be properly stiffened and shall be twice returned at the periphery. The second return shall be gusseted in the corners to further brace the door.

Large doors (e.g, those fitted to the rear of individual sections) shall be further stiffened with "top hat" section channels welded to the inside of the door.

Each door shall be mounted on pin type hinges and shall be secured by means of a lever operated tapered tongue catch or catches (hinges and catches shall be Perano, Barker Nelson, or equal approved). The lever shall be provided with an external stop to prevent rotation in excess of 360° and to provide a padlocking facility (a hole in the stop and a hole in the lever).

Where doors are mounted adjacent to one another the spacing shall be arranged to permit each door to open through at least 150°, without fouling the adjacent door. A stop shall be provided which shall prevent the door from opening further to avoid damaged paintwork.

Doors fitted with flush mounted equipment shall be properly braced and stiffened to support the equipment. The hinges shall be easily able to support the mass added to the door when the flush fitted equipment is installed.

Where cover plates are provided behind the doors, the cover plates shall be adequately recessed to permit the spindle on the lever to drive the tapered tongue catch into a slot in the framework of the board without fouling the cover plate. The space between the back of the door and the face of the cover plate shall be nominally 80 mm.

Cover plates shall be fabricated as for the doors and shall be further stiffened to compensate for the machine-punched circuit breaker slots. The cover plates shall be secured at the top edge with at least two square key driven catches whilst at the lower edge they shall be located with two 6 mm diameter tapered dowel pins located in holes drilled in the architrave. Each pin shall be fitted with a 1,2 mm thick spacer washer. Both the pins and the washers shall be welded to the cover.

Corrosion Protection

The enclosures shall be painted with a high quality polyurethane-based powder coat suitable for interior and exterior conditions and applied by electrostatic spray. The sprayed powder coat shall be baked in accordance with the paint manufacturer's specification.

The enclosures shall be painted white internally and an Electric Orange colour (SANS 1091) externally.

The dry film coat shall be as uniform as possible but shall not be less than 50 microns nor more than 100 microns. The finish shall be high gloss with a minimum of surface defects / blemishes.

Busbar Chambers

A totally enclosed busbar chamber shall be provided throughout the length of enclosures for main DBs and MCCs. The busbar chamber shall be fitted with front, back and top covers to give full access to the busbars. The top covers shall be bolted on and the front and back covers secured with square-key latches, with one catch per cover being lockable with a padlock.

The busbar chamber shall be so positioned at the top that each and every connection is easily accessible and sufficient space is provided to easily operate a torque wrench on each bolt / nut.

Dielectric barriers shall be provided in the busbar chamber at every second section. The dielectric may not be split and installed as separate parts, but shall instead be slotted to allow the busbars to pass through. The slotted holes shall be fitted with U-shaped rubber gasketting to ensure a snug fit. These dielectric barriers may not be employed to support the busbars. The dielectric shall be bolted to the sheet steel at the periphery of the busbar chamber.

The penetrations for circuits into or out of the busbar chamber shall also be provided with similar dielectric barriers at the points of penetration.

The space normally used for the busbar chamber shall be divided into two separate, totally isolated chambers, namely a busbar chamber and a wiring channel for signal and communication cabling / wiring.

The wiring channel shall be 100 mm deep and shall be separated from the busbar chamber with a 1,6 mm thick sheet steel partition.

C3.12.12.3 Construction of Wall-Mounted Enclosures

Material and Fabrication

Both flush-and surface-mounting enclosures shall consist of a tray and an architrave frame on which the chassis, front panel and any door are mounted, except that surface-mounted enclosures of width and height both not greater than 400 mm need not have an architrave frame.

Enclosures shall generally be constructed of sheet steel of minimum thickness of 1,2 mm except that cabinets of width and height both not greater than 400 mm may be constructed of sheet steel of minimum thickness of 0,8 mm.

3CR12 steel shall be used.

Wall trays of flush-mounting enclosures shall be fitted with expanded metal spot welded to the rear and metal straps welded to the sides to ensure bonding with the structure of the wall.

Trays of surface-mounting enclosures shall be slightly larger than the architrave frame and shall have a return to present a flat surface to the architrave frame.

A mounting panel of 20 mm thick, fine grade, knot-free pine shall be fitted to the back of panels for telephone and electronic building services if and where required.

Doors and Cover Panels

Doors shall be provided for wall-mounted enclosures.

Doors shall be constructed of the same thickness and material as the remainder of the enclosure.

Door hinges shall facilitate removal of doors without the use of tools. Hinge or hinge-pins shall not be removable when doors are closed.

Doors shall be fitted with handles and spring-loaded pad-lockable catches including stainless steel disc lock to Master Lock or similar approved by the Employer.

Locks are specified, shall have master key facilities for the entire services installation. Four master keys shall be provided.

Where doors are fitted with locks, the operating handle or toggle or the main disconnector or local disconnector shall be accessible and operable without opening the door.

Cover panels shall be secured by means of catches with square keys, or approved equivalent, quick-release fasteners and shall be fitted with chromium-plated knobs to facilitate removal.

Visible nuts shall be chromium-plated dome nuts. Visible bolts, washers or other fasteners shall be chromium-plated. Self-tapping screws will not be permitted.

Cover panels shall have machine-punched openings for instruments and for equipment operating handles and toggles.

Openings shall be provided for spare accommodation which shall be blanked off by escutcheon blanks or clamped steel plates.

Installation

The Contractor shall check the dimensions of access ways and the space provided for DBs, MCCs and other panels on the latest architectural drawings to ensure that the enclosures are appropriately designed.

Floor-mounted enclosures shall be mounted over cable trenches. Trench bridging supports shall be provided at the ends of the enclosure and at every second section. The supports shall be manufactured in the form of a top-hat section from 3 mm thick steel and then hot-dip galvanised.

C3.12.13 LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR FOR DISTRIBUTION BOARDS, MOTOR CONTROL CENTRES, CUBICLES AND PANELS

C3.12.13.1 General

Switchgear, control gear and instrumentation shall be rated for the system voltage, frequency and number of phases and for the load current and applicable maximum prospective fault current as specified on the drawings.

C3.12.13.2 Surge Arresters

Surge arresters shall be provided for each phase in all boards, connected to each phase of the incoming cables.

Surge arresters shall conform to the relevant SANS codes and other Specifications, shall bear the SABS mark, and shall be solidly earthed directly onto the cubicle earth bar by means of a copper strap and be as short and straight as possible.

C3.12.13.3 Air Circuit Breakers (ACBs)

ACBs shall:

- Be of the metal-clad, withdrawable type complying with the relevant codes and specifications.
- Be three pole unless otherwise stated in the Drawings.
- Have an adjustable thermal overload trip unit and an adjustable magnetic short-circuit trip unit. All trip units shall be direct acting. Both trip units shall be replaceable by units of different ratings. ACBs noted on the drawings as ”selective” shall incorporate an adjustable time delay on the magnetic short-circuit trip unit
- Be horizontally withdrawable allowing full maintenance and tests without the breaker having to be removed from the withdrawal mechanism.
- Be designed for trip-free manual closing and electrical tripping of the type specified in the Project Specification or drawings, e.g., shunt, remote or under voltage tripping, delayed contacts, AC or DC coil voltage
- Be provided with interlocking to ensure that an ACB is fully isolated before access to any live terminals can be obtained.
- Be provided with interlocks to allow the ACB to be operated in the withdrawn maintenance/test position, and to prevent the circuit breaker from being closed unless fully in the engaged or test position and from being moved when the mechanism is closed.
- Incorporate a mechanically operated "ON/OFF" or ("I/O") position indicator with facilities for padlocking in the "Off" position.
- Be provided with lockable safety shutters that operate automatically with the movement of the circuit breaker, to screen the fixed contacts.

- Have two normally open and two normally closed spare auxiliary contacts unless otherwise stated elsewhere. It shall also be possible to install a change-over contact if required at a later stage. Auxiliary contacts shall be capable of making and carrying continuously 1A AC or DC. They shall be capable of breaking 500 VA AC at 0,2 PF and 20 watts DC at an L/R of < 40 ms.
- Have a one second fault withstand rating unless otherwise stated elsewhere.

Special equipment should not be required to remove the circuit breaker from its withdrawal mechanism for transporting. If special equipment is required, it shall be provided with the circuit breaker.

All non-current-carrying metal parts of the circuit breaker shall be solidly interconnected and connected to an earth contact which shall engage with a copper plate connected to the main earth bar of the cubicle, and the arrangement shall be such that the circuit breaker frame is earthed before the circuit breaker contacts engage with the live fixed contacts.

Where noted on the drawings special purpose interlocking (key / mechanical / electrical) shall be provided between ACBs.

C3.12.13.4 Moulded Case Circuit Breakers (MCCB's)

Moulded case circuit breakers shall comply with the relevant codes and specifications and shall be of flush panel mounting type.

MCCB's:

- With ratings of 100 A and less shall be suitable for mounting on a DIN rail.
- With ratings in excess of 100 A for distribution networks shall each have an adjustable thermal overload trip unit and an adjustable magnetic short-circuit trip unit. Both trip units shall be replaceable by units of different ratings. MCCB's for motor starter circuits shall be of the current limiting type with an adjustable magnetic short circuit trip unit.
- With ratings of 600 A or more shall have extension type operating handles, which shall be interlocked with the enclosure compartment doors to prevent the door being opened unless the MCCB is in the off position.

Mechanically coupled single-pole circuit breakers used as double or triple-pole circuit breakers will not be acceptable unless overload releases are internally coupled.

The fault current interrupting rating of MCCB's shall not be less than the maximum prospective fault current and not less than 5 kA.

Neutral bars associated with each bank of MCCB's shall be positioned below each bank and shall be wired in the same sequence as the MCCB's.

MCCB's with shunt release shall have an auxiliary contact arranged to interrupt the shunt release current at the end of the opening operation. MCCB's with an under-voltage release shall be equipped with a time delay relay.

MCCB's shall be fitted with the specified number of spare auxiliary contacts as required in the motor protection and control philosophy. Where spare auxiliary contacts are not called for, it shall nevertheless be possible to fit at least one normally open and one normally closed contact or a change-over contact at a later stage. Auxiliary contacts shall be capable of making and carrying continuously 1A ac or dc. They shall be capable of breaking 500 VA a.c. at 0,2 PF and 20 watts dc at an L/R of < 40 ms.

Where required, MCCB's shall be capable of remote closing using the specified control voltage.

MCCBs shall be lockable in the "Off" position.

Where MCCB's are of the current limiting type, the Contractor shall determine, and offer suitable ratings in collaboration with the MCCB supplier, to ensure discrimination and adequate short-circuit current capability. Calculations shall be submitted with the tender indicating the degree of current limiting and discrimination achieved as well as techniques used. Full details shall be submitted of the current limiting characteristics of each MCCB rating offered.

MCCB's for DC applications shall be of the current limiting type and shall have at least one pole in the positive and one pole in the negative circuit. Where additional poles are required in series to meet requirements of the specified application, the series connections between poles of like polarity shall be such that they cannot be removed without special tools.

C3.12.13.5 Disconnectors

All disconnectors shall be of the "load-break-fault-make" type complying with the relevant SANS specification.

The disconnectors shall have the ratings specified on the drawings.

The handle of the disconnector shall form part of the panel door. It shall not be possible to close the disconnector without the door being closed and it shall not be possible to open the door without the disconnector being switched off.

Disconnector handles shall have an integral key lock or padlocking facility.

The fault carrying capability of the disconnectors shall be equivalent to or higher than the fault level of the associated busbar but not less than 5 kA.

C3.12.13.6 Switches and Selector Switches

Switches and selector switches shall comply with the relevant SANS specification.

Switches and selector switches shall be capable of carrying, making and breaking the full rated current and of making onto the maximum prospective fault current.

The fault rating of switches and selector switches shall not be less than the maximum prospective fault current and not less than 5 kA.

The operating knob and indicator plate shall be manufactured of insulating material and the switch positions shall be clearly and indelibly marked thereon.

The switches and selector switches shall be provided with substantial contacts and the terminals shall be clearly marked and arranged for easy wiring.

The voltmeter or ammeter selector switch shall be mounted directly below the associated volt or ammeter.

Voltmeter selector switches shall be arranged so that voltages between phases, and phases to neutral, can be read. Voltmeter selector switches shall be of the break-before-make type.

The voltmeter selector switch shall have one "off" and six "metering" positions and shall be suitable for panel mounting in such a way that the operation knob and indicator plate can be mounted on the front of a panel and the switch itself at the back of the panel.

Ammeter selector switches shall be of the make-before-break type with one "off" and four "metering" positions arranged to read the current in each phase and in the neutral. When in the "Off" position the metering circuit shall be short-circuited.

The physical construction of ammeter selector switches shall conform to that of voltmeter selector switches.

Switch enclosures shall be provided with an interlocked cover to ensure that the switch is in the "Off" position before the cover can be opened for inspection or fuse removal. It shall not be possible to close the switch without the cover being closed.

Switches shall be provided with a clear "ON/OFF" or "I/O" position indicator.

C3.12.13.7 Bus-Section Switches

Bus-section switches shall be interlocked with the incoming switchgear by means of special-purpose key interlocking facility.

Bus-section switches of rating less than 1 000 A shall comprise isolators.

Bus-section switches of rating of 1 000 A and higher shall be air circuit breakers incorporating magnetic short-circuit trip units without thermal overload trip units.

Busbar selector or change-over switches shall be provided with suitable position indicators.

C3.12.13.8 Time Switches

The contacts shall be approved single-pole changeover contacts rated at 16 A and operated by an electronic potential free circuit with 8 hour back-up.

Time switches shall be fitted with a manual overriding switch.

An external bypass switch shall be provided in each time switch circuit.

Time switches shall have the following features:

- Daily programmable with minimum 30 minute "on" and "off" control facilities.
- Weekly programmable with day omission facilities of minimum 12 hours, i.e, mornings or afternoons.

The whole mechanism shall be totally enclosed in a dust-proof enclosure.

C3.12.13.9 Photo Switches

Photo switches shall comply with the relevant codes and specifications.

Photo switches shall have silver to silver or other approved single-pole changeover contacts rated to switch a reactive load of 1 800 VA at 230 V and 50 Hz.

An external bypass switch shall be provided in each photo switch circuit.

The photo-electric cell shall switch streetlights "On" when daylight drops to approximately 40 lux and it shall switch "Off" at approximately 80 lux.

The photo-electric cells shall have a time delay of not less than 30 seconds.

Photo-electric cells shall be completely waterproof and shall be of robust construction.

The material of the cover shall not crack, deform or deteriorate in any way whatsoever and shall be colour-fast in all weather conditions.

The photo-electric cells shall be provided with built-in lightning arresters.

Samples of photo-electric cells shall be submitted to the Employer’s Agent for approval prior to the ordering thereof.

The prices for the erection of photo-electric cells shall include the supply and delivery and the connection of cables, etc., from the photocells to LV cubicles, DB's or minisubs.

C3.12.13.10 Combination Fuse-Switch (CFS) Units

The fuse-switch units shall comply with the relevant codes and specifications and shall be fitted with high rupturing capacity (HRC) cartridge type fuses-links complying with the relevant codes and specifications.

Fuse-switches shall be capable of braking the full rated current and shall have a fault current rating of not less than the maximum prospective fault current and not less than 10 kA for one second.

Fused isolators, i.e, fuse-switches which rely on the fuses to reduce the fault current through the switch portion to provide a higher fault current rating, are not permitted.

Fuse-gear with the fuses mounted in the cover of the unit, with one cover forming the operating lever, are not permitted.

Fuse-switch units shall have chassis and be designed to accommodate HRC fuse links and shall be of the double air-break, quick-make, quick-break type with a spring mechanism smoothly driven by springs on both sides of the mechanism.

The fixed contacts shall be shrouded and arranged so that when the switch is in the open position the double-break isolates the HRC fuse links so that they can be replaced in complete safety.

Fuse-switch units shall be triple-pole units and neutral links shall be provided inside the back of the distribution boards to facilitate routine testing.

All components shall be capable of continuously carrying rated current without excessive temperature rise.

Fuse-switch units shall be provided with interlocks such that:

- The cover panel cannot be opened whilst the switch is closed and
- The unit cannot be operated with the cover open unless an interlock is purposely defeated.

The fuse-switch shall have a handle and an ON/OFF position indicator mechanically operated by the moving contacts to ensure accurate and positive indication.

Provide facilities for padlocking in the "Off" position.

In all cases, the top terminal of fuses shall be the live terminal.

Six spare fuses shall be provided for each rating fitted.

C3.12.13.11 Fuse Links and Holders

Fuse links shall be high-rupturing capacity (HRC) cartridge type fuse links conforming to the relevant codes and specifications.

HRC fuse link holders shall be of the withdrawable Bakelite type and shall conform to the relevant codes and specifications.

Each fuse link and holder shall incorporate a visual inspection eye for fault location.

Fuses protecting a specific instrument shall be mounted as a group in close proximity to the relevant instrument.

A label with the rating of each fuse shall be mounted in close proximity to the relevant fuse holder or fuse switch.

Six spare fuses shall be provided for each rating fitted.

The spare fuses shall not be used by the Contractor during erection, commissioning or maintenance.

C3.12.13.12 Earth Leakage Protection Units

Earth leakage protection units shall conform to the relevant codes and specifications.

All single and three phase socket outlets shall be provided with earth leakage protection devices unless specifically excluded in the Code of Practice for the Wiring of Premises.

All units shall have test push buttons and, unless otherwise specified the sensitivity shall be 30 mA.

Earth leakage shall be arranged to disconnect the faulty circuit from both phase and neutral of a single-phase system, and from all three phases of a three phase system.

C3.12.13.13 Contactors

All contactors for low voltage shall be of the electro-magnetic operated air-break type with specific requirements as required for the operation and control of the related equipment as specified elsewhere.

Contactors shall be in accordance with the relevant codes and specifications. Category AC3 or DC2 shall in general be used, whichever is applicable. Category AC4 and DC3, whichever is applicable, shall be used for heavy plugging and inching duty systems, e.g, cranes, etc.

Contactors shall have suitable capacities for direct-on-line starting, star delta starting or any other form of starting, whichever is specified in the drawings. The contactors shall be rated for at least 130% of the associated load current.

Each contactor shall be provided with at least two normally open and two normally closed auxiliary contacts, unless otherwise specified.

Contactors shall be suitable for remote and automatic operation where required. Where the number of auxiliary contacts required for remote and automatic operation is greater than can be accommodated on the contactor, an auxiliary relay or on additional contactor, shall be provided.

Each contactor shall be capable of carrying, making and breaking over-currents during the operating time of its own overcurrent tripping devices at a recovery voltage of 90% of the specified system voltage.

All Contactors for starting squirrel-cage motors direct-on-line shall be rated to break 10 times the full-load running current of the motor.

The contactor shall be co-ordinated with the short circuit protective device to ensure adequate protection for the specified operational current, voltage and the corresponding utilisation category according to Type 2 Co-ordination as per SANS 60947-4-1, i.e, that, under short-circuit conditions, the contactor or starter shall cause no danger to persons or installation and shall be suitable for further use.

C3.12.14 BUSBARS

C3.12.14.1 General

Busbars, metal-enclosed busbar trunking systems and connections shall comply with the relevant codes and specifications.

The main busbars, distribution busbars, risers and droppers shall be of hard drawn high conductivity copper, having a constant rectangular cross section throughout. They shall not be less than specified for the main incoming circuit breaker or isolator. Where busbars are fed directly from a transformer, the busbar rating shall be 125% of the transformer rating.

The busbars shall be designed to withstand for 3 seconds the mechanical and thermal stresses associated with the prospective short-circuit current specified in the Drawings.

Where busbars terminating at the end of switchboards are intended for future extension, these busbars shall be predrilled to accommodate the extension. Where pre-fitted space is specified for future equipment, the busbars in the proposed position shall be predrilled and nuts and bolts shall be provided to accommodate the future busbars or cables feeding the equipment.

The main busbars shall be mounted horizontally with the longer dimension in the vertical plane. The main busbars shall be arranged in stepped formation, with the red phase at the top rear and the neutral at the bottom front. Joints in busbars shall be avoided as far as possible, but where they are necessary, the joint shall be formed by offsetting one of the bars by a deviation equal to its own thickness to overlap the adjoining busbar. The length of the overlap shall be equal to twice the width of the bar, and the joint shall be secured with a minimum of 4 hexagon-headed bolts, washers (plain and spring) and nuts. All joints shall be tightened to the correct torque before the DB or MCC is delivered to site, and again checked just prior to commissioning.

Spacing of busbars shall not be less than twice the longer dimension of the busbar and not less than 50 mm between busbars, and 150 mm to the enclosure.

Busbars shall be mounted on substantial moulded epoxy or resin insulators fixed with robust steel brackets. Bare conductors shall be so spaced that with all clamps, lugs and lead-offs in position, the spacing between any conductor and earth shall not be less than 40 mm. Parallel busbars shall be separated by a minimum distance equal to the thickness of each single busbar. Parallel busbars shall be connected together at spacings of not more than 450 mm to equalise current distribution.

The minimum clearances between current carrying parts and between current carrying parts and other metal parts shall be in accordance with the relevant codes and specifications.

Busbars shall be mounted at least 100 mm away from the nearest equipment. Special attention should be given to spacing between fuse-switches and busbars.

All busbars shall be covered with coloured heat-shrinkable material. The colour shall correspond to the colour of the supply phase. Busbars may alternatively be covered with two coats of coloured insulation paint. Busbar joints shall be covered with a suitable non-hardening compound and then taped with coloured PVC tape. Busbars shall be radius-edged where they change direction. PVC tape shall not be allowed for phase identification.

The following colours shall be used:

Number of Phases	Phase Colour	Neutral Colour	Earth Colour	Special Purpose Colour
1	Red	Black	Green/Yellow	Orange
2	Red and White	Black	Green/Yellow	Orange
3	Red, White and Blue	Black	Green/Yellow	Orange
4 and more	Any base colour except Green, Yellow and Orange with serial numbers (numerals or words)	Numbered as for the phase colours	Green/Yellow	-

The switchgear manufacturer shall provide necessary copper flexible or bar connections between the riser terminals and the cable terminals. The switchgear riser terminals shall be properly tinned.

Connections to the busbars shall be effected by means of the correct clamps or lugs with soldered connections or with connections crimped with the correct equipment.

The neutral busbar cross-section shall be equal to that of the phase busbars, and may not be reduced without the approval of the Employer's Agent.

the current density of copper busbars shall not exceed 2 A/mm² for currents up to 1 600 A, or 1,6 A/mm² for currents above 1 600 A.

All terminations onto busbars and busbar interconnections shall be bolted with cadmium-plated high tensile bolts, washers, spring washers and nuts. In corrosive areas, substitute lock nuts for spring washers. The largest possible size bolt that will fit into holes in lugs and fixing holes of equipment shall be used in every instance. Bolts shall be of sufficient length that at least two but not more than five threads protrude beyond the nut. Connections shall be kept as short and straight as possible and where dissimilar metals are connected means shall be provided to prevent electrochemical reactions and corrosion.

The maximum current density in busbars and connections shall be such that in no part of the switchgear equipment including circuit breakers, isolating equipment, busbars, current transformers, cable boxes, and connections shall exceed a temperature of 60°C i.e, a temperature rise of 20°C at an ambient temperature of 40°C.

Busbars shall be properly insulated and sufficiently supported to withstand the maximum fault current at the points where they pass through panels or partitions of the switchboard. This shall preferably be achieved by means of resin bound synthetic wood or similar material with cut-outs which fit tightly around the busbars. The insulating panel shall be firmly bolted to the frame. Busbars or "droppers" that pass through internal partitions in the switchboard shall be similarly insulated and supported.

C3.12.15 EARTH BARS

A main earth bar shall be mounted at the bottom along the full length inside the switchboard and may be bolted to the framework of the switchboard. For back access switchboards, the earth bar shall be mounted at the rear. The steelwork of a switchboard and in particular gland plates shall be solidly and effectively bonded to the main earth bar. Earth bars shall have sufficient ways for all the earth conductors and, in addition, 30% spare space shall be provided.

Switchboards with short-circuit ratings in excess of 5 kA shall be equipped with a copper earth bar with a cross section not less than S = 0,006 x I mm² where “S” is the area in mm² and “I” is the maximum prospective fault current in Amps. However, in main DBs and MCCs, the earth bar shall not be less than 70 mm x 8 mm in cross-section, and shall be fitted with earthing studs in each section of the enclosure.

Switchboards with short-circuit ratings not exceeding 5 kA shall be equipped with an earth bar comprising box terminals with pressure shoes on a rectangular copper bar measuring at least 2,5 mm x 12,5 mm mounted on insulating pedestals. An earthing stud shall be welded to the metal tray of the distribution board. An earthing conductor equal in cross-sectioned area to the incoming earthing conductor shall connect this earthing stud to the earth bar.

C3.12.16 CURRENT TRANSFORMERS

C3.12.16.1 General

Current transformers shall comply with the relevant codes and specifications and shall be marked clearly and indelibly as specified therein on a rating plate securely attached to the transformer.

Each panel shall be equipped with the current transformers as specified elsewhere or in the drawings.

Current transformers shall be suitable for a system with an effectively earthed neutral or an non-effectively earthed neutral.

For current transformers with a system voltage less than 3,6 kV the insulation level shall be determined by the rated short duration power frequency withstand voltage e.g, 2 kV for a 400V system.

Current transformers with system voltages greater than 3,6 kV shall be insulated to withstand test voltages defined by the rated lightning-impulse and short-duration-power-frequency voltages and shall be as follows for indoor switchgear :

Highest Voltage for Equipment R.M.S.	Rated Lighting-Impulse Withstand Voltage	Rated Power-Frequency Short Duration Withstand Voltage
kV	(Peak) kV	(r.m.s.) kV
3.6	40	10
7.2	60	20
12	95	28
24	125	50
36	170	70

The short-time thermal and dynamic current rating of current transformers shall not be less than that of the associated circuit breaker, isolator or busbar.

The rated primary currents of current transformers shall be 10, 15, 20, 30, 50 and 75 Amperes or their decimal multiples.

The current transformers secondary ratings shall be 5 A.

Current transformers shall be accessible and easily removable. All current transformers of any one type and rating shall be identical and interchangeable with one another.

The class of insulation of current transformers shall be Type A (maximum temperature rise 60° K).

Protection current transformers shall be of the low reactance type having toroidal cores with fully distributed secondary windings. Turns compensation shall not be utilised on protection current transformers.

The error in turns ratio on any tapping of a Class X current transformer shall not exceed ± 0,25%.

The same set of current transformers shall not be used for both indication instruments and protective relays, separate cores having a low saturation factor (< than 5 preferably) shall be used for metering.

The VA ratings shall be sufficient to operate the various metering equipment and relays but shall not be less than 10 VA.

The accuracy limit factor of the protection current transformers shall be 15 unless otherwise specified.

The following classes of current transformers shall be used.

Function	Description	Class
Metering	kVA, kW and kWh meters	0,5
Indication	Ammeters	1,0
Protection	Over-current, earth fault and thermal overload	10P
Special Protection	Differential protection, restricted earth fault and pilot wire protection	X

The arrangement of the current transformer cores with respect to the primary terminals and mechanism of the circuit breaker shall be subject to the approval of the Employer's Agent prior to manufacture.

Where it is not possible to easily read the rating plates of current transformers, additional rating plates shall be located on the rear inner panel of the breaker cubicle relay compartment for each current transformer where they can be easily read. These shall be a duplicate of the rating plates which appear on each current transformer. In addition, the phase colour with which each current transformer is associated shall appear beneath each rating plate. Information shall be provided on the above rating plates to indicate which secondary terminals are associated with which winding. This information shall be in addition to that called for in the relevant codes and specifications.

The information on the additional plates shall include the relative arrangement of the current transformer cores with respect to the circuit breaker terminals and shall also indicate their polarity.

Secondary windings of current transformers shall be earthed to the approval of the Employer's Agent at one point only. Each group of current transformers (i.e, protection, metering, etc.) shall be earthed directly to the earth bar by way of isolating links of the type where the link cannot be removed from the terminal. These links shall be readily accessible and safe with the circuit breaker in the isolated position. They shall not be in a live compartment.

All current transformer connections shall be brought to a terminal block in an easily accessible position inside the switchgear relay panel.

If remote metering is specified, then the metering current transformer shall also be wired to an easily accessible terminal block at the back of each panel. A metering test block with special links shall be provided to make changes to the remote metering circuits possible without the danger of opening the CT's on load.

Each LV current transformer shall be of the ring type and be provided with a robust mounting bracket and approved terminal studs on the circumference of the coil for the connections. The current transformers shall be mounted on rigid supports in such a manner that the axis of the coil is in a vertical plane to facilitate the threading through of the interconnecting wiring to the relevant switchgear.

C3.12.16.2 Current Transformer Testing

Test certificates shall be submitted to the Employer's Agent and be included in manuals. Test shall be executed in accordance with the relevant codes and specifications.

Type Tests

Type tests are not required if the manufacturer holds certificates of type tests on a similar transformer. Type test certificates shall be provided upon request by the Employer's Agent.

Routine Tests: General

Verification of terminal markings and polarity tests.

Insulation test shall be made on the windings as specified as follows:

- Power frequency tests on primary windings and measurements of partial discharges.
- Power frequency tests on secondary windings and between sections of primary and secondary windings.
- Overvoltage interturn tests.

Additional Routine Tests for Measuring Current Transformers

Tests shall be performed to verify limits of current error and phase displacement.

Additional Routine Tests for Protection Current Transformers: Class 10P

Tests shall be performed to verify limits of current error and phase displacement.

Tests shall be performed to verify limits of composite error.

Secondary winding resistance corrected to 75°C.

Additional Routine Tests for Special Purpose Current Transformers: Class X

Routine tests shall be performed to verity and establish the following:

- Rated knee-point e.m.f.
- Exciting current.
- Secondary winding resistance corrected to 75°C.
- Turn ratios.

A magnetising curve shall also be provided to the Employer's Agent for Class X current transformers prior to the installation of current transformers in the switchgear.

Witnessing of Tests:

It should be noted that witnessing of tests shall not relieve the Contractor of his/her responsibilities for meeting all the requirements of the specification, and it shall not prevent subsequent rejection if such material or equipment is later found to be not in compliance with the specification.

C3.12.16.3 Additional Information to be Submitted with the Tender

A typical drawing showing the assembly of the current transformer and its core and winding shall be submitted with the tender.

C3.12.17 LOW VOLTAGE MOTOR PROTECTION AND RELAYS

C3.12.17.1 For Motors up to and including 55 kW

All three phase motor contactors shall be provided with three pole thermal overload relays which are selected for the applicable motor ratings.

The overload relays shall have inverse time current characteristics which comply with the relevant codes and specifications. Where motors have exceptional long starting times the trip class shall be selected to ensure that tripping doesn't occur during motor starting.

The overload thermal relays shall be phase loss sensitive and shall be provided with a manual reset button.

All three phase motors shall be provided with suitable phase failure relays providing protection against:

- Single phasing.
- Phase reversal.
- Phase angle errors.
- Unbalance supply voltage.

When motors for pumping installations or submersible pumps are specified, an underload or undercurrent relay with suitable current transformers shall be provided.

Where relays are mounted inside panels and the trip indicators on the relays are disabled due to the loss of control voltage when cubicle doors are opened, additional signal lamp indicators shall be provided on the cubicle doors otherwise the relays shall be flush mounted on the doors.

C3.12.17.2 For Motors larger than 55 kW

Motors larger than 55 kW shall be protected with electronic motor protection relays (MPR). The relay shall make provision for the minimum protection functions as follows:

- Thermal overload with thermal capacity memory.
- Single phasing.
- Phase sequence.
- Restart control (The cooling characteristics of the motor shall be accurately simulated to block starting until the motor has cooled down sufficiently for both hot and cold starts).
- Stall protection.
- Underload or undercurrent protection shall be provided for all motors used for pump installations. Where this feature does not form part of the relay a separate relay providing an underload function shall be provided.

When earth fault and short circuit functions are specified the trip signals shall be wired to trip the backup circuit breaker unless positive proof exists that the contactors are capable of breaking the present and future fault currents. Otherwise, these trip signals shall be delayed by the MPR to ensure that the fuses blow before the contactor is tripped.

Special care shall be taken in the selection of motor protection relays when reduced current starters, e.g, soft starters or variable speed drives are specified. Contractors shall submit to the Employer's Agent written confirmation obtained from the manufacturer of the relay that the relay offered is suitable for the application.

Where relays are mounted inside panels and the trip indicators on the relays are disabled due to the loss of control voltage when cubicle doors are opened additional signal lamp indicators shall be provided on the cubicle doors otherwise the relays shall be flush mounted on the doors.

Motor windings are equipped with thermistors a suitable thermistor overload relay shall be provided (motors between 55 kW and 150 kW). Care shall be taken that the total resistance of the thermistors when connected in series do not exceed the tripping range of the relay.

The relay shall have contacts for a manual reset button and a LED display trip indicator which shall be mounted on the front of the panel.

Unless otherwise specified the thermistor overload relay shall be suitable to function in conjunction with thermistors with a temperature reference value of 140°C (Class B motor winding temperature rise).

Thermistors installed for winding temperature alarms the thermistor overload relay shall be suitable to function in conjunction with thermistors with a temperature reference value of 130° (Class B motor winding temperature rise).

Motor windings and the bearings shall be equipped with platinum resistance detectors (RTD's) Pt-100 W for motors above 150 kW, and a suitable temperature controller for each RTD shall be provided with the following features:

- Adjustable present process temperature value and adjustable set temperature value in separate four digit LCD displays.
- An adjustable alarm output with indicator.
- Temperature range 0 - 150°C.
- Trip indicator.
- Relay control and alarm outputs.
- Dielectric strength : 2 kV for 1 minute.
- The temperature controllers for the windings shall be set for the protection of a Class H motor winding temperature rise.
  i.e. Alarm : 165°C
  Trip : 180°C
- The bearing temperature controllers shall be set as follows:
  i.e. Alarm : 85°C
  Trip : 90°C

The unit shall be provided with a 4 to 20 mA output to transmit the process value or other output as may be required.

All the temperature controllers specified for one motor shall all be mounted in a 300 mm rack as a unit and shall be flush mounted on the cubicle door of the relevant motor.

The unit shall be provided with an override key switch to facilitate the exchange of a temperature controller without causing the motor to trip.

Temperature controllers shall be equipped with 2 pole "two in one" 3 wire surge arresters providing protection from phase to earth and from neutral to earth. Surge arresters shall comply with the relevant codes and specifications.

C3.12.18 WIRING IN DBS, MCCS AND PANELS

In general, all internal wiring in the cubicles shall be carried out in 600 V PVC insulated copper multi-strand conductors. If the internal ambient temperature of the cubicle is likely to exceed 50°C silicon rubber insulated stranded copper conductors shall be used. The minimum cross-sectional area for control circuits shall be 1,5 mm2 and 2,5 mm2 for load and CT circuits. The current carrying capacity of conductors shall be determined in accordance with the relevant codes and specifications taking the appropriate correction factors for ambient air temperatures, grouping and condition of use into account.

Where several conductors are used, these shall be neatly grouped and bound together in groups not exceeding 10 conductors and shall be arranged in neat vertical or horizontal rows or installed in PVC trunking with slotted sides. Wiring shall follow the board construction features as far as possible without the twisting or crossing of conductors.

No joints will be allowed in internal wiring, and all connections to busbars or earth bars shall be made with approved tinned copper cable lugs soldered or crimped to the ends of the conductors and bolted to busbars by means of cadmium-plated high tensile steel bolts and nuts provided with spring washers.

Connections of conductors to equipment i.e. circuit breakers, isolators or contactors shall be made by a ferrule of correct size or by the soldering of the end of the conductor. Conductors connected to terminal blocks need not to be soldered or ferruled.

Conductors terminating on meters, fuse holders and other equipment with screwed terminals shall be fitted with pre-insulated lugs. The lugs shall be soldered or crimped to the end of the conductor. The correct amount of insulation shall be stripped from the end to fit into the terminal. Strands may not be cut from the end of the conductor.

Crimping tools used shall be of the ratchet type and indent an identifying symbol on the terminal insulation.

All wiring is to be kept free and away from any exposed terminals or other uninsulated current carrying parts. Wiring shall also be kept free from metal edges and shall be protected where they cross metal edges. Grommets shall be installed in each hole in the metalwork through which conductors pass. Connections to equipment on swing doors shall be arranged so as to give a twisting motion and not a bending motion to the conductors.

Only wires of the same potential shall be grouped together and power control circuit wiring shall be in separate wiring channels. Wiring channels shall not be more than 60% full.

Wires shall be clearly marked at all termination points in accordance with the numbering of the board manufacturer's wiring diagram, by means of suitable markers.
Additional red cable markers marked "T" in white shall also be fitted on wires associated with trip circuits.

When the board main disconnector or local disconnector is switched off, no live incoming or other wiring shall be accessible. The incoming terminals shall be screened or inaccessible. Where connections are taken from the incoming sides of the main switch, they shall be screened by a screen marked "ISOLATE FEEDER BEFORE REMOVING SCREEN". If any circuits are energised from other sources, clear warning notices to that effect shall be fitted and such terminals shall be clearly marked.

All control terminals shall be accessible from the rear, except in the case of front access boards.

Where neutral connections are looped between the terminals of instruments a common lug or ferrule shall be used to ensure that the neutral is not broken when the instruments are removed.

The supply end connections to all equipment shall always be at the top and the load end connections at the bottom.

Solid copper busbars shall be used to connect equipment to the main busbars where the current rating exceeds 200 A and shall be insulated by means of at least two half lapped layers of PVC tape.

A maximum of two conductors shall be used per equipment terminal.

Where small leads are connected directly onto busbars, such as for voltmeters, etc. they shall be provided with a 20A fuse mounted directly on the busbar and a 2 Amp fuse at the piece of equipment on the front of the panel.

Unless otherwise approved the following insulation colours shall identify wiring:

Red phase of 3-phase circuits	-	red
White phase of 3-phase circuits	-	white
Blue phase of 3-phase circuits	-	blue
Live of single-phase circuits	-	red
Neutral	-	black
Earth	-	green/yellow
Alarm circuits	-	orange
AC control circuits	-	red
DC control circuits	-	blue
Instruments	-	grey

In DBs and MCCs, accessible PVC wireways shall be provided for wiring between compartments. Signal cabling shall be run in galvanised steel conduit.

Internal wiring shall be kept separated from external wiring and, as far as possible, the internal serving of cables entering the enclosure shall be left around conductors until the cable enters the compartment to which it is connected.

Low current signal cables shall be kept separate from power cables up to the point where the conductors are connected to the terminals on the equipment. Where required, sheet metal wireways shall be provided to ensure this separation.

C3.12.19 SWITCHBOARDS ACCESSORIES

C3.12.19.1 Control Push Buttons

Push buttons shall:

- Comply with the relevant codes and specifications.
- Be provided by a single reputable supply and shall be selected for the required rating, contact action, duty, environmental conditions e.g, temperatures and vibrations and mounting characteristics e.g, flush mounted, enclosed, self-contained, illuminated, etc.
- All be of the same physical dimension and shall be interchangeable between normally open and normally closed contacts. Push buttons shall preferably also be interchangeable with indicator lamps, key switches, etc. All push buttons shall be provided with replaceable lenses.
- Shall be labelled by means of removable legend plates clearly indicating it's function. Legend plates shall be interchangeable.

Push button terminals shall be suitable for conductor sizes to be used. Push button assemblies mounted on doors of control boards shall be enclosed to prevent inadvertent contact with the terminals and when the doors are open.

Contacts shall be silver-tipped or be constructed of an approved high quality material.

Keylock push buttons shall be supplied with duplicate keys. The removal action of the key shall suit the application.

Illuminated push buttons shall comply with the specification for indicator lamps and lights.

<u>On Motor Control Centres</u>

All motor control cubicles shall be provided with "STOP/START" push buttons as follows (or as specified in the Project Specification):

- Start Button : Green
- Stop Button : Red

When specified in the Drawings in the drawings, the following push buttons shall be provided:

- Trip Reset Button : Black
- Emergency Stop Button : Red with yellow background
- Lamp Test Button : White
- Any Other Function Button : Pale Blue

Start push buttons shall have normally open contacts. Stop push buttons shall have normally closed or normally open contacts, as may be required.

<u>On Electrically Controlled Switchgear:</u>

When specified in the Project Specification*** and/or indicated on drawings push buttons shall be provided as follows:

- Open Button : Green (O)
- Close Button : Red (I)
- Reset Button : Black
- Lamp Test Button : White
- Any other Function Button : Pale Blue

C3.12.19.2 Signal Lights

Indicator lights shall comply with the relevant codes and specifications.

Indicator lights shall be provided as indicated on the drawings.

Similar cluster multi-led (8 chip) long life signal lamps shall be provided for all indications.

LED's shall be selected and rated for the specified control voltage and shall be equipped with a suitable current limiting protection resistor. Each LED shall be provided with a Zener transient protection diode. Suitable LED's are type MDA 22 for AC applications under 110 V and DC applications, and type MAC 22 for AC applications above and including 110 V as obtainable from Mimic Crafts. Equivalents shall be submitted for approval by the Employer's Agent.
Indicator light lenses shall be of the same size, shall have a minimum diameter of 22 mm and shall be of the front removable screw type. The lamps shall be replaceable from the front of the panel without the use of tools. Indicator light construction shall be suitable for the operating environment and shall be equipped with interchangeable lenses.

Indicator lights shall be labelled by means of a removable legend plate clearly indicating it's function. Legend plates shall be interchangeable.

Two spare lamps shall be provided for each type and colour lamp used on the boards unless otherwise specified.

The spare lamps shall not be used by the Contractor during erection, commissioning or maintenance.

<u>On Motor Control Centres</u>

When indicated on the drawings, the following indicator lights shall be provided:

- Drive stopped power available : White
- Drive running : Green
- Drive tripped : Red
- Emergency stop activated : Yellow
- Moisture ingress : Blue

<u>On Switchgear</u>

The following lens colours shall be used:

- Circuit Breaker, Isolator closed or abnormal state : Red
- Circuit Breaker tripped (caution) : Yellow
- Circuit Breaker open (ready for operation) : Green
- Interlocking : White
- Other functions : White

Painted lenses shall not be acceptable.

Where indicating lamps are supplied from the substation batteries, it shall be separately wired to an easily accessible terminal block at the back of the board and shall not form part of the wiring of the spring charge mechanisms of equipment or tripping circuits. The indicator lights shall be wired to a lamp test push button mounted on one of the cubicles, preferably a buscoupler or an incomer. The lamp test circuit shall be equipped with a timer (0-10 min) to prevent the unnecessary drainage of batteries.

C3.12.20 METERING AND INDICATION EQUIPMENT

C3.12.20.1 General

All meters and indicating instruments shall be of the flush mounted type. Meters not designed for flush mounting, shall be mounted on suitable brackets inside the equipment panel for relay panels, control panels and distribution boards. A suitable door with a glass-covered window shall then be provided in front of the meter.

Metering and indicating instruments shall be mounted at between 1,2 m and 2 m above floor level, except where the dimensions, type and mounting position of the panel make this impossible.

All meters shall be protected with suitable fuses.

C3.12.20.2 Ammeters

Ammeters shall:

- Comply with the relevant codes and specifications.
- Be of the flush mounted, 96 mm square, quadratic scale type unless otherwise approved by the Employer's Agent.
- Be of the combined instantaneous and 15 minute integrating time lag thermal demand type. The instantaneous movement shall be of the moving iron type to Accuracy Class 2,5 of IEC 60051-2. The accuracy of the thermal demand movement shall be within 3%.
- Have a full scale reading that corresponds with the rated primary current of the associated current transformer with an extended scale to at least 120 % of the full scale value.
- Have their scale plates marked with a red line at the full load current of transformers and motors, and at the associated current transformer primary rating in all other cases.
- Have movements suitable for use in either 1 A or 5 A current transformer secondary circuits.
- Be fitted with zero adjustment screws

Each ammeter shall be clearly marked with the appropriate colour of the phase to which it is connected.

Where ammeters are to be used with dual ratio current transformers, loose scale plates shall be supplied for each ratio. The ratio shall be indicated on the scale plate.

Ammeters shall be mounted in a horizontal line on cabinets and cubicles.

C3.12.20.3 Voltmeters

Voltmeters shall:

- Comply with the relevant codes and specifications, and shall be of Accuracy Class 2,5.
- Be of the suppressed zero, 96 mm square, quadratic scale, flush mounted type, unless otherwise specified.
- Have scales that shall extend to at least 115% of the nominal system voltage.
- Have the nominal system voltage clearly marked with a red line on the scale plate.
- Be fitted with zero adjustment screws.
- Be equipped with a voltage selector switch. This selector switch shall be suitable for phase to phase selection on high voltage three-wire systems and for both phase to phase and phase to neutral selection on low voltage four-wire systems. The selection switch shall be mounted directly underneath the voltmeter.

Voltage transformers will not be used on 400/230 V systems. On all higher voltage systems, the voltmeters shall be supplied from voltage transformers with 110 V secondary windings.

C3.12.20.4 kWh, kW Maximum Demand, kVA Maximum Demand and Combined kWh / kVA Maximum Demand Meters

All of the above meters shall:

- Comply with the relevant codes and specifications with Class 1.5 accuracy, unless otherwise specified.
- Be of the directly-operated voltage type for voltages up to 400/230 V unless otherwise specified. Meters to be used on higher voltage systems shall be operated through voltage transformers with 110 V secondary windings.

Three and single phase kWh meters, up to 80 A shall be directly-operated types and those above 80 A shall be operated through current transformers.

kW and kVA Maximum demand meters and combined kVA/kWh meters shall be operated through current transformers.

kWh Meters shall have cyclometer dials and shall be direct reading without the use of a multiplication factor. kWh-Meters or combined kWh/kVA maximum demand meters can, however, be of the non-direct reading type, but in this case, only one multiplication factor shall be used to obtain both the kWh and kVA readings.

Any multiplication factor applicable to any meter shall be clearly indicated on the meter, or on a label adjacent to the meter, in unit form and not as a combination of several factors. The manner in which this factor is calculated shall however also be displayed indicating the CT and VT ratios used.

All meters shall be fitted with security seal fitting facilities.

Maximum demand indicators shall be resettable from the front without the removal of any covers being necessary, and shall have security seal facilities.

The integrating period on all maximum demand meters shall be 30 minutes.

Combined kVA maximum demand and kWh meters shall be the relevant codes and specifications suitable for the type of system in which it is to be used.

C3.12.20.5 Power Factor Indicators

Power factor meters shall:

- Comply with the relevant codes and specifications.
- Be suitable for use on 3 phase, 3 or 4 wire system. Unbalanced conditions shall be allowed for.
- Be suitable for operation with the current and voltage transformers specified.
- Have scales calibrated at least from 0,6 leading to 0,6 lagging, or a wider range.
- Be of the 96 mm square, or larger, flush mounted type.

Where power factor indication is specified in the Project Specification***, only one meter shall be provided on each circuit where indication is required. The meter shall be installed on the Yellow phase circuit.

C3.12.21 NAME PLATES AND LABELS

C3.12.21.1 Name Plates

All equipment shall be provided with a manufacturer's name plate/plates fixed in an easily accessible and readable position on equipment or inside cubicles showing the following data.

- The manufacturers name or trademark.
- Type, designation or identification number or other means of identification making it possible to obtain relevant information from the manufacturer of equipment.
- SANS or IEC designation.
- Rated operational voltage.
- Short circuit strength in kA.
- Degree of protection IP rating.
- Maximum current carrying capacity of busbars.
- Maximum current carrying capacity of equipment.
- Voltage transformer ratio (where applicable).
- Current transformer ratio, burden, class and knee point voltage (where applicable).
- Current transformer connection instructions for various CT ratios (where applicable provide separate nameplate close to the relevant terminal blocks).

C3.12.21.2 Labels

Labels shall:

- Generally, have black lettering on a white background. Danger and safety notices shall have red lettering on a white back- ground and be in both official languages.
- Be engraved "trafolite", aluminium or an approved alternative secured with screws, not glue, or in an approved aluminium guide rail.
- Have lettering which shall generally be 6 mm high except that of "main switch" and "local switch" which shall be 10 mm high. The lettering of labels indicating names of panels shall be 20 mm high.
- Where possible, not be fixed to removable panels or doors.

Each cubicle shall also be provided with labels of similar wording at the back of the cubicle.

The manufacturer shall consider the wording on the drawings as preliminary only and shall obtain the correct final wording from the Employer's Agent before the labels are manufactured.

All equipment situated inside the boards, e.g, contactors, relays, fuses, timers and time switches, shall be clearly labelled indicating function and circuit controlled.

Typical labels are as follows:

- Cabinet: cabinet description.
- Incoming cables/busbar: size and origin.
- Main disconnector: "main switch" and danger notice.
- Local disconnector: "local switch" and danger notice.
- Fuses and combination fuse switches: circuit designation and fuse rating.
- Circuit breakers: circuit designation and overcurrent adjustment where applicable.
- Earth leakage protection units: circuit designations.
- Contactors, relays, time-switches, timers, control fuses, etc: designation of control circuit and circuits controlled, function and fuse ratings.
- Push buttons: circuit designation and function.
- Indicating lamps: circuit designation and condition.
- Instruments and selector switches: circuit designation and phase colour.
- Meters (kVA and/or kWh): circuit designation and phase colours where applicable, reading description, and a single multiplication factor for each reading.
- Terminal blocks: terminal designations and function.
- Current transformers: ratios and terminal designations.

C3.12.21.3 Legend Cards for Distribution Boards or Cubicles and Motor Control Centres:

An index card shall be installed in a holder, with a 2 mm thick transparent acrylic panel, which shall be screwed or welded inside a door, or where no doors are fitted, to the front plate of the cabinet. The legend card shall list the outgoing circuit designations in accordance with the layout and schematic drawings, functions and outlet locations.

C3.12.22 WIRING AND CABLE TERMINATIONS AND TEST TERMINAL BLOCKS

C3.12.22.1 General

Electrical terminal blocks shall comply with the relevant codes and specifications and shall be indelibly marked as stated in this specification in respect of ratings, conductor sizes and identification symbols.

Terminal metal parts, bolts and screws shall be of non-corrosive material, enclosed in fire resistant, moulded plastic insulating bodies. No metal part shall project beyond the insulating material to ensure protection against accidental contact by personnel, against short circuits and tracking.

The terminal blocks shall have a temperature rating of at least -50˚C to 100˚C for indoor and outdoor switchgear.

C3.12.22.2 Rail-Mounted Wiring Terminal Blocks

The construction of the terminal blocks and mounting rail shall be of robust construction as to ensure a firm and positive location of the terminal blocks. It shall be possible to add additional terminal blocks or replace blocks within the terminal sequence without having to disconnect or dismantle the terminal block or adjacent terminal blocks, or having to loosen any fastening device at the rear of the mounting rail. The terminal blocks shall be held in position by means of an end barrier or a shield to insulate the open end.

It shall be possible to use terminals for different sizes of conductors on the same mounting rail. Where smaller terminal blocks occur adjacent to larger terminal blocks, suitable shielding barriers shall be inserted to cover the terminals that might otherwise be exposed.

Terminals shall be sized and rated to match the conductors that are connected to them.

Each terminal blocks shall have provision for clip-in numbering or labelling strips to be installed, together with clear protective caps and shall be clearly marked in accordance with the Board Manufacturer's drawings and wiring diagrams.

All outgoing circuits of the switchboards shall be provided with suitable terminal strips of the shoe clamping type, a rating of at least 15A and wired in such a manner that all incoming cables installed at the site can easily be connected. Terminals which rely on pinch screws rotating on wire strands shall not be acceptable.

Terminal strips for auxiliary power, control alarm and trip circuits etc. shall be kept separate to ensure that cables can be made off without disturbing power cables.

Full details and samples of terminal strips shall be submitted to the Employer’s Agent for prior approval.

Petroleum-jelly filled pilot cables shall be terminated and jointed in moisture-proof, blocking type terminations/joints which shall prevent the ingress of moisture, as well as the escaping of petroleum-jelly from the cable. Epoxy-filled terminations and joints will be acceptable. However, prior approval of terminations and joints shall be obtained from the Employer’s Agent.

C3.12.22.3 Power Cable Terminals

The terminal strip shall consist of a metal mounting strip onto which cable connecting modules are fixed. The terminals for power cables shall have bolt fixing, complete with arc shields and suitably rated for the applicable cable sizes. For cables up to and including 10 mm², clamp type terminals may be provided, but the type where the clamp screws are in direct contact with the conductor will not be acceptable.

The terminals for power cables shall be large enough for the terminating lugs of the cable sizes specified.

Terminals for power circuits, including the neutral connection, shall be arranged in a straight horizontal line with adequate clearance between live and earth connections with the cable lugs fitted. Rigid barriers, not the thin flexible type, shall be provided between terminals.

Diagonal or vertical arrangement of terminals for power circuits will not be accepted.

Where aluminium core cables are used, suitable tinned, copper or aluminium lugs with Densal paste shall be used for the termination.

The cost for the supply and delivery of lugs and paste shall form part of the price for the erection of the cabinets.

The terminal strip for power cables shall be positioned at least 50 mm from the gland plate. The terminals to which a cable will be connected, shall be directly above/below the specific cable gland for bottom/top entry respectively.

Where terminals are mounted more than 400 mm from the gland plate, provision shall be made for bracing and for fixing the leads of smaller cables to prevent vibration.

The terminals of each individual circuit shall be clearly labelled with the circuit name and number.

C3.12.23 GLANDS AND GLAND PLATES FOR PVC AND PILOT CABLES

C3.12.23.1 Glands

Mechanical cable glands and flameproof glands shall comply with the relevant codes and specifications.

Glands shall be weatherproof, dust ignition proof, hose-proof or for use on type 'e' enclosures i.e, use in explosive gas atmospheres.

Glands shall be provided with brass locknuts and double outer sealing in corrosive environments. Areas which are classified as highly corrosive shall be equipped with H-C (Hydrocarbon resistant) or UV-C (Ultra-Violet and chemical resistant) seals as may be applicable.

Glands and components shall be manufactured of non-corrosive material such as nickel plated brass.

Adjustable cable glands of the correct size designation shall be provided in switchboards for all cable types as specified.

Glands shall be equipped with cable or armour gripping devices as may be applicable and shall be constructed to ensure electrical earthing continuity between the armour of the cable and the gland plate or the metallic structure. Glands shall be provided with an earthing bond attachment of acceptable rating.

It shall be possible to convert glands for armoured cables to be suitable for unarmoured cables by replacing the cone bush and compression ring with a rubber compression bush and rings.

Where cables with metal screens or metal sheaths are specified the gland shall be designed to earth the screen or sheath through the gland on the earth bar. It shall be possible to bring earth continuity conductors through glands for ECC cables without having to cut grooves in the barrel or cone bush. Suitable replacement parts shall be used.

Glands for outdoor use shall be equipped with a waterproofing shroud and an inner seal kit.

All pilot cable ends shall be made off in glands as prescribed by the manufacturer, of correct size and complete with neoprene shrouds if used outdoors at minisubs or outdoor cubicles. The armouring shall be clamped between substantial tapered sections, which form an integral part of the gland, secured by lock nuts to give a earth connection.

C3.12.23.2 Gland Plates

Gland plates for cable entries to boards will be from above and/or from below as specified on the drawings.

Gland plates shall be at least 200 mm above the normal floor level.

Gland plates shall be from non-magnetising material where single core cables are terminated to the boards.

C3.12.24 CIRCUITRY

C3.12.24.1 Minimum Sizes

The following minimum wiring and cable sizes apply, unless otherwise specified***:

- PVC-insulated wiring and cabling for single-phase power and lighting - 2,5 mm²
- PVC-insulated wiring and cabling for signal, control, alarm and communication - 1,5 mm²
- PVC/PVC/SWA/PVC cabling for three-phase circuits - 1,5 mm²

C3.12.24.2 Neutral Conductor

A neutral conductor, equal in size to the phase conductors shall be run to each three-phase outlet and appliance unless otherwise specified.

C3.12.24.3 Segregation of Circuits

Separate wireways, or separate compartments of multi-compartment wireways shall be provided for the following circuits:

- normal power and lighting circuits
- emergency power and lighting circuits
- standby power and lighting circuits
- low voltage (50 V to 1 000 V) control, instrument, signal and alarm circuits
- extra low voltage (up to 50 V) control, instrument, signal, alarm, fire detection, intercommunication circuits

C3.12.24.4 Identification Colours

The following colours shall be used to identify wiring and cable cores:

- red phase of three-phase circuits - red
- white phase of three-phase circuits - white
- blue phase of three-phase circuits - blue
- live of single-phase circuits - red
- neutral - black
- earth - green/yellow
- alarm circuits - orange
- AC control circuits - red
- DC control circuits - blue
- instrument circuits - grey

Where the colour of conductor insulation is unobtainable, correctly coloured sleeves shall be fitted to each end of the conductor.

Three-phase circuits shall be terminated with the red phase on the left, white phase central and blue phase on the right viewed from the front of the switchgear.

C3.12.25 EARTHING

C3.12.25.1 General

The design and installation of an earth electrode system shall be carried out in accordance with the relevant codes and specifications. The installation and extraneous conductive parts shall be bonded by means of earth conductors to the earth electrode via an earth bar.

C3.12.25.2 Earth Electrode

An array of earth rods shall be interconnected with 70 mm² bare, stranded copper conductors buried 700 mm underground. The earth rods shall be spaced at least 1,5 m apart and not less than the depth of the rods below final ground level.

The array of earth rods shall consist of five rods, four in the form of a 3 m square with a fifth in the centre. The interconnections shall form the sides of the square and shall form a cross thus connecting the centre earth rod.
Once all the rods have been fully installed, the copper conductor shall be laid and exothermically welded to the exposed head of each rod. The copper conductor shall then be pinned to the bottom of the slot and the slot then filled with approved clean, compacted river sand.

The tails of the copper conductor shall be run in a PVC conduit between the point where the conductor tails rise from the slot in the blinding and the main earth bar. The conduit shall be cast into the building structure.

At each corner of the building near the corner "Copperweld" rod, a 2 m long copper wire tail shall be exothermically welded to the foundation earth conductor. The free end of each tail shall be run to a position beyond the outer edge of the concrete around the building and so arranged for easy retrieval. These positions shall be clearly marked on the record drawings.

Earth Mat

An earth mat shall comprise 70 mm² bare, stranded copper conductors buried underground at a depth of at least 700 mm below finished ground level in the form of a flat spiral of 24 turns spaced *25 mm from each other thus approximate a circle of 1,75 m diameter.*

C3.12.25.3 Earth Bar

An earth bar shall be installed in each LV switchroom for the bonding of the earth electrode, main distribution board earth bar, water mains, any supplier's earth terminal, any transformer's neutral terminal and tank earth terminal and any HV switchgear frame.

The earth bar shall comprise a 50 mm x 6,3 mm copper section 500 mm long with pre-drilled 10 mm holes for connection bolts and shall be mounted in the cable trench on spacers away from the wall.

Earth conductors shall be connected to the earth bar by means of soldered or crimped lugs and 10 mm diameter cadmium-plated steel bolts.

The earth conductors to the earth bar from the main distribution board, earth electrode, water mains, and transformer tank shall comprise 70 mm² bare stranded copper conductor. The earth conductor to any transformer's neutral terminal shall comprise a 70 mm² PVC-insulated copper conductor.

C3.12.25.4 Earth Electrode Resistance Measurement

Once the earth electrode has been installed, and before it becomes inaccessible, its resistance shall be measured by an earthing and lightning protection specialist and the Contractor shall immediately confirm in writing to the Employer’s Agent, the measured resistance value. If the resistance exceeds 1 (one) ohm, the earthing and lightning protection specialist shall provide advice regarding further electrode enhancement that may be required. An earthing specialist shall install additional earthing components where required and measure the new earth resistance after the new earth mat has been installed, and submit a certificate of compliance with this specification and the relavant standards to the Employer’s Agent.

C3.12.25.5 Earth Continuity

Earth continuity conductors shall be provided to earth outlet and each metallic appliance and luminaire.

The earth continuity conductors shall be separate bare or green PVC insulated copper conductors when associated with wiring in wireways.

2,5 mm² Earth continuity conductors shall be green/yellow PVC-insulated.

With a multi-core cable circuit, the earth continuity conductor may be a separate core of a multi-core cable identified with green sleeves at each end.

Where earth continuity conductors are looped between outlets, the looped ends shall be twisted and ferruled *without breaking the electrical or mechanical continuity of the earth conductor.*

C3.12.25.6 Equi-Potential Bonding

All accessible extraneous parts of electrical equipment / electrically-driven equipment and other conductive elements shall be bonded in accordance with SANS 10142-1.

Where applicable, the water main shall be bonded to the earth bar but where non-metallic water pipes are used the metallic water meters and/or valves shall be bonded to the earth bar.

Metallic cold and hot water pipes, waste pipes, sanitary appliances, ventilation pipes and ducts shall be bonded by means of 12 mm x 0,8 mm solid or perforated copper tape (not wire) clamped by means of brass screws and nuts.

Metallic roofs, gutters and downpipes shall be bonded to earth by means of 12 mm x 0,8 mm solid or perforated copper tape (not wire) clamped by means of galvanised bolts and nuts.

Self-tapping screws may not be used for any earthing or bonding functions.

Copper bonding conductors shall be routed on the outside of the building in securely fixed galvanised conduits from 2 000 mm above ground level to 300 mm below ground level.

All bonding shall be completed work before painting commences.

C3.12.25.7 Testing

The following tests shall be carried out and the results submitted to the Employer's Agent before any paving is carried out over the earth conductor:

- Measure the resistance between the earth electrode and the mass of the earth by one of the methods described in the relevant codes and specifications.
- Test the earth and bonding continuity in accordance with the Wiring Code.

C3.12.25.8 Earthing of Fences

The fence of outdoor transformer and/or switchgear installations shall be earthed by means of a 70 mm² bare, stranded copper conductor 400 mm below ground level and 500 mm outside the fence around the whole perimeter of the fence. At each corner, the perimeter conductor shall be bonded to the fence pole and to a 1,8 m earth rod by means of a 70 mm² bare, stranded copper conductor.

The perimeter conductor shall be bonded to the main earth bar by means of a 70 mm² bare, stranded copper conductor.

C3.12.26 WIREWAYS

C3.12.26.1 General

Metallic wireways shall be electrically continuous and the maximum resistance between any two parts shall not exceed 1 ohm.

Wireways shall be mechanically continuous providing a degree of protection of at least IP3 X (that is providing protection against the entry of solid objects exceeding 2,5 mm diameter).

Conduit installations shall provide a degree of protection of IP44 i.e, dust and splashproof. Exterior conduit installations shall provide a degree of protection of IP65 i.e, dust-tight, and hose and weather proof.

Where cabling is to be installed afterwards by others, galvanised steel draw wires shall be provided in the wireways.

Metallic wireways shall be installed at least 160 mm, and non-metallic wireways at least 300 mm, away from gas, steam, hot water or similar piping. Wireways shall be prevented from contacting piping so as to avoid electrolytic corrosion.

C3.12.26.2 Conduits

No conduit may be smaller than 20 mm diameter.

Galvanised Steel Conduit

Galvanised steel conduit shall comply with the relevant codes and specifications for screwed metal conduit and plain ended metallic conduit and shall be hot dipped galvanised to the relevant codes and specifications.

PVC Conduit

PVC conduit shall comply with the relevant codes and specifications and shall be installed strictly in accordance with manufacturer's recommendations. All PVC conduit and associated fittings and accessories shall from the same manufacturer.

PVC conduit may only be used strictly in accordance with the requirements of SANS 10142 and where:

- Specifically noted or permitted by the Employer’s Agent,
- Not exposed to temperatures in excess of 50°C,
- Not exposed to mechanical damage, and
- Not used to support any loads.

Flexible Conduit

Flexible conduit shall comply with the relevant codes and specifications and shall be constructed of metal-reinforced self-extinguishing plastic metallic flexible conduit with a sheath of self-extinguishing plastic. The internal diameter shall not be less than 15 mm. Flexible conduit connectors shall securely grip the conduit and be manufactured of zinc, or cadmium plated steel, or brass.

Where flexible conduit is run in ceiling spaces which form air conditioning plenums, the flexible conduit shall be of galvanised, corrugated steel construction with no PVC components.

Flexible conduit shall terminate on a conduit box unless a draw box exists within 2 metres.

C3.12.26.3 Installation of Conduits

The interior surface of conduits shall have no sharp protrusions. Brass bushes shall be fitted to steel conduit ends. Metallic conduit installations shall be bonded to earth such that earth continuity does not exceeding 1 ohm. Lock nuts shall be fitted to running joints. Open conduit ends shall be plugged to prevent the ingress of dirt and moisture.

Concealed Conduit

Unless otherwise specified, conduits shall be concealed by being cast into concrete or built into brick or blockwork as applicable. Chasing may only be carried out with the express permission of the Employer's Agent and the civil/building contractor.

Conduits in structural concrete shall be located as close as possible to the neutral axis of the concrete section and shall be secured to prevent movement during concreting.

Surface mounted Conduit

Where surface mounted conduit is specified, it shall be fixed with spacer bar saddles. The maximum distance between saddles shall not exceed 2 m for steel conduit and 1 m for PVC conduit. A saddle shall be installed within 100 mm of a conduit box.

Labels shall be removed from surface mounted conduit.

Routing of Conduit

Conduit in roof spaces, ceiling voids and exposed areas shall be routed parallel and at right angles to structural elements with no diagonal routing.

Wherever possible, conduits shall be run in straight lines with easy curves and shall be drained. Manufactured bends except for 50 mm diameter conduit, and joints at bends, shall be avoided. The minimum radius of a bend shall be four times the conduit diameter.

Terminations of Conduit

Conduits to luminaires, appliances, conduit boxes and bonding trays shall be terminated as follows:

- Concealed Steel Conduit - with two locknuts and a brass bush, or, with one locknut and a brass bush nut.
- Surface mounted Steel Conduit - with a coupling on the outside and a locknut and a brass bush or a brass bush nut on the inside.
- PVC Conduit - with a PVC threaded adapter and lock nut with no stress on termination.

Corrosion Protection of Conduits

Exposed running threads of galvanised steel conduit shall be painted with two coats of zinc-rich paint.

All conduits cast into concrete shall be positioned so that there will be at least 25 mm of concrete cover.

Where the galvanising of galvanised steel conduit is damaged, he surface shall be lightly abraded and painted with two coats of zinc-rich paint.

Future Extensions

Galvanised steel conduit shall be installed where future extensions are required. In roof spaces, conduit stubs shall be terminated 40 mm above tie beams and with a minimum clearance of 900 mm.

Where conduits are exposed, the surface shall be lightly abraded and two coats of zinc rich paint shall be applied.

In concrete, conduits shall be terminated 150 mm beyond the concrete in the required direction and a draw box shall be provided within 2 metres. Conduit ends shall be threaded and a coupling and brass plug shall be screwed on.

C3.12.26.4 Conduit Boxes

Conduit boxes and their cover plates shall comply with the relevant codes and specifications as applicable. Strong mounting lugs and sufficient conduit knockouts shall be provided.

Metallic conduit boxes may be malleable iron or pressed steel and shall be galvanised where used with galvanised steel or PVC conduit.

Where conduit boxes are installed externally, they shall be galvanised, primed and painted steel, or malleable iron, or of suitable non-metallic construction and shall be dust, hose and weatherproof to IP65.

Where the temperature may exceed 60°C, for instance where incandescent or other luminaires are mounted against an outlet box, ordinary PVC boxes shall not be installed but steel, or heat-resistant non-metallic boxes shall be installed.

Blank Cover Plates

Blank cover plates shall be fitted to draw boxes and unused outlet boxes

The finish of blank cover plates to wall-mounted boxes shall match that of switch and socket outlet plates.

Cover plates shall be installed to ceiling-mounted boxes so as to finish flush with the ceiling – they must be installed before painting of ceilings commences.

Suitable brass cover plates shall be installed to floor-mounted boxes to finish flush with the floor finish. The brass cover plates shall be sufficiently thick and reinforced to be rigid, shall be secured with countersunk brass screws and shall be sealed with a gasket

Non-metallic cover plates shall be fixed with nylon screws to PVC conduit boxes.

Where boxes have been installed with fixing lugs below the finished wall surface, spacers of coiled steel wire or of pipe as necessary shall be fitted.

Draw Boxes

Draw boxes to facilitate the drawing in of cables shall be provided and particularly after 180° of bends, and after every 15 m of straight runs.

Draw boxes shall be located so as to avoid detracting from the appearance of the building. The location of draw boxes shall be subject to the approval of the Employer's Agent.

Where several conduits on the same route require draw boxes a single, large draw box shall be provided.

Expansion Joints

The location of structural expansion joints shall be ascertained and conduit expansion joints shall be installed where conduits have to cross structural expansion joints.

The conduit expansion joints shall be arranged with a draw box.

Where several conduits on the same route cross a structural expansion joint, a single, large draw box shall be provided.

The gap between the inner conduit and outer conduit sleeve shall be sealed with a suitable sealing compound.

Conduit Boxes related to Architectural Features

Where conduit boxes are to be mounted on wall or ceiling panels, tiled surfaces, panelling or other finishes, the Contractor shall ensure that such boxes are installed symmetrically by measurement and co-ordinating such positions on site. It will not be sufficient to scale such positions off the drawings.

Where several outlets are close to each other, they shall be aligned and spaced evenly.

C3.12.26.5 Trunking

Metallic trunking shall comply with the relevant codes and specifications.

Steel trunking shall be manufactured of at least 1,6 mm thick steel and galvanised to the relevant codes and specifications as appropriate. Where painting is required, the surface shall be lightly abraded and painted with an approved primer followed by two coats of high gloss enamel paint. All painting shall be done in accordance with the relevant codes and specifications.

Where steel trunking is cut to length on site, the edges shall be rendered smooth, the surface lightly abraded and painted with an approved primer followed by the reinstatement of the paint system.

Light steel trunking may only be installed where specified and shall be manufactured of are least 0,8 mm thick steel epoxy polyester powder coated to the relevant codes and specifications.

Unless otherwise specified, bridges of 32 mm dia. conduit shall be for each compartment between trunking routes and between trunking and distribution boards, telephone and communications panels.

Aluminium trunking shall be anodised to the relevant codes and specifications.

Installation

Trunking shall be installed complete with end caps, outlets, internal splices, covers, internal partitions, two clips, knockouts, adaptors, cable retainers, suspension rods, fixings, brackets, clamps, hangers, nuts, bolts, washers, screws and all other accessories required to complete the installation.

Cable retainers shall be installed at spacings of not more than 1 metre.

At changes of direction (elbows, tees, cross-overs, etc.), internal splices and exterior covers shall be provided to present a smooth appearance.

Snap-in covers may be used on trunking up to 70 mm wide. Trunking wider than 70 mm shall be fitted with machine screws secured with retained nuts at sufficient points to prevent distortion of the cover.

Trunking shall be supported to prevent deflection beyond 1/180th of the span or 3 mm whichever is the lesser.

Partitions shall be provided to separate different services as required.

Power Skirting

Power skirting shall have 3 partitioned compartments unless otherwise specified.

Power skirting shall allow access to the telephone compartment without any danger of contact with live parts.

Provide cabling throughout power skirting and with sufficient slack to facilitate the addition and repositioning of outlets.

Power skirting shall be finished in the scheduled colour.

Underfloor Ducting

Underfloor ducting shall have 3 partitioned compartments unless otherwise specified.

Outlets shall allow access to the telephone compartment without any danger of contact with live parts.

Samples, shop drawings and complete technical literature with approvals, shall be subject to the approval of the Employer’s Agent.

Underfloor ducting shall be installed within an accuracy of ± 12 mm from the positions shown on the drawings and it is a requirement that dimensioned "as-built" drawings of the installation be prepared by the Contractor.

Underfloor ducting shall be installed complete with elbows, tees, cross-overs, outlets, outlet pedestals, end caps, adapters, fixings, and all other accessories required to complete the installation.

Cabling throughout underfloor ducting shall be provided with sufficient slack to facilitate the addition and repositioning of outlets.

The installation shall provide a degree of protection of IP 67 i.e, dust and watertight to SANS 60529 and be watertight to 12 mm water gauge.

Building Elements as Wireways

With the express approval of the Employer's Agent, suitable building elements, such as hollow mullions may be used as wireways provided that:

- The wiring is not exposed,
- Metallic building elements are bonded to earth,
- The building elements are non-inflammable or self-extinguishing, and
- Re-wireability is facilitated.

C3.12.27 WIRING IN WIREWAYS

Unless otherwise specified, wiring shall comprise copper conductor PVC-insulated cable complying with the relevant codes and specifications bearing the SANS mark and rated for 660 V general service.

PVC-insulated cable may only be used where the ambient temperature does not exceed 50°C. Heat-resisting cable complying with SANS 5513 shall be used where temperatures exceed 50°C and where directly terminated to a water heater, or any other appliance or luminaire which operates at temperatures in excess of 50°C.

Care shall be taken not to apply excessive tension to wiring when drawing in and not to cut or abrade cabling.

Where wiring is installed in trunking, the Contractor shall ensure that it is located in its appropriate compartment to prevent cross-overs. Cables shall be strapped together in groups of not more than ten at spacings not exceeding 1 000 mm by means of suitable strapping.

No joints may be made in PVC/insulated cable except at the distribution board, outlet, appliance or luminaire. Any joints specified or permitted by the Employer's Agent shall comprise sufficiently rated brass terminals in porcelain-insulated shrouds.

Wiring shall be installed in wireways after the completion of wireway installation and plaster work but before painting has commenced.

Not more than two circuits of a similar nature will be allowed in one conduit unless otherwise specified.

The wiring of circuits shall be arranged in the loop-in system and not more than four cable ends may be terminated at a termination point.

Cutting away of cable strands or insulation is not permitted.

Where installed in vertical wireways, the weight of the wiring shall be supported by means of clamps at spacings not greater than 5 m. In conduits, such clamps shall be located in conduit boxes.

Where wireways pass through a fire wall, a fire barrier shall be provided.

C3.12.28 CABLE TRAYS AND LADDERS

C3.12.28.1 General

All steel cable trays and ladders shall be galvanised.

Where painting is required, an approved primer followed two coats of high gloss enamel paint to SANS 630, or apply an epoxy-polyester powder coating to SANS 1274 shall be applied.

Cable trays and ladders and their accessories shall be pre-manufactured. On site fabrication will not be allowed without the express permission of the Employer's Agent. Where standard lengths are cut on site, the cut edges shall be rendered smooth, the surface lightly abraded and painted with two coats of zinc-rich paint and if painted, reinstate the paint system.

C3.12.28.2 Installation

Cable trays and ladders shall be installed complete with cross-overs, tees, reducers, bends, elbows, cornices, splices, traying arms, fixings, brackets, "unistruts" or similar approved, clamps, hangers, nuts, bolts, washers, screws and all other accessories required to complete the installation.

Cable trays and ladders shall be supported to prevent sagging beyond 1/180th of the span or 3 mm whichever is the lesser. Each length shall be supported in at least two places along the length. The diameter of expanding bolts, studs, etc., and nuts, bolts and patent fixings, etc., securing the trays and ladders shall not be less than 10 mm.

C3.12.28.3 Heavy Duty Cable Ladders

Cable ladders shall, unless otherwise specified, be heavy duty manufactured of sheet steel at least 2,0 mm thick with shoulders at least 75 mm high. Cable ladders and accessories shall be hot-dip galvanised to SANS 121.

Rungs shall be spaced at intervals not greater than 300 mm. Bends, tees, elbows, cross-overs and reducers shall have minimum radii of 450 mm.
Cable ladders on shall be supported on approved traying arms of length to suit ladder width and fitted with end caps.

Cable ladder lengths over 3 m shall be supported in at least three places along the length.

Bolts, nuts and washers securing splice pieces shall be at least 6 mm diameter.

Where cable ladders ramp slightly so that a bend is not required hinged splice pieces hinging on 8 mm nuts, bolts and washers and with radiused corners shall be provided.

C3.12.28.4 Light/Medium Duty Cable Ladders

Light/Medium duty cable ladders may only be installed where specified or where expressly permitted by the Employer's Agent. These cable ladders shall be manufactured of sheet steel with shoulders comprising 41,3 mm x 10 mm x 1,6 mm pressed steel channels. Cable ladders and accessories shall be hot dip galvanised to SANS 121. Rungs shall be spaced at intervals not greater than 300 mm. Bends, tees, elbows, cross-overs and reducers shall have minimum radii of 300 mm. Cable ladders shall be supported on traying arms GKN or approved alternative of length to suit ladder width and fitted with end caps. Cable ladder lengths over 3 m shall be supported in at least 3 places along the length. Changes of direction shall be undertaken with manufactured elbows hinged horizontal splices or hinged vertical splices. Bolts, nuts and washers securing splices shall be at least 10 mm diameter.

The hinge pin of the hinged horizontal splice shall be at least 8 mm diameter.

Hinged horizontal or vertical splices may be used for elbows and bends up to 45°. Manufactured elbows and bends shall be used for elbows and bends over 45°.

C3.12.28.5 Heavy Duty Cable Trays

Cable trays, unless otherwise specified, shall be heavy duty manufactured from perforated sheet steel at least 2,5 mm thick with shoulders at least 75 mm high. Heavy duty cable tray and accessories shall be hot-dip galvanised to SANS 121.

Cornices shall be provided at changes of direction to allow minimum bending radii of cables.

Heavy duty cable trays on shall be supported on approved traying arms of length to suit tray width and fitted with end caps.

C3.12.28.6 Light/Medium Duty Cable Tray

Light/Medium duty cable trays may only be installed where specified or where expressly permitted by the Employer's Agent and shall be manufactured from perforated sheet steel at least 1,2 mm thick with shoulders at least 20 mm high. Light duty cable trays and accessories shall be galvanised to SANS 10684.

Cornices shall be provided at changes of direction to allow minimum bending radii of cables.

Light duty cable trays shall be supported on approved traying arms of length to suit tray width.

C3.12.29 ACCESSORIES - LIGHT SWITCHES AND SOCKET OUTLETS

C3.12.29.1 Light Switches

Wall switches shall comply with SANS 60669 and bear the SABS mark and shall be of the tumbler-operated microgap type. Samples shall be submitted to the Employer's Agent and will be subject to his/her approval.

Wall switches shall be rated for 250V 16 A and shall be installed with the centre 1 350 mm above finished floor level

Switch boxes and cover plates shall comply with SANS 60669.

Multiple switches may be allowed only if the switches control the same circuit. Switches controlling separate circuits on different phases shall be installed in separate boxes.

Switch toggles or rockers shall operate in a vertical direction.

Where indicating lights are specified, they shall form an integral part of the switch and shall have neon lamps or light-emitting diodes.

Metallic switch plates shall be secured with two chromium plated countersunk screws. Non-metallic switch plates shall be secured with two nylon countersunk screws.

Flush Wall Switches

Where conduit is routed flush, flush wall switches shall be built into conduit boxes.

Surface-mounted Flush-Pattern Switches

Where flush-pattern switches are to be mounted on the surface they shall be mounted in 100 mm x 50 mm or 100 mm x 100 mm by 35 mm deep extension boxes.

Industrial Surface-mounted Switches

The box and cover plate shall be constructed of steel and fitted together to make a dustproof assembly, IP44 to SANS 60529. The switch toggle or rocker shall be shrouded where it protrudes through the cover plate.

Where required, dustproof industrial surface-mounted switches shall incorporate hinged and sprung dust-proof flaps over the switches.

Hose-proof Switches

Switches designated hose-proof, weather-proof or waterproof shall be of non-metallic construction and hose-proof to IPW65 of SANS 60529. Operation may be rotary, or rocker through a membrane.

Ceiling Switches

Ceiling switches shall be rated for 250 V 10 A amp shall be installed on a round conduit box. The base shall be bakelite and the cover of bakelite with a brass screw ring insert.

A 1,25 m length of nylon cord shall be provided.

C3.12.29.2 Socket Outlets

General

Socket outlets shall comply with SANS 60884 and bear the SABS mark. All socket outlets shall be earth leakage protected. Samples shall be submitted to the Employer's Agent and will be subject to his/her approval.

Unless otherwise specified, socket outlets shall be rated for 250 V (phase to neutral) 16 A, shall be switched and have safety shutters on the phase and neutral contact tubes.

Where indicating lights are specified they shall form an integral part of the socket outlet and shall have neon lamps or light-emitting diodes.

Socket outlets shall be installed with the centres at the following heights above finished floor level unless otherwise specified on the drawings.

- Generally, unless otherwise specified : 300 mm
- Hospitals, clinics etc. : 450 mm
- Kitchens, laboratories, industrial areas, plant rooms
- and over work tops : 1 200 mm

Metallic socket outlet plates shall be secured with two countersunk chromium-plated screws. Non-metallic plates shall be secured with two countersunk nylon screws.

Flush Single-phase Socket Outlets (16 A)

Flush single phase socket outlets shall be rated for 250 V 16 A and shall incorporate three contact tubes. They shall be mounted in 100 mm x 100 mm conduit boxes.

Surface-mounted Flush-pattern Single-phase Socket Outlets

Where flush-pattern single-phase socket outlets are to be mounted on the surface they shall be mounted in 100 mm x 50 mm or 100 mm x 100 mm extension boxes.

Industrial Surface-mounted Single-phase Socket Outlets

The box and cover plate shall be constructed of steel and fitted together to make a dust-proof assembly, IP44 to SANS 60529. The switch toggle or rocker shall be shrouded where it protrudes through the cover plate.

Where required, dust-proof industrial surface-mounted socket outlets shall incorporate hinged and sprung dust proof flaps over the switches and contact tubes.

Moulded Case Circuit Breaker Single-phase Socket Outlets

The socket outlets shall comprise a miniature circuit breaker and a 250 V, 16 A three contact tube socket outlet mounted in a standard 100 mm x 100 mm box. The miniature circuit breaker shall be rated at 16 A unless otherwise scheduled.

Hose-proof Socket Outlets

Socket outlets designated hose-proof, weather-proof or water-proof shall be hose-proof to IPW65 of SANS 60529 when the plug is removed and with the plug inserted.

Three-phase Socket Outlets

Three-phase socket outlets shall be 380 V, 6 h pattern with five contact tubes for three-phases, neutral and earth. Each outlet shall incorporate a switch which can only operate with the plug inserted. Unless otherwise specified, the outlets shall be rated at 16 A.

Stove Connectors

Stove connectors shall be rated for 433/250V, 15 A with four contact tubes for three-phases and neutral. Earth continuity shall be provided through the metallic casing of the socket outlet to the metallic casing of the plug by means of a screwing ring.

Stove connectors shall comply with the Appendix referred to in SANS 10142-1.

5 A Single-phase Socket Outlets

5 A single-phase socket outlets shall be unswitched, rated for 250 V, and have three contact tubes with shuttered live and neutral tubes. The socket outlets may be mounted in pre-punched trunking, 63 mm diameter, 100 mm x 50 mm or 100 mm x 100 mm conduit boxes.

Shaver Socket Outlets

Shaver socket outlets shall comply with SANS 60884 and shall incorporate a double-wound isolating transformer rated at least 20 VA and providing 115 V and 230 V.

The socket contacts shall be suitable for 115 V North American pattern plug tops and 230 V European pattern plug tops. Insertion of a plug top shall switch on the transformer primary and removal of the plug top shall switch it off.

Overload protection shall be included.

13 A Single-phase Socket Outlets

13 A single-phase socket outlets shall comply with SANS 60884.

C3.12.29.3 Isolators (Switch Disconnectors) For Building Services Applications

Isolators shall comprise air-break switch disconnectors complying with SANS 60947-3 and shall be double-pole for single-phase circuits and triple-pole for three-phase circuits, rated for 433/250 V.

The current rating shall be 63 A unless otherwise specified.

Isolators for single-phase appliances with loads less than 2,5 kVA may have current ratings of 13 A.

Where the final connection from the isolator comprises a flexible cord, the isolator assembly shall incorporate an indicating light, a grommet and cord grip or a compression gland, and a fuse rated to protect the cord.

Metallic cover plates shall be secured with two countersunk chromium-plated screws and non-metallic cover plates with two countersunk nylon screws.

Where indicating lights are specified they shall form an integral part of the isolator assembly and shall have neon lamps or light-emitting diodes.

Isolators up to 63 A current rating shall be installed in 100 mm x 100 mm conduit boxes..

C3.12.30 LUMINAIRES

C3.12.30.1 General

Luminaires shall be installed complete with mounting accessories, brackets, poles, stirrups, baseplates etc.

Luminaires shall include lamps, indicator lamps, control gear, power factor correction equipment, electro-magnetic interference suppression equipment and all other accessories necessary to render the luminaires fully operative.

Luminaires shall not emit electro-magnetic or radio/television interference in excess of the limitations stipulated by SANS 10142-1

Luminaires shall have internal wiring of copper conductors of not less than 0,5 mm², with suitable heat-resistant wiring to SANS 5513. PVC insulated wire shall not enter luminaires with polycarbonate components. A terminal block shall be fitted to each luminaire.

Luminaires shall each have an earth terminal and shall be bonded to earth.

Each luminaire shall be labelled next to the lamp holder and on the control gear with the following information:

- voltage rating
- lamp type
- lamp wattage (for incandescent lamps, the maximum wattage).

Control gear shall be power factor corrected to at least 0,9 lagging, shall have a circuit efficiency of not less than 0,85 and shall be silent in operation.

On request of the Employer's Agent, the Contractor shall submit luminaire details (including photometric data, and noise level reports) prepared by an accredited laboratory.

On request of the Employer's Agent, the Contractor shall remove any luminaire from site and submit that luminaire(s) to tests required by Employer's Agent.

Luminaires shall be designed and installed to avoid excessive temperatures. Components and materials shall be so selected that they are not adversely affected by the operating temperature.

The harmonic distortion of a lamp circuit shall not exceed 30%.

C3.12.30.2 Installation

Luminaires shall be:

- Installed in accordance with the manufacturer's recommendations.
- Mounted after the first coat of paint has been applied and the installation completed after the final coat of paint has been applied.
- Fixed at the centre and two outer positions if equal to or narrower than 225 mm.
- Fixed and at the four corners if wider than 225 mm at the centre.
- Fixed together with brass bushes and lock nuts where they but against one another.

Conduits shall be connected directly to exterior luminaires and to luminaires with a degree of protection in excess of IP44. Gasketting and sealants shall be applied between luminaires and the surface to which they are mounted. For wall-mounted luminaires, the conduit shall enter the luminaire at a slight downward angle to the horizontal.

Where luminaires are mounted on or in ceilings made of panels, the luminaires shall be mounted symmetrically. Where the mass of the luminaires exceeds the load carrying capability of the ceiling systems, suitable hangers shall be installed.

Connections to luminaires mounted on or in ceilings shall comprise metallic conduit, flexible conduit (without a PVC sheath), or silicone rubber flexible cord. All such connections shall be coordinated with the Contractors installing the ceiling, air conditioning and other services.

C3.12.30.3 Exterior Luminaires

Exterior luminaires shall have a degree of protection of at least IPW65 of SANS 60539. Lenses shall be resistant to degradation and discolouration from ultra-violet radiation. Materials shall be corrosion-resistant and selected to avoid electrolytic corrosion. Luminaires constructed of sheet steel or sheet aluminium are not acceptable.

The bodies shall be painted cast-iron, painted, or anodised (Class C) die-cast LM6 aluminium, glass-reinforced polyester, or polycarbonate.

Gaskets shall be silicone rubber or neoprene.

Lenses shall be polycarbonate or heat-resistant glass. Lens, or lens-frame, securing screws shall be stainless steel.

Floodlight luminaires shall incorporate calibrated horizontal and vertical angle scales.

C3.12.30.4 Emergency and Standby Luminaires

Emergency Fluorescent Luminaires (with integral battery)

Each emergency fluorescent luminaire with integral battery shall incorporate a mains failure relay, battery charger, nickel cadmium battery, and inverter which shall provide emergency lighting by means of one lamp operating at 100% light output for at least one hour. The battery charger shall fully recharge the batteries within 24 hours.

Mercury Vapour Luminaires on Emergency and Standby Circuits

Each mercury vapour luminaire on an emergency or standby circuit shall incorporate a mains failure relay, change-over switchgear, a photo switch and quartz halogen lamp. The quartz halogen lamp shall operate on mains failure until the mercury vapour lamp has run up when the photo switch shall extinguish the quartz-halogen lamp.

High-pressure Sodium Luminaires on Emergency and Standby Circuits

Each high-pressure sodium luminaire on an emergency or standby circuit shall have a lamp with a run up time of not less than 20 seconds.

Exit Signs

Each exit sign with integral battery shall incorporate two fluorescent lamps each with its own separate control gear, mains failure relay, battery charger, nickel cadmium battery and inverter which shall provide emergency lighting by means of one lamp operating at 100% light output for at least one hour. The battery charger shall fully recharge the batteries within 24 hours.

Exit sign lettering shall be at least 150 mm high.

Exit signs shall comply with SANS 1186-3. Surface-mounted exit signs shall incorporate an aperture of at least 200 mm x 50 mm with prismatic diffuser to provide downward light.

C3.12.30.5 Fluorescent Luminaires

Interior fluorescent luminaires shall comply with SANS 475.

Three 20 mm diameter knockouts shall be provided in the backplate, one in the centre and one at each end. Each knockout shall have accompanying slots for screws to fit a standard round conduit box and arranged so that the luminaire can be turned through an angle of 90°C. The backplate shall extend the entire length of the luminaire. Luminaires shall be so constructed that it is possible to reach the control gear without disconnecting any wiring and without removing the luminaire from its installed position.

Fluorescent channel luminaires shall consist of a ventilated rectangular wiring channel.

Lenses, diffusers and louvres shall be sufficiently strong and rigid to resist distortion and breakage during normal operation and maintenance.

Lenses, diffusers and louvres shall be constructed of:

- flame-retardant acrylic (methacrylate),
- flame-retardant, UV and light stabilised polystyrene, or
- UV and light stabilised polycarbonate.

Lampholders shall be telescopic or hinged sprung-ratchet.
Lamps shall comply with SANS 1041 and shall have an average life of at least 7 500 hours on a 3 hour on/off switching cycle. On request, the Contractor shall submit to the Employer's Agent the light output of the lamps at 100 hours and 2 000 hours. The light output at 2 000 hours shall not be less than 80% of the output at 100 hours.

No lamp flicker of lamps shall be visible under normal operation after initial stabilisation period of 100 hours. Lamp colour shall be SABS colour reference 2 unless otherwise specified. 18 W, 36 W, and 58 W fluorescent lamps (26 mm diameter) shall be "colour 84" unless otherwise specified

C3.12.30.6 Gas-Discharge Luminaires

Ballasts shall comply with SANS 1266 and shall be cast in epoxy-resin and provided with heat sinks, cooling fins, etc., to limit the operating temperature to avoid any adverse effects on any components.

Interior luminaires shall comply with SANS 475.

Mercury vapour lamps shall be of the colour corrected, high pressure, fluorescent type.

High pressure sodium vapour lamps shall be of the colour enhanced type.

C3.12.31 LIGHTNING PROTECTION

C3.12.31.1 Scope

The following sections of work are to be included in the lightning protection installation.

- Air terminations (other than metallic roofs).
- Down conductors (other than reinforcing steel and metallic columns).
- Earth terminals.
- Earth conductors and associated excavations and backfilling.
- Bonding.

C3.12.31.2 Definitions

"Air termination" means the part of a lightning protective system that is intended to intercept lightning discharges (Air terminations include masts, metallic roofs, roof conductors and finials).

"Down conductor" means a conductor that connects an air termination to the earth terminal.

"Earth terminal" means the above ground terminal of the earthing system.

"Earthing system" means that part of the lightning protective system that is intended to discharge lightning currents into the general mass of the earth.

"Finial" means an air termination consisting of a metal rod with a rounded end.

C3.12.31.3 Compliance with Regulations and Standards

The lightning protection installation shall comply with SANS 62305.

C3.12.31.4 Drawings

The Contractor shall submit to the Employer's Agent, shop drawings showing details of reinforcing steel bonding terminals and will be subject to his/her approval.

C3.12.31.5 Conductors

Conductors above ground may be of copper or of a suitable corrosion resistant aluminium alloy.

Aluminium conductors may not be installed in direct contact with concrete or plaster but shall be installed with suitable insulating sleeves and stand-off brackets.

Aluminium conductors may only be connected to copper with cadmium-plated or heavily tinned connectors.

Copper conductors may only be connected to galvanised steel via a heavily tinned connector above ground.

Underground connections shall only be made between similar metals.

Copper conductors may not be installed in the vicinity of underground galvanised steel services. Similarly, galvanised steel conductors may not be installed in the vicinity of underground copper services.

Stainless steel components shall be of Grade 304 or alternative subject to the approval of the Employer's Agent.

Aluminium may not be installed underground except in short lengths completely protected by a plastic sleeve with both ends above ground and facing downwards.

If any steel components are used they shall be hot dip galvanised to SANS 121.

C3.12.31.6 Conductor Fastenings

Conductors shall be securely fastened at spacings of not less than 1,5 m.

The fastenings shall allow for thermal expansion and contraction and shall be such as to prevent direct contact between aluminium and concrete or plaster.

The fastening system shall comprise components selected to avoid corrosion, and deterioration from weather, ultra-violet radiation, moisture, heat and cold.

C3.12.31.7 Testing

Permanent testing joints shall be provided between each down conductor and it associated earth conductor.

The following tests shall be conducted and the results submitted to the Employer's Agent:

- Earth resistance of earth conductor.
- Continuity of any trench earth.
- Continuity of overhead system by measuring between one down conductor and each of the remaining down conductors with the earth conductors disconnected.

C3.12.31.8 Roof Conductors, Finials and Down Conductors

These shall comprise strip, rod, tube or stranded conductor of at least 50 mm² cross-sectional area, of copper, brass, phosphor-bronze, aluminium, stainless steel or galvanised steel save that galvanised steel, however, may not be used within 50 km of the coast.

C3.12.31.9 Reinforcing Steel Connections

Where reinforcing steel is to be connected to the lightning protective system, a corrosion resistant terminal shall be embedded in the concrete, the terminal being connected internally to the reinforcing steel by means of a robust conductor clamped to the reinforcing steel.

C3.12.31.10 Joints

Lengths of tube, rod or stranded conductor shall be jointed with suitable crimped ferrules.

Lengths of strip shall be jointed by double riveting, two nuts and bolts with washers, brazing, welding, or by clamping. Rivets, nuts, bolts and washers shall be of the same material as the conductor. Self-tapping screws or pop rivets may not be used for any joints.

The surfaces of joints shall be prepared by thorough cleaning and coating with suitable compound. Riveted, screwed or bolted joints shall be painted or coated with compound.

C3.12.31.11 Earth Rods

Single earth rods shall be installed at a depth of at least 1,5 m below final ground level.

An array of earth rods shall be installed at a depth of at least 0,9 m below final ground level.

C3.12.31.12 Bonding

Any metallic objects within 500 mm of a roof or down conductor shall be bonded. Such objects include but are not limited to, antennae, pipes, stairways, balustrades and sunscreens.

At least one earth terminal or down conductor shall be bonded to any metallic water main.

All metallic finials, ducts, vent pipes that are on, or project above the roof, shall be bonded to a roof or down conductor. Any metallic foil or wire netting immediately under the roof shall be bonded to a roof or down conductor at no less than two non-contiguous places.

C3.12.31.13 Antennae Earthing

Antennae shall be bonded via a down conductor to an earth terminal and to any metallic water main.

C3.12.32 TRIPPING AND EMERGENCY LIGHTING BATTERIES AND TRICKLE CHARGERS

C3.12.32.1 Batteries

Trickle chargers and battery cabinets shall be provided as required.

Each set of batteries shall be provided with a separate battery charger.

The battery bank and charging equipment shall be housed in a floor-standing metal-clad cabinet as one unit if nickel cadmium batteries are used. Lead acid batteries shall, however, be housed in separate free-standing treated hardwood racks.

The battery charger shall be connected to a terminal block at the back of the switchgear panel by means of PVC cable and shall be supplied from the voltage transformers where no external supply is available.

No fuses shall be installed in the trip circuits from the batteries to the switchgear panels.

Where spring charging motor and solenoid mechanisms are used, 110 V battery sets shall be provided for the supply of the mechanisms, as well as for tripping and closing coils. 110 V Battery sets shall also be provided for 33 kV and higher voltage substations. In all other cases, 32 V battery sets shall be provided unless otherwise specified.

The battery sets shall be capable of providing the full standing load of all associated equipment during complete failures of the AC supply, for a minimum period of 6 hours, after which period it shall be possible to open and close all circuit breakers once in rapid succession. The battery sets offered shall be fully capable of providing the load requirements of all motors, lamps, relays, coils, etc.

Lead acid battery sets shall be housed in a hard-wood cabinet, finished in alkaline or acid resistant paint, whichever is applicable. The cells shall be so arranged that the electrolyte is clearly visible and to allow for easy maintenance of the batteries.

All batteries shall be of the Ni-cad type unless otherwise specified.

The batteries are to be contained in non-corrodible transparent cases to enable electrolyte levels to be easily checked, with high and low level marks clearly visible.

C3.12.32.2 Charging Equipment

Rectifier

The unit shall comprise a double wound transformer with solid state type rectifier.

The output voltage variation shall be not more than ±1% for variations of ±10% of the input voltage at the temperature ranges specified for the site.

The charger shall be of the constant voltage control type with a higher (booster) and lower (trickle) rate of charge. The higher rate of charge shall be such as to completely charge a fully discharged battery in a period of 15 hours.

The capacity of the charger shall be rated to provide the full standing load plus battery charging current, for the specified ultimate loads.

Instruments

The following minimum instruments are required:

- DC ammeter - charging current
- DC voltmeter

Indication Light

An indication light is required to indicate that the AC supply is switched on.

Switches and Fuses

The following switches are required:

- A main switch to isolate the AC input.
- Fuses on the DC and AC sides except in the trip circuit.

Control of the Charge Rate

The following are required to control the rate of charge:

- A push button or switch to select the higher rate of charge.
- A timer to switch over automatically from the higher rate to the lower rate of charge after a period adjustable from 1 to 10 hours.

Protection and Alarms

If a standing load is to be supplied to switchgear and control panels then the following protection systems with alarms shall be provided to trip the standing load supplies:

- AC supply fail relay with time delay
- DC under-voltage relay with 90% setting
- Tripping indication for the above conditions

If supervisory indication is specified for the system then a charger failure alarm relay shall be provided and the auxiliary switches of all the relays including the above-mentioned, shall be wired to an easily accessible terminal block in the charger cabinet.

Where a standing load is to be supplied from the battery unit, the standing load supply shall be separated from the tripping and control supply. The standing load supply only shall be automatically disconnected in case of:

- Failure of the AC supply
- The battery voltage falling below 90% of the nominal voltage.

C3.12.32.3 Installation

The units shall be properly bolted on floors where possible.

The charger shall be connected to the AC supplies.

The batteries shall be connected to the switchgear or light fittings (stand-by lights) where applicable, by means of suitable PVC cable.

All battery electrolyte levels shall be checked and corrected if necessary.

The battery sets shall be fully charged.

The metal work of all units shall be correctly earthed to the substation earth bar by means of 70 mm² stranded copper conductor or 30 mm x 3 mm copper bar.

C3.12.33 STREET AND SECURITY LIGHTING

Street and security lighting shall in general conform to SANS 475.

C3.12.34 STEEL POLES FOR STREET LIGHTING

All steel street lighting poles shall be properly treated against corrosion. Painting and/or galvanising shall be carried out as specified elsewhere.

All steel poles shall be designed to withstand all static and dynamic loads on the pole, fittings and street lighting brackets with a minimum factor of safety of 2,5.

The poles shall be designed to withstand a wind speed of 120 km/h unless otherwise specified at a height of 10 m above ground level and exerted on the projected area of the pole, fittings and street lighting brackets.

Each steel pole shall be equipped with a suitable base plate, at least 350 mm in diameter or square plates with an equal or larger surface area. The base plates shall be held in position by means of steel hook bolts to be hooked into the steel pole. The plates are not to be welded to the steel pole. The base plate shall have the same finish as the pole.

Poles shall be completely hot dipped galvanised and shall be suitable for coastal areas.

Size of Spigots

Contractors shall ensure that the diameters and lengths of the pole spigots shall suit the types of luminaires offered.

Cable Entries

Each steel pole shall be provided with a suitable cable entry hole. The hole shall be so located that after erection the entry hole shall be approximately 700 mm below ground level.

The edges of the cable entry hole shall be smooth to prevent damage to cables.

The dimensions of the entry hole shall be such that two 25 mm², 4-core PVC insulated steel wire armoured cables can be easily installed.

Cable Termination Compartment

Each pole shall be provided with a suitable cable termination compartment with a bracket complete with a 5 A, 5 kA miniature circuit breaker mounted on the bracket. Each luminaire shall be protected by a circuit breaker on double outreach installations.

An earthing stud welded to the inside of the pole shall also be provided inside the compartment. The earth conductors of the incoming cable and the earth conductor from the luminaire shall be terminated on the same earthing stud.

The cover of the compartment shall be watertight and sealed with a gasket. It shall be retained by a lug and secured by a bolt with a seven sided shrouded head.

The compartment shall incorporate a suitable gland plate for the termination of the incoming cables.

Pole Mounted Protection Boxes

Where steel street lighting poles are to be used in an overhead reticulation system, the pole shall be provided complete with a pole mounted weatherproof PVC circuit breaker box with tripping lever fitted with a 5 A, 5 kA single phase miniature circuit breaker.

C3.12.35 LOW VOLTAGE AND PILOT CABLES

C3.12.35.1 Low Voltage Cables (1 000 V)

All low voltage cables shall be polyvinyl chloride insulated with steel wire armouring or strip aluminium armouring, as specified, and served overall with a final layer of polyvinyl chloride.

Cables shall be round with the number of cores specified and suitable for general service as prescribed in SANS 1507.

The cores shall be stranded copper or solid shaped aluminium.

The cables with stranded copper cores shall be armoured with single steel wire armouring, unless otherwise specified.

The cables with solid aluminium cores shall be armoured with strip aluminium armouring or steel wire armouring as specified.

C3.12.35.2 Pilot Cables

Pilot cables shall comply with the requirements of SANS 1574.

Pilot cable cores shall be 0,9 mm diameter unless otherwise specified.

Pilot cables may be installed in the same trenches as low voltage or high voltage power cables at depths varying between 0,8 and 1,5 m. Pilot cables may also be installed directly underneath and parallel with overhead power lines.

Pilot cables shall be used for protection applications, as well as speech and data communications.

The electrical requirements are as follows:

- Continuous working voltage : 250 V, 50 Hz between cores
- Maximum loop resistance : 56 ohm/km
- Minimum insulation resistance : 30 000 megaohm/km
- Mutual capacitance of pair : 60 nanofarad/km maximum at 800 Hz
- Capacitance unbalanced : 600 pF/km maximum at 800 Hz
- Overvoltage withstand capabilities : 5 kV between any two cores; 10 kV between any core and any metal work that may be earthed
- General : Pilot cables shall be designed to ensure the minimum cross-talk level and maximum immunity against induced effects

All pilot cables shall be fully waterproof, even when operating for extended periods of time fully submerged in water or waterlogged soil.

- Cable insulation shall be PVC
- Bedding layers shall be PVC
- Galvanised steel wire armouring shall be provided.
- The outer sheath of the cable shall be PVC and an overall conductive coating of colloidal graphite or other conductive material shall be applied to the serving to facilitate voltage testing to earth.
- All cores shall be clearly and indelibly identified by means of numbers or a colour code.
- Contractors may offer alternative cables, but full constructional detail shall be submitted with tenders.

Tests and Inspections

Tender prices shall include for the costs of performing the following tests on each drum of cable:

- Conductor resistance test
- Overvoltage tests
- Capacitive tests

The Employer's Agent shall be notified at least two weeks in advance of when such tests are to be performed and reserves the right to witness all such tests.

Test certificates of all tests shall be submitted to the Employer's Agent prior to or with the delivery of the cables.

Pilot Cable Terminal Boxes

The multicore cables shall be connected to the panels and equipment via terminal strips in terminal boxes in all substations.

Tenderers shall allow for the supply and installation of centrally situated, wall mounted terminal boxes when applicable.

The terminal boxes shall be manufactured from mild steel of minimum thickness of 2 mm. A steel frame shall be used to ensure rigidity where necessary. The terminal boxes shall be fitted with front opening hinged lockable doors.

All doors shall be of a neat dustproof fit, and the enclosures shall be completely vermin proof.

The terminal boxes shall be adequately ventilated for the prevention of condensation.

The terminal boxes shall be wall mounted.

The terminal strips inside the terminal box shall comply with the standard specification.

Terminal blocks shall have separate terminals for incoming and outgoing wires, and not more than two wires shall be connected to any one terminal. Insulating barriers shall be provided between adjacent pairs of terminals. The height of the barriers and the spacing of the terminals shall be such as to give adequate protection while allowing easy access to terminals. The connections shall be suitable for the cables provided.

C3.12.35.3 Excavations and Laying of Cables

11 kV Cables, low voltage cables, pilot cables, telecommunication cables and pipes shall be laid in the same trenches, where applicable, and in the positions as shown on the drawings.

The rates for the laying of cables shall include for the laying of cables over or under other services.

The spacing between cables shall be exactly as shown on the drawings. The positions of cables shall always be measured from boundary lines of stands, unless otherwise specified.

After all cables have been laid and correctly spaced, they shall be inspected and be subject to the approval of the Employer's Agent before trenches are backfilled. In the event of the Contractor not notifying the Employer's Agent well in advance of an inspection, the Contractor shall then open sections of the trenches for inspection at his own cost.

Trenches will be excavated and backfilled by the civil contractor but the tendered prices for laying cables in trenches excavated by others shall include:

- Levelling off the bottom of trenches.
- Supply and laying of a 75 mm minimum layer of sifted soil.
- Supplying and covering of the cables with a 75 mm layer of sifted soil after the cables have been laid and spaced and after the inspection and approval by the Employer's Agent.

Cables shall be drawn off drums in the same direction where more than one drum is involved in a cable laying route. The drums shall be suitably placed along the cable route. All drums shall be rolled as indicated by the arrows marked on the drums.

No crossing of cores shall be permitted in cable boxes.

C3.12.35.4 Cable Pipe Ducts

Concrete, polyethylene or PVC pipes for cable pipe ducts will be supplied and installed with draw wires by the civil contractor.

The pipe ducts shall be neatly trimmed at the ends after laying, and a heat-shrinkable duct end cap shall be fitted over each and every open end through which no cable is installed. Where the size of the duct does not permit the fitting of these covers, then the open ends shall be sealed by means of a weak cement mix of 7 sand to 1 cement. Polystyrene plugs of suitable size may also be used.

C3.12.35.5 Jointing Pits

The Contractor will be required to provide workable jointing pits where cables are to be jointed. The costs of jointing pits are to be included in the rates for laying cables.

C3.12.35.6 Cable Crossings

Where power cables cross communication cables and/or pipes and vice versa, the crossings shall be done in accordance with the requirements of SANS and NRS. The power cables shall be laid underneath the communication cables and concrete slabs shall be laid above the power cables to separate the power and telecommunication cables.

Where power cables cross each other the cables shall not be laid directly on top of each other but shall be separated with a 100mm layer of sifted soil. Where the cables cross, they shall not be bent with less than the minimum allowable radius.

After completion of the work the Contractor shall certify in writing that he complied with all the requirements specified by the authorities.

C3.12.35.7 Marking Tape

Yellow PVC marking tape, 150 mm wide, with the wording "Buried Electric Cable - Caution", printed in red or black, shall be laid approximately 300 mm below ground level above the high voltage cables. One marking tape shall be laid for every two high voltage cables installed.

C3.12.35.8 Cable Markers

Cable markers shall be installed. Cable markers shall be subject to the approval of the Employer's Agent prior to installation.

C3.12.36 LOW VOLTAGE ELECTRIC MOTORS

C3.12.36.1 General

This specification covers low voltage (less than 1 000 V), 3 phase a.c. squirrel cage induction motors.

The motors shall be designed, manufactured, tested, delivered, erected and commissioned in accordance with:

- SANS 60034 : Rotating Electrical Machines, Parts 1 to 18
- SANS 60072 : Dimensions and output series for rotating electrical machines.
- SANS 1804 : Induction Motors, Parts 1 to 4

Where reference is made to a code, specification or standard, the reference shall be taken to be the latest edition, including addenda, amendments and revisions thereto.

All deviations from these specifications shall be clearly pointed out at tender stage as deviations not indicated, will not be accepted.

Motors of the same manufacture shall be used throughout the project unless otherwise approved by the Employer's Agent.

Motors shall be designed for fixed speed or variable speed operation as specified.

C3.12.36.2 Materials

All materials shall be new, of the best quality and of the class most suitable for the application. All parts shall be capable of withstanding variations of temperature arising under working conditions without distortion, deterioration or setting up of undue stress in any part.

Mild steel plate for fabricated parts shall be of weldable quality in accordance with SANS 50025. No welding, burning in, filling, plugging up or metal deposition to correct defects in any component will be permitted unless agreed to by the Employer's Agent in writing, following an inspection on the defect.

C3.12.36.3 Interchangeability

Motors of the same rating shall be interchangeable without them having to be modified.

The corresponding parts of motors that are identical, for all practical purposes, shall be interchangeable without them having to be modified. The same requirement applies to spare parts.

C3.12.36.4 Drawings and Information

The following drawings and information shall be submitted for approval before manufacture commences:

Dimensioned outline and required foundation drawings of the motors. (Shaft diameter, shaft height and motor mass to be clearly shown).

Cross-sectional dimensioned drawings of the terminal boxes.

Detailed drawings of the motor base plate showing full constructional details with dimensions.

C3.12.36.5 Inspection of Manufacture

The Employer and the Employer's Agent reserves the right to inspect the motors or associated parts at any stage of manufacture.

The Contractor shall ascertain at what stages inspections will be carried out and shall give the Employer's Agent not less than seven days' notice of when the inspections may be undertaken.

C3.12.36.6 Guarantee and Maintenance

All motors provided under the Contract shall be fully guaranteed for a period of twelve months from the date of handing over to the Employer.

A full maintenance service shall be provided during this period. The Tenderer shall indicate with his tender what duties have been included and the time intervals between services. Should the Tenderer fail to provide this information, the Employer's Agent reserves the right to prescribe the duties as well as time intervals with which the Contractor shall comply.

C3.12.36.7 Motor Ratings

Motors shall have continuous maximum ratings not less than the following:

- 50 kW or under - not less than 25% in excess of the maximum likely to be drawn by the driven unit within its operating range.
- Over 50 kW and up to 100 kW - not less than 15% in excess of the maximum likely to be drawn by the pumps within its operating range.
- Over 100 kW - not less than 10% in excess than the maximum likely to be drawn by the pumps within the operating range.

Where operating at other than continuous running duty is required, (i.e, short time or intermittent periods, as for valve actuators, hoists, etc.), motors shall have appropriate ratings in respect of output, duty and starting class.

The motor shall develop adequate torque to accelerate the driven equipment to full speed, within an acceptable time, using the starting method. For direct-on-line (DOL) starting the motor voltage shall be taken to be 85% of the rated voltage. For other starting methods the motor voltage shall be taken to be the output voltage of the reduced-voltage starter.

Motors shall be designed to allow at least 6 starts per hour, not less than two of which shall be consecutive.

The rated voltage shall be 400V.

The rated frequency shall be 50 Hz.

The motors shall be capable of operating with Zone A combined voltage and frequency variations as defined in SANS 60034-1.

The rated speed shall be nominal 1 500 rpm unless otherwise specified elsewhere and the operating speed range shall be as required by the driven equipment.

Motors shall be rated for continuous running i.e, Duty S1 to SANS 60034-1 and shall have a service factor of 1.

C3.12.36.8 Mounting

The motors shall be mounted to suit the driven equipment. The mounting arrangement shall be as stated elsewhere.

Motors shall be mounted on common baseplates with the driven equipment. When uncoupled from the load, it shall be possible to lift the motor clear without withdrawing the rotor and with the minimum amount of dismantling. Baseplates shall be provided with the driven equipment unless otherwise stated.

Motor feet shall be fitted with Grade 316 stainless steel jacking screws for both horizontal and vertical adjustment.

Mounting bolts shall be included in the tendered amount, unless otherwise stated.

C3.12.36.9 Enclosures and Cooling

Motors shall be totally enclosed with a protection rating of IP55 in accordance with SANS 60034-5, unless otherwise stated.

The cooling system shall be in accordance with SANS 60034-6 and the cooling method (IC Code) shall be as specified.

Ambient and cooling temperatures shall be in accordance with SANS 60034-1, unless otherwise stated.

Noise levels shall not exceed the levels permitted in SANS 60034-9.

C3.12.36.10 Windings

Unless otherwise specified, thermal class and temperature rise of the motor winding insulation system shall be in accordance with SANS 60034-1 (i.e, Class F insulation, but Class H temperature rise).

With self-ventilated cooling systems, allowance shall be made for the speed dependency of heat transfer.

Converter-fed motors (variable speed drives) shall be rated to allow for additional harmonic losses in accordance with SANS 60034-17.

For converter-fed motors (variable speed drives), the motor manufacturer shall check the voltage stress withstand capability of the motor against the converter supplier's specification. To ensure that no service lifetime reduction of the motor insulation occurs, the actual stress due to converter operation shall be lower than the repetitive voltage stress withstand capability of the motor winding insulation system.

Functional evaluation of the winding insulation systems shall be carried out in accordance with SANS 60034-18-31. In the case of converter-fed motors, special attention is required because of the additional stress factors produced, such as increased voltage stress and high frequency repetition rate, additional heating as a result of harmonic losses, and mechanical vibrations.

C3.12.36.11 Bearings

Type

Bearings shall be of the rolling- or sliding-element type as appropriate. Vertical shafts shall have approved thrust and guide bearings. Grease-lubricated bearings shall be sealed or re-greaseable. Rolling-element bearings shall be loaded conservatively, in order that the grease may be renewed at intervals of not less than 4 000 hours, and they shall be equipped with grease nipples.

Where bearings are oil-lubricated, they shall be provided with a readily accessible filler and clearly visible oil level indicator. For large motors, forced lubrication may be provided as an alternative and details of the system shall be submitted with the tender.

Sliding-element bearings shall be fitted where rolling-element bearings cannot be fitted because of high speed, torque and/or bearing loads. Motors having sliding-element bearings shall be designed to allow measurement of bearing wear with a minimum of dismantling being necessary.

Sliding-element bearings shall be of the plain journal type, and not of the segmental type, and they shall be automatically lubricated by at least two oil rings, or a single disc integrally mounted on the shaft, running in an oil bath of adequate capacity. The oil bath shall be fitted with a drain plug and an external oil level indicating device which is readily accessible or visible.

For sliding-element bearing motors employing forced oil lubrication, full particulars of the proposed lubricating system shall be submitted.

Care shall be taken that bearings are properly sealed in order to prevent ingress of bearing lubricant into windings and cores. For purpose of maintenance, end-shield bearings are preferred. A minimum L10 bearing life of 40 000 hours is required. Unless otherwise approved in writing, motor bearings shall be designed to allow the motor to run indefinitely when uncoupled from the driven machine.

Insulation

To prevent damage by any shaft currents which may be produced (e.g, on converter-fed motors), the bearings and their lubricating and cooling systems, shall be insulated from the bedplate or frame. Although both bearings shall be insulated, the drive-end bearing insulation shall be shorted out with a copper earth strap to prevent the buildup of static electricity on the rotor.

Flow Indicator

A flow indicator and/or pressure switch shall be provided on forced-lubricating systems to indicate failure of the system. Adjustable alarm and cut-out contacts shall be provided.

C3.12.36.12 Temperature Detectors

All motors 55 kW and larger but smaller than 150 kW shall be provided with two PTC thermistors per winding suitable for Class B temperature rise protection i.e, with reference temperature of 140°C. The three thermistors shall be connected in series via terminal blocks in the terminal box. (one per winding connected to terminal blocks shall be spare)

All motors of 150 kW and larger shall be provided with two platinum resistance detectors (RTD's) of type PT 100 ohm per winding and one per bearing. The bearing detectors shall touch the outer bearing race and shall be spring loaded and of the screw type with weatherproof die cast alloy heads. The RTD's shall be of the three wire type with a stainless steel sheath and mineral insulation. The bearing RTD's shall be provided with 2 wire transmitters with a 4 - 20 mA output terminated in a die-cast cap.

The wires of all detectors must be wired to a terminal strip in a suitable terminal box on the motor. The motor manufacturer shall provide a 1 inch BSP threaded hole in the motor casing to enable the installation of a bearing temperature probe by others.

C3.12.36.13 Anti-Condensation Heaters

For all motors 7.5 kW and above, anti-condensation heaters shall be built into the stators of motors and rated for a single-phase power supply of 240 V a.c. 50 Hz.

The terminals of the heaters shall be wired to a heater terminal box.

C3.12.36.14 Terminal Boxes and Terminations

The terminal box for the main supply cable(s) shall be adequately sized for the cables and shall have a removable cover and gland plate. The degree of protection shall not be less than IP55.

Phase segregation shall be provided to prevent flashover, if the air and creepage distances between phases, and phases to earth are not adequate.

All terminals must be properly and permanently marked for easy identification.

Terminal boxes shall be on the left-hand side if viewed from the drive end, unless other specified.

An explosion-relief diaphragm shall be provided to direct high-pressure gases away from personnel who may be near the motor in the event of a terminal box fault.

Terminal boxes shall be fault-tested for both a through-fault and a short-circuit in the terminal box, based on the maximum fault level at the point of connection.

The terminal box shall be suitable for the cable termination method.

C3.12.36.15 Information Plates

In addition to the information required by SANS 60034-1, the following shall also be marked on the name plates: Year of manufacture

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C3.12.36.16 Couplings and Direction of Rotation

Couplings between the motors and the driven equipment shall be provided with the driven equipment unless otherwise stated.

The motor's direction of rotation shall be to suit the driven equipment, and the motor terminals shall be marked in accordance with SANS 60034-8.

C3.12.36.17 Balance and Critical Speed

Motors and couplings shall be accurately and efficiently balanced statically, and dynamically, so that there will be no unbalanced end-thrust, when either new or worn, and to eliminate noise and vibration when running.

Where end-thrust arises, adequate long-wearing thrust bearings shall be provided. Dynamic balancing shall be done by the removal of parent metal, in a manner which does not affect the structural strength of the rotating element.

The use of solder, or similar deposits for balancing, will not be accepted. The operating speed of rotating elements shall be below and as far removed as possible from the critical resonant speeds thereof.

The permitted levels of vibration generated within the motors shall not exceed the values given in SANS 60034-14.

Notwithstanding the acceptance of the vibration limits during the works test, the Employer's Agent reserves the right to call for a vibration test on the installed equipment, if he considers it necessary and the Contractor shall be responsible for reducing the vibrations to within the specified limits.

The motors shall have a suitable margin of safety between critical speed and normal running speed. The first critical speed shall be not less than 120 percent of nominal speed.

C3.12.36.18 Testing

Motors shall be tested at the manufacturer's works, with the scope of the tests depending on whether the motors have been built to a new or proven design as set out below.

Four copies of all test certificates shall be submitted to the Employer's Agent no later than when the motors are delivered.

<u>New Designs (Type Tests)</u>

Any single motor, or the first motor of any batch of identical motors, shall be subjected to the following tests:

The remaining motors shall be tested as for motors built to a proven design.

<u>Proven Designs (Routine Tests)</u>

All motors that have been built to a proven design shall be subjected to the following tests:
Type test certificates shall be provided for the motors that are only subjected to routine tests.

C3.12.36.19 Installation

The motors shall preferably be installed by the motor supplier and shall be installed strictly in accordance with the supplier's installation instructions.

To allow for interchangeability of motors, the motors shall be installed on 2 mm thick corrosion-resistant shims to allow for shaft height variation.

The motor frame shall be insulated from the baseplate if necessary to prevent circulating bearing currents with converter-fed motors. The coupling shall similarly be insulated if required.

The motor shall be aligned to the driven equipment using laser aligning equipment or approved equivalent. Final alignment shall be done before commissioning may start and shall be witnessed by the Employer's Agent. Alignment shall be within the tolerances specified for the shaft coupling.

C3.12.36.20 Pre-Commissioning of LV Motors

Once the motor and driven equipment have been aligned successfully, the following minimum pre-commissioning checks shall be carried out.
Should dampness in the windings be detected through the measurement of low insulation resistance (refer above), then the motor shall be dried out and a withstand voltage test carried out at 80% of the test voltage recommended in SANS 60034-1 for factory testing (i.e, 80% of 2 V_R + 1 kV).

It is recommended that the test voltage for measuring insulation resistance be limited to 500 V dc, and the minimum acceptable insulation resistance shall be 1,5 MΩ.

The method adopted for drying-out shall be by applying heat, preferably by circulating current through the windings or, alternatively, by means of space heaters located in and around the machine.

Insulation resistance measurements and temperature readings shall be taken regularly every half hour at the start of dry-out until the motor attains an even temperature and thereafter every hour. The characteristic dry-out curve of insulation resistance versus temperature shall be plotted and dry-out may be considered complete when the required polarization index is achieved.

All equipment and the personnel required for the drying out operation, shall be provided by the Contractor. The onus remains on the Contractor to satisfy himself that a motor is dry before it is connected to the supply. Any motor which fails as a result of being commissioned in a damp condition, shall be repaired free of charge by the Contractor.

C3.12.36.21 Soft Starters

The Soft Starters (SS) shall comply with SANS 60947 where applicable with special reference to cubicle construction, wiring of cubicles and accessories.

The SS shall be suitable to operate at fault level as stated and/or as indicated on the drawings.

The harmonics generated by the SS shall not exceed the following levels as laid down by the Supply Authority.
Any equipment which is sensitive to harmonics shall be designed to function under voltage conditions which may have up to 5% total harmonic distortion and up to 2% individual harmonic content.

The availability of spares shall be guaranteed for 10 years after the contract is accepted.

The system voltage for the SSs are as stated and/or as indicated on the drawings.

C3.12.36.22 Electronic Equipment and Components

The control circuitry shall consist of independent electronic control and protective circuits arranged on separate PCB's. This circuitry shall be isolated from the mains supply by means of isolating transformers.

The electronic equipment shall be of modular construction mounted on plug-in boards. Such modules shall be suitably coded so as to prevent insertion into wrong sockets.

The material used for the printed circuit boards shall be either of the following:

- A phenolic laminate Type XXXPC copper clad, of thickness at least 1,6 mm and copper foil of thickness 70 micro mm, that complies with the requirements of SABS 1100, or
- An epoxy fibre glass laminate whose relevant properties are equivalent to, or better than those of Type XXXPC.

Other printed circuit boards may be used (e.g, flexible type) subject to agreement by the Employer's Agent.

The connections to the printed circuit boards shall, wherever possible, be made by means of suitable connectors with gold-plated contacts that are designed to be soldered to the tracks of the printed circuit board.

Means shall be provided for mounting the printed circuit board assembly inside the enclosure so as to facilitate easy insertion and withdrawal of the assembly. The assembly shall be mechanically secured so as to prevent vibration.

The printed circuit board assembly shall be designed with suitable means of self-diagnostic indication of faults and indication of status for the purposes of easy service and maintenance or shall be provided with easily accessible test points to facilitate diagnostic tests for faults. Suitable test equipment shall form part of the contract.

The power supply to electronic control equipment shall be provided with an electrostatic screen between the primary and secondary windings. The screen shall be connected directly to earth.

Electrolytic capacitors used in the dc application of electronic equipment (e.g, filter circuits) shall be of the long-life grade complying with IEC Publication 384-4.

All semiconductor devices, power transformers, chokes and other components forming necessary parts of the drive equipment shall be suitable for the particular application with respect to their rated voltages, rated currents, temperature rise and service life.

Solid state electronic components shall be used.

C3.12.36.23 Digital Technology

Digital control based on the latest processor technology shall be used. However, standard products and components shall be used and purpose made systems shall not be acceptable.

C3.12.36.24 Modbus RTU Interface Protocol

When specified the SS shall be equipped with MODBUS RTU interface protocol with facilities to report all fault conditions on a first in first out basis as well as control functions and the parameters during normal running condition. A suitable data storage buffer shall be provided of sufficient capacity to ensure a real time record of the above information and of any other variables the Contractor consider necessary for fault diagnostics.

C3.12.36.25 Control Card Monitoring

All control cards shall be provided with suitable monitoring, either by means of on-board identification, or if specified via the Modbus interface to permit identification of and replacement of faulty control card with a minimum of drive downtime.

C3.12.36.26 Hardwire Trip Interlocks

Protection devices in the SS shall be hardwired to ensure that an electrical fault within the controller trip the feeder circuit breaker.

Electrical interlocks shall be provided to trip the SS in the event the access doors to the power section and the DC sections of the drive being opened.

C3.12.36.27 Main Power Equipment

The main power equipment unit shall comprise the following:

Area/Plant/Location	Load Description	Tag No.
Backwash Recovery Plant	Vortex Degriter 1	DG-001
Backwash Recovery Plant	Vortex Degriter 2	DG-002
Backwash Recovery Plant	Air Blower 1	AB-001
Backwash Recovery Plant	Air Blower 2	AB-001
Balancing Tank	Mixer 1	M-1001
Balancing Tank	Mixer 2	M-1002
Balancing Tank	Mixer 3	M-1003
Balancing Tank	Mixer 4	M-1003
Poly System	Polymer Feed Pump 1	M-1004
Poly System	Polymer Feed Pump 2	M-1005
Poly System	Polymer Feed Pump 3	M-1006
Poly System	Polymer Feed Pump 4	M-1007
Poly System	Flash Mixer	M-1007
Gravity Thickener	Rotating Bridge Motor 1	M-1008
Gravity Thickener	Thickened Sludge Actuated Valve	M-1009
Centrifuge	Centrifuge Feeder Pump 1	M-1010
Centrifuge	Centrifuge Feeder Pump 2	M-1011
Centrifuge	Centrifuge 1	Centrifuge 1
Centrifuge	Centrifuge 2	Centrifuge 2
Return Flow	Return Flow Pump 1	M-1012
Return Flow	Return Flow Pump 2	M-1013

C3.12.36.28 Cubicle Arrangement

The cubicle shall form part of the MCC panel.

The SS equipment e.g, thyristor stack, control circuitry, etc, shall be housed in separate compartments so as to create a neat appearance.

The equipment shall be arranged so that the various parts of the SS are easily accessible.

The instrument and control panel shall be flush mounted on the front of the cubicle at a comfortable height from the ground.

The main isolator handle shall be mounted on the front of the cubicle and shall be door inter-locked. If an MCCB is used, the toggle shall protrude through the door.

When more than one cubicle/panel is provided, the cubicles shall form a straight line and be of the same height so as to create a neat appearance.

The cubicles shall be of the free standing type.

In the event of the SS being mounted in a panel by the SS manufacturer, the Contractor shall ensure that this panel conforms with the rest of the MCC e.g, colour shall be matched, labels shall be matched, etc.

C3.12.36.29 Ventilation

The temperature in the MCC room may rise to 45°C and the equipment shall be rated to operate continuously at this temperature.

Adequate ventilation shall be provided to ensure sufficient cooling of the MCC and all related equipment.

In the event of forced air cooling being applied, the fans shall be mounted for optimal airflow and heat exchange.

Air filters shall be provided at the air-intake of the cubicle.

The hot air shall be exhausted into the MCC room.

C3.12.36.30 Protection

The SS shall be provided with the following integral protection features for itself and the motor. A separate motor protection relay shall be provided if these features are not part of the SS protection features. The tenderer shall explain how each requirement is met and shall supply detailed supporting literature.

Thermal Overload

This shall have current time characteristics matched to the thermal damage curve of the associated thyristors and the motor. It shall be possible to operate the SS continuously at 4,5 times the full load current for 60 seconds and 107,5% of the rated voltage without incorrect tripping of the supply. The SS shall also be capable of 6 motor starts per hour.

Short Circuits and Earth Faults

The SS shall be fully protected against short circuits and earth faults on the supply connections and on the motor. This protection shall preferably be instantaneous in operation and arranged to trip the supply. It shall not operate incorrectly if the SS is able to feed current to a supply side fault unless the condition is sustained for long enough to damage the SS components.

Electronic Equipment

This shall be provided with all protection equipment necessary to ensure that diode over voltages, over currents, or other transient conditions will not result in component failure. Such protection shall be arranged to disconnect the SS, where necessary for its safety.

Loss of Phase

Loss of a supply phase shall cause the drive to be disconnected sufficient rapidly to prevent damage.

Incorrect Phase Rotation

The drive controls shall be capable of detecting this condition and preventing start-up.

Bearing and Winding Temperatures and Bearings

Where specified, the motor windings and/or bearings shall be equipped with RTD's and suitable temperature control relays arranged to trip the drive for excessive temperature conditions.

Faults

SSs shall also be protected against the following faults:
Indications and Transducers

All protection functions shall be complete with the necessary current and voltage transducers and the condition that originated any drive shutdown shall be indicated clearly on approved operation indicators.

The following are examples of indications to be displayed on the panel door. Contractors shall provide information of fault indications offered applicable to the equipment.
Details of the other motor protections to be incorporated in the SS are stated elsewhere.

Remote Indication

A potential free contact wired to terminals at the back of the panel shall be provided to indicate a system fault for remote indication.

C3.12.36.31 Control, Indication and Instrumentation

The following minimum controls and instrumentation shall be provided on the front panel of the electronic compartment:

Controls

The push button for the emergency stop shall be red, only manually resettable and will prevent the motor from starting from the local or any remote position. (Parallel circuitry to a terminal block to be provided for a similar switch at the motor).

Local/Remote switches shall be provided if specified and/or as indicated on the drawings for the following:

Signal Lamps and Push Buttons

The following main colour-codes shall be used for signal lamps and push buttons:

- Trip : Red
- Run, Ready : Green
- Drive Unit Healthy : White
- Stop Emergency : Red
- Trip Reset : Blue
- Lamp Test : White
- Siren Mute : Yellow

Instrumentation

One ammeter to indicate motor current and one non-resettable running hour meter are required.

Remote Control and Indications

The SS drives shall be suitable for remote control operation and monitoring as specified in the Project Specification. All the required functions and signals shall be wired to terminal blocks which are easily accessible.

C3.12.36.32 Method of Operation

A 400V/50 Hz supply shall be fed to the motor via six phased controlled thyristors. Six thyristors shall be used to enable full wave utilization of all three supply phases. The firing angle of the six thyristors determines the shape of the output voltage which is fed to the motor. The output (firing angle) shall be varied in such a way so as to ensure the following:
The accelerating time i.e. the time allowed for bringing the motor up to full speed shall be adjustable from 4-20 seconds.

Closed loop control shall be applied during starting by means of current feedback to achieve the required current limiting, which shall be adjustable from 100-300% FLC.

A bypass contactor shall be incorporated in the SS. The contactor shall receive a close signal from the soft starter once the full speed of the motor is reached. It shall also be possible to operate the contactor manually in the event of the SS failing i.e, direct on line starting shall be possible.

C3.12.36.33 Equipment

Each SS panel shall comprise the following:

C3.12.36.34 Inspections, Tests and Training

Factory Tests and Inspections

The manufacturer shall perform all routine tests in the factory as described by SANS as well as the manufacturer's own standard routine tests on all materials, equipment and auxiliary equipment.

The Contractor shall submit a list of tests and inspections to be performed on the equipment on the SS for approval.

The Contractor shall perform any additional standard tests that may be required by the Employer's Agent.

The Employer's Agent shall indicate which tests shall be witnessed by a representative of the Employer and the Employer's Agent.

The Contractor shall submit four copies of the test certificates with the test results of all the tests performed to the Employer's Agent not later than the delivery date of the equipment.

Site Tests

On completion of erection and installation on site the Contractor shall perform all the tests that may be required to ensure that the Works are ready for handing over and putting into regular use.

Contractors shall provide their own test equipment which shall be of acceptable standards.

The Contractor shall submit a list of tests and inspections to be performed on the equipment for approval.

The Contractor shall perform any additional standard test that may be required by the Employer's Agent.

The Employer's Agent and the Employer reserve the right to appoint representatives/inspectors to witness every test.

Four copies of site test certificates shall be submitted to the Employer's Agent within 7 days after completion of each test.

Arrangements for Witnessing Tests

The Contractor shall make arrangements with the Employer's Agent for tests to be witnessed.

Timeous notice shall be given to avoid undue delays in the completion of tests.

Arrangements for tests on site shall be made only after the Contractor have pre-commissioned the equipment and satisfied himself that it is in running order.

C3.12.36.35 Training

The Contractor shall allow for two on-site training sessions. Each session shall last at least one full day and include programming and setting up procedures of the SSs.

C3.12.36.36 Individual Compensation of Low Voltage (up to 1 000 V) Motors

Capacitors shall preferably be installed inside the motor control centres.

Internally fused three phase capacitor units shall be used.

Where capacitors are connected in small banks they shall be "group fused" with suitably rated fuses.

No additional protection is needed for individual three phase capacitors where the motors to be compensated have motor protection relays installed.

The motor protection relay settings shall be adjusted taking the capacitor current into account to ensure that proper protection is given to the motor.

To provide protection to switchgear and capacitors against inrush currents, all the incoming cables to the capacitors shall be coiled close to the capacitors with approximately five turns and 50 mm diameter to form an inductor.

The capacitor current shall not be higher than 90% of the no-load current of the motor to ensure that the self-excitation voltage caused by the capacitor is lower than the rated voltage of the motor.

Labels shall be provided on all panels containing power factor correction capacitors to warn the maintenance personnel about possible static charges on the capacitors which should be discharged before attempting any maintenance work.

C3.12.36.37 Capacitors

The capacitors shall comply with SANS 60831 for Medium Voltage Capacitors and IEC 60831 for Low Voltage Capacitors and shall:

Current Rating

The capacitors shall be rated to pass continuously 150% of the nominal rated current (IEC rating plus 20% excess).

Discharging

Discharging shall be by means of internal resistors or transformers. The discharging period shall be maximum 5 minutes to reach a voltage of 50V.

Interlocking

Interlocking shall be provided to prevent closing of the contactor during the capacitor discharging period.

C3.12.36.38 Electrical Equipment

Each capacitor step shall include the following electrical equipment:

- Switch-disconnector
- HRC fuses
- Current transformers
- Contactors
- Harmonic watchdog if specified.

Refer also the relevant standard specifications as indicated pertaining to abovementioned equipment. Unless otherwise specified the rating of equipment shall be at least 1,5 times the capacitor current rating.

Protection Relay

A harmonic watchdog relay shall be provided where specified with a single channel THD transducer which provide an accurate current loop signal proportional to Total Harmonic Distortion (THD), and with a relay output with adjustable trip level.
Reactive Power Control

The power factor shall automatically be controlled by means of Reactive Power Control Relay.

The reactive power controller shall be of the solid state adjustable type suitable for the operating voltage and shall be flush mounted in the panel.

The regulator shall have no-volt or mains failure return characteristics.

The no-volt or mains failure return control equipment shall also allow the switching off of all banks after a total mains failure occurred, to minimise the total inrush currents to all banks.

Further fail safe operation shall be provided such that, in the event of loss of phase, current transformer failure, or control supply (longer than 20 milli-seconds) a control relay shall de-energise all outputs and on restoration set up the sequence from step one after taking a new measurement.

When the measured lagging or leading power factor value exceeds a preset level, a minimum time lag of 20 seconds and maximum of 30 seconds for an on or off switching step shall take place. Switching time from stage to stage shall be independent of the reactive power.

The sensitivity of response shall be continuously adjustable, by current lagging or leading.

Harmonic suppression shall be incorporated as standard to avoid zero crossing error caused by a distorted waveform.

It shall be possible to set the target power factor and to set an alarm cos ø limit below the set point.

The reactive power controller shall also take the discharging time of the capacitors into account when applicable.

To match the controller to various capacitor step sizes and input current transformer ratios it shall be possible to set the activating current by altering the "$^{C}/_{K}$ ratio".

C3.12.36.39 Installation and Erection

The power factor correction equipment shall be properly fixed to the floors or supporting steel work.

The Contractor shall note sizes and positions of cable trenches and vertical shafts and shall include in his tender all supporting steelwork to straddle trenches and vertical shafts to support power factor correction equipment securely.

The tendered prices for the erection of power factor correction equipment shall include the making off and terminating of all cables and wires.

The power factor correction equipment shall be properly earthed to the substation and/or building earthing system.

When aluminium core cables are used, suitable tinned copper or aluminium lugs with an approved electrical jointing paste shall be used for the terminations.

The costs for the supply and delivery of the lugs and paste shall be included in the price for the erection of the power factor correction equipment.

Routine Tests

Test certificates for the following tests on each capacitor shall be submitted to the Employer's Agent:

C3.12.37 PV SOLAR SYSTEM

C3.12.37.1 General

It is envisioned to use a PV Solar System to supply power to the new MCC when solar energy is available.

C3.12.37.1 Inverter

The Inverter shall be in accordance with or better than the following requirements:

Input DC:
Max. input voltage:1100 V
Rated voltage:600 V
Start-up voltage:195 V
MPPT voltage range:180-1000 V
Max. input current:10*26 A
Max. short circuit current:10*40 A
MPPT number/Max. input strings number:10/20

Output AC
Rated output power: 100 kW
Max. apparent output power: 110 kVA
Max. output power: 110 kW
Rated grid voltage: 3/N/PE, 230 V / 400 V
Rated grid frequency: 50 Hz
Rated grid output current: 144.3 A
Max. output current: 167.1 A
Power Factor: >0.99 (0.8 leading - 0.8 lagging)
THDi: <3%
DC injection current: <0.5% In

Efficiency
Max. efficiency: 98.7%

Protection
DC reverse-polarity protection: Yes
Short circuit protection: Yes
Output over current protection: Yes
Surge protection: DC Type II / AC Type II
Grid monitoring: Yes
Anti-islanding protection: Yes
Strings monitoring: Yes
I/V Curve scanning: Yes
Integrated AFCI (DC arc-fault circuit protection): Yes
Integrated DC switch: Yes
Integrated AC switch: Yes

C3.12.37.2 PV Solar Panels

The solar panels shall have a 12-year product warrantee and a 25-year linear power warranty
The solar panels shall be certified to withstand wind load (2400 Pascal) and weight load of 5400 Pascal)

C3.12.37.3 Wiring, Cabling and accessories

The PV Solar Installation shall include all wiring, cabling, combiner boxes, and all accessories in order for the system to be fully complete and fully functional.

C3.12.38 OPERATING AND MAINTENANCE INSTRUCTIONS

Details of the requirements are given in the Mechanical Specification.

C3.12.39 COMMISSIONING

The commissioning process that is to be followed is set out in the Commissioning Plan.

C3.12.40 INSTRUCTING OPERATORS DURING INITIAL PERIOD OF OPERATION

Experienced electrical representatives of the Contractor and, where applicable, other sub-contractors shall attend the commissioning and performance testing of all equipment and shall explain in detail and demonstrate to at least one mechanical and one electrical and on instrumentation operator employed by the Employer, the contents of the instructions referred to above and the correct methods of operating and maintaining the plant and equipment. The prices tendered in the Bills of Quantities will be deemed to include allowances for such explanations and demonstrations as may be required to be provided by the Contractor and sub-contractors to ensure that the Employer's operating staff is fully informed as to how the plant and equipment is to be cared for, operated, maintained and safeguarded.

C3.12.41 SCHEDULED VISITS DURING THE DEFECTS LIABILITY PERIOD

During the Defects Liability Period, the Contractor shall visit the site (over and above such visits as may become necessary due to system breakdowns) at quarterly intervals to ascertain that the system is functioning correctly.

Within 14 days of each such visit the Contractor shall submit a short report to the Employer's Agent which shall include details of all faults that were found as well as a statement that such faults were rectified. At the end of the Defects Liability Period, the Contractor must analyse these findings in a "Close-out report" submitted to the Employer's Agent, in which he/she shall include any recommendations with regard to the augmenting of the system, procuring of additional facilities/equipment, suggested modifications, etc. Items have been included in the Bill of Quantities to enable the costs of these scheduled visits and reports to be priced.

C3.12.40.1 Scheduled Items

Payment will be made based on the items in the Bills of Quantities which have been subdivided as follows:

Preliminary and General

Fixed Charge Items - lump sum items are scheduled

Time Related Items - lump sum items are scheduled

Health and Safety - lump sum items are scheduled

Training of the Employer's staff - lump sum items are scheduled

Inspections and reporting during the Defects Liability Period- lump sum items are scheduled

Provisional Sums - lump sum items are scheduled and include provision for third party inspections.

Mechanical Plant and Equipment

Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s) of plant.

Taking delivery, handling, erection, installation and painting of the plant and equipment - a separate item is schedule for each of the foregoing items.

Site testing, commissioning, and adjusting the plant and equipment supplied and installed including instructing Employer's staff as specified - lump sum items are scheduled.

Electrical Equipment

Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s).

Taking delivery, handling, erection, and installation of the plant and equipment - a separate item is schedule for each of the foregoing items.

Site testing, commissioning, and adjusting the plant and equipment supplied and installed including instructing Employer's staff as specified - lump sum items are scheduled.

Instrumentation

Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s).

Taking delivery, handling, erection, and installation of the plant and equipment - a separate item is schedule for each of the foregoing items.

Site testing, commissioning, and adjusting the plant and equipment supplied and installed including instructing Employer's staff as specified - lump sum items are scheduled.

ELECTRICAL TECHNICAL DATA SHEETS

TECHNICAL DATA SHEET No E01: MCC 3

Item	Tenderer to Complete
Manufacturer	
Place of manufacture	
Complies with SANS 1973 Yes/No	
>10 kA Type Test panel (STA), which complies with SANS 1973-1:2003 Yes/No	
SANS certification or manufacturer's self-certification	
Busbars:	
Manufacturer (if different manufacturer to that of the MCC)	
Material	
Current density	
Moulded Case Circuit Breakers:	
Manufacturer	
Type (up to 100 A)	
Type (over 100A)	
Main Isolators:	
Manufacturer	
Type	
Selector Switches:	
Manufacturer	
Type	

Item	Tenderer to Complete
HRC Fuse Links:	
Manufacturer	
Type	
Contactors:	
Manufacturer	
Type	
Auxiliary Relays:	
Manufacturer	
Type	
Earth Leakage Relays:	
Manufacturer	
Type	
Pushbuttons:	
Manufacturer	
Type	
Indicator Lamps:	
Manufacturer	
Type	
Emergency Stop Buttons:	
Manufacturer	
Type	

Item	Tenderer to Complete
Surge Arrestors:	
Manufacturer	
Type	
Control Circuit Transformers:	
Manufacturer	
Type	
Panel Extract Fans	
Manufacturer	
Type	
Other Equipment Offered by Tenderer:	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No E02: LV METERING AND INDICATION EQUIPMENT

Item	Tenderer to Complete
Current Transformers:	
Manufacturer	
Type	
Ammeters:	
Manufacturer	
Type	
Voltmeters:	
Manufacturer	
Type	
Kilowatt Hour Meters:	
Manufacturer	
Type	
Running Hour Meters:	
Manufacturer	
Type	
Digital Motor Speed Indicators:	
Manufacturer	
Type	
Digital Flow Indicator:	
Manufacturer	
Type	

Item	Tenderer to Complete
Digital Pump Pressure Indicators:	
Manufacturer	
Type	
Digital Sump Level Indicator:	
Manufacturer	
Type	
Other Equipment Offered By Tenderer:	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No E03: LV / MV, CONTROL, SIGNAL & INSTRUMENTATION CABLES & SUNDRY EQUIPMENT

Item	Tenderer to Complete
LV Cables:	
Manufacturer	
Type e.g. Cu PVC/PVC/SWA/PVC	
Rating	
SABS approved (Yes/No)	
LV Cable Joints:	
Manufacturer	
Type	
MV Power Cables (PILC):	
Manufacturer	
Place of manufacture	
Type	
Rating	
Complies with SABS 0198 (Yes/No)	
MV Power Cables (XLPE):	
Manufacturer	
Place of manufacture	
Type	
Rating	
Complies with SABS 0198 (Yes/No)	
Signal Cables:	
Manufacturer	

Item	Tenderer to Complete
Type	
SABS approved (Yes/No)	
Control Cables:	
PVC PVC SWA PVC Copper Conductor Cables:	
Manufacturer	
Type	
Complies with SANS 1507 (Yes/No)	
Instrumentation Cables:	
Individually-screened, overall-screened, twisted pair, PVC PVC SWA PVC, copper conductor cables:	
Manufacturer	
Place of manufacture	
Compliance standard	
Cable Ladders and Trays:	
Cable ladder manufacturer and range	
Cable perforated tray manufacturer and range	
Other Equipment Offered By Tenderer:	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No E04: SOFT STARTERS

Item	Tenderer to Complete
Manufacturer	
Place of manufacture	
Range/Model number	
Part number	
Output Voltage	
Output Current	
Maximum Input Voltage variation	
Output frequency	
Integral Bypass Contactor (Yes/No)	
Current Rating of Bypass Contactor	
Operating temperature limits	
Protection available in integral protection module	
Protection available in integral protection module	
Other Equipment Offered by Tenderer:	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No E05: MOTOR STARTERS

Item	Tenderer to Complete
Manufacture:	
Manufacturer	
Place of manufacture	
Installation contractor	
Induction rating (H)	
Taps (No and percentage)	
Type & Model Range:	
Switch Disconnector	
Earth Switch	
Dielectric Type of Contactor	
Model / Range of Contactor	
Electrical Ratings:	
Rated voltage	
Rated impulse voltage withstand level (peak)	
Rated short-time withstand current	
Busbar current rating	
Contactor current rating	
Switch-disconnector-fuse	
(a) current rating	
(b) fuse rating	
Instrumentation & Indication:	

Item	Tenderer to Complete
Type of voltmeter	
Type of ammeter	
Type of kWh meter	
Type of voltage transducer	
Type of current transducer	
Type of indication lamps	
CT Manufacturer	
Protection & Relays:	
VT Manufacturer	
CT Manufacturer	
Type of motor protection relay	
Tools and Spares:	
Tools supplied	
Spares supplied	
Other Equipment Offered By Tenderer:	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No E06: LUMINAIRES & SSO's

Item	Tenderer to Complete
Type B1	
Manufacturer	
Model no.	
Country of Origin	
Approved by which standards	
Dimensions	
Technical brochure included with tender (Yes/No)	
Guarantee	
Type B1 (Emergency)	
Manufacturer	
Model no.	
Country of Origin	
Approved by which standards	
Dimensions	
Technical brochure included with tender (Yes/No)	
Battery back-up time	
Battery type	
Maintenance free battery (Yes/No)	
Guarantee	
Type C1	
Manufacturer	
Model No	

Item	Tenderer to Complete
Country of Origin	
Approved by which standards	
Dimensions	
Technical brochure included with tender (Yes/No)	
Type D1	
Manufacturer	
Model No	
Country of Origin	
Approved by which standards	
Dimensions	
Technical brochure included with tender (Yes/No)	
Guarantee	
Street Light LED light fitting	
Manufacturer	
Model No	
Country of Origin	
Approved by which standards	
Dimensions	
Technical brochure included with tender (Yes/No)	
Guarantee	
Street Light 8m fibreglass pole	
Manufacturer	
Model No	

Item	Tenderer to Complete
Country of Origin	
Approved by which standards	
Dimensions	
Technical brochure included with tender (Yes/No)	
Guarantee	
Type G2	
Manufacturer	
Model No	
Country of Origin	
Approved by which standards	
Dimensions	
Technical brochure included with tender (Yes/No)	
Guarantee	
Socket Outlet – Wall box mounted	
Manufacturer	
Model No	
Socket Outlets – Power skirting mounted	
Manufacturer	
Model No	
2 compartment Power Skirting	
Manufacturer	
Model No	

Item	Tenderer to Complete
IP65 Three Phase (SSO)	
Manufacturer	
Model No	
Photo Electric Cell	
Manufacturer	
Model No	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No E07: FIRE DETECTION SYSTEM

Item	Tenderer to Complete
Optical Smoke Detector:	
Manufacturer	
Model No	
Country of Origin	
Approved by which standards	
Dimensions	
Technical brochure included with tender (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf

TECHNICAL DATA SHEET No E08: ELECTRICAL INSTALLATION AND REFERENCES

Item	
Installation of electrical plant and equipment:	
Name and address of erector/installer	
Name of the person who will be responsible for all aspects of this work	
Contact details of purchasers who have obtained satisfactory service from equipment of the type offered for the plant:	
Transformers	
MV switchgear	
LV MCC's	
Generations	
Commissioning:	
The signature below the serves to confirm that the Tenderer has read and understood the contractual requirements pertaining to the commissioning of the plant and equipment	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer)

C3.13: GENERAL ELECTRONIC SPECIFICATIONS

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INSTRUMENTATION SPECIFICATION

C3.13.1 Scope

The Contract Works include the design, supply, delivery, temporary storage, installation, testing, commissioning and handing over in proper working order of the complete installations as described in all the constituent parts of this document.

The scope of works will include but will not be limited to the following:

- Updating the scope of works on the Existing SCADA server and workstation
- PLCs and I/O
- Battery supply for PLCs
- Instrumentation and cabling
- Dedicated earthing system for the electronic systems
- Lightning protection (Surge protection)

Supervisory Control and Data Acquisition (SCADA) System

The Employer currently has a service level agreement with Adroit Technologies for supplying the SCADA software and applicable licenses across the DM and it is envisioned that the SCADA software and licenses will be free-issued to the contractor under this contract. An allowance will be made for any additional SCADA hardware and other software to be supplied under this contract under the specification and approval from the Employer's ICT department. The existing SCADA system on the WTW allows for the remote monitoring and control the plant equipment. The Contractor shall make the necessary modifications on the existing SCADA for the new Backwash Water Recovery Facility and 4Mℓ Reservoir. The SCADA mimics shall be developed by an accredited Adroit System Integrator under the contract and shall be approved by the Engineer and Employer's operation department. Important information such as the 4Mℓ Reservoir Level data shall be relayed to the Central SCADA at the Oslo Beach Disaster management Centre and allowance shall be made to update the SCADA mimics accordingly.

Uninterruptible Power Supply

A suitably rated UPS will be provided for the SCADA System and operator PC in addition to the backup generator to provide uninterruptable power while the backup generator starts or fails to start. The UPS shall be capable of providing 2 hours under rated load.

Telemetry

The existing telemetry system allows for remote monitoring and control from the central control at the WTW. The system will be equipped with alarms for malfunctioning equipment. Remote control shall allow for equipment to be operated from the Central Control Room if the automatic operation breaks down or is unsatisfactory in unusual circumstances.

C3.13.2 Technical Specification

This technical specification specifies the standard of workmanship and quality of material required for the installations as described in this Specification and/or schedules, and/or on the drawings, and/or in the Bill of Quantities.

Should there be any conflict between the Electrical Specification(s) and this specification, the electrical Project Specification takes precedence. In the event of there being a discrepancy between any specification and/or a drawing(s) and/or the Bills of Quantities, the discrepancy must be drawn to the attention of, and resolved by, the Employer's Agent before the execution of any work associated with the discrepancy.

If, at any stage, the Contractor wishes to deviate from these specifications, he/she may do so only if permission has been obtained in writing from the Employer's Agent.

Tenderers are required to enter at the time of tendering in the Technical Data Sheets, the manufacturers of the materials on which their tender is based, and the catalogue numbers and other information by which the materials may be identified. Technical brochures of the equipment offered shall be submitted with the tender to enable the equipment concerned to be identified without ambiguity.

Tenderers may only offer equipment for which proven backup is available in South Africa.

Only technicians and artisans with adequate and applicable training and experience may be used to carry out the work on this Contract.

If requested by the Employer's Agent, the Contractor shall submit samples of cables, terminals, labels, trunks and other construction materials which he/she proposes to use on the installation which samples will be subject to the approval of the Employer's Agent.

All materials and equipment used shall be suitable for the environment and the service for which it is to be used. This pertains, inter alia, to corrosion protection, UV stability and the like.

If installation commences with any type of material or equipment, then the same type shall be used throughout the Contract.

Equipment offered shall be small enough to be moved through the available doorways, passages, etc, to their final locations.

Dimensions scaled from drawings shall not be used to obtain lengths of trays, trunks, cables etc. The runs shall be measured on site.

The Contractor must make due allowance for other contractors' operations in progress concurrent with his/her own activities.

Any damage to protective coatings, equipment, services or structures caused by the Contractor shall be made good.

The Contractor must prevent pollution caused by spillages of fuels and lubricants, etc.

C3.13.3 Definitions

"Supply" means purchase, procure, acquire, store off site as necessary, deliver to site, and off load, position, stack and store on site.

"Install" means set out, erect, mount, align, fix, connect, adjust, test and commission and hand over in proper working order.

"Provide" means supply and install.

"Installation" means the installation(s) covered by this this Contract.

"Approved" means acceptable to the Employer in the sole opinion of the Employer's Agent.

C3.13.4 Compliance with Regulations and Standards

The instrumentation installations shall comply with the latest revisions and amendments of the South African Bureau of Standards Code of Practice for the Wiring of Premises, SANS 10142, referred to herein as the "Wiring Code".

The Contractor shall comply with the requirements of the Occupational Health and Safety Act (Act No 85 of 1993 as amended) and the Regulations pertaining thereto and will be required to ensure the safe operation and the safety of all people on site and proper management of the works.

The Contractor shall be registered with the Department of Labour

The standard regulations of any State department or other statutory body.

The Local Authority's By-laws and Regulations and any regulations of the Power Supply Authority.

Telkom's & ICASA's requirements and regulations where applicable.

The relevant codes and specifications.

The Local Authority's fire codes and regulations if and where applicable.

The regulations of the gas supplier if and where applicable.

If conflict appears to exist between any of the regulations and standards referred to above and the specifications, the Contractor must refer such conflict to the Employer's Agent in writing prior to any of the affected materials being ordered or any associated work being carried out.

C3.13.5 Drawings and Other Documents

The Employer's Agent's drawings covering the various sections of the installation are listed elsewhere. The working drawings shall, however, consist of the following, where applicable:

- The Employer's Agent's drawings.
- The Architect's drawings if and where applicable.
- The Structural Engineer's drawings.
- The drawings of other services installations that are relevant for co-ordination and/or installation.

Unless otherwise specified, three sets of the Employer's Agent's drawings will be issued to the Contractor for construction purposes. If required, additional copies may be purchased from the Employer's Agent.

The following drawings, documentation and manuals pertaining to the Electronic Works shall be provided by the successful Contractor at various stages of the Contract:

Prior to Construction

Detailed Control network architecture drawings

Detailed Control System Functional Design Specification and control philosophy including SCADA Mimics (FDS) (for both PLC and SCADA) – (A Basic control philosophy and FDS with framework will be supplied by the Engineer)

SCADA object library (symbols, animated and static)

SCADA mimics and trends templates

SCADA report templates

SCADA and PLC Interface Control Document (detailing the communication interfaces with Intelligent Electrical Devices, Soft Starters, VSD's, generator controllers and electric actuators)

SCADA/PLC panel schematic/wiring and instrumentation loop drawings

SCADA/PLC system UPS/ electrical power distribution drawings

PLC system earthing distribution drawings

PLC network architecture drawings

PLC I/O Listing

HMI Panel General arrangement drawing

Detailed, construction P&ID Drawings

Field instrumentation datasheets

Field instrumentation hook up drawings

Cable rack drawings

Cable schedule

After Construction (As-Built):

Detailed SCADA network architecture drawings

Detailed Control System architecture drawings

Control System Functional Design Specification (FDS) to include SCADA mimics, screenshots of trends, equipment faceplates, and PLC software blocks amongst other items as defined in the Umgeni Water guideline for Functional Design Specification.

Detailed as built Control philosophy including normal operating values, alarm and trip set points.

SCADA control room operator console drawings

SCADA and PLC Interface Control Document (detailing the communication interfaces with Intelligent Electronic Devices, Soft Starters, VSD's, generator controllers and electric actuators)

SCADA/PLC panel schematic/wiring and instrumentation loop drawings

SCADA/PLC system UPS/ electrical power distribution drawings

PLC system earthing distribution drawings

PLC network architecture drawings

PLC I/O Listing

PLC Panel General arrangement drawing

Control System Disaster Recovery Plan Procedure (Including Software and hardware "hard reboot")

Site system earthing distribution drawings

Cable Schedule

Cable rack drawings

A comprehensive Operations and Maintenance Manual shall be supplied for the entire works system. The manual shall bound and shall include the following content:

- Control System FDS
- Standard Operating procedures describing automatic and manual operation
- Routine inspections
- Fault conditions and remedies
- Fault-finding procedure
- Equipment manuals and technical data sheets
- Instrument datasheets
- Listing of parts and spares lists
- Listing of all software licenses and as built software on USB drive

In addition to the requirements of this Specification, the following accredited training shall be provided for staff members of each of the following categories:

- Plant operator training
- Control system fault-finding training
- Control system maintenance training
- SCADA system fault-finding training
- SCADA system maintenance training
- Accredited PLC system fundamentals, fault finding and maintenance training.

The training shall be provided by way of formal training sessions by the Contractor/OEM suppliers who shall certify that the training has been completed satisfactorily.

The Contractor shall submit shop drawings to the Employer's Agent for examination and to demonstrate compliance with the requirements of the Contract. Shop drawings shall include drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, manufacturer, supplier or distributor and which illustrate some portion of the work.

The Employer's Agent's examination of shop drawings or samples shall not relieve the Contractor of responsibility for compliance with the requirements of this Contract unless the Contractor has informed the Employer's Agent in writing of such deviations at the time of submission of shop drawings or samples and the Employer's Agent has given written approval for the specific deviation. Furthermore, the Employer's Agent's examination of the shop drawings will not relieve the Contractor of responsibility for errors or omissions in the shop drawings or samples or for responsibility for erection or installation fit.

The Contractor shall submit to the Employer's Agent marked-up structural drawings, or other drawings, showing changes and/or additional requirements to be made in the structure in order to accommodate equipment that is to be installed under this Contract.

The Contractor will not be allowed to rely on the Employer's Agent for as-installed information which he/she may have compiled, to produce record drawings.

Drawings to be entitled "Record Drawing" shall bear the signature of the Contractor, or his authorised representative, and the date.

The Contractor shall obtain from the Employer's Agent, electronic copies of the drawings for the preparation of record drawings that are to be provided by the Contractor on completion of the Works. One set of the record drawings shall be submitted for verification by the Employer's Agent.

A set of final layout and schematic record drawings shall be provided in a purpose made holder inside the door of each distribution board and motor control centre, or where no doors are fitted, to the front plate of the cabinet. The frame shall be adequately sized to receive the equivalent of two A1 size drawings folded to a nominal size of A4.

For main boards, supply schematic drawings in aluminium picture frame with glass and sealed rear backing suitable for mounting against the substation wall shall be provided by the Contractor.

The Contractor shall provide a complete set of tools associated with equipment for each installation.

The Works will not be accepted until the manuals have been approved by the Employer's Agent and handed over to the Employer.

C3.13.6 Instrumentation Design Documentation

This specification defines the requirements for generic instrumentation design documents that the Contractor is to produce. The design documents are collectively referred to as the 'instrumentation design data pack'. P&IDs are excluded from this specification as they covered elsewhere.

Document Register:

The document register shall provide an all-inclusive listing of all instrumentation documentation and drawings.

The following information shall be included:

Description
Document Number
Document File Name
Document Description (Title of the document)
Document Type (whether it is a loop drawing, hook-up, etc.)
Document file extension (e.g. xls, dwg, etc.)
Document Drawing Size
Sheet No.
Total No. of Sheets per drawing
Document Revision No.
Document Revised By
Document Revision Checked By
Document Revision Approved By
Document Revision Date
Document Revision Status

Instrument List:

The instrument list shall provide a listing of all instrumentation required for the project. The instrument list shall have columns that can be used for monitoring the progress of purchasing, expediting, delivery and installation.

“Wired” (e.g. a pressure transmitter) and “unwired” (e.g. a pressure gauge) instruments shall both be listed.

The Instrument list shall contain the following information:

Description
Instrument tag number as per instrument naming conventions
Description of instrument process service, i.e, “Conveyor- primary crushing product”
Instrument functional description along with its measurement principle, e.g, “blocked chute detector”
Manufacturer name
Model Number
Reference Datasheet Number
Hook-up (installation detail) document number
Instrument range or scale
Engineering units for range and calibrated range
Loop Number per naming conventions
Controller software address
Reference P&ID number
External Power requirements (120 V ac, 24 Vac, 120 V dc or N/A for not applicable)
Delivery status tracking
Installation status tracking
Calibration status tracking (With calibrated range inserted into field)

I/O List:

The I/O list shall provide and show the links between the instrumentation and the control system. The following information shall be included in the I/O list:

Description
A Panel number assigned per C&I naming conventions, e.g, “00-INL-01”
A Node Number in each given panel, e.g, “02”
A Rack Number in each given panel, e.g, “01”
A Slot/Card Position Number in a given Rack, e.g, “04”
Card Manufacturer name
Specific Card Model number
A Brief card technical description, i.e, “24 DC 4ch Digital Input”
Channel Number in the card
I/O Type (AI, AO, DI, DO...)
Tag number of instrument assigned to a channel
Software address assigned
Instrument functional description along with its measurement principle
Revision number

I/O Loading:

The I/O loading report shall provide a count of all the different I/O per area.

The following information shall be included in the I/O loading report:

Description
I/O Type (AI, AO, DI, DO...)
I/O Count
Total I/O count per area

Instrument Cable Schedule:

The cable schedule shall provide a summary of all the electronic cables required for the project. It may also be used for monitoring the progress of purchasing, expediting, delivery and installation by the Contractor

It is preferred that the generation of the cable schedule be automatic from the software design environment.

The following information shall be included in the Cable Schedule:

Description
Cable type code, unique per cable type.
A brief technical description of the cable
Cable construction, Type of sheath material, e.g. PVC/PVC
Size of conductor in mm² (wire cross section)
Cable outer diameter in millimetre
Size of the cable gland
Cable tag number as per C&I naming conventions
Source of the cable, connected to the originator of the signal (i.e, instrument)
Destination of the cable connected to the receptor of the signal
Estimated cable length in metres
Actual cable length in meters (for future input)

Instrument Cable Summary:

The cable summary shall provide a summary of all the different types of electronic cables required for the project with the cost per metre. It must be summarised per area.

It can also be used for monitoring the progress of purchasing, expediting, delivery and installation by the Contractor

The following information shall be included in the Instrument Cable Summary:

Description
Cable type code
Short description of the cable
Manufacturer of the cable
Part number as per De Beers part numbers
Material of the sheath
Estimated cable length in meters
Actual cable length in metres (for future input)

Instrument Panel List:

The instrument panel list shall provide a summary of all control panels, junction boxes, power distribution boxes, solenoid valve boxes and remote I/O boxes required for the project.

The following information shall be included in the Panel list:

Description
Panel tag number as per C&I naming conventions
Service description of the panel
Size of the panel
Mounting style of the panel (wall, stand or floor)
Construction material of the panel
Enclosure class/IP rating
Reference to relevant panel general arrangement drawing
Revision of layout drawing

Block Diagrams:

Cable Block Diagrams shall provide a graphical representation of the cables listed in the cable schedule.

Cable Block Diagrams shall be produced for all cables, including field bus cabling, multicore cabling, network cabling, telecommunication cables, security system cables, IT cabling and fire protection system cabling.

The following information is required in the Cable Block Diagrams:

Description
Equipment numbers e.g, Panel number, JB number, instrument number, etc.
Cable numbers
Cable size (number of pairs or cores)
Length of the cable

Control System Network Diagrams (Network Configuration):

This drawing shall provide an overall view of the total network of the control system.

The following information is required in the Network Diagrams:

Description
All SCADA equipment
All controller equipment
All network equipment
All connections amongst these equipment
Network cable types and lengths
Network cable numbers

Control System Power Single Line Diagrams:

Power single line diagrams shall show incoming and outgoing power (240VAC, 120VAC, 24VDC) and must be used for determining power supply requirements.

The following information is required in the Power Single Line Diagrams:

Description
Main power supply source
UPS and transformer ratings and equipment numbers
Isolator ratings and equipment numbers
Circuit breaker ratings and equipment numbers
Fuse ratings and equipment numbers
Colour codes and numbering for all wiring
Power cable numbers
Power distribution board numbers
Power consumption of equipment requiring power

Control System Earth Layout Diagram:

The earth layout diagram must be provided and shall show the power safety earth, the high quality signal earth and the relation between it.

The following information is required in the Earth Layout Diagram:

Description
Interface to safety earth layout
Overall high-quality earth layout
All main equipment to be grounded

Instrument Location Drawings:

Instrument location diagrams shall be provided to show the exact location of the instruments in the field during the construction phase of a project.

Major pieces of Equipment such as tanks and pumps will be shown for orientation purposes, but all instrumentation must be shown.

The tag number of each instrument device will be provided in this drawing.

The following information is required in the Instrumentation Location Diagram:

Description
The location of field mounted instrumentation with its associated tag number
The location of junction boxes and remote-control panels

Instrument Racking & Routing Diagrams:

Instrumentation racking & routing diagrams shall be provided to show the exact location and route of the instrumentation cable racks. This drawing will indicate the position of all cable racks during the construction phase.

The following information is required in the Racking and Routing Diagram:

Description
The location of cable racks in the field
The cable rack sizes

Control/Equipment Rooms Floor/Layout Plans:

The layout of the control and equipment rooms shall be provided. Any item that will occupy a physical space in the room shall be included in the layout plans.

The drawing shall include all furniture, computers, monitors, printers, panels, servers, UPS, other equipment items and electrical and network connection points to be installed in the room.

The following aspects shall be considered and identified in the drawings:

Description
Dimensions of the room
Required electrical power outlets
Required network connection points
Room access points
Equipment and furniture arrangement
Dimensions for all equipment and furniture to be installed in the room

Control Panel Wiring Diagrams:

Panel wiring diagrams shall show all the necessary information to perform the wiring within a panel (internal wiring). They are also used for the manufacture, commissioning and maintenance and/or later modifications of the panels.

For panels with terminal strips interconnected only (i.e, wiring between marshalling terminal strip and I/O card), drawings shall include the following:

Description
Point to point wiring requirements
Core numbers for wires
Colour codes for wires
Wire types and sizes
Terminal strip numbers and terminal numbers
Identification of the name of the cable source and destination

Termination Wiring Diagrams:

Termination wiring diagrams shall be prepared show all terminations for field wiring.

Termination wiring diagrams shall be provided for instruments, junction boxes, remote I/O panels or any other panel with external electrical connections in order to show the incoming and outgoing cables as applicable, and the cable/conductors terminated in the specific panel strip.

The following information shall be included in the termination wiring diagrams:

Description
Identification of the panel or device
Identification of the terminal strip number
Identification of terminal numbers
Identification of cable names
Identification of wires by colour and number

Panel General Arrangement Drawings:

The general arrangement drawings shall show the dimensional mounting arrangement of all devices specific to a particular panel.

Panel general arrangement drawings shall depict equipment that is mounted on back panels inside electrical enclosures and show any front-panel penetrations if required.

Drawings must be prepared “to scale”.

The following information shall be shown, as applicable, in the panel general arrangement drawings depending on the panel type:

Description
Panel material / wall thickness
Panel dimensions
Panel mounting style
Paint and colour requirement
Enclosure class / IP rating
Type of terminals to be used
Quantity of terminals per type
Layout of all equipment in the panel
Wiring specification (size, colour and type)
Power supply requirements
Quantity and rating of circuit breakers
Quantity and rating of fuses
Type and size of trunking used
Specific component mounting details
Gland plate details
Mounting Rail details

Installation Data Sheet:

The instrument data sheet must fully specify the instrument required for the application. Specification forms shall, as a minimum, comply with the requirements of ISA standard no. S20.

Every data sheet shall include the tag number or list of instrument tag numbers assigned to the specification.

Process parameters such as temperature, pressure, flow rates, specific gravity and viscosity are often required in order to adequately specify an instrument.

Other parameters that may be required (as applicable) include:

Description
Instrument type service description
Instrument type functional description
Calibration range
Measuring range
Engineering units
Electrical power requirements (loop or external powered) and values (220 Vac, 24 V dc)
Power consumption
Air supply requirements
Environmental conditions (Ambient temperature limits, shock resistance, etc.)
Type of output signals required (4-20 mA for analogue and 24V DC for digital)
Enclosure class and materials
Electrical connection size and cable gland type
Process connection type, size and rating (e.g, 150lb RF flange)
Mounting type (integral, remote or direct)
Process fluid / product (water, slurry, etc.)
An instrument tag or tag list
Face to face dimensions (especially for in-line instruments)

Instrumentation Pneumatic Tubing Connection Diagram:

This type of drawing shall be produced for solenoid valve blocks to indicate all the air tubing interconnections and the connection to the air supply line. This connection diagram must show all instrument air piping to the instrument.

The following information shall be provided:

Description
Valve block numbers
Valve block port numbers
Instrument tubing numbers
Instrument tag numbers

Loop Drawings:

Loop diagrams shall comply with the basic requirements of the ISA Standard no. S5.1. and these drawings shall provide information about the complete circuit wiring of an instrument.

Loop drawings shall contain the following information:

Description
All instruments part of the loop with their respective tag numbers
The instrument tag number
All wiring details from the field to the controller I/O module / card
Instrument power supply details
The controller number, rack number, slot and I/O address
Instrument termination details
Field junction box numbers and termination details
Panel terminal strip details
All wire and cable sizes, colours, types and numbers

C3.13.7 Inspection and Testing

The Employer's Agent shall be allowed reasonable access for inspection of any equipment which is being manufactured for this Contract.

The Employer's Agent may inspect the work at any stage of erection, and the Contractor shall provide such facilities (including tools and instruments) as reasonably may be required to perform such inspection. Such inspection by the Employer's Agent shall not relieve the Contractor of ensuring that the works are completed in all aspects in accordance with specifications.

Provision shall be made for all equipment, cabinets, consoles etc, to be inspected by the Employer's Agent at the manufacturer's premises prior to delivery to site. At least 7 days' notice must be given to the Employer's Agent of the date when such inspection is required.

C3.13.8 Construction Aspects

All holes, wireways, trenches, etc required for this installation and made by the Contractor shall be reinstated to their original condition.

In all cases where the Contractor uses facilities provided by others, it is the responsibility of the Contractor to ensure that these are provided correctly to match his requirements. If discrepancies are found, these shall be brought to the attention of the Employer's Agent immediately and prior to the installation of equipment.

No face brick or other finished surfaces may be chased without the permission of the Employer's Agent.

No cutting of structural concrete will be permitted without the permission of the Employer's Agent.

The Contractor shall provide and erect all necessary scaffolding for this contract. Scaffolding erected by another Contractor may be utilised by the Contractor provided suitable arrangements are made with the other Contractor.

C3.13.9 Installation and Layouts of Equipment

Equipment shall be mounted for maximum accessibility and visibility.

Workmanship shall be of good quality and all cutting, drilling, welding, etc, shall be neatly done. Each completed installation, including supports, brackets and wiring shall present a clean, compact appearance.

All fixing hardware for field mounted equipment shall be finished off free from burrs or jagged edges.

Field cables, which must be connected to equipment which is mounted in an enclosure of any kind (box, console, panel etc.), shall terminate on terminal strips and shall not be wired directly to the equipment.

All wiring must be contained within conduit or trunking or within metal enclosed equipment.

When two or more parallel rows of terminal blocks are used, the clear space between the blocks shall be at least 120 mm.

Where two or more pieces of electrical equipment in close proximity have similar signal or supply conditions, use shall be made of a junction box to group the tail cables in order that a common multicore cable may be run to the control room.

Cable entries into outdoor junction boxes shall be bottom-entry only.

Cables carrying 230 V AC (power or ON/OFF signals) may only be run on the same cable tray as analogue signal cables if the spacing between the cables is at least 100 mm, or if individually and overall screened cables are used. Low voltage signals and power/audio output signals may not be run in the same cable without the permission of the Employer's Agent.

C3.13.10 Equipment Numbering and Marking

Each item of equipment shall be marked with a manufacturer's data plate specifying, where applicable, the following:

- Manufacturer's name
- Model and serial number
- Power supply requirement
- Tag number

C3.13.11 Cables and Cable Cores

All cables shall comply with the relevant SANS specification for the particular type of cable.

Outer insulation material of cables for installation in confined spaces shall be fire retardant, non-toxic and Halogen free.

Unused or spare cable cores shall be strapped together with cable straps should they not be connected to spare terminals.

Consistency in the use of core colours and / or numbers shall be maintained throughout the installation to avoid confusion. Colour and / or number coding of cores shall be shown on the relevant drawings.

Cores passing through holes in chassis or screens shall be fully protected by correctly fitted grommets or bushes.

Cores carried across a hinged portion of a chassis or door shall be flexible. Sufficient slack shall be provided to obviate tension.

The insulation of a core shall not be stripped back further than or less than necessary.

The conductor shall not be exposed with a crimped insulated terminal lug fitted.

Not more than one core shall be connected to one side of a connection terminal block.

Core terminations shall be fitted with interlocking engraved (black letters on white background) plastic cable ferrules, reference numbered to correspond with the related schematic or wiring diagrams. Split or clip-on ferrules or adhesive marking tapes are not acceptable. The markings for horizontal runs shall be from left to right when facing them, and for vertical runs from the bottom upwards.

The wiring inside panels and junction boxes shall be well planned and neatly arranged in the best possible manner, allowing for forming of cores so that there is no strain on them.

C3.13.12 Signal Cable Installation

Cables shall be installed neatly, either saddled or strapped to the panel or supporting steelwork. Where this is not possible or practical, the cable loom shall be strapped together using proprietary type plastic cable straps available for this purpose. Cotton insulation or thread shall not be used.

Cables shall be secured and connected at terminations so as to prevent undue mechanical stresses upon glands, conductors or terminals.

Signal and communication cables shall be segregated and separated from power cables on separate racking, parallel routes shall be separated by a minimum distance of at least 300mm, space permitting and if physically possible.

Cables shall not be installed double-banked on racks.

Armoured cables shall be secured to racks or angle-iron supports by 10 mm wide stainless steel strapping and purpose-made buckles.

Unarmoured cables shall be secured to racks or supports by fit for purpose PVC or nylon cable straps.

The span of strapping shall be such as to prevent bunching of cables, and in any event should not exceed 1 000 mm.

Cables running horizontally on cable racks mounted vertically (edgewise) shall be secured to cable racks at 600 mm intervals, which shall be reduced as necessary to prevent unsightly sagging of cables.

Cables laid flat in racks parallel with a slightly inclined ground or floor surfaces need not be secured to the racks more often than is necessary to prevent cables from walking as a consequence of expansion, contraction or vibration.

Any horizontal or vertical cable run that are not strapped or supported in such a way that the cable cannot fall in the event of fire shall be strapped by 10 mm wide stainless steel strapping and purpose-made buckles at 1 meter intervals.

Holes for cables passing through panel steelwork shall be made smooth or bushed to prevent severing of the cable and fitted with appropriate grommets.

Joints in cables are prohibited unless the route lengths exceed the maximum lengths the manufacturer can supply. In this eventuality, approved proprietary types of junction boxes shall be used. Joints shall only be used with approval from the Employer.

When stripping insulation from cores, the conductors shall not be nicked or cut.

All conductors shall be terminated in an insulated double crimped termination lug of the correct size using a crimping tool approved by the manufacturer of the terminal.

Bare conductor terminations shall not be accepted.

Pin lugs shall be used for connections using terminal strips and spade lugs when terminating under a screw head.

Holes into air-conditioned rooms shall be completely sealed off to maintain the air conditioning system performance.

Cable screens at the unearthed end of the cable are to be tied back and covered with heat-shrink sleeve. Cable screens shall not be cut off at the cable sheath.

Cables shall enter an enclosure from the bottom and shall be formed to relieve stress on the cable end, with a sealing boot fitted over the cable gland.

Cables to instruments shall be terminated in a locally mounted approved three way bottom entry IP65 connection box (as per current mine standard) with a short length (1 to 2 metres) of flexible cable with a single 150 mm diameter loop strapped to a suitably supported angle iron.

The connection box can be multiple-way units to accommodate more than one loop, provided the loops are associated. A terminal strip shall be fitted inside the box for core connections.

Sealing boots shall cover the cable glands fitted to connection boxes.

C3.13.13 Communication Cable Installation

Bus cables shall be installed in their own steel cable channels or conduits. If not installed in conduit, bus cables should be brightly coloured and installed where they are clearly visible and separated from all other cables in order to improve any interference pickup and to avoid accidental damage.

When installing, it is important not to distort or damage bus cables since this can cause reflections to occur in the network. In particular, do not twist or stretch bus cables, do not quash or crimp them and adhere to the recommended minimum bend radius (typically for solid core, 75 mm minimum, for stranded cables, 45 mm for a single bend and 65 mm for repeated bending).

To reduce the chances of interference pickup, it is important that bus cables are run separately from other types of cable. It is useful to categorise various cable applications as follows:

Category I:

Fieldbus and LAN cables (e.g, PROFIBUS, AS-I, Ethernet)

Shielded cables for digital data (e.g, printer, RS232)

Shielded cables for low voltage (≤ 25V) analogue and digital signals.

Low voltage power supply cables (≤ 60V).

Coaxial signal cables

Category II:

Cables carrying DC voltages > 60V and ≤ 400 V

Cables carrying AC voltages > 25V and ≤ 400 V

Category III:

Cables carrying DC or AC voltages > 400 V

Cables with heavy currents.

Motor/drive/inverter cables.

Telephone cables (can have transients > 2000V).

Category IV:

Cables of categories I to III at risk from direct lightning strikes (e.g, connections between components in different buildings).

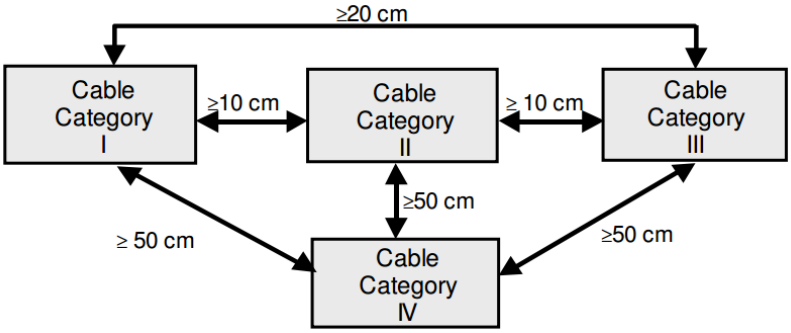


Figure 1: Minimum Separation Distances

Where cables have to cross, they should cross at right angles and should never run in parallel even for short distances.

Cables from the same category can be bundled together or laid directly beside each other in the same cable trays. Cables of different category must be separated by at least 100 mm.

When separated by earthed steel partitions with a steel lid, the bundles can be placed next to each other. All channels and partitions must be properly earthed using flexible bonding links protected against corrosion. Note that braided straps are better than solid metal for high-frequency EMC protection.

The braided shields of all communication cables entering the wiring closet should be earthed with metal clamps as close as possible to the point of entry to the cabinet.

C3.13.14 Profibus Installation

Profibus® installations shall comply with all requirements of IEC 61158, component manufacturer's recommendations and the following:

The maximum number of stations permitted within a network shall be 126 i.e, Slave Address 0 to 125.

The maximum number of stations per segment including all repeaters shall be 32.

The data transfer rate shall be a minimum of 1500 kbit/s for control purposes.

SWA type cable shall be used where buried directly buried within ground.

Trailing type cable shall be used where connected slaves are subject to movement

Bus cable “Type A” shall be used in compliance with IEC 61158.

The cable cross sectional area used shall be compatible with the mechanical specifications of the bus interface connector.

In order to minimise cable reflections and ensure a defined noise level on the data lines, the data transfer cable must be terminated at BOTH ends with a terminating resister combination. Active terminators, supplied via UPS are required in this regard to ensure high network availability.

To prevent EMC interference, the cable shield should be connected to the functional ground of the device (generally the electrically conductive case). This is done by connecting the cable shield to the metal case of the Sub-D connector and the functional ground over a large area. The bus connector must have a low-impedance connection to the cable shield.

For equipment containing frequency inverters (variable speed drives), the manufacturer’s regulations for EMC compliance must be observed for filters, chokes and shielding.

PROFIBUS cables shall be shielded with a combination of both conductive braid and conductive foil. "Shield" refers to both types of shields (braid and foil). A foil shield should not be used on its own, because it is very thin and can easily be damaged. The cable shield must be connected to the functional ground at both ends of the cable by making a large-area connection to a grounded conductive surface.

When laying the bus cables, particular care should be taken to ensure that the cable shield (braid shield and foil shield, if available) is connected to the shield grounding clamp over a large area. The two PROFIBUS data lines are designated A and B. There are no regulations on which cable core colour should be connected to which of the two data terminals on each fieldbus device; the sole requirement is to ensure that the same core colour is connected to the same terminal (A or B) for all stations throughout the entire system (across all stations and bus segments).

Profibus cables must be run in separate cable runs at least 10cm apart from any other electrical cable.

All cable ducts should be constructed of electrically conducting material and connected to functional ground at regular intervals. Bus cables should not be subject to mechanical loads which exceed the manufacturer’s specifications. If this cannot be avoided, additional protective measures should be taken, e.g, by laying the cables in a steel pipe or rugged metal duct. The pipe or duct should then be grounded at regular intervals and protected against corrosion.

Fibre optic cables are required for bus installations which are outside of buildings.

A test report in compliance with IEC 61158 shall be prepared for each network segment during the network commissioning phase.

C3.13.15 Cable Numbering and Marking

The Contractor shall prepare a cable schedule from which all cable identification tag numbers will be derived.

Cables shall be labelled with the cable number at the origin and destination points and at entries / exits to racking / ducting / penetrations, by means of a label, approved by the Engineer, suitably attached to the cable.

The cable marking label shall be finished with a “fit-for-purpose’ plastic sleeve, approved by the Employer’s Agent, suitably attached to the cable.

A wire marking system shall be used to identify all cable cores at both ends in accordance with the loop and termination wiring diagrams.

C3.13.16 Screening and Earthing

Sensor cable screen conductors, used for grounding unwanted signal noise, shall be terminated to an isolated signal earth bar (instrument earth) located in the PLC panel or remote IO panels. An isolated earth bar is an earth bar that is isolated from the safety earth and connected to generation origin earth.

Individual and overall screen wires of all sensor cables shall be terminated at the equipment room side only and shall be left disconnected (floating) and insulated at the instrument in the field.

All single pair cable screen conductors shall be insulated and tied back at the sensor.

Analogue single pair cable screen conductors shall be connected to individual terminals in a junction box.

Overall analogue cable screen conductors and digital cable screen conductors shall be insulated and tied back inside the junction boxes.

Under no circumstances shall the screen conductors be utilised for any purpose other than for noise immunity.

The safety earth (or electrical earth) shall be utilised for the safety earthing of all metal automation equipment and supports.

C3.13.17 Field Boxes Numbering and Marking

The Contractor shall prepare a ‘junction box/panel schedule’ from where all field-mounted box identification numbers shall be derived.

Each field box shall be identified by means of an engraved label in a holder such that the label can be removed without damage to the box/panel. The attachment of label holders shall not degrade the IP rating of the box/panel.

The box/panel identification plate shall specify, where applicable, the following:

- Panel Number
- Equipment/Panel Service
- Network/Control System Unique Identification
- Source of power feed

Pressure Gauges are covered in the Mechanical Specification

C3.13.18 Pressure Transmitters

Pressure transmitters and differential pressure transmitters shall be of the indicating, electronic type based on capacitance principle.

Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by means of a hand held calibrator or by software application to which the device is networked.

Transmitters shall be fitted with a 4-line LCD on-site display which shall show the measured value and shall provide a means to access and set configuration parameters.

Sensor Type	:	Piezo-resistive, metallic welded membrane
Sensor Overpressure	:	40 x the nominal pressure
Wetted parts	:	316 Stainless Steel
Body material	:	316 Stainless Steel
Process Connection	:	½" NPT
Electrical Connection	:	Gland and 20 mm ISO conduit
Electronics Housing Protection	:	IP65
Overpressure Limit	:	200% of maximum process static pressure
Mounting	:	Pipestand or direct process connection as appropriate to application
Output	:	4-20 mA HART into 250 W load
Signal on alarm	:	Configurable (overshoot or undershoot)
Supply	:	9 to 32 V DC (loop powered)
Calibration Adjustments	:	Independent Zero and span
Element Temperature Limitation	:	100° C
Humidity Limits	:	0 - 100% relative humidity
Accuracy	:	0,15% of span or better
Repeatability	:	0,05% of span
Response time	:	250 ms
Dead Band	:	not to exceed 0.1% of span
Ambient Temperature Effect	:	not to exceed 0,5% of maximum span/10° C change
Preferred type	:	Endress & Hauser, Honeywell, Fischer Rosemount

C3.13.19 Temperature Instruments

Thermowells:

Thermowells shall be provided for all temperature measuring elements that are inserted into process vessels and process pipes.

The tips of thermowells in pipes shall be situated in the third of the pipe. Care shall be taken to ensure that the wake frequency is less than the natural frequency of the well.

Type	:	Fabricated
Material	:	316 Stainless Steel or process compatible
Internal Diameter	:	8 mm nominal
External Diameter	:	10 mm nominal
Process Connection	:	½" NPT male
Bulb Connection	:	½" NPT female
Preferred	:	Wika, Honeywell

Thermocouples:

Thermocouples shall be used for general temperature measurement where the temperature needs to be read at a remote location, e.g, at a control panel and shall be in accordance with IEC 60548.

The length that is selected shall be such as to permit good thermal contact at the tip of the couple with the end of the well.

Type	:	Type "J" (Iron Constantan), mineral insulated
Emf Output to Temperature Relationship	:	According to tables in BS1829
Diameter	:	6 mm nominal OD
Performance	:	± 2°C up to 300° C
Response time	:	5 s
Preferred	:	Temperature Controls

Resistance Temperature Detectors (RTDs):

RTDs shall be used where greater accuracy than thermocouples is required.

The length that is selected shall be such as to permit good thermal contact at the tip of the RTD with the end of the well.

Type	:	PT 100 3 wire simplex mineral insulated
Diameter	:	6 mm nominal OD
Resistance/Temperature Relationship	:	As per IEC 60751
Accuracy	:	± 0,5% of span, or better
Repeatability	:	± 0,1% of span
Dead Band	:	Not to exceed 0,1% of span
Ambient Temperature effect	:	Not to exceed 0,5% of span per 10°C change

Vibration resistance	:	50 g peak to peak
Response time	:	5 s
Preferred	:	Endress & Hauser, Temperature Controls

Filled Systems:

Filled systems shall be all welded, including the bulb and capillary tube.

Maximum temperature shall not exceed 300°C; over-range shall be minimum 50%.

Filled systems shall not be used on shutdown services.

Maximum length shall be 3 m.

Accuracy shall be 1% of span or better.

Preferred	:	Temperature Controls

Temperature Gauges:

Gauges shall be either a bimetal coil type or a gas filled system as appropriate for the application.

The gauges shall be 150 mm nominal diameter. The viewing angle shall be adjustable.

The case and movement material shall be stainless steel.

The dials shall be white with black lettering and marked in degrees centigrade.

The bulb shall be 8 mm nominal diameter with a length to suit the application.

Capillary tubes shall be provided where the application demands.

Gauges shall be furnished with a pre-fabricated stainless steel thermowell which shall have a process connection of ½" NPT male and a bulk connection of ½ NPT female.

Accuracy	:	± 1% of span
Response time	:	1,2 x maximum span
Preferred	:	Temperature Controls. Rhomberg

Temperature Transmitters:

The temperature transmitter shall be of the electronic type with connections for a 3-wire RTD/thermocouple type connection.

The unit shall comprise of a head mounted transmitter and an integral element unless stated otherwise.

Transmitter:

Mounting	:	Head mounted, encapsulated unit.
Ambient Temperature limitation	:	70°C
Humidity Limits	:	0-100% relative humidity
Power Supply	:	24V DC (loop powered)
Output	:	4-20 mA HART into 250 W load
Accuracy	:	± 0,03% of span
Rise time	:	approximately 0,8 s

Damping time	:	Configurable
Burnout Facility	:	Upscale or downscale option
Calibration Adjustments	:	Independent Zero and span
Input	:	To suit sensor type
Protection	:	Reverse polarity protected
Configuration	:	Software configurable
Sensor detection	:	Sensor break and wire resistance

Head:

Material	:	Aluminium
Protection Class	:	IP65
Electrical Connection	:	Gland and 20 mm ISO conduit
Preferred	:	Honeywell Smart, Temperature Controls Endress & Hauser

C3.13.20 Flow Instruments

a. Orifice Plates:

The design shall comply with BS 1042 Part 1 1984, or ISO 5167.

Material shall be Grade 316 stainless steel unless otherwise stated.

The direction of flow, the orifice size and the tag number shall be stamped into the protruding lug (handle) of the orifice plate. This information shall be clearly visible when the orifice plate is in service.

The accuracy of each individual installation shall be determined and corrections for the thermal expansion of the plate, the adiabatic expansion of the fluid (if applicable) and the drain hole (if applicable), shall be applied. Determination of head loss shall be calculated.

Flange tappings shall be used.

b. Venturies:

Venturies may only be used to measure the flow of liquids and slurries that are not abrasive. They may be used in applications where the requirement for greater accuracy or lower pressure loss is justified by the higher expense, compared to an orifice plate.

The differential pressure shall be measured using a standard DP cell.

The design shall comply with the requirements of ES1042 Part 1 1984 or ISO 5167.

Material shall be Grade 316 stainless steel unless otherwise stated.

Accuracy	:	± 0,75% of full scale
Preferred	:	Proflow, Kent

c. Flow Nozzles:

The use of a nozzle may be considered for applications requiring higher flow rates or greater accuracy than an orifice plate. Applications are more suited to gases and clean liquids, especially those that discharge from the pipe to atmosphere.

The differential pressure shall be measured using a standard DP cell.

The design shall comply with the requirements of BS1042 Part 1 1984, or ISO 5167.

Material shall be Grade 316 stainless steel otherwise stated.

Accuracy	:	± 1% of full scale
Preferred	:	Proflow, Kent

d. Dall Tubes:

The use of a Dall tube may be considered where lower pressure loss and lower cost at the expense of accuracy, is required, compared to the Venturi.

The differential pressure shall be measured using a standard DP cell.

The design shall comply with the requirements of ES1042 Part 1 1984, or ISO 5167.

Material shall be stainless steel, unless the process conditions dictate otherwise.

Data sheets shall be provided showing the information required to perform the calculations and the tolerances permitted.

Accuracy	:	± 1% of full scale
Preferred	:	Proflow, Kent

e. Electromagnetic Flow Meters:

Transmitters shall operate on the law of induction principle. They shall be compact and suitable for mounting in the field without additional protection.

The flowmeter shall be suitable for use in pipelines that are cathodically protected.

Supply shall include gaskets and earthing rings.

A primary head simulator shall be offered as an option.

Empty pipe detection shall be included.

The primary head shall meet the following requirements:

Connection flange rating	:	SANS 1123 Table 1000
Connection flange material	:	Or Ni Steel - depending on application
Tube Material	:	1.4435/ 316 L
Liner Material	:	PTFE
Electrode Material	:	Hastelloy Tantalum depending on application
Meter Casing	:	Die Cast Aluminium
Power Supply	:	24V DC

Enclosure Class	:	IP67
Ambient Temperature Range	:	-10 to +50°C
Electrical Connections	:	Gland and 20 mm ISO conduit

Field excitation shall be pulsed D.C.

The signal converter shall meet the following requirements:

- Transmitter electronics shall be either head mounted or remote mounted depending on application.
- The ingress protection rating of the converter shall be the same as for the primary element, typically IP67
- Transmitter shall have microprocessor based electronics with local flow indication and ability to display and change, on-line, range and units.
- The low-flow cut-out shall be user configurable.
- Parameter and data storage shall be kept in non-volatile memory.
- Output shall be 4 to 20 mA, isolated. Where transmitters have dual ranges, each range shall have a separate output.
- Totaliser pulsed output shall be maximum 10 pps with a minimum pulse width of 50 ms.

Accuracy	:	0,5% of span over a velocity range of 0,5 ms
Repeatability	:	0,2% of span
Ambient temperature effect	:	not to exceed 0.5% of maximum span per 10°C change
Minimum sensitivity	:	5 uS/cm
Preferred	:	Krohne, Endress & Hauser, Flowmetrix

f. Open Channel Flow Meters:

The flow of liquids in open channels shall be measured by means of either weirs or flumes.

The variable head at the weir/flume shall be detected by an ultrasonic sensor located upstream, just clear of the effects of drawdown. Other level measuring devices, such as the capacitance or bubbler types, will not be considered.

The design, location and materials for the weir or flume shall be determined by the application, and in accordance with BS 3680, Part 4.

Pre-constructed weirs and / or flumes shall be manufactured to the specific standard for the application, and correctly installed at the site.

Weirs

Ensure that the nappe has sufficient clearance under maximum flow conditions.

Where floating debris exist, broad crested weirs shall be used, unless a suitable debris trap is installed upstream of the weir.

The geometry of the weir shall be selected to suit the application and the expected flow rates.

Long-base weirs may be used for river flow measurement where construction of flumes may be impractical.

Flumes

Flumes may be selected where there is insufficient fall to permit unobstructed downstream flow from a weir and/or where silting at a weir may occur, or where floating debris may be present.

The geometry of the flume shall be selected to suit the application.

The surfaces shall be smooth, especially near the throat.

The structure shall be rigid and watertight, and capable of withstanding flood conditions.

Uniform approach of flow is required. The approach channel shall be in the order of 5 times the width of the channel in full flow.

Flow ranges	:	Rectangular weir	: 0-15 to 0-650 l/s
		Triangular weir	: 0-10 to 0-130 l/s
		Trapezoidal weir	: 0-15 to 0-650 l/s
		Flumes	Wide range
Accuracy	:	Rectangular thin-plate weirs	: 1% to 4%
		Broad-crested weirs	: 3% to 5%
		"V" notch weir (20° to 100°)	: 1% to 2%
		Triangular profile weirs	: 2% to 5%
		Standing-wave flumes	: 2% to 5%.
Preferred	:	Endress & Hauser	

g. Ultrasonic Flow Meters:

Transducers

This section covers ultrasonic transducers located above the surface of the water, at the measuring point.

Suitable support brackets shall be supplied for the ultrasonic transducers.

Enclosure	:	IP65
Membrane	:	Stainless Steel
Electrical Connection	:	20 mm ISO conduit
Max Operating Temperature	:	60°C

Transmitters

Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by hand-held calibrator.

The ability of the system to be configured to ignore unwanted signals from obstructions is essential.

Enclosure	:	To suit application
Output	:	4-20 mA into 250 W load
Power Supply	:	24 V DC
Calibration Adjustments	:	Independent for Zero & span
Accuracy	:	1% of span or better

Repeatability	:	0,2% of span
Dead Band	:	<0,2% of span
Ambient Temperature Effect	:	<0,5% of maximum span per 10°C change
Preferred	:	Endress & Hauser, Siemens

h. Rotameters (Variable Area Meters):

Rotameters shall be provided for low flow rates if local indication is required. Rotameters shall also be provided if the rangeability, nonlinearity, viscosity, or hazardous nature of the fluid makes a differential-pressure type instrument unreliable. Rotameters shall have line class block valves upstream and downstream for maintenance.

A safety-glass indicating tube shall be provided for pressure below 1 000 kPa and temperatures below 100°C. An armoured tube with magnetic pickup shall be provided for other applications. Armoured meter tubes shall have internal guides.

All wetted parts of rotameters on high pressures shall be stainless steel. Teflon or other liner materials shall be considered for corrosive fluids.

The manufacturer's standard tube and float shall be supplied to provide a normal flow rate between 40 and 80 percent of the meter capacity. The anticipated minimum and maximum flow rate shall be between 10 and 90 percent of the meter capacity.

Rotameters shall be accurate within ± 2% of the full scale and shall have direct reading indicating scales or percentage scales with stainless steel factor tags. Indicating scales shall have full length safety glasses with shields and gaskets on both sides. If percentage scales are used, the scale factor shall be tagged on the rotameter.

Rotameters shall have beaded, ribbed or flat tube indicators. Plain tempered tubes are not acceptable.

Variable area rotameters shall be completely assembled prior to shipment.

Preferred : Krohne, Fischer & Porter

C3.13.21 Fluid Level Instruments

a. Ultrasonic Level Transmitters:

<u>Transducers</u>

Suitable stainless steel support brackets shall be supplied for all types of ultrasonic transducers.

Coatings shall be applied to exposed surfaces that may be subject to damage from the process.

Alternative mounting methods (e.g, suspension) may be required in some applications.

Process Connection	:	Wall mounted bracket, or to suit.
Enclosure	:	IP68
Membrane	:	Stainless Steel
Electrical Connection.	:	Gland and 20 mm ISO conduit
Max Operating Temp.	:	60°C

Transmitters

Transmitters shall comprise of a remote electronics unit and a single field mounted ultrasonic emitter/sensor.

Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by hand-held calibrator.

The transmitter shall have the ability to linearise the O/P depending on the geometry of the vessel, and thus relate O/P to either level or volume.

The ability of the system to be configured to ignore unwanted signals from obstructions or agitators is essential.

Enclosure	:	To suit application
Output	:	4-20 mA HART into 250 W load
Power Supply	:	24V DC
Calibration Adjustments	:	Independent for zero & span
Accuracy	:	1% of span or better
Repeatability	:	0,2% of span
Dead Band	:	<0,2% of span
Ambient Temperature Effect	:	<0,5% of maximum span per 10°C
Preferred	:	Milltronics, Endress & Hauser, Siemens, ABB

Rods shall be of a material that is compatible with the process fluid. Coatings, such as Teflon, shall be used to protect the rods in most applications. The structure and physical attributes of the coatings shall not change due to changing process temperatures

Probe

Material	:	Stainless steel
Sheath	:	PTFE
Insertion Length	:	To suit application
Process Connection	:	1½" B.S. P/N.P.T
Temperature	:	Maximum process temperature 80°C
Pressure	:	Maximum process pressure 1 000 kPa

Transmitter

Transmitter shall be of electronic type for rod or rope probe connection. Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by hand-held calibration.

Enclosure	:	To suit (IP68)

Output: 4-20 mA into a 250W load

Power Supply	:	24V DC
Calibration adjustments	:	Independent for Zero & span
Accuracy	:	1% of span or better
Repeatability	:	0,2% of span
Dead Band	:	<0,2% of span
Ambient temp. effect	:	<0,5% of maximum span per 10°C change
Preferred	:	Endress & Hauser

C3.13.22 Analytical Instruments

a. Total Suspended Solids Meter:

Transmitted light absorption principle; pulsed NIR 880 nm; with reference measurement.

Reflection and absorption of light on suspended solids and sludge particles. The light passes the measured particles between the emitter and the detector in a straight line.

Sensor

Enclosure Protection	:	IP68
Measuring Scale	:	0-50 g/L
Process Connection	:	3/4" NPT with retractable assembly
Output	:	4-20 mA
Temperature range	:	0-80°C
Accuracy	:	± 2% of reading
Process pressure range	:	0.5 to 10 bar

Transmitter

Multiparameter converter for liquid analytical measurements. The wall mount option shall be used.

Measuring accuracy of Total suspended solids shall be <2% of reading after linearisation

Display	:	LCD
Preferred	:	Krohne, Endress & Hauser.
Max Ambient Temp	:	50°C

b. Ultrasonic Sludge Blanket Level Detector:

Immersion sensor for sedimentation tanks in water, wastewater and utilities. Measuring principle shall be via an ultrasonic sensor. Application shall be continuous interface measurement in sedimentation basins with automatic wiper. Installation shall be Submerged sensor with fixed cable.

Measurement range:	0.3 to 10 m (1 to 32 ft)
Measuring principle:	Ultrasonic return-time measurement
Material:	Sensor: ABS and epoxy resin
Wiper:	EPDM
Housing:	Polyamide
Process temperature:	1 to 50 °C (34 to 122 °F)
Process pressure:	0 to 0.3 bar (0 to 4.4 psi)
Ingres protection:	IP68
Preferred:	Endress & Hauser

C3.13.23 Cables and Wires

All general wiring shall be multi-stranded of minimum thickness of 0,5 mm2 with colour-fast PVC insulation.

All cables supplies shall be supplied in quantities which allow for a reasonable amount of wastage.

No multicore cable shall be fully utilised. A minimum of 2 cores or 10% of the cores, whichever is the greater shall be left for spare.

All cabling shall be arranged for maximum accessibility and shall allow for equipment removal without disturbing other operating equipment or disfiguring wiring.

Installed cabling shall not obstruct vision or access to any other equipment.

No cabling shall be installed directly in concrete or brickwork.

Only SWA cables may be buried directly in the ground.

Cables within buildings are to be carried on overhead cable trays attached to the building frame or other supports.

When laying cables great care shall be taken to avoid twisting, kinking, excessive tension, mechanical pressure and sharp bending.

Cables shall run parallel.

Only the use of approved lubricants to assist in the drawing in of cable into conduit shall be permitted.

At all cable ends compression gland fittings shall be used.

Every cable shall have a label attached at each end as identification.

Slotted cable trunking shall be used inside cabinets wherever possible.

Wire bundle runs in consoles, etc shall be bound with nylon cable ties at intervals not exceeding five bundle diameters.

Bundles shall have uniform appearance, circular cross sections, and shall be securely fastened to the panel framework.

C3.13.24 Cable and Wire Terminating and Mounting Hardware

Every terminal strip shall be numbered or named.

Every terminal shall be numbered.

Cable glands shall be of the compression ferrule type with "O" ring seals.

No joints will be allowed in cables or wires between terminations.

All cable cores and wires shall be numbered at all termination points with "slip-on" interlocking type cable markers. Split-ferrule types are unacceptable. In the case of multi-core cables each core shall be numbered.

Wherever possible, terminations of cable cores and wires shall be made using spade, pin or bootlace ferrule type crimp-on lugs.

Lugs may only be crimped with controlled pressure crimping tools of the correct size for the lug used.

Thin, collapsing pipe type ferrules shall not be used.

High quality wire strippers shall always be used and care taken not to nick or otherwise damage the strands.

Terminals shall be located so that all connections can be made easily.

When wiring of different potentials and types of supply use the same terminal rail then a clear space or a barrier shall be provided between terminal blocks.

Metal wireways shall be electrically continuous.

Cable and wireways supports shall be spaced adequately to avoid sagging between supports. Cable trays and wireways shall be firmly fastened to such supports.

Any bending, jagged edges or any other forms of damage or deformation of cable trays or wireways shall be made good, before cables are installed.

Conduit shall be thoroughly cleaned and have all burrs removed before the drawing in of any cable.

Where outlet boxes, draw boxes, etc, are to be mounted in highly visible areas special attention shall be given to their aesthetic appearance.

Cable routes shall be chosen to avoid high temperatures and other hazards.

All main cable routes must be vermin-proofed.

Where trays are joined together, galvanized or cadmium plated bolts and nuts are to be used. Welding is not permitted.

The tray shall be supported at every change in direction of the cable tray route. The minimum radius of any bend of the tray is to suit the minimum bending radius of the largest cable on the tray.

Cable trays shall be firmly secured in position in such a manner to cause as little obstruction to walkways etc., as possible.

Hangers, supports and anchors for wireways and equipment, shall be designed and installed with regard to appearance and convenience as well as for adequate strength and rigidity. Only professional quality fixing material and methods shall be used. Nails and glue are not acceptable.

C3.13.25 Surge Protection

The lightning and switching transients and the regulation of the available 230VAC supplies will be as for a normal industrial supply.

The Tenderer has to allow for additional surge suppression and voltage stabilisation equipment if this is required to protect his equipment or to guarantee its correct operation.

Equipment which is connected to signal lines of any type which run for any distance outside a building, shall, if technically possible, be surge protected to survive twenty 8/20 microsecond current impulses with maximum amplitude of 10 kA when applied in common mode between the signal lines connected together and earth. Ten of the test pulses shall be applied as positive pulses with respect to earth and the other ten as negative pulses.

In addition, the protected equipment shall be able to survive 20 8/20 microsecond current impulses with maximum amplitude of 2 kA when applied in differential mode. Ten of the test pulses shall be applied with any particular polarity and the other ten with the polarity reversed.

The test pulses shall be applied at intervals of not less than one minute.

The surge protection equipment may be built into the equipment being protected. If the provided internal protection is inadequate to meet this specification, then additional external protection has to be provided.

Equipment which is connected to signal lines of any type of which the entire length of the run is within the same building and for which the signal cable is longer than 30 m, shall be protected as in 24.2, except that the maximum amplitude for the common mode test shall be 2 kA and the maximum amplitude for the differential mode test shall be 500 A.
Surge protection devices shall be chosen in such a way that the protected circuit shall still function to specification in spite of the introduction of series and/or shunt impedances by the protecting devices.

The above test specifications are based on recommendations of CSIR report No Ek/85/6/1.

C3.13.26 Earthing

The screen of analogue or high-speed digital signal cables shall be continuous from field device through to control room panel and shall be connected to equipment earth onto special equipment earth busbars in the control room or control panel.

Instruments requiring the screen to be earthed locally at the sensing element, shall remain continuous to the control room and shall not be connected to the instrument earth or make contact with other screens at the junction box.

The screens of all tail cables entering junction boxes shall be kept clear of system earth and shall be connected to the screen of the interconnecting multi-core cable.

The case of each device shall be earthed to the system earth by mounting directly on a steel frame or by means of a third wire.

Steel framework of panels shall be strapped together and provision must be made for bolting to an incoming earthing cable separate from system earth.

All power supply cables from the local cubicles, boxes, panels or MCC's are to have the armouring and earth core, if any, adequately bonded to the earth terminal or strip in the distribution board.

If an armoured signal cable is screened as well, then the armouring shall be connected to system earth at both ends. If the cable is armoured but not screened, then the armouring must be used as if it was the screen.

The Contractor shall establish the suitability of the provided earth for electronic systems. The onus regarding the effectiveness of the systems remains on the electronic contractor.

C3.13.27 Electrical Power Supplies

If an AC circuit runs from any one cabinet etc to another cabinet etc, or field equipment, then each circuit shall be individually protected by means of a fuse or circuit breaker.

AC loads within a cabinet etc, shall be supplied from circuits which are individually protected by fuses or circuit breakers.

All power distribution terminal blocks shall be covered by a shield marked "Isolate Feeder Before Removing Shield".

Boards shall be wired such that when the main switch for a panel is switched off at the distribution board, no live incoming wiring shall be accessible in the panel.

C3.13.28 Uninterruptable Power Supply (UPS)

Electricity supply for the electronic equipment will be at 24 VDC from 2 x 12V deep cycle 102AH batteries for the PLC panel in a pad lockable section within the MCC. The charger for these batteries will be mounted in the small power and lighting section of the MCC panel. From this 24 VDC supply, the instrumentation will be powered, instrumentation will generally be loop powered.
The PLCs and panel PCs will be powered from this same source

C3.13.29 Intruder Detection and Alarm System

Intruder alarm systems shall comply with SANS 2220 and shall be installed if and where specified and shall include a main control panel, one operator LCD keypad, passive infrared detectors, magnetic door switches, a siren and an outdoor strobe light located as shown on the equipment layout drawing.

The intruder alarm system shall be linked to the PLC to alert the Employer’s staff about unauthorised entry, the system status and faults. The intruder alarm signals shall be transmitted via the telemetry link. Potential free contracts shall be provided for this purpose.

The control panel shall be installed in a suitable enclosure, manufactured from mild steel.

The zoning of the system shall be confirmed in consultation with the Employer’s Agent prior to installation. This shall include the arming and disarming delay times.

The main control panel shall have a charger and maintenance-free battery to provide 24 hours standby.

The operator keypad unit shall have a backlit LCD display and a user keypad.

An external LED indication unit shall be installed outside the entrance door to indicate that the alarm is set and to provide a warning indication if the alarm has been triggered by an intruder.

All wiring shall be drawn into conduits which shall be provided for this purpose under the Contract.

The intruder alarm system shall make provision for interface signals to the PLC system via potential free contacts. The minimum signals shall be:

- Armed
- Dis-armed
- Alarm
- System failure
- Battery low

All aspects of the proposed system shall be approved by the Employer's Agent prior to installation.

The Contractor shall provide comprehensive relevant instructional manuals and training on the operation of the Intruder Detection System. Provision shall be made for the training of at least six [6] persons on at least two [2] different dates or as reasonably requested by the Employer's Agent. All training and manuals shall be in English and the predominant local language.

C3.13.30 Fire Detection and Alarm System

A conventional (non-addressable) fire detection system shall be provided for smoke detection in electrical equipment rooms, with the control panel, call points and detectors located as shown on the equipment layout drawing.

The fire detection and alarm system shall be linked to the PLC to alert the Employer's staff about a fire, the system status and faults. The fire detection alarm signals shall be transmitted via the telemetry link.

The control panel shall be installed in a suitable enclosure, manufactured from mild steel.

The zoning of the system shall be confirmed in consultation with the Employer's Agent prior to installation.

The control panel shall be an 8-zone panel with a charger and maintenance free battery for 24 hours standby, and shall comply with SANS 50054.

Smoke detectors shall be of the optical type or to SANS 50054, and shall plug into separate bases.

Call points shall be of the glassless type with key reset.

All wiring shall be of the fire resistant type and shall be drawn into conduits which shall be provided for this purpose under the Contract.

The fire detection alarm system shall make provision for interface signals to the PLC system via potential free contacts. The minimum signals shall be:

- Set (Normal)
- Un-set
- Alarm
- System failure
- Battery low

All aspects of the proposed system shall be approved by the Employer's Agent prior to installation.

The Contractor shall provide comprehensive relevant instructional manuals and training on the operation of the Fire Detection systems. Provision shall be made for the training of at least six [6] persons on at least two different dates or as reasonably requested by the Employer's Agent. All training and manuals shall be in English and the predominant local language.

C3.13.31 P&IDs

General:

The visual appearance of P&IDs shall be such as to provide a balance between the desire to show all data but with the need to make them legible and easy to read. Some details that are available from other documentation such as instrument loop diagrams, vessel data sheets and the like should not necessarily be included on P&IDs.

Database driven packages e.g, Bentley AutoPlant, AutoCAD P&ID, Dessoft are preferred over standard CAD drafting packages.

Functions:

The P&ID is to be used by all of the disciplines to detail the components needed to indicate how the process is intended to operate.

P&IDs must display the following information as a minimum:

- Material/fluid flows
- All unit processes
- Piping between the various sections of the plant and process equipment - piping on a P&ID may include instrument connections or heat tracing depending upon the nature, size and complexity of the project.
- Major components of mechanical equipment (pumps, vendor packages, filters, clarification equipment, tanks, etc.).
- Valves and directions of fluid flows.
- Field mounted Instruments.
- Electrical equipment - P&IDs typically show equipment that require either signal or power wiring e.g, motors, VFD's etc.
- Communications links.

Drawing Size:

P&ID drawings shall, wherever practicable, be 841 mm x 594 mm (A1 size). It may however be necessary to scale fixed size equipment symbols due to P&ID density or other factors.

Drawing Layout:

The layout of each P&ID shall be uncluttered and allow for future modifications. As a norm, no more than ten items of major equipment shall be drawn per P&ID. A set of pumps in the same service is considered as one item of equipment for the purpose of the P&ID layout.

The primary 'Process Flow' on each P&ID shall be depicted from left to right.

The inlet and outlet of equipment shall be drawn relative to the actual equipment layout (e.g., cooling water supply at the bottom of an exchanger, while tube bundle and cooling water outlet should be at the top of an exchanger).

Primary process lines shall be distinguished from secondary process, and utility lines. This distinction shall be as detailed in the Lines and Layering Section below.

Off-page Service Descriptions shall display the following information:

- P&ID number and origin/destination
- Type of fluid (e.g, process water) or line description (e.g, feed, tower).
- Line function (e.g, low level override) or controlled (e.g, PV-10014A/B) for instrument.

Service description and origin/destination text shall start at the left hand side of the off-page connector symbol.

Utility connectors may be shown at any convenient location in the body of the P&ID.

Utility collection/distribution P&IDs layout shall be drawn relative to 'plot plan' orientation.

When match lines are required on Utility P&IDs, they shall correspond to the matching lines of the connecting drawing.

Equipment symbols shall be arranged relative to their elevation (e.g, pumps at bottom of P&ID).

Control valve actuators shall be drawn above a horizontal line or left of a vertical line, whenever possible.

Compressors, and Hydraulic Pack's piping, instrumentation, and auxiliaries shall be drawn on a separate auxiliary P&ID.

Standard Cover Sheets:

A standard cover sheet shall be included which will contain an illustrated summary of all symbols and conventions used.

The complete set shall consist of the following information:

- Mechanical equipment symbols
- Mechanical equipment numbering convention
- Line numbering convention
- Pipe Product codes
- Pipe Material codes
- Valve Conventions
- Instrument and lines symbols
- Instrument Tag numbering convention
- Letter identification Table
- Miscellaneous equipment symbols
- Typical instrument's configuration layout

Lines and Layers:

The recommended layers for plotting on original drawing A1 size is as follows:

Name	Colour	Line Thickness	Description
Layer 1	Green	0,7mm	Equipment & Major process lines
Layer 2	Magenta	0,35mm	New major pipelines
Layer 3	Red	0,5mm	Minor Process Lines
Layer 4	Yellow	1,0mm	Major Process lines
Layer 5	Grey	0,12mm	Arrows & Borders
Layer 6	White	0,25mm	General
Layer 7	Cyan	0,25mm	Text & Utility Lines
Layer 8	Blue	0,35mm	Borders

- Line thickness shall be adjusted when P&IDs are plotted in smaller size.
- Existing equipment and instrumentation should be indicated in dotted lines as opposed to solid lines.
- Flow arrows at corners and intersecting lines, where there is a change in direction in the major flow must be shown.
- Break vertical primary process lines when crossing horizontal primary process lines.
- Break secondary and utility lines for primary process lines.
- Break vertical secondary and utility lines for horizontal secondary and utility lines.
- Break instrument lines for all process and utility lines.
- For utility collection/distribution P&IDs, break entering and exiting lines around pipe rack lines.
- Maintain line break gaps at 3 mm.
- Avoid routing lines across equipment or text.

Text:

The recommended text heights for plotting on original drawing A1 size is as follows:

Element Type	Height (mm)	Weight (mm)
General Text	2,0	0,25
Equipment Tags	3,0	0,35
Equipment Title	2,5	0,25
Line Numbers	2,0	0,25

- General text and notes shall be aligned left and start in the upper left corner of the notes area.
- Equipment text shall be top/center justified.
- Where a note contains more than one line, the line spacing between each line shall be 1 mm.
- The spacing between notes shall be 1 mm beneath the last line of the preceding note maintaining top/left text justification.
- Text shall be horizontal wherever possible.
- Vertical text shall be placed to the right of supporting graphics where possible.
- Vertical text shall be read only from the left/bottom.
- Line numbering shall be shown with the orientation of the line.
- Control valve failure action abbreviation shall be shown 1,5 mm directly below control valve.

Instrument Bubbles:

The specific configuration requirements with respect to instrumentation bubbles depicted shall be as follows:

- The area and equipment number shall be displayed next to the instrument bubble.
- Instrumentation device and function symbols shall be as per the ISA 5.1 standard as a minimum.
- Multiple instruments of the same type, indicated with a suffix A, B, C, etc. shall have individual instrument bubbles as per ISA.
- Each and every instrument (hand switches, indicator lights, etc.) shall be indicated on the P&ID. (Exclusion of any item from the P&ID shall exclude the item from design and procurement.)
- Local control boxes shall be indicated as field mounted bubbles (double line).
- Graphical grouping of associated bubbles may be done using dash-dot or similar line type (e.g, control boxes, UPS signals, etc.)
- All Identification letters shall be as per the ISA 5.1 standard as a minimum.

Equipment Representation:

The specific configuration requirements with respect to equipment depicted shall be as follows:

- Equipment symbols shall be simple outline representation. Discretion shall be exercised to ensure that equipment symbols do not dominate the drawing, but the symbols shall be large enough for clear understanding. Equipment shall not be drawn to scale but shall be relative to one another both in size and general orientation.
- Nozzles on equipment, including spares, shall be shown as single lines and manholes shall be shown as double lines. Process and utility nozzles shall not be labelled. Nozzle sizes shall be shown unless the size is implied by piping connections.
- Equipment’s symbol that is not specifically identified in this standard shall be drawn with reasonable depiction of the actual equipment that is installed in the field.
- Equipment shall include as a minimum: Equipment Number and Title/Service.
- Equipment’s internals (normally non-visible) shall be depicted as dashed lines. Details of internals features that have no significant bearing on the piping design and layout or equipment operation shall be omitted.
- Equipment elevations should not be shown unless they are necessary to specify process requirements for associated equipment location or orientation relative to one another.
- Associated trim for vent, drain valves, instrument bridles shall be shown.
- Jacketing requirements for equipment shall be shown.

Equipment Data (Specific Requirements):

The specific configuration requirements with respect to equipment data is as follows:

- Blower symbols shall be shown as centrifugal or positive displacement as required.
- If a suitable chute is not in the library, the specific chute shall be drawn manually and assembled into a symbol for the P&ID. If the chute is more than a once-off requirement, then the chute drawing shall be sent to the responsible parties for inclusion in the library.
- The compressor symbol shall be shown for each stage of multistage compressors. Multistage compressors may be shown on multiple P&IDs, but appropriate cross reference shall be made.
- Each item of driven equipment shall have a motor symbol attached, which is assigned a motor tag name. The instrument bubble (MC…) is then attached to the motor symbol. The motor tag name may be switched off from the P&ID (by using attribute visibility and selecting the text component and unselecting the number check box) so as not to clutter the P&ID. The motor symbol acts as a visual aid and generates a motor list, which may be used for procurement purposes. Consistency in this application is essential to ensure correctness of the motor list.
- Packaged equipment shall be drawn in its entirety.

Piping:

The specific configuration requirements with respect to pipes indicated is as follows:

- Line data identification shall be shown.
- Suffixes shall not be used as part of the sequence number.
- Sequence numbers typically originate and terminate at equipment. Different sequence numbers shall be assigned to line branches that terminate at different equipment numbers or lines.
- The sequence number shall not be changed when the line flows through a piping specialty item or a control valve or when there is a line class break.
- Different sequence numbers shall be assigned to the inlet and outlet of pressure relief valves.
- Insulation code changes shall be shown.
- Special layout requirements (e.g, No Pockets) shall be indicated with a note.
- Line Service Codes shall be included and these shall consist of one to three alpha characters.

Valves:

The specific configuration requirements with respect to valves indicated on P&ID’s is as follows:

- Valve symbols shall be as per the ISA symbol list for valves.
- All valve symbols shall be shown as full size. Valve symbols for drain and vent valves shall also be full size.
- Valve size shall not be shown unless the size cannot be clearly identified from the P&ID.
- The listed ISA valve symbols shall be used for defining control valve body types. If the control valve body type is unknown, a gate valve or rotary valve symbol shall be used as the generic symbol.
- A note or symbol shall be used to specify a valve’s required installation/orientation when necessary (e.g, valves with a vented ball/disc).

- The appropriate actuator symbols (e.g, diaphragm and piston) shall be used to distinguish automated valves from manual valves.
- Automated valve fail actions shall be shown with text (FC/FO/FL/FI) per ISA. Stem arrows as outlined in ISA shall not be used.
- For multi-port automated valves, FL and FI where appropriate shall be used. FO and FC shall not be used. Arrows shall be used to show fail position flow paths. Note that multiple arrows may be required. Valves that have different fail actions for loss of signal and for loss of motive power require an explanatory note.
- Valve body sizes shall be shown for all automated valves if not line otherwise implied.
- Automated valve specifications or commodity codes shall not be shown.
- For automated valves, tight shut-off requirements shall be indicted by using the abbreviation “TSO”.
- Valve identifying tags shall not be shown with bubbles when the associated loop tag is readily apparent. An identifying tag with a bubble shall be shown for split range valves, self-contained regulators or valves located on a separate P&ID from its controller.
- The ranges (e.g, 0-50%, 50-100%) shall be shown for split range control valves. The preferred labelling is controller percentage output since it applies to both pneumatic and electronic systems.
- Valve positioners shall not be shown unless necessary to clarify loop operation (e.g, when used with trip solenoids or pneumatic trip relays). When shown, valve positioners are normally included with the automated valve symbol and are not tagged.
- If current to pneumatic converters (I/Ps) are used, they shall be shown with a bubble symbol, tag and function box.
- All solenoids that actuate final control elements (e.g., trip valves and pneumatic relays) shall be shown.
- Solenoid valve fail actions shall be shown using a directional arrow indicating the open flow path when de-energized. Note that a 4-way solenoid valve requires two directional arrows to adequately define the flow paths. Resets (manual or remote), if included with the solenoid valve, shall be shown.
- Automated valve auxiliaries (e.g., hand wheels, volume tanks, nitrogen back-up bottles) shall be shown. Typical details shall be used to reduce clutter.
- A note shall be used to identify the need for valve travel stops.
- Normally closed manual valves shall be shown using a darkened solid symbol.
- When darkened in valves cannot be used because of symbol type (e.g., butterfly valve), the abbreviation for Normally Closed (NC) shall be shown directly below the valve in a horizontal line or to the right of the valve in a vertical line.
- On-off valves shall be shown in their normal operating position. Control valves or relief valves must not be shown as normally closed.

Instrumentation Symbols and Identification:

The specific configuration requirements with respect to valves indicated is as follows:

- A standard instrumentation symbol list, contained in most intelligent database drive packages shall be used.
- The ISA standard for instrumentation tagging shall be used in all instances.
- Interlock symbols shall be depicted as follows:
  - For discrete, hardware-based interlocks, use the conventional diamond symbol per ISA
  - For PLC-based interlocks, use the diamond-in-a-box symbol per ISA
  - For DCS-based interlocks, use the DCS symbol (circle-in-a-box)
  - For PLC's integral to the DCS, use the PLC symbol (diamond-in-a box)
- Directional arrows shall be used on instrumentation signal lines only when the function is not obvious (e.g., cascades, selectors, interlocks).
- Instrument Function Symbols shall be used to clarify the function of certain tagged instrument bubbles. The symbol shall be placed outside the bubble at the upper right.
- The off-page connector shall be used to depict continuation of instrumentation signals from one P&ID to another.
- Any individual instrument bubble shall not be shown more than once, unless needed to clarify operation of the loop. If an instrument bubble must be shown more than once, then the succeeding occurrences shall be shown as dotted.
- Instrument Line Symbols shall be as per ISA.
- To avoid misinterpretations of physical and wiring connections between the transmitter and other devices or systems all transmitters shall be shown.
- Dip tubes, bubblers and still-wells for both process and instrumentation shall be shown. Notes for relevant specifications, materials, dimensions, weep holes, spray heads, etc. shall be shown as required.
- Flow meters shall be shown with the appropriate ISA symbol. If no unique symbols exist or if a device type is unknown, then a generic symbol shall be used and a text label provided to identify the measurement type. A tag for all in-line generic flow meter bubbles shall be provided. A bubble with loop tag shall be shown for other flow meter element symbols only if the loop association is not readily apparent.
- The size of all in-line devices shall be shown if not line sized or otherwise implied.
- Flow meter accuracies must not be shown. The use of a note to indicate a special meter requirement is optional.
- If used, flow conditioning devices (e.g, straightening vanes) shall be labelled with an instrumentation tag (e.g., “FX-…”) associated with the flow measurement loop.
- ISO-9000 or other quality designations must not be shown.
- A symbol and tag for a thermo well shall be shown if it is a stand-alone, spare or test well.
- Thermo well symbols or tags shall not be shown if a thermal measuring element is connected to it unless the loop association is not readily apparent. If a bare element is necessary (no thermo well), then a note or text label (e.g, BARE) must be added with the text placed outside the symbol in the lower right.
- Thermal or temperature measuring elements (TE) with a symbol or tag shall not be shown unless the loop association is not readily apparent (e.g, dual elements).

- Process connection purge and blowback requirements shall be shown for all measuring devices requiring it. Purge media and pressure shall be included. Detailed hardware associated with purge/blowback (e.g., Rotameters) on installation details, shall be shown on auxiliary P&IDs, or cover sheets.
- Air supplies to individual devices are not generally shown. Air supplies to solenoids or other special applications shall be shown as needed to clarify valve porting or operation (e.g, trip solenoids or pneumatic hand switches).
- Analyser sample points and connections shall be shown.
- The sampling system (when applicable) shall be appropriately depicted on the P&ID
- A single stream analyser shall be shown on the same P&ID as its sample point.
- Multi-stream analysers shall be shown only once with off-page connectors from/to the multiple sample points/returns. Sample connections that supply/return samples to/from multiple analysers shall be shown only once, with continuations to/from other analysers. Measured components shall be indicated at the upper left of each analyser or sample point bubble as required.
- If an indicator is integral to a transmitter, then a single bubble and tag (e.g., LIT) shall be used. If separate devices are used for the transmitter and the indicator (e.g, a remotely located indicator), then separate bubbles and tags (e.g, LT and LI) shall be shown.
- Level and gauge glasses shall be shown with the appropriate symbol and tag. A single function (one bubble and tag) shall be used regardless of the number of individual sections required to span the length. A text label or note may be used to define the number of sections. Separate bubbles and tags shall be shown for redundant glasses or those for applications with separate taps (e.g., overlapping gauges).
- The distance between level connections shall not be shown.

Safety/Relief Devices:

The specific configuration requirements with respect to safety relief devices indicated is as follows:

- Relief devices and conservation vents (e.g, PSE and PSV) shall be tagged and shown.
- Optional explanatory text maybe used for clarification of the type and function of the device (e.g, “Emergency Relief,” “Conservation Vent,” “Explosion Panel”) and shall be located next to the tag. PSV typically refers to reclosing devices. PSE typically refers to non-reclosing devices. PSE may only be used for safety related service. PCV or PCE shall be used for non-safety conservation vents.

Interlocks and Alarms:

Interlocks and alarms need not be shown on P&ID’s

Equipment and Instrumentation Tagging:

Where no Employer directed equipment and instrumentation tagging convention is provided, the following shall be adhered to as a minimum:

Area codes:

The following area coding convention shall be used throughout the site:

Example:

F	A	A

FAA where:

F is the plant description
A is the area location
A (third letter) denotes the stream description

A complete list of area codes shall be developed for the project.

Equipment numbering convention:

The following numbering convention shall be used:

Example:

FAA	-	PMP	-	001

FAA-PMP-001 where:

FAA is the area code
PMP is the equipment Identification code
01 is a sequential number

A complete list of equipment codes shall be developed for the project.

Line numbering convention:

The following line numbering convention shall be used on all P&ID drawings:

Example:

25	-	PW	-	CS	-	001

25-PW-CS-001 where:

25 is the nominal pipe size
PW is the product code
CS is the pipe material code
001 is a sequential number

A complete list of pipe product and material codes shall be developed for the project.

Mechanical valve numbering convention:

The following numbering convention shall be used:

Example:

FAA	**-**	**HV**	**-**	**001**

FAA-HV-001 where:

FAA is the area code
HV is the valve code
001 is a sequential number

A complete list of valve codes shall be developed for the project.

Instrument Tag numbering convention:

The instrumentation tag numbering convention used in this specification is based on the ISA 5.1 standard and also uses the mechanical equipment number that the instrument is attached to.

Example:

FAA	**-**	**PMP**	**-**	**LSL**	**-**	**001**	**A**

FAA-PMP-LSL-001A where:

FAA is the area identification code
PMP is the mechanical equipment number
LSL is instrument identification letter as defined by the ISA standard
001 is a sequential number
A, B, C, D denotes the number of similar instruments within the same loop

Electrical Equipment Tag numbering convention:

The following electrical equipment tag numbering convention shall be used.

Example:

FAA	**-**	**PMP**	**-**	**MCC**	**-**	**001**	**A**

FAA-LSL-8301A where:

FAA is the area identification code
PMP is the mechanical equipment number
MCC is electrical identification code letter
001 is a sequential number
A, B, C, D denotes the number of similar electrical equipment within the same loop

Motor Control Equipment and I/O Tagging Convention:

The following shall be used in conjunction with the motor control equipment number for the identification of motor control equipment on P&ID's:

Motor Controlled Equipment	
MCD	Motor Control Drive (DOL)
MCV	Variable Speed Drive
MCS	Soft Starter

The following shall be used in conjunction with the motor control equipment number for the identification of motor control I/O:

Digital Inputs	
A	Healthy
B	Running
C	Remote/Local
D	Tripped
E	Fault
A	Healthy
Digital Outputs	
F	Start
G	Stop
H	Reset
Analog Inputs	
I	Speed Feedback
Analog Outputs	
J	Speed Feedback
Information Tags	
K	Number of Starts
L	Operating Hours

Instrument LOOP numbering convention

The following instrument loop numbering convention shall be used:

Example:

TGA	-	D	PMP	-	001

TGA-D-00.80 where

TGA is the process area code
D is the first letter of the instrument function and
PMP001 is the mechanical equipment number that the instrument is associated with.

C3.13.32 Programmable Logic Controllers

General:

A dedicated PLC shall be provided for the entire area of control as specified. The PLC shall be compatible and similar to the existing PLC System (1768 CompactLogix Controllers) on the plant for conformity and ease of maintenance.

PLCs and their associated peripherals are generally intended to be used in an industrial environment and shall therefore be provided within an enclosure suitable for that environment.

Hardware shall be field-proven under similar conditions and shall be suitably protected against excessive temperature, electrical interference, input and output overvoltage or short-circuit, and loss of program memory.

The equipment supplied shall incorporate a non-volatile form of program memory which does not rely on an internal or external source of power to retain program memory in the event of a loss of normal power.

The CPU and I/O modules of the PLC shall be supplied with a minimum of 20% excess program memory and I/O capacity for initial operation of all specified process components. However, the specifications of the PLC shall allow for future expansion of up to 50% additional memory and I/O capacity.

The PLC system shall be of a modular design with the mounting racks for the central controller, extension racks, power supply cards, central processing units interface cards, I/O cards, etc. interchangeable between the various nodes.

Cards and slots shall be mechanically coded to prevent the incorrect card being inserted into a given slot. Alternatively, the controller shall employ an interrogation software which shall detect the insertion of an incorrect module and prevent controller operation if an incorrect module is installed.

It shall be possible to change the modules without disturbing field wiring. Connection blocks shall plug into the modules and shall be coded, to prevent connection blocks being plugged into the wrong modules. All modules shall have surge protection, which meets the requirements of IEC 61000-4-5 or similar standard.

The suppliers shall guarantee the availability of local field service facilities and unit replacement ex-stock from the local depot, for at least three years after the completion of the Defects Liability Period.

PLC Inputs / Outputs:

All inputs shall have visual status indication on the modules. A maximum of 8 inputs with a single neutral shall be provided per module.

Output modules shall be of the opto-electric switched solid state relay (SSR) type. The module shall be able to withstand a peak load of 15 A for one cycle and intermittent load of 9 A for 3 cycles, per channel. For SSR type output modules, fuse terminals with blown fuse indicators shall be provided. Should the fuse fail to blow, then the fault shall only affect the switched output, and shall not affect the remaining outputs within the group. All outputs shall have visual indications. Electromechanical relay outputs shall be capable of performing at least 0,3 million operations with the load specified for AC-15 utilisation category (durability class 0.3) according to IEC 60947-5-1.

For both the input and the output modules the LED’s shall give a true load - side indication to and from the field devices.

Analog input modules shall be of the multiple input range type. This may be either by means of plug-in type measuring range cards or by dip-switch selection. The input resolution of the module shall be a minimum of 12 bits. All inputs shall be individually isolated. Input modules with LED indication for "Communication Active" and "Out of Range" are preferred. Where a large number of Analog inputs with relatively slow changing values is required to be monitored, use may be made of Analog multiplexer modules. The multiplexer shall be compatible with the Analog input module and shall therefore be supplied by the same manufacturer. The input resolution of the multiplexer shall be 12 bits.

Analog output modules need not necessarily be of the full multiple output range type. The output resolution shall be 12 bits. The outputs shall be electrically isolated from the logic circuitry and shall be electrically isolated from each other. Output modules with "Communication Active" indicators are preferred. Galvanic isolation in the form of opto isolators shall be provided for all inputs and outputs and the driving logic of the modules.

All outputs shall revert to the off state when the PLC CPU fails or is switched off or is re-started (i.e, Run mode switched from stop to run)

The onus is on the Tenderer to determine the precise I/O requirements and provide the necessary I/O's with spare allowance as per the requirements set out.

All Inputs and outputs, digital and Analog shall be clearly labelled with the relevant plant Tag number. Labels shall be printed in black on white and either inserted in the IO Card connector block or printed on adhesive paper which is then adhered to the IO Card or connector block.

All I/O cards shall be wired using OEM supplied 'ribbon' type cables to OEM supplied terminal and relay banks. No loose type 'loom' wiring shall be permitted between the I/O cards and terminal/relay banks.

Data Communication:

The PLC shall be able to communicate with the SCADA systems and/ or with other PLCs via Industrial Ethernet™.

A robust and secure network protocol that adheres to a deterministic message passing methodology shall be used.

Network failure shall not affect the operation of the PLC in any way. The PLC shall act on the last received communication information from a device and further generate a fault signalling communications time-out if communications with a device is interrupted for more than 300 ms.

Data communications response time on the network shall not exceed 1 second at any time.

Remote programming over the PLC network shall not disrupt the normal flow of PLC communication messages.

All PLC to PLC and PLC to HMI/SCADA communications message blocks shall be clearly documented in the SCADA/PLC FDS document. Sufficient spare capacity shall be assigned for future message extensions. All message items (status bits and measured value words) shall be uniquely addressed.

PLC Software:

The PLC shall be programmed using standard commercially available programming software which adheres to the IEC31161-3 standard. The price quoted for the PLC shall include all licensing costs.

PLC code shall be programmed using the Function Block Diagram and Sequential Function Chart representations.

Programming using Ladder Logic is expressly prohibited

The Contractor shall provide his own computer hardware and programming software for programming, testing and commissioning of the PLC.

It shall be possible to remotely program the PLC over the communications network via a suitably configured firewall.

All PLC programs shall be stored on CD/DVD ROMS, from which it shall be possible to download onto the PLC on site by means of a programming tool. "Master" and "Back-up" CD/DVD ROMS of all programs shall be issued to the Employer after commissioning.

It shall be possible to modify and/ or update the software in the CPU without disrupting its operation (i.e, on-the-fly updates)

The programming software shall provide an on-line debugging and simulation facility where status of all inputs, outputs and internal registers can be examined and modified for debugging and software testing and acceptance purposes.

PLC Software Programming:

PLC software shall be structured efficiently such that overall cycle time shall not exceed 300 milliseconds for general control applications and 30 milliseconds for motion control applications. Cycle time sharing may only be adopted for slow processing analogs or closed loop controllers. Critical control logic may not be cycle-time shared.

The Contractor shall prepare and submit for approval, a Functional Design Specification explaining how the PLC software will be implemented and how the required control philosophy will be programmed. The FDS shall include the following as a minimum as well as any additional information as specified.

- Software structural breakdown and description.
- Equipment modes of operation description.
- Tag numbering system (equipment and software).
- Complete device list (sensors, actuators and the like and instruments).
- Complete input and output list with physical addresses.
- Logic diagrams for control of all devices.
- Complete list of all alarms generated within the PLC
- Equipment start-up and shutdown sequences (including Flow Charts).
- List of registers and timers with default settings.
- Complete data communications structure with Tags for HMI and/or SCADA systems.

The FDS shall be subject to the approval of the Employer’s Agent prior to commencement of the software configuration.

Typical Modes of Control:

The software code in the PLC shall integrate with the controlled equipment's wiring control circuit, normally MCC's etc. and the Employer's standard modes of control.

Software modules shall operate in various control modes described below. The PLC software module shall manage the mode selections so that each module is independently mode managed.

Remote (Automatic) Mode:

A module that is selected Automatic shall be controlled by another software module, e.g, a control sequence, in the next control. Switching to Automatic mode shall be permissible at all times. All interlocks shall apply in this mode.

Local (Manual) Mode:

Local mode shall only be selected by an Operator, or SCADA. All interlocks shall apply in this mode. Local mode selection shall be permissible at all times. If a manual operation is performed on a module, it shall automatically switch to Local mode. The module shall remain in Local mode until selected back to Remote.

This mode allows for the control of equipment from a Field Control Panel situated somewhere in the facility, local to the equipment being controlled. An example of where this field control mode would apply would be when setting the gap on a ventilation fan louver. The hydraulic system would need to be controlled from a field panel.

Maintenance Mode (Off):

A sequence cannot run if one or more sub-ordinate modules are selected to maintenance mode. The maintenance selection may also be a 'process' type interlock on upstream equipment. Maintenance mode bypasses all process interlocks. Safety interlocks are still active.

Software Blocks:

A modular software design shall be adopted. This implies standard software blocks are to be used for common control equipment such as motors, valves, actuators, measured values, alarms, totalisers, sequence and closed loop controllers.

Motors

Standard motor control blocks shall be provided for uni-directional and bi-directional direct on-line starters as well as for reactive, soft or variable speed starters.

Motor starts shall be latched and reset on any fault condition. Start-up time shall be monitored and the latch reset if failed to start within the number of seconds specified by the motor manufacturer. The latch shall also be reset if the running feedback fails even after initial start-up.

Bi-directional start commands shall be suitably cross interlocked to prevent both commands being issued simultaneously.

A minimum of 8 interlocks will be provided for on the block and faceplate. The interlocks must be able to be bypassed via the faceplate by a person with a suitable user access authority level.

The motor control blocks shall make allowance for starts per hour limitations. The motor control blocks shall also make allowance for the transfer of asset management data e.g, power consumption to higher level MIS systems as required by the FDS.

Valves and Actuators – On/Off

Standard valve control blocks shall be provided for discrete open and close type valves and continuously variable valves with and without feedback. Both valve limits shall be monitored and failed to open or failed to close within time-out of the number of seconds specified shall be reported. Where feedback switches are not installed, the feedback signal feature shall be disabled on the valve block.

Valve control shall make provision for continuous open commands on single actuators, which shall be latched, as well as for flapper gate type valves with dual actuators, where a separate open or close command is given. Control logic shall be suitably cross interlocked to prevent both commands being issued simultaneously.

Valve and Actuator control shall include open and close hysteresis to prevent “hunting” or excessive switching of outputs.

A minimum of 8 interlocks will be provided for on the block and faceplate. The interlocks must be able to be bypassed via the faceplate by a person with a suitable user access authority level.

Valves and Actuators - Modulating:

Standard valve control blocks shall be provided for all modulating control valve actuators.

Where feedback switches are fitted, both valve limits shall be monitored and failed to open or failed to close within time-out 3(variable) seconds shall be reported and logged. Where feedback switches are not fitted, the feedback signal feature shall be disabled on the valve block. Optional rotary feedback instrumentation may be fitted for applications as required. The failure of valve positioning within time-out 3(variable) seconds shall be reported and logged.

A minimum of 8 interlocks will be provided for on the block and faceplate. The interlocks must be able to be bypassed via the faceplate by a person with a suitable user access authority level.

Measured Values:

Measured value blocks shall be provided for all analog inputs which will make provision for noise filtering, limit value monitoring signal line break/ short circuit monitoring and date and time stamping.

All measured values shall be capable of reporting high-high, high, low and low-low values where, high-high or low-low imply emergency limits and high or low imply operational limits. Limits shall operate on measured value hysteresis of typically 2-5% (variable).

Measured values shall be normalised typically 0-10 000 before being communicated to the SCADA.

Digital Input Blocks:

Digital inputs that require minimum on time filtering functionality, to eliminate contact chattering, shall use this module. The functionality of each digital includes the delay time, active & reset of alarms, status & delay signals.

Both positive and negative signal edges are to be delayed, providing delayed signals in phase to the original signal.

Alarms:

Alarm blocks shall be provided for selected analogue inputs/outputs, digital inputs for motors, valves and actuators.

Alarm blocks shall date and time stamp changes in alarm states and provide alarm latching and reset functionality.

Alarm blocks shall make provision for time limit triggered alarms, frequency filtering and alarm overrides or enables.

Totalisers:

Software blocks shall be provided for totalising run hours, flows or levels over configurable time intervals or frequencies.

Totalisers shall be reset-able and provide enable and override facilities.

Totaliser values shall be normalized typically 0-10 000 before being communicated to the SCADA/HMI system.

Control Sequencers:

Sequential start-up and shut-down shall be achieved by a Sequential Function Chart control language implementing step and transition logic.

A sequence shall be able to be paused, reset or shutdown at any time.

Closed Loop Controllers:

High Speed Proportional, Integral and Derivative (PID) closed loop and open loop control software blocks shall be provided. The controller shall allow the configuration of P, I and D components via the SCADA/HMI system and operate in either Automatic, Manual or Cascade mode.

Limits on Closed loop controllers and failure to maintain closed loop control shall be reported as alarms on the SCADA/HMI system.

It shall be possible to configure controllers for Cascade control, ratio control and summation/difference control purposes.

Interlocks:

The PLC shall provide for two types of interlocks namely process and safety interlocks.

Process Interlocks:

These are dictated by the physical flow of material through the plant and are typically programmed between motor, valve, actuator and controller software blocks.

Equipment being prevented from start-up by a process interlock shall clearly (via 128 character description) indicate this condition on the SCADA/HMI system.

Safety Interlocks:

These are typically hardwired into the motor, valve or actuators control circuit and shall indicate as faults on the SCADA/HMI system.

No process interlocks, sequential starts and stops, or closed loop control may be programmed elsewhere other than in the PLC.

Installation:

The Contractor shall adhere strictly to the recommended mounting, earthing and electromagnetic shielding requirements of the PLC manufacturer. The Contractor shall ensure that the PLC will not operate at any time outside the environmental limits published by the manufacturer. The average maximum and minimum temperatures, the humidity as well as the heat dissipation of the PLC shall be taken into consideration when designing panel.

If forced ventilation and / or panel heaters are required to provide the climate necessary for the PLC equipment, then this shall be included in the panel design, together with climate monitors to inform the operator in the control room when the equipment is operating in undesirable conditions. Detectors shall be provided and wired to an input card of the local PLC to alert the operator via the alarm panel if the “climate” drifts outside the preset values.

A PLC shall always be installed in a panel with a glass window in the door such that PLC and IO status can be clearly observed without having to open the panel door(s).

Inspection and Method of Testing:

The PLC shall be inspected by the Employer’s Agent and tested by the systems integrator (which tests shall be witnessed by the Employer’s Agent) prior to delivery, installation and switch on at site.

The Tenderer shall allow in his tendered amounts for all costs that shall be incurred by himself and/ or the Employer’s Agent to perform these inspections and tests.

The Contractor shall have all equipment available to do all tests. Any additional equipment required for the tests shall be obtained by the Contractor and remain the Contractor’s property.

The Employer’s Agent reserves the right to inspect any equipment covered by this Specification at any stage during manufacture.

A test report template shall be submitted with the tender detailing exactly which tests will be made, and how they will be performed. After testing at the system integrators offices, one original and one copy of the official test report shall be submitted to the Employer’s Agent.

Should the Employer’s Agent, when called upon to witness tests and inspections, find that the Contractor has not made reasonably certain that the tests will be successful, he/she can cancel such tests and postpone them to a future date so that the Contractor can ascertain by pre-testing that the equipment to be tested will be of acceptable standards.

Any such re-test expenses by the Contractor and/or the Employer’s Agent shall be borne by the Contractor.

Any equipment or workmanship found by the Employer’s Agent to be of inferior quality during construction, erection, commissioning, or during the guarantee periods, shall be replaced promptly to an acceptable quality and standard, at the Contractor's expense.

The final acceptance tests shall be undertaken after completion of the full installation on site.

Minimum Inspections and Tests:

The minimum inspection of the PLC by the Employer's Agent shall include the following as well as any specific requirements stated elsewhere.

- Correct choice of PLC CPU and Power supply (Calculations to be presented)
- Correct configuration of all Input and Output Cards (Drawings to be presented)
- Correct wiring of all expansion/ remote modules (Drawings)
- Correct wiring of all input and outputs to marshalling strips (Drawings)
- Code review of all PLC Control Logic (Logic Diagrams, Flowcharts and SW Printouts to be presented)
- Review of the Contractor's Quality Control Documentation (check-lists to be presented)

The minimum testing of the PLC system shall include the following as well as any further specific requirements specified elsewhere.

- Thin slice testing of all software control bocks
- Correct operation of all control logic
- Correct operation of all modes of operation
- Correct detection and annunciation of simulated faults
- Correct inter PLC/SCADA/DCS data communication
- PLC Cycle time measurement
- PLC/ SCADA/DCS data communications response time measurement.

The method of testing shall be using the actual PLC that will be delivered to site set up in a simulated environment. Simulation of the process to be controlled shall be as simple and cost effective as possible.

C3.13.33 Functional Design Specification

The Functional Design Specification (FDS) is a document that describes the configuration and programming of the automation system. It shall be compiled by the Contractor and will be subject to the approval of the Employer's Agent before bulk coding begins. There may be instances where certain aspects of the FDS are required to be tested in order to limit project risks – these tests shall be done during the thin slice testing phase of the software configuration.

The FDS shall comply with the format below:

Control System General:

- Introduction
- Control System Configuration - a drawing of how SCADA and PLC are arranged and interconnected
- Equipment Tag Numbering Convention – a table or drawing
- Software Tag Numbering Convention – a table or drawing
- Controlled Equipment:
  - Motor List - Include detail that indicates whether it's a DOL, VFC, SS and additional protection e.g, MPR
  - Instrument List - include detail describing type, make model, range, interface etc.

- Control Philosophy i.e, the prescribed control philosophy/narrative as modified by the Contractor, with the consent of the Employer's Agent, to suit the system being supplied
- Start-up and Shutdown Sequences (if applicable) - clearly described with all step and transition information
- Control Loops (if applicable) - Clearly described with PV, CV and theoretical values for P&I parameters

SCADA:

- SCADA Configuration - more detail than the general diagram if required
- SCADA Hardware - make, model, part numbers etc. right down to component level
- SCADA Networks
- Communications Tasks - describe protocols, protocol configuration, computer names, PLC drivers etc.
- Data Communications Structures - clear description on how the SCADA fetches information from the PLCs and the actual TAG lists
- SCADA Software Package(s)
- Operating System
- SCADA Package - type, Name, Version, Tag count etc.
- Database System - type, Name Version
- Reporting Software
- Remote access
- Folder Structure i.e, for the configuration files specification to this contract
- SCADA Features
- Modes of Operation
- Mimic Displays - include screen mock-ups
- Mimic Dynamic Graphic Symbols - Include symbol mock-ups with clear documentation describing all logic and decision making behind them
  - Motors
  - Valves
  - Analogs
  - Controllers
  - Sequences
  - Totalizers
- Equipment Display Faceplates - include symbol mock-ups with clear documentation describing all logic and decision making behind them
  - Motors
  - Valves
  - Analogs
  - Controllers
  - Sequences
  - Totalizers
  - Historical and Real-Time Trending - Describe scanning, scanning frequency, logging, log file location, include screen mock-ups etc
  - Alarm and Event Management - describe in detail, how these are generated cleared, logged etc., include screen mock-up

- Alarm hierarchy
- Priority
- Alarm grouping (alarm lists)

- System Reports - describe in detail, how these are generated, run, stored etc., include screen mock-up
- Operator Access Security Model - essentially a copy from the contract specification
- System Back-up and Storage - describe how this is done automatically, manually, all procedures, include screen grabs
- Operational data storage (of machine)
- Structure – tables
- Period

PLC:

PLC Configuration

Describe in detail, right down to rack layout, PSU, CPU, IO arrangement, IO communications.

PLC Hardware - make, model, types etc.

PLC Networks

Describe protocol, message blocks, timing etc., if required
Communications Tasks
Data Communications Structures (TAG lists)
Communication protocols

PLC Software:

General

(Programming language, version etc. Also describe how the code is structured and in what order the program is processed, cycle time etc.)

PLC Inputs and Outputs

(Include a complete list with addresses)

PLC Software Structure

Modes of Operation - essentially a copy of the Contract Specification
Software Function Blocks / Code Blocks - describe in detail, include printouts and logic diagrams, parameter descriptions etc.)

- Motors
- Valves
- Analogs
- Controllers
- Sequences
- Totalizers

Interlocks (Process and Safety) - i.e, list them clearly
Safe Start Warnings

System Back-up and Storage:

Describe how the PLC software should be backed up, restored etc.

Appendices to be included

HMI, SCADA Screen grabs, Displays, Tag lists etc.
PLC Code Flowcharts, Code Listings, Logic Diagrams, IO Lists etc.

C3.13.34 Cyber Security

This specification addresses industrial automation and control systems whose compromise could result in any or all of the following situations:

- Endangerment of public or employee safety
- Violation of regulatory requirements
- Loss of proprietary or confidential information
- Economic loss and the
- Impact on national security

The concept of automation systems security is applied in the broadest possible sense, encompassing all types of plants, facilities, and systems in all industries. Manufacturing and control systems include, but are not limited to:

- Hardware and software systems such as DCS, PLC, PAC's, SCADA, networked electronic sensing, and monitoring and diagnostic systems
- Associated internal, human, network, or machine interfaces used to provide control, safety, and manufacturing operations functionality to continuous, batch, discrete, and other processes.

Themes:

ISA 99 has associated detailed technical requirements with seven foundational themes as follows:

- Identification and authentication control
- Use control
- System integrity
- Data confidentiality

- Restricted data flow
- Timely response to events and
- Resource availability

Detailed technical requirements for each theme listed above are Part 4 of the ISA 99 standard.

System Design Principles:

Control equipment design shall follow the following principles:

- An auditable cybersecurity risk assessment and design process shall be followed as well as the following:
- Plant LAN connections to the control network shall be via a firewall
- Plant LAN connections should not be made unless absolutely required to run or maintain the plant or for valid business reasons
- Any modem required for technical support shall be identified and made secure

System Configuration and Integration:

Control equipment system configuration and integration shall follow the following principles:

- The latest supported security patches installed.
- The latest supported anti-virus program and the latest anti-virus signature files shall be installed.
- The anti-virus program and anti-virus signatures must be kept up-to-date at all times
- All workstations shall be configured to disable the Internet browser application from making connections to the Internet. A workstation user must never be able to open the Internet Explorer and connect to an external internet site.
- E-mail programs must never be run on any workstation or any computer directly connected to the control LAN at any time
- During installation, all default user passwords should be changed to prevent unauthorized users from accessing the system. Only the personnel actually engineering the system should know the passwords for that specific system. Accounts should be set up consistent with the duties of each user. Administrator privileges should be reserved for only the very few individuals who will be responsible for these tasks – in general, users who are performing engineering tasks
- The automation system should never be connected to any network unless it is properly protected with a correctly configured firewall. The firewall should specifically block any/all port 80 traffic (Internet) and any port that could be used for e-mail traffic. All ports should be blocked in both directions except for those needed for the applications on the control network
- Each person doing configuration work on the control system should have a unique account (user-specific name and password), so user activities can be properly controlled.
- All user accounts not required for commissioning and start-up should be deleted from the control system before the system is shipped to the customer. After starting up is complete, all non-customer accounts should be deleted. To insure only authorized customers' accounts remain on the system after implementation, the customer administrator should change the admin password and delete any vendor accounts.
- General business laptop or desktop computers shall not be used as control system workstations, nor should they ever be connected into the control system. Data should be moved between general purpose laptops and desktops by the use of USB thumb drives or CDs. All portable media must be virus scanned prior to insertion into a control system workstation.

Intrusion Detection:

Network intrusion detection systems (NIDS), monitor packets on the control system network and attempts to discover if a hacker is attempting to break into a system (or cause a denial of service attack). A typical example is a system that watches for large numbers of TCP connection requests to many different ports on a target machine, thus discovering if someone is attempting a TCP port scan. A NIDS may run either on the target machine that watches its own traffic or on an independent machine promiscuously watching all network traffic. A "network" IDS monitors many machines, whereas the others monitor only a single machine (the ones on which they are installed).

In most networks, the NIDS is located at the firewalled connection from the Internet to the corporate or plant LAN. This way, intruders can be detected before they get onto the internal LANs. Also, the NIDS requires IT resources to monitor the communication logs for abnormal activity, which adds costs to this solution. Depending on the control system security risk analysis done by the user, the cost of using a NIDS between the plant and control LANs can be justified.

If a NIDS is used as part of a control system protection solution, it should be installed between the plant LAN and the plant LAN router/firewall.

C3.13.35 Supervisory Control and Data Acquisition (SCADA)

SCADA systems and their associated peripherals are generally intended to be used in an industrial environment and shall therefore be provided within an enclosure suitable for that environment.

Conformal coated printed circuit boards and components shall be supplied where the equipment may be exposed to the following:

H_2S - Hydrogen sulfide
SO_2, SO_3 - Sulfur dioxide/trioxide
CnHn - Hydrocarbons
NO_x - Oxides of nitrogen
Cl_2 - Wet Chlorine/Dry Chlorine
NH_3 - Ammonia

The conformal coating shall comply with the ISA-S71.04 standard for Class G1, G2 and G3 environments.

SCADA Software:

The SCADA package and licensing shall be supplied by the employer to the contractor. The software shall be sized by the contractor for the required number of Tags as well as the FDS requirements including 20% spare Tag capacity. The user configured environment i.e, mimics, trends, alarms and events etc. shall be upgradable without having to replace the existing program.

The architecture of the SCADA package shall be robust and modular and shall make maximum use of the operating systems multitasking and system services capabilities. All status and error events shall be written to the operating systems event log as well as the SCADA system event lot.

A design and a run-time version of the SCADA package shall be provided such that the Employer can make changes to the SCADA mimics, face-plates and Tag database and download these to the live system without having to restart the computers (so called on-the-fly changes).

The SCADA software shall be Employer-server capable such that one or more SCADA server(s) can be configured with all mimics, graphics, alarms and events that can then be accessed and displayed on one or more Employer workstation(s).

The SCADA shall communicate with the PLCs via an industrial type, high speed, deterministic network and with other office computers and systems via Ethernet network. Serial communications protocols with the PLCs will not be acceptable.

The SCADA system shall support data acquisition via OPC DA (version to be compatible with PLC version) and A&E (version to be compatible with PLC version).

Typical Modes of Control:

The software code in the PLC shall reflect the controlled equipment's wiring control circuit and the Employer's standard modes of control.

Software modules shall operate in two control modes, automatic and manual. The front-end control modules for motors, valves etc. shall be provided with an additional modes called maintenance and local modes. The PLC software module shall manage the mode selections so that each module is independently mode managed.

Automatic Mode:

A module that is selected auto shall be controlled by another software module, e.g, a control sequence, in the next control. Switching to auto mode shall be permissible at all times. All interlocks shall apply in this mode.

Manual Mode:

Manual mode shall only be selected by an Operator, from the HMI or SCADA. All interlocks shall apply in this mode. Manual mode selection shall be permissible at all times. If a manual operation is performed on a module, it shall automatically switch to manual mode. The module shall remain in manual mode until selected back to auto.

Maintenance Mode:

A front end control module can be selected to maintenance mode only when the equipment is de-energised and in manual mode. A sequence cannot run if one or more sub-ordinate modules are selected to maintenance mode. The maintenance selection may also be a 'process' type interlock on upstream equipment. Maintenance mode bypasses all process interlocks. Safety interlocks are still active. A Maintenance Mode request switches equipment between Manual and Maintenance Mode.

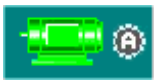
Field Control/Local Mode:

The field control mode allows for the control of equipment from a Field Control Panel situated somewhere in the facility, local to the equipment being controlled. An example of where this field control mode would apply would be when setting the gap on a ventilation fan louver. The hydraulic system would need to be controlled from a field panel.

Equipment mode shall always be indicated alongside the equipment. The equipment mode shall be presented by coloring a section of the equipment graphic according. An example of equipment mode indications is provided below:

Equipment Mode	Symbol	Example
Local control (i.e. not central / sequence)	Cross hatching over equipment symbol and mode symbol	
Maintenance (out of service / testing / Process I/L override)	Spanner symbol beside equipment (Orange)	
Manual (OIS control, not in sequence)	Hand symbol beside equipment (Cyan)	
Auto (PLC / sequence ontrol)	Circled ‘A’ symbol beside equipment	
Simulation mode active	Blue cloud with ‘S’ beside the equipment	
Bypass mode active	Red cloud with ‘B’ beside the equipment	

Below is an example detailing the appearance of a conveyor as it moves through all of these states and modes:

Equipment Status	Symbol
Drive Auto, Safety Interlock	
Drive Auto, Process Interlock	
Drive Auto, Ready (Stopped)	
Drive Auto, Starting	
Drive Auto, Running	
Drive Auto, Stopping	
Drive Manual, Not Ready	
Drive Maintenance, Ready	
Drive, Local / PLC Out control	
Drive, PLC Offline	

Equipment Status Display:

All equipment controlled by the PLC, shall be represented by a dynamic graphic symbol in the SCADA system.

The Graphic symbol shall reflect the equipment status via the following system colours as well as descriptive text;

Text	Colour
Healthy (Auto/Man)	White
Healthy (Field)	Flashing White
Tripped	Flashing Amber
Tripped Ack.	Amber
Faulty	Flashing Red
Faulty Ack	Red
Running (Auto/Man)	Green
Unknown (Comms Failure)	Grey

Graphic symbols shall as far as is possible reflect the IEC standard for Process and Instrumentation Diagrams and as per qualifying statements.

Process Mimics:

Process mimics shall be configured to represent process flow as accurately as possible using IEC standard symbols.

No more than 64 dynamic elements shall be allowed on any one screen and dynamic update time per element shall be 2 seconds or better.

The mimic load time, from selection on menu or overview mimic to completely loaded and dynamisized, shall not exceed 3 seconds.

All the mimics shall conform to the screen of full HD 21 inch screen layout and label font sizes shall be standardized throughout. No font smaller than 10 point shall be used.

Equipment Display Faceplates:

All operating equipment such as Motors, Valves, Actuators, Measured values and Controllers shall be represented by standard display faceplates (Dialogs). Faceplates may be customized for specialized equipment only as agreed to by the Employer or as per qualifying statements.

Faceplates shall clearly identify the operated equipment by its TAG number and clearly display equipment status, start/ stop, auto/manual, set-point adjustments and reset commands as required.

Operating system colours shall be used throughout so that changes to the OS's colour and font size scheme does not detrimentally affect the visual appearance and operational representation of the controlled equipment.

Examples of faceplates are shown below:



Figure 2: Equipment Faceplate

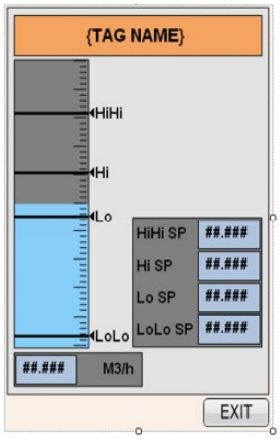


Figure 3: Analog Faceplate



Figure 4: Valve Faceplate

Historical and Real-Time Trending:

It shall be possible to configure any measured value or individual status signal for real-time or historical trending.

Real-time trending shall be configurable from as little as every 1second through to every hour. At least 8 trends per screen shall be allowed where each trend line shall have a different colour. Real-time trend data shall be maintained in memory and or relational database.

Measured values shall be normalized in a range of 0 to 10 000 when sent or received from the PLC and shall be individually scalable in any required engineering range for trending purposes.

Digital trend data shall be logged on a change of state basis.

Historical trends (Data Logging) shall be written to and read from either disk file or relational database. Intelligent archiving must be used to optimise disk space usage.

Alarms and Events:

All alarming functionality to be implemented shall comply with the EEMUA Best Practise Guidelines as well as the ISA 18.2 Alarm Management Standards.

A comprehensive Alarm and Event system shall be provided by the SCADA system. Alarms and Events shall be viewable from a separate screen and the last 5 alarms or events shall be visible at the bottom of every mimic.

State changes from any motor, valve, actuator, measured value, controller, set point or individual status bit shall be configurable for alarming and / or event logging.

The alarm screen shall provide colour-coded “in-coming” (new), “acknowledged” and “out-going” (cleared) alarms similar to the colours described in the modes of operation or as per qualifying statements specified elsewhere. New alarms shall be latched until acknowledged. Acknowledge alarms shall be cleared only once the field condition has been rectified.

There shall be a minimum of three classifications of alarms:

- Event: An event has occurred in the system that is not an alarm condition for the operators. An example of this would be equipment starting / stopping or a valve opening / closing.
- Warning: A condition has occurred that warrants operator intervention however, poses no immediate threat to production.
- Urgent: A condition has occurred that warrants operator intervention and poses a real threat to the facility.

The following shall be freely configurable:

- Alarm priorities
- Alarm categories
- Operator input downtime reasons and notes

Alarm and event lists shall be fully sortable, searchable and provide filtering functionality. Sorting shall be typically by the Alarm or Events date and time stamp filtering shall be typically by plant section and or Tag number.

It shall be possible to configure alarms for automatic printing to either hardcopy or software (PDF) file format. Non-sensible alarms shall be suppressed at the lowest control level in the event of communications or power failures where it will be known that large numbers of controlled equipment may raise unnecessary alarms. Alarms shall NOT be generated for equipment that is *Out Of Service*.

NOTE: Measured value alarms shall preferably be date and time stamped in the PLC and not the SCADA system.

The option for alarm/event SMS's to be sent out with different escalation levels is required.

Calculations and Statistical Analysis:

The SCADA system shall natively perform a wide variety of mathematical, logical, statistical and similar functions on measured values or individual status bits.

Calculation and logical functions should be configurable to run real-time, event triggered or at scheduled intervals.

In addition to Calculations and Functions, application scripting shall be considered as an additional bonus feature.

Reporting:

The SCADA system shall natively provide a basic level of reporting. On demand and scheduled reporting shall be provided. Reports should be configurable in the same manner as display mimics and should be printable on demand, event triggered or at scheduled intervals.

The report printing functionality shall be adequately threaded and multitasked such that it does not interfere with or hold up the regular updates of mimic dynamic elements and/ or SCADA to PLC data communications.

Preference shall be given to a locally developed "Web/ Internet" based, open database connectivity capable, SCADA reporting package.

Database Management System:

The SCADA package shall be supplied with a complete Relational Database Management SYSTEM (RDBMS) including all server and Employer Access licenses as specified by the Employer after award of the contract.

The Database shall be normalized and optimized for the total number of measured values and status bits retrieved from the PLC's. The systems integrator shall provide proof of such normalization.

The Database shall be automatically backed-up and archived and shall be fully restorable in the event of a SCADA or computer failure.

SCADA Mimics to be Provided:

The minimum mimics to be provided are listed elsewhere and shall reflect the Process Flow Diagrams as accurately as possible.

SCADA Measured Values Trends and Historical Data:

Measured values and control loops to be trended are listed elsewhere. Scan rates and scaling factors are specified per measured value.

Generally, all values shall be averaged and historically recorded hourly, weekly, monthly and quarterly up to a maximum of one year.

The SCADA package shall provide historical data compression and measured value logging based on rate of change or value deviation.

It shall be possible to view and analyse historical data from the SCADA trending functions.

Annual historical data shall be backed-up to CD and purged from the SCADA Database. This function would be performed manually.

SCADA Reports:

Production and equipment status or fault reports to be provided as listed.

Reports shall be produced in a portable file format that can easily be imported to spreadsheet programs or presentation programs.

SCADA Operator Access Security:

The SCADA system shall provide access security to prevent unauthorised access to the system. Securing the system through usernames and passwords will prevent accidental reconfiguring by the process controllers and managers and provide a traceable log of all SCADA activity.

At least four levels of security shall be provided. The SCADA Operating System security groups should be used or created as follows:

Users:

When the system boots up the SCADA Server shall start as an OS service.

The SCADA user interface shall then be automatically loaded.

After the UI has been loaded a “logon” mimic shall be displayed. This will force the operator, process controller or manager to logon before accessing the live mimics so that an audit log of all users can be kept.

All SCADA system configuration menu items will be inaccessible.

All conventional OS Desktop operations shall be inaccessible. The Task Manager shall not be accessible from the keyboard. The OS Explorer shall not be accessible.

Operation of the Stiffy drive and the CD ROM drive shall also be disabled.

Process Controllers:

The process controllers must logon to be able to perform their functions as follows:

- Move from mimic to mimic.
- Stop, start and reset all equipment.
- Change value settings.
- Acknowledge alarms.
- Reconfigure trend periods.
- Print trends

System Managers:

In addition to the permissions of process controllers, the managers must be able to perform the following functions:

- View the events list.
- Reconfigure the events list.
- Print the events list.

System Administrators:

Will have access to all SCADA design time/ configuration menu items and functionality.

SCADA Cyber Security:

To ensure the highest degree of security of SCADA systems, the Contractor shall isolate the SCADA network from any other network connections. Any connection to another network introduces security risks, particularly if the connection creates a pathway from or to the Internet. Although direct connections with other networks may allow important information to be passed efficiently and conveniently, insecure connections are not acceptable; isolation of the SCADA network is the primary goal.

Strategies such as utilization of “demilitarized zones” (DMZs) and data warehousing are acceptable strategies to facilitate the secure transfer of data from the SCADA network to business networks.

The Contractor shall remove or disable unused services and network daemons to reduce the risk of direct attack. This is particularly important when SCADA networks are interconnected with other networks. Examples of services to remove from SCADA networks include automated meter reading/remote billing systems, email services, and Internet access. An example of a feature to disable is remote maintenance.

Where backdoors or vendor connections are required in the SCADA system, strong authentication must be implemented to ensure secure communications. Modems, wireless, and wired networks used for communications and maintenance represent a significant vulnerability to the SCADA network and remote sites and, as such, shall be assessed for intrusion and attack.

The Contractor shall establish and provide disaster recovery plan that allows for rapid recovery from any emergency (including a cyber-attack). System backups are an essential part of any plan and shall allow rapid reconstruction of the network.

SCADA System Installation:

The SCADA servers and network equipment shall be permanently installed in a custom standard 19" rack mount equipment cabinet (typically 24U high) with glass doors and shelves as per issued engineering drawings.

The SCADA workstation computers shall be permanently installed in custom control desks.

The workstation control desk and equipment cabinet shall be suitably ventilated with filtered air.

All power, peripheral and network cabling shall be neatly arranged and tied back with cable ties. Where cabling has to run along floors, walls or ceilings, adequately sized PVC ducting shall be provided.

All electronic equipment shall be suitably earthed and protected against lighting, power failures and voltage dips/surges. Where power requirements of any of the equipment exceed 5 A, suitable circuit breakers shall be supplied in a UPS distribution board.

All power supplied from the UPS shall be via coded, red flat top earth 15 A plugs and sockets.

The SCADA computers and peripherals shall also be protected from electromagnetic radiation that could typically radiate from two-way radios used by the operators in the control room.

Inspection and Method of Testing:

The SCADA shall be inspected by the Employer's Agent and tested by the Contractor (which tests shall be witnessed by the Employer's Agent) prior to delivery, installation and switch on at site.

The Tenderer shall allow in his tender price for all costs that shall be incurred by himself and/ or the Employer's Agent to perform these inspections and tests.

The Contractor shall have all equipment available to do all tests. Any additional equipment required for the tests shall be obtained by the Contractor and remain the Contractor's property.

The Employer's Agent reserves the right to inspect any equipment covered by this Specification at any stage during manufacture.

A test report template shall be submitted with the tender detailing exactly which tests will be made, and how they will be performed. After testing at the system integrators offices, one original and one copy of the official test report shall be submitted to the Employer's Agent.

Should the Employer's Agent, when called upon to witness tests and inspections, find that the Contractor has not made reasonably certain that the tests will be successful, he/she may cancel such tests and postpone them to a future date so that the Contractor can ascertain by pre-testing that the equipment to be tested will be of acceptable standards.

Any such re-test expenses incurred by the Contractor and/or the Employer's Agent shall be borne by the Contractor.

Any equipment or workmanship found by the Employer's Agent to be of inferior quality during construction, erection, commissioning, or during the guarantee periods, shall be replaced promptly to an acceptable quality and standard, at the Contractor's expense.

The final acceptance tests shall be undertaken after completion of the full installation on site.

Minimum Inspections and Tests:

The minimum inspection of the SCADA shall include the following as well as any further qualifying statements specified elsewhere:

- Correct choice of PCs CPU, Motherboard and all components.
- Correct and neat assembly of all components.
- Correct configuration of the PCs BIOS.
- Correct installation and configuration of the Operating System.
- Review of all SCADA software configuration.

The minimum testing of the SCADA shall include the following including as well as any further qualifying statements specified elsewhere:

- Correct thin slice operation of all SCADA faceplates and objects
- Correct operation of all Mimics and Dynamic Elements.
- Correct operation of all Modes of Operation.
- Correct detection and annunciation of simulated Faults / Alarms.
- Correct scaling, trending and logging of measured values.
- Correct PLC/ SCADA data communication.
- SCADA command and load time response measurements.
- PLC / SCADA data communications response time measurement.

The preferred method of testing shall be using the actual SCADA connected to a PLC that will ultimately be delivered to site, set up in a simulated environment. Simulation of the process to be controlled shall be as simple and as cost effective as possible.

Training:

User Training:

All users shall be trained on the basic operation of the platform application. This would include the following items:

- Interpreting graphic symbols
- Manipulating display elements (i.e, opening and closing of valves, changing of set-points etc.)
- Identifying and interacting with alarms, process events and sequencing
- Navigating around displays

Operations Training:

All operators shall be trained on the basic operation of the platform application. This would include the following items:

- Interaction with the control system under all modes of operation
- Use of the alarm system
- User of the event system
- Use of the trend system
- Recognition of abnormal control conditions such as forced values
- Responding to process/control upsets
- Understanding the display navigation design
- Retrieval of historical data
- Adjusting of set-points
- Adjusting modes and outputs
- Stating up the plant/sequences
- Stopping the plant/sequences
- Recognition of special equipment or devices operating in maintenance/local modes

Maintenance Training:

All maintenance persons shall be trained on the basic operation of the platform application. This would include the following items:

- Use of the SCADA system to accomplish required maintenance tacks
- Vendor documentation for SCADA hardware components
- Vendor documentation for SCADA configuration tools
- Management of change process covering the SCADA

Engineering and Administration Training:

All Engineers and Administration staff shall be trained on the basic operation of the platform application. This would include the following items:

- Use of the SCADA to accomplish engineering tasks
- Vendor documentation for SCADA hardware components
- Vendor documentation for SCADA configuration tools
- Familiarity with operations functionality
- Familiarity with diagnostics tools
- System back and recovery procedures
- SCADA security and how SCADA user account and user privileges are to be used
- Management of change process covering the SCADA
- Any necessary periodic review or update to software

Documentation:

The following documentation shall be provided by the Contractor at the various project phases listed below:

With tender

- SCADA Server manufacturer's datasheet
- SCADA Workstation manufacturer's datasheet
- SCADA network switch manufacturer's datasheet
- Manufacturer's datasheets for all associated components e.g, fibre optic transceivers power supplies and other intelligent hardware

During construction

- Control system architecture drawing
- SCADA tag list
- SCADA loading calculations
- SCADA server panel General Arrangement drawing
- SCADA server panel schematic/wiring drawings
- SCADA Functional Design Specification (FDS)
- SCADA server panel point to point wiring check certificates
- SCADA server panel IP certificate
- SCADA server panel Quality Control Documentation certificates
- SCADA server panel Certificate of Compliance and test report
- SCADA trend list
- SCADA mimic list
- SCADA alarms list
- SCADA reports list

As Built

- Control system architecture drawing
- SCADA tag list
- SCADA final loading calculations
- SCADA server panel General Arrangement drawing
- SCADA server panel schematic/wiring drawings
- SCADA Functional Design Specification (FDS)
- SCADA Disaster Recovery Plan
- Network drawing

C3.13.36 Industrial Automation Ethernet Networks

General:

The network system shall be based on existing IEEE 802.3 Ethernet standards. There shall be no modifications of Ethernet protocol that create incompatibility with commercial off-the-shelf Ethernet products.

The network system shall use standard unmodified TCP, UDP and IP protocols for Ethernet frame encapsulation and transport across the network, as specified in the IETF RFC documents.

The network system shall be able to integrate into all other parts of the network and to communicate with the network equipment using open-standard, non-proprietary protocols. The network components shall be interoperable with standard network equipment, such as switches, routers, firewalls.

The network system shall utilise a common industrial application layer protocol, using a single media-independent network technology, enabling interoperability across a broad range of vendors and devices. This protocol shall be managed by a vendor neutral organisation that maintains conformance testing to ensure vendor interoperability and specification compliance.

Design Requirements:

The network system shall be designed to meet the following requirements:

- The network shall be able to meet real-time communication requirements of the industrial control equipment.
- The network shall have resources available to support the required number of network nodes and amount of traffic they generate, with additional capacity for future expansion.
- The network shall provide high availability for all critical components by using redundant network hardware, power supplies and power sources, cabling infrastructure and network data paths
- The network shall be compliant with the ANSI/ISA-99 standards for industrial automation and control system security

Network Cabling, Connectors and Patch Panels:

The following Ethernet physical media standards shall be supported in the network:

- 100Base-TX copper
- 100Base-FX fibre (multi-mode and single mode)
- 1000Base-SX fibre (multimode)
- 1000Base-LX fibre (single mode)

2-pair and 4-pair twisted pair cables (shielded or unshielded) shall meet the transmission performance requirements of ANSI/TIA/EIA-568-B standards.

The following fibre optic cable shall be supported and meet the requirements of ANSI/TIA/EIA 568-C.3 standards:

- Multi-mode 50/125 mm
- Multi-mode 62.5/125 mm
- Single mode 9/125 mm

Copper and fibre industrial cabling components shall support the minimum environmental recommendations of IEC 60068-2 standards, and EMI requirements for IEC light industrial (IEC 61000-4, 61000-6, 61131-2, 61326-1).

The following industrial Ethernet cabling shall be available for installation in harsh environments:

- Cat5e unshielded twisted pair cable (UTP), four- and eight-conductor styles
- Shielded twisted pair cable (STP), four- and eight-conductor styles
- 600V STP cable, four- and eight-conductor styles, for use in a cable tray shared with high voltage power cables

Ruggedized IP-rated fibre cables shall be used for indoor and outdoor industrial applications.

Network equipment enclosures shall be used to house networking devices and patch panels in harsh environments unless the network hardware is designed for mounting in such environment.

Network equipment enclosures shall provide a wire duct for communication cables and fibre optic cables between the communication devices in control panel and communication raceways. Plastic wire duct design shall take into account minimum bend radius of communications cable.

Cabling systems shall utilize patch panels, surface mount box, or other enclosure, which allows the cable to be permanently terminated and tested. Direct cabling to switches shall be avoided. Connections between switches and patch panels will be made with patch cables not exceeding 3 metres in length and shall conform to ISO/IEC 11801 standards.

Industrial Ethernet Switches:

Industrial Ethernet switches shall meet the following environmental and power specifications:

- IEC 60529 IP20 or IP30 environmental rating
- Industrial DIN-rail enclosure
- Passive cooling with no moving parts
- Operating temperature 0°C…+60° C
- Ambient relative humidity 5% to 95% (non-condensing)
- Redundant power source 12...48V DC
- Two front panel connectors for DC power and alarm signals

- Internal temperature sensors
- Two independent alarm relays

Extended temperature, vibration, shock and surge, and noise immunity ratings shall comply with specifications for industrial environments.

Industrial Ethernet switches shall support one or several of the following media types for end device connectivity:

- 100Base-TX copper with RJ-45 ports
- 100Base-FX multi-mode fibre with small form-factor pluggable (SFP) slots or built-in ports
- 1000Base-TX copper with RJ-45 ports

Industrial Ethernet switches shall support one or several of the following media types for connectivity to other industrial switches and distribution layer devices:

- 100Base-TX copper with RJ-45 ports
- 100Base-FX multi-mode and single mode fibre with SFP slots
- 1000Base-TX copper with RJ-45 ports
- 1000Base-SX multi-mode fibre with SFP slots
- 1000Base-LX single mode fibre with SFP slots

Industrial Ethernet switches shall have one of the following numbers of ports:

- 6 ports, fixed configuration
- 6 ports expandable up to 24 ports with extension modules
- 10 ports, fixed configuration
- 10 ports expandable up to 24 ports with extension modules
- 20 ports, fixed configuration

The switches with Gigabit speed capabilities shall have one of the following:

- Two copper ports (RJ-45)
- Two SFP slots
- Two dual-purpose ports (RJ-45 or SFP)

Industrial Ethernet switches shall be able to trigger an alarm when the following fault conditions occur:

- Power supply fault
- Low and high temperature
- FCS bit error rate exceeded
- Link fault (loss of signal)
- Port not forwarding
- Port not operating (startup self-test fault)

Industrial Ethernet switches shall have LED indicators displaying hardware and network link status:

Module status indicator with the following states:

- Switch is operating properly
- A recoverable minor fault has occurred
- A non-recoverable major fault has occurred
- The switch is performing a power-on self-test (POST)

Network status indicator with the following states:

- The device has at least one established connection to a control system
- Control system connection has timed out
- Duplicate IP address
- The switch is performing a POST

Setup status indicator with the following states:

- Switch is configured as a managed switch
- Switch is in initial setup
- Switch is in recovery state or initial setup is incomplete
- Switch failed to start initial setup or recovery
- Power status indicator

Port status indicators with the following states:

- No link
- Link present
- Port is sending or receiving data
- Link fault
- Port is disabled due to an address violation, Ethernet loop detection, or manual configuration

Industrial Ethernet switches shall support a common application layer protocol used for the control system for configuration and monitoring purposes. The switch shall have the ability to be added as an I/O device to a programmable logic controller (PLC) and provide an application protocol interface for read-only and read-write access to switch parameters.

Industrial Ethernet switches shall support the following methods of diagnostic and monitoring:

- Web interface (HTTP)
- SNMP protocol version 2c and 3
- Port mirroring
- Application protocol interface to a control system

Industrial Ethernet switches shall be available with standard and advanced software set.

Industrial Ethernet switches with standard software set shall include the following networking functionality based on open standards protocols:

- VLAN and trunking support: IEEE 802.1q
- Rapid Spanning Tree protocol (RSTP): IEEE 802.1
- Multiple Spanning Tree protocol (MSTP): IEEE 802.1q-200
- Multicast traffic management with IGMPv3 snooping, filtering and querier: RFC 4541

Industrial Ethernet switches shall include a loop-prevention network protocol with the ability to support large number of switches in a ring topology. The protocol convergence time shall meet the requirements of typical industrial applications.

Network Installation:

The following requirements are applicable when installing network equipment and cabling:

- All equipment racks shall be level and plumb
- All cable bundles within the network rack/enclosure shall be secured and tied with velcro wrap
- All cables and equipment shall be installed in strict conformance with the manufacturer's recommendations
  - Cables shall be installed avoiding sharp bends
  - Install cable using lubricant designed for cable pulling
  - Cable ties or other cable supports shall be installed without crimping the LAN cables
  - Install LAN cables without splices
  - Installed bend radii shall not exceed 4 times the cable diameter
  - Terminate all pairs at the jack and the patch panel
  - Install cables away from electrical motors and transformers.
  - Install cables away from fluorescent lighting.
- All cables and terminations shall be labeled with cable designations
- Each data port shall be individually labeled with its patch panel/switch port ID
- Each device with a unique IP address shall be individually labeled with its IP address.

Network Testing:

All tests, verifications, checks, and recommendations shall be in conformance with the ANSI/TIA or ISO/IEC specifications. ANSI/TIA or ISO/IEC specifications define electrical and mechanical parameters that are the basis for all tests and test equipment usage defined in this section.

All tests, verifications, checks, and recommendations shall be in conformance with all applicable vendor specifications and guidelines. Manufacturers' specifications and guidelines may define additional electrical and mechanical parameters beyond ANSI/TIA or ISO/IEC specifications and must be included in the basis for all tests and test equipment usage defined in this section.

The Contractor shall utilize any required test equipment, equipment management tools, and additional tools as needed to validate the network installation. All test equipment shall bear current calibration certification from a certified calibration laboratory, as appropriate.

The installed twisted-pair copper cabling links shall be tested to meet the requirements of the ANSI/TIA/EIA 568-B standards and to the maximum rating for the grade of the installed cable.

The installed Ethernet Network System shall be tested for performance and functionality according to the IETF RFC 2544 recommendations. The performance of each network link shall be measured in both directions. The duration of each test trial shall be at least 60 seconds. The following minimum tests shall be performed:

- Throughput – the maximum rate at which frames can be transmitted from the source to the destination with zero lost frames or errors.
- Latency – the total time it takes for a frame to travel from source to destination. The minimum, average, and maximum latency values for each frame size shall be reported.
- Frame Loss – the percentage of frames transmitted that are not received at the destination.
- Back-to-Back Frames (burstability) – the maximum number of frames that can be sent from the source to the destination within a specified interval with zero lost frames.
- Jitter – the variation in the arrival time of frames received at the destination.
- Bit Error Rate – the percentage of bit errors measured at the destination relative to the number of bits sent by the source.

- Verification of the Link Integrity Status LED on both sides of each link.
- Verification of proper operation and failover of each redundant component and links.
- Verification of alarming of each link failure.
- Verification of configuration parameters for each network component (IP addressing, VLAN and port assignment, speed/duplex settings).
- Verification of the necessary network services including but not limited to DHCP, DNS, FTP, and HTTP.

Upon completion and testing of the installed network, the Contractor shall submit test reports in printed form. Test reports shall show all test results performed by the Contractor for each port and piece of equipment. Date of test equipment calibration shall also be provided.

C3.13.37 Operating and Maintenance Instructions

Details of the requirements are given in the Mechanical Specification.

C3.13.38 Commissioning

The commissioning process that is to be followed is set out in the Commissioning Plan

C3.13.39 Scheduled Visits During the Defects Liability Period

During the Defects Liability Period, the Contractor shall visit the site (over and above such visits as may become necessary due to system breakdowns) at quarterly intervals to ascertain that the system is functioning correctly. Items have been included in the Bill of Quantities to enable the costs of these scheduled visits to be priced.

Within 14 days of each such visit the Contractor shall submit a short report to the Employer's Agent which shall include details of all faults that were found as well as a statement that such faults were rectified. At the end of the Defects Liability Period, the Contractor must analyse these findings in a "Close-out report" submitted to the Employer's Agent, in which he/she shall include any recommendations with regard to the augmenting of the system, procuring of additional facilities/equipment, suggested modifications, etc.

C3.13.40 Scheduled Items

Payment will be made based on the items in the Bills of Quantities which have been subdivided as follows:

Preliminary and General:

- Fixed Charge Items - lump sum items are scheduled
- Time Related Items - lump sum items are scheduled
- Health and Safety - lump sum items are scheduled
- Training of the Employer's staff - lump sum items are scheduled
- Inspections and reporting during the Defects Liability Period- lump sum items are scheduled
- Provisional Sums - lump sum items are scheduled and include provision for third part inspections.
- In the unlikely event of

Mechanical Plant and Equipment:

- Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s) of plant.
- Taking delivery, handling, erection, installation and painting of the plant and equipment - a separate item is schedule for each of the foregoing items.
- Site testing, commissioning, and adjusting the plant and equipment supplied and installed including instructing Employer's staff as specified - lump sum items are scheduled.

Electrical Equipment:

- Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s).
- Taking delivery, handling, erection, and installation of the plant and equipment - a separate item is schedule for each of the foregoing items.
- Site testing, commissioning, and adjusting the plant and equipment supplied and installed including instructing Employer's staff as specified - lump sum items are scheduled.

Instrumentation

- Design, supply & delivery to site of the plant and equipment including, quality assurance, factory testing, and temporary storage - a separate item is scheduled for each substantial component(s).
- Taking delivery, handling, erection, and installation of the plant and equipment - a separate item is schedule for each of the foregoing items.
- Site testing, commissioning, and adjusting the plant and equipment supplied and installed including instructing Employer's staff as specified - lump sum items are scheduled.

TECHNICAL DATA SHEET No. IN01: PROGRAMMABLE LOGIC CONTROLLER

Item	Tenderer to Complete
PLC:	
Manufacturer	
Place of manufacture	
Type / Model No	
Processor:	
Model No.	
Maximum number of racks	
I/O capacity (digital)	
I/O capacity (analogue)	
Memory capacity	
Memory extendable (Yes/No)	
I/O Cards:	
Model No.	
I/O capacity (digital)	
I/O capacity (analogue)	
I/O capacity (communications)	
Total number required	
Remote I/O Cards:	
Model No.	
I/O Capacity (digital)	
I/O capacity (analogue)	

Item	Tenderer to Complete
I/O capacity (communications)	
Total number required	
Power Supply:	
Supply voltage	
Maximum variation permissible	
Back-up battery provided (Yes/No)	
Software:	
Programming tool	
Programming language	
Logic	
Literature:	
Technical literature provided with tender (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN02: INSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1001	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN03: INSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1002	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN04: NSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1003	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN05: NSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1004	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....…….....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN06: NSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1005	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN07: NSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1006	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN08: INSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1004	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN09: INSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1005	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN10: INSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Level Indicating Transmitter LIT-1006	
Manufacturer	
Sensor Type / Material	
Sensor Range	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN11: INSTRUMENTS

Item	Tenderer to Complete
Flow Measurement – Electromagnetic Flow Meter: FIT-1001	
Manufacturer	
Country of manufacturer	
Model / Type	
Accuracy / Range of Flow	
Face to face dimension (overall length in mm)	
Are insulating flange joints required (Yes/No)	
If “yes” give details of manufacturer and types of insulations	
Sensor Type / Material	
Sensor Range	
Process Connection / Material	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN12: INSTRUMENTS

Item	Tenderer to Complete
Flow Measurement – Electromagnetic Flow Meter: FIT-1002	
Manufacturer	
Country of manufacturer	
Model / Type	
Accuracy / Range of Flow	
Face to face dimension (overall length in mm)	
Are insulating flange joints required (Yes/No)	
If “yes” give details of manufacturer and types of insulations	
Sensor Type / Material	
Sensor Range	
Process Connection / Material	
Transmitter Type	
Transmitter Display Type	
Transmitter Supply voltage	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....
(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN13: INSTRUMENTS

Item	Tenderer to Complete
Total Suspended Solids Meter AIT-1001	
Manufacturer	
Country of manufacturer	
Model / Type	
Sensor Range	
Process Connection	
Accuracy	
Sensor body	
Transmitter Display	
Transmitter mount option	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....

(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN14: INSTRUMENTS

Item	Tenderer to Complete
Ultrasonic Sludge Blanket Level Detector AIT-1002	
Manufacturer	
Country of manufacturer	
Model / Type	
Sensor Range	
Ingres protection	
Accuracy	
Sensor body	
Transmitter Display	
Transmitter mount option	
In accordance with specification (Yes/No)	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....

(of person authorised to sign on behalf of the Tenderer

TECHNICAL DATA SHEET No. IN15: INSTRUMENTATION JUNCTION BOXES

Item	Tenderer to Complete
Manufacturer	
Type	
Model No.	
Material of construction	
IP rating	
Cable entry type	
Number of cable entries	
Internal terminal rail	
Colour	
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.	

SIGNATURE: ..... **DATE:** .....…….....
(of person authorised to sign on behalf of the Tenderer)

TECHNICAL DATA SHEET No. IN16: BATTERY BACKUP SYSTEM

Item		Tenderer to Complete
Manufacturer		
Place of manufacture		
Type		
Ratings:		
Power	(W)	
Output voltage	(V)	
Output voltage variation	(%)	
Input voltage	(V)	
Input voltage variation	(%)	
Stored energy time	(minutes)	
Surge/Filter Protection		
Batteries:		
Manufacturer		
Type		
Voltage		
Rating		
Communication Link:		
Type		
Protocol		
The information provided by the Tenderer in this Technical Data Sheet is for tender evaluation purposes only and does not over-ride any aspects of the specification. Acceptance of the tender submitted does not imply acceptance of any items that are not compliant with the specification.		

SIGNATURE: ..... DATE: .....
(of person authorised *to sign on behalf of the Tenderer)*

TECHNICAL DATA SHEET No. IN17: INSTRUMENTATION INSTALLATION AND REFERENCES

Item	Tenderer to Complete
Installation of instrumentation plant and equipment:	
Name and address of erector/installer	
Name of the person who will be responsible for all aspects of this work	
Contact details of purchasers who have obtained satisfactory service from equipment of the type offered for the plant:	
PLC	
HMI	
Fire Detection System	
Flow instruments	
Fluid level instruments	
Analytical instruments	
Commissioning:	
The signature below the serves to confirm that the Tenderer has read and understood the contractual requirements pertaining to the commissioning of the plant and equipment	

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer)

C3.14: COMMISSIONING PLAN STANDARD SPECIFICATION

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C3.14.5 CONTRACTOR'S COMMISSIONING PROGRAM SW.648
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C3.14.7 HANDOVER OF COMMISSIONING DOCUMENTATION SW.651
C3.14.8 SCHEDULED ITEMS SW.651

C3.14.1 SCOPE

The Contract Works include the design, supply, delivery, temporary storage, installation, testing, commissioning and handing over in proper working order of the complete installations as described in all of the constituent parts of this document.

This specification deals with the following six stages of the commissioning processes of the mechanical, electrical, and instrumentation plant and, where applicable, the interfaces with the civil and building components of the works.

Pre-commissioning – Stage 1
Cold Commissioning – Stage 2
Dry Commissioning – Stage 3
Wet Commissioning – Stage 4
Hot Commissioning – Stage 5
Documentation and Handover – Stage 6

C3.14.2 COMPLIANCE WITH OTHER SPECIFICATIONS

Whilst this commissioning specification contains specific commissioning requirements, nothing contained herein changes any of the technical and/or contractual requirements that are prescribed elsewhere.

C3.14.3 DEFINITIONS

Pre-commissioning (Stage 1) is to be carried out after completion of the installation(s) and comprises the inspection of the quality of the materials and workmanship and, in the case of electrical and control circuits, the testing thereof and the signature of the Certificate of Compliance.

Cold Commissioning (Stage 2) is to be carried out after all of the Pre-commissioning Category A and Category B Punch List items have been attended to. During Cold Commissioning, instrumentation feedbacks and controls are to be monitored in manual operation and loads and controls are to be altered manually and monitored to ensure all electrical loads and instrumentation are operational.

Dry Commissioning (Stage 3) is to be carried out after all of the Cold Commissioning Category A and Category B Punch List items have been attended to. During dry commissioning, the systems are to be tested in automatic control mode, but without any process medium. It is noted that this type of commissioning can only be done on certain systems as operating electrical loads without process medium may not be possible.

Wet Commissioning (Stage 4) is to be carried out after all of the Dry Commissioning Category A and Category B Punch List items have been attended to. During wet commissioning, the systems are to be tested in manual and automatic control mode with process medium included. Wet commissioning is to be carried out independently of the rest of the system and by only taking into account the specific area where instruments relating to wetted system components are used. Performance testing such as pump performance tests shall be carried out during this Stage 4.

Hot Commissioning (Stage 5) is to be carried out after all of the wet commissioning Category A and Category B Punch List items have been attended to. During Hot Commissioning, the system(s) is to be tested in automatic control mode whilst taking cognisance of the whole system and the effects on all components. Safety circuits are to be tested to ensure emergency conditions will be anticipated and controlled. Should further plant performance tests be deemed necessary, they shall be carried out during this Stage 5.

Documentation and Handover (Stage 6) is to be carried out after all items on all of the Category A, Category B, and Category C Punch Lists created during all the commissioning Stages 1 to 5 have been attended to. All of the commissioning documentation shall be submitted to the Employer's Agent and, once the documentation has been accepted by the Employer's Agent, formal handover of the system to the Employer will take place.

Punch List is a list of items that requires attention. There are three categories of Punch Lists namely:

- Category A Punch List is a list of items that are critical and is such that the current stage of commissioning may not proceed further until all items on the list have been attended to.
- Category B Punch List is a list of items that are not critical and that do not prevent the current stage of commissioning continuing but is such that all items on the list must be attended to before the commencement of the following stage of commissioning.
- Category C Punch List is a list of items that are not critical and that do not prevent the commissioning process to continue to the next Stage but is such that all items must be attended to before the commencement of Commissioning Stage 6.

C3.14.4 RESPONSIBILITY

The Contractor is responsible for planning, supervising, controlling, and executing all stages of the commissioning processes and procedures. The Commissioning Plan shall be prepared by compiling the documentation outlined below for Stages 1 to 6 at least four weeks prior to the scheduled date for Pre-commissioning (Stage 1). All documentation prepared by the Contractor will be subject to the approval of the Employer's Agent who will liaise with, and arrange for input from, the Employer's operating staff as and where necessary insofar as the new works may be required to interact with the Employer's system(s).

If the Contractor engages sub-contractors to carry out specialised work on the project, for example to carry out instrumentation and / or telemetry design and installation, the Contractor remains responsible for ensuring compliance of his/her sub-contractors with this commissioning specification and for coordinating their work with others.

C3.14.5 CONTRACTOR'S COMMISSIONING PROGRAM

Before Pre-commissioning (Stage 1) can commence, the Contractor must issue a "Ready for Commissioning" notice to the Employer and the Employer's Agent. The "Ready for Commissioning" notice must only be issued when all applicable site acceptance tests have been completed and all test certificates have been issued to the Employer's Agent's Representative for items such as:

- Electrical plant and equipment including motor control panels and distribution boards
- Civil structures including concrete cube tests for strength concrete, water tightness tests in the case of water retaining reservoirs, erection of handrails and safety notices, chevron painting of hazardous areas, open / closed stop positions for butterfly valves.
- Mechanical plant and equipment such as the correct alignment of pumps and motors, grouting of pump base plates, load testing of crawl beams, travelling gantries and other lifting equipment, checking of flanged connections for stress-free alignment, pressure testing of pipes, alignment of valves and drive shafts in the case of sleeve valves or other shaft driven equipment.

The Contractor's construction programme for the project must allow adequate time for all work to be completed prior to the "Ready for Commissioning" notice being issued and for the six commissioning stages to be completed before the Due Completion Date.

C3.14.6 INDICATIVE COMMISSIONING DOCUMENTATION

The format of the commissioning plan documentation that the Contractor will be required to prepare shall be similar to the tables shown below. The "Brief Descriptions" shown in the tables below are indicative only and are not to be taken as being prescriptive for this contract.

Project Name & Contract No					
Pre- Commissioning (Stage 1) Procedure					
Item No	**Brief Description**	**Action by**			
		Contractor* **	**Employer's Agent**	**Employer**	**Contractor's Signature**
1.1	Ensure all mechanical loads are fastened and torqued.	√	N/A	N/A	
1.2	Ensure all grouting has been completed	√	N/A	N/A	
1.3	Isolate and lock out to motor control circuit	√	N/A	N/A	
1.4	Isolate and lock out all feeders to individual loads	√	N/A	N/A	
1.5	Disconnect power cables to all electrical loads on both sides	√	N/A	N/A	
1.6	Check drawings with MCC (wire numbers, wiring etc.)	√	N/A	N/A	
etc	etc				

*** The Contractor may choose to introduce a separate column for each of his/her sub-contractors.
Certified as having been carried out and checked:

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer)

Project Name & Contract No					
Hot Commissioning (Stage 5) Procedure					
Item No	**Brief Description**	**Action by**			
		Contractor* **	**Employer's Agent**	**Employer**	**Contractor's Signature**
5.1	Fill and scour the inlet pipeline from xxxx	N/A	N/A	√	
5.2	Open valve to xxxx	N/A	N/A	√	
5.3	Read and record flow meter No 2	N/A	√		
5.4	Energise MCC No 1	√	N/A	N/A	
5.5	Ensure signal from flow meter is displayed on SCADA and sent to telemetry	√	N/A	N/A	
etc	etc				

*** The Contractor may choose to introduce a separate column for each of his/her sub-contractors.

Certified as having been carried out and checked:

SIGNATURE: ..... DATE: .....….....
(of person authorised to sign on behalf of the Tenderer)

C3.14.7 HANDOVER OF COMMISSIONING DOCUMENTATION

All of the commissioning documents, duly certified as completed and correct by the Contractor, shall be issued to the Employer's Agent. Once the commissioning documentation has been accepted by the Employer, and the Operating and Instruction Manuals have been finalised, formal handover of the Works to the Employer will take place.

C3.14.8 SCHEDULED ITEMS

Items have been included in the Bill of Quantities to enable Tenderers to price the preparation and submission of the Operating and Maintenance manuals and the commissioning of the plant and equipment supplied and installed under the Contract.

C3.15: OPERATION AND CONTROL PHILOSOPHY OF THE BACKWASH WATER RECOVERY SYSTEM

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C3.15.2 GENERAL DESCRIPTION OF THE BHOBHOYI WATER TREATMENT WORKS – BACKWASH WATER RECOVERY SYSTEM SW.653
C3.15.3 CONTROL PHILOSOPHY BASIC REQUIREMENTS SW.656
C3.15.4 PROCESS DESIGN PHILOSOPHY SW.656

C3.15.1 INTRODUCTION

General Arrangement of Works Operating and Control Philosophy

Section C3.15.2 sets out a General Description of the Bhobhoyi Backwash Water Recovery Project.

Section C3.15.3 describes in brief the basic arrangement of this Works Operating and Control Philosophy.

Section C3.15.3 sets out the basic requirements of the Control Philosophy.

Section C3.15.4 sets out the Process Design basis.

From Section C3.15.5 onwards, each Section of this Works Operating and Control Philosophy is arranged in two parts as follows:

Works Design Basis and Operation

Works Control Systems

C3.15.2 GENERAL DESCRIPTION OF THE BHOBHOYI WATER TREATMENT WORKS – BACKWASH WATER RECOVERY SYSTEM

The Backwash Water Recovery Facility (BWRF) comprises the detailed design and construction of:

- A Grip Trap to separate the grit from the backwash water.
- A reinforced concrete Balancing Tank to balance the flows from backwashing.
- A Facilities Building to house the dosing pumps, flush mixer, recycle pumping station sludge dewatering equipment.
- A Sludge thickener.
- Interlinking pipework ranging from 250 to 750 mm dia pipelines.
- A 4Mℓ clear water concrete Reservoir.

Diagram 1: Concept Process Flow Diagram

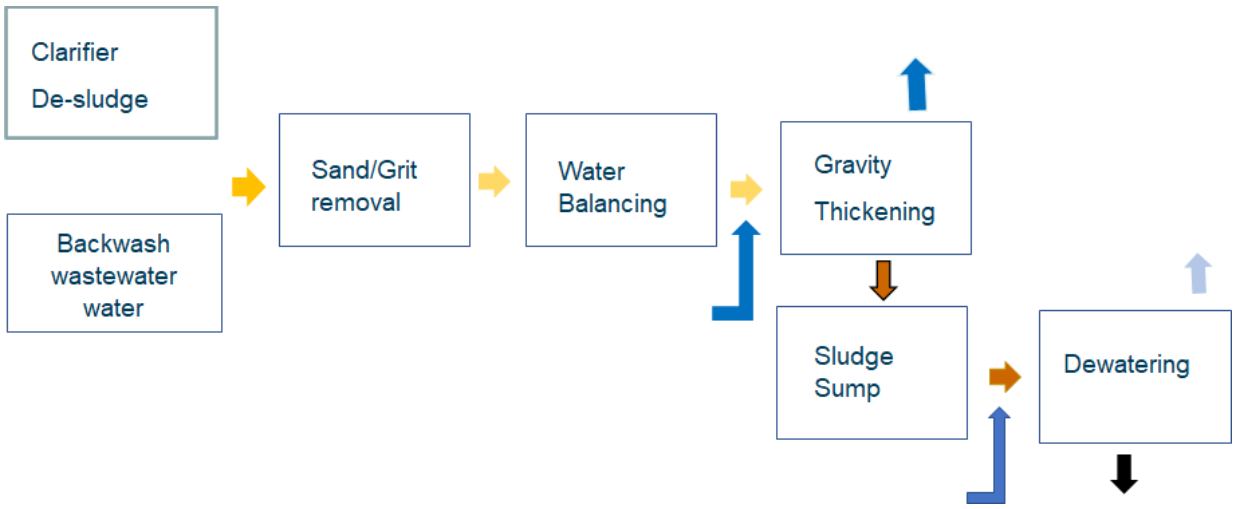


Table 2: Hydraulic Design Parameters and Loading

Process Parameters	Unit	Value	Comment(s)
Backwash flow	m^3/h	153	Based on worst case backwash scenario and is about 3 % of 108 Mℓ/day
Desludge flow	m^3/h	90	Based on 2% of 108 Mℓ/day
Combined flow	m^3/h	243	This equates to 5.832 Mℓ/day, and this is 5.4% of the ultimate treatment capacity of 108 Mℓ/day
Recovery	Mℓ/day	5.72	5.0% of the ultimate treatment capacity of 108 Mℓ/day

Table 2: Centrifuge Design Parameters and Loading

Decanting Centrifuge Specification		
Parameter	**Value/Range**	**Comment**
Type of feed	Water treatment sludge	
Number of units	2	Duty/Standby
Centrifuge feed (m^3/h)	23.6	Average feed flow
	43.7	Maximum feed flow
Feed solids (%)	4 - 6	
Feed solids (kg/hr)	100 - 2500	
Polymer	0.05% - 1 .00% Anionic emulsion	
Recovery (%)	95	
Sludge cake (% w/v)	20 - 25	

Table 3: Polymer dosing detailed specification(s)

Parameter	Value/Range	Comment
Polymer product	Anionic polymer emulsion	Client preference over alternative powder product
Thickener feed (m^3/h)	243.00	
Centrifuge feed (m^3/h)	23.59	Average feed flow
Polymer dosage (mg/l)	Maximum of 5 mg/ℓ	For both thickening and dewatering
Stock solution (%)	0.05 to 1.0	Sized based on 0.5 %
Thickener dosing pump rate (ℓ/h)	243	
Centrifuge dosing pump rate (ℓ/h)	40	Based on maximum sludge feed
Combined daily dosing volume (L)	6800	
Daily emulsion required (kg)	34	
14-day storage (kg)	476	
Number of 25 kg drums	20	
30-day storage (kg)	1020	
Number of 25 kg drums	41	

C3.15.3 CONTROL PHILOSOPHY BASIC REQUIREMENTS

This Control Philosophy shall be read together with the P&ID drawings MD5775-RHD-BR-ZZ-E-0005

Unless otherwise stated in this document, the following general notes apply throughout this document:

- All set points shall be adjustable in the Programmable Logic Controller [PLC] through the Supervisory Control and Data Acquisition [SCADA] system, both locally through the SCADA interface node and remotely via the central SCADA system. Initial values for set points are included in this document; however, they are to be confirmed by the contractor/supplier during commissioning.
- Standard equipment protection and alarms such as emergency stops, trip wires, field control stations, lid/cover limit switches, no-run feedback signal when called on, high motor winding temperature, overcurrent, earth fault, locked rotor, phase failure, water ingress into motor oil, etc. are listed separately in the mechanical, electrical and electronic specifications and are not repeated in this control philosophy. Only process alarms and specific equipment protection and alarms are listed in this control philosophy.
- Where an alarm is generated by a PLC, it shall be displayed on both the local SCADA interface node and the central SCADA system. Alarms can only be reset when the alarm condition has dropped and will have to be reset manually on both the local SCADA interface node and the central SCADA system. Furthermore, the alarm shall be date and time stamped and recorded in an alarm history list on the SCADA system.
- Where a PLC function or an instrument has an indication output, it shall be trended on the central SCADA system and displayed on both the local SCADA interface node and the central SCADA system.
- On/Off indication of each motor shall be displayed on both the local SCADA interface node and the central SCADA system.
- Equipment operated on a duty/standby basis shall have manual duty rotation and manual standby changeover. Indication of selected duty equipment shall be displayed on both the local SCADA interface node and the central SCADA system. Duty/standby operation shall be hardwire interlocked in the relevant MCC and shall be active in automatic operation only. In manual mode, operation shall be at the Operator’s discretion.

C3.15.4 PROCESS DESIGN PHILOSOPHY

C3.15.4.1 General

Backwash recovery system is designed to processand handle the backwash wastewater and clarifier delsudge from the treatment works at a design flow of 5.83 Mℓ/day. The ultimate recovered flow back into the treatment works is 5.72 Mℓ/day, this is 5.4 % of the ultimate treatment capacity of 108 Mℓ/day and a maximum recovery rate of 98 %.

C3.15.4.2 Backwash Water Channel

There is a channel feeding the combined stream of backwash water and clarifier desludge into the degritters. An ultrasonic level indicating transmitter will be Installed in the inlet channel to provide flow data into the SCADA system and will be used as start/stop trigger for the degritter mechanical and control equipment.

C3.15.4.3 Degritters

There are two Forced Vortex Degritter / Sand Trap for the removal of filter sand from combined stream of backwash wastewater and clarifier delsude with duty/standbuy configuration. Each unit will have a hydraulic capacity of the design flow of 5.83 Mℓ/day. Upstream of the digritters is an inlet channel to control the velocity flow. Each unit has a diameter of 2000 mm. The grit to be removed will have a specific gravity of 2.65 and a effective diameter of 0.2 mm

An air lift pump/blower will be installed for pumping out the grit. A flow properller/mechanical stirrer is installed to aid enhancing flow partens and lowering the grit into the bottom of the digritter (storage hopper) for pumping It out.

The Vortex degritter shall have a flow switch to start/stop the mechanical and process control equipment (mechanical stirrer ,air lift blower/pump, air control valve and the water supply control valve. The automation ofthe grit removal shall be by means of a programmable timer or other suiitable means as per the supplier's reccommendations. A manual push start/stop button must be installed to initiate and terminate air blower for the grit removal cycle.

Allowance will be made for penstocks upstream to isolate either of the vortex digritters so that the grit can be cleaned out manually

C3.15.4.4 Balancing Tank

There is a balancing tank for containment and balancing of flows, this ensures that there is a continous but consistent flow control into the downstream unit processes (gravity thickening and centrifuge dewatering). The volume of the balancing tank is 600 m^3. There are three mixers in the balancing in the balancing tank to ensure the contents of the balancing tank are continously mixed and are homogenous. The mixers will run continuously during normal operation.

The hydraulic design of the Balancing Tank is such that should the TWL exceed the level 147.550m or there is a problem with the Polymer Dosing section, then flows will spill over to the emergency overflow.

An ultrasonic level sensor shall be installed to continously monitor the level in the balancing tank . Level indication shall be trended and displayed on SCADA.

C3.15.4.5 Polymer Dosing

Sludge polymer is dosed prior the gravity thickeners as well prior the centrifuge decanters to assist with the thickening and dewatering processes. The sludge polymer shall be delivered to site in liquid emulsion form in 25 kg drums and will be stored in the bulk storage area. The emulsion is used to make a stock dosing solution of 0.05 % to 1.0% concertation. The polymer will be diluted in a vendor package polymer preparation unit. The vendor package has a dedicated PLC/control panel.

The control of the polymer dosing in this section is based on flow proportional dosing.

- Dosing will be flow-proportional with an initial set point input of the polymer dosing in mg/ℓ (up to 10 mg/ℓ)
- The system will measure the flow into the gravity thickener /centrifuges
- The system will then adjust the poly pump rate such that the set point is met.
- The formula Polymer pump flow will be proportional to a = Setpoint and xstream flow with the required conversion factors as determined by the supplier.

As a result, the need for measuring suspended solids in the thickener feed or in the gravity thickener would only be for process monitoring purposes.

C3.15.4.6 Gravity Thickener

The gravity thickener is used to thicken the thin sludge from the balancing tank. The gravity thickener has a rotating bridge, it continuously rotates about the thickener for sludge collection. When sufficient sludge is collected, the desludge from the thickener is via a timer controlled desludge valve, the thickened sludge is stored into the thickened sludge sump.

The gravity thickener will run continuously, the level will be monitored by means of an ultrasonic level transmitter. If the level of the gravity thickener reaches a Low Level, an alarm will be sent to the SCADA. If the gravity thickener reaches a Low-Low Level, the gravity thickener will be stopped and an alarm will be sent to the SCADA.

C3.15.4.7 Centrifuge

The centrifuge is used for dewatering the sludge i.e., solid-liquid separation. It increases the solids content of the sludge. This cake is to be disposed off-site. The centrate is recycled to the head of works

The sludge sump acts as a balancing tank between the gravity thickener and the centrifuge. The tank is mechanically agitated, and the level is monitored by a level sensor. The thickened sludge is pumped into the centrifuge for further dewatering, there is polymer dosage into the centrifuge. The sludge is fed from the sump into the decanting centrifuges (duty/standby), the level sensor in the thickened sludge sump starts/stops the centrifuge feed pumps. The centrifuge operates continuously for a 20-hour daily operation.

The control of the centrifuge will be as recommended and required by the equipment supplier and will be documented during the detail design stage of the contractor.

C3.15.4.8 Return Flow

Supernatant from the gravity thickener and centrate from the centrifuge are recycled to the recovery/return flow sump, and then it is pumped back to the Head of Works to reduce overall water losses on the plant. There are 2 No return flow pumps (duty/standby), there is a level sensor in the return flow sump that continuously indicates the level in the sump, the level starts/stops the return flow pumps. The return flow pumps will be constructed at the discharge point of the return flow sump.

C4: SITE INFORMATION

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C4.3: Atmospheric/Climatic SI.4
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C4.6: Nameboard Drawing SI.7
C4.7: Geotechnical Report SI.8
C4.8: Environmental Management Plan SI.9

C4.1 SITE INFORMATION: SITE OF WORKS AND SITE CONDITIONS

The site is situated approximately 9 km inland of Port Shepstone as shown in C4.2 - Locality Plan.

The site conditions at the existing Bhobhoyi Water Treatment Works are detailed below:

Condition	Description
Supply of electricity	11 kV, 50 hertz, 3-phase supply from Eskom transformed to 380/220 V by Eskom.
Altitude above sea level	Approximately 150 m
Ambient temperatures	Maximum : 44ºC
	Minimum : 4ºC
	24 hour Average Max : 30ºC
Maximum relative humidity	100%
Environmental atmosphere	Humid and therefore severely corrosive.
Lightning	Severe

C4.2 SITE INFORMATION: GEOTECHNICAL

Tenderers must satisfy themselves as to the nature of materials to be excavated under this contract.

No responsibility is accepted for any conclusions drawn by Tenderers from the results and information supplied (if any) and Tenderers must satisfy themselves as to the nature of materials to be excavated under this contract. Tenderers are at liberty to excavate any further trial holes or to carry out other investigations to satisfy themselves as to the nature of the ground that will be encountered in carryout the Works, provided that they advise the Employer's Agent of their intention to carry out such further trial hole excavations or other investigations so that the necessary safety requirements and protection of existing infrastructure and services can be ensured. Any trial hole excavated in areas close to pedestrian or vehicular traffic shall be barricaded and shall be backfilled immediately after inspection of the soil conditions.

The Tenderer shall be fully liable for any claims for losses, damage or injuries whatsoever arising out of, or as a consequence of, carrying out trial hole excavations for the purpose of his/her tender. Furthermore, the Employer's Agent's authority for the carrying out of any exploratory excavations is subject to the Tenderer indemnifying the Employer and the Employer's Agent against any such claims.

.

C4.3 SITE INFORMATION: ATMOSPHERIC / CLIMATIC

Extension of time will be considered for abnormal rainfall. The numbers of days per month on which work is expected not to be possible as a result of normal rainfall, and for which the Contractor shall make provision in his tendered rates, prices and programme, are listed in Table C4.2.1 hereafter. Only the number of days lost as a result of abnormal rainfall conditions, exceeding the number of days listed in Table C4.2.1, will qualify for consideration of extension of time.

Table C4.2.1: Expected Number of Working Days Lost per Month Due to Normal Rainfall

MONTH	Expected number of working days lost as result of normal rainfall	Average monthly Rainfall (mm)
January	**5*	*98,4*
February	*5*	*98,3*
March	*4*	*61,1*
April	*1*	*90,3*
May	*1*	*37,5*
June	*1*	*31,0*
July	*1*	*42,3*
August	*1*	*33,7*
September	*2*	*53,2*
October	*3*	*96,9*
November	*4*	*117,2*
December	**5*	*133,5*
TOTAL	***33 days***	***893,4***

*(Based on information obtained from the Weather Bureau, Department of Environment Affairs, Pretoria. The average monthly rainfall figures quoted, are included for information only, and shall not be taken into consideration for calculation of extensions of time. * The number of working days lost for December and January have been adjusted to allow for the builders' holidays from 16 December to 3 January.)*

Extensions of time as a result of abnormal rainfall conditions shall be calculated monthly being equal to the number of working days certified by the Employer's Agent's Representative as lost due to rainfall, less the number of days allowed for as in Table C4.2.1, which could result in a negative figure for certain months. The total extension of time as a result of abnormal rainfall conditions for which the Contractor may apply, shall be the cumulative algebraic sum of the monthly extensions. Should the sum thus obtained be negative, the extension of time shall be taken as nil.

During the execution of the Works, the Employer's Agent's Representative will certify a day lost due to abnormal rainfall and adverse weather conditions only:

- if no work was possible on the relevant working day on any item which is on the critical path according to the latest approved construction programme; or
- if less than 30% of the work force and plant on site could work during that specific working day.

C4.4 SITE INFORMATION: ENVIRONMENTAL

The Contractor will be responsible for environmental control on site during the construction and maintenance periods and shall ensure compliance at all times with the Environmental Management Plan a copy of which is bound into this document.

C4.5 SITE INFORMATION: LOCALITY PLAN

Locality Plan



Royal HaskoningDHV
Enhancing Society Together

P.O. Box 1066
Pietermaritzburg
3200

Tel: (033) 328 1000
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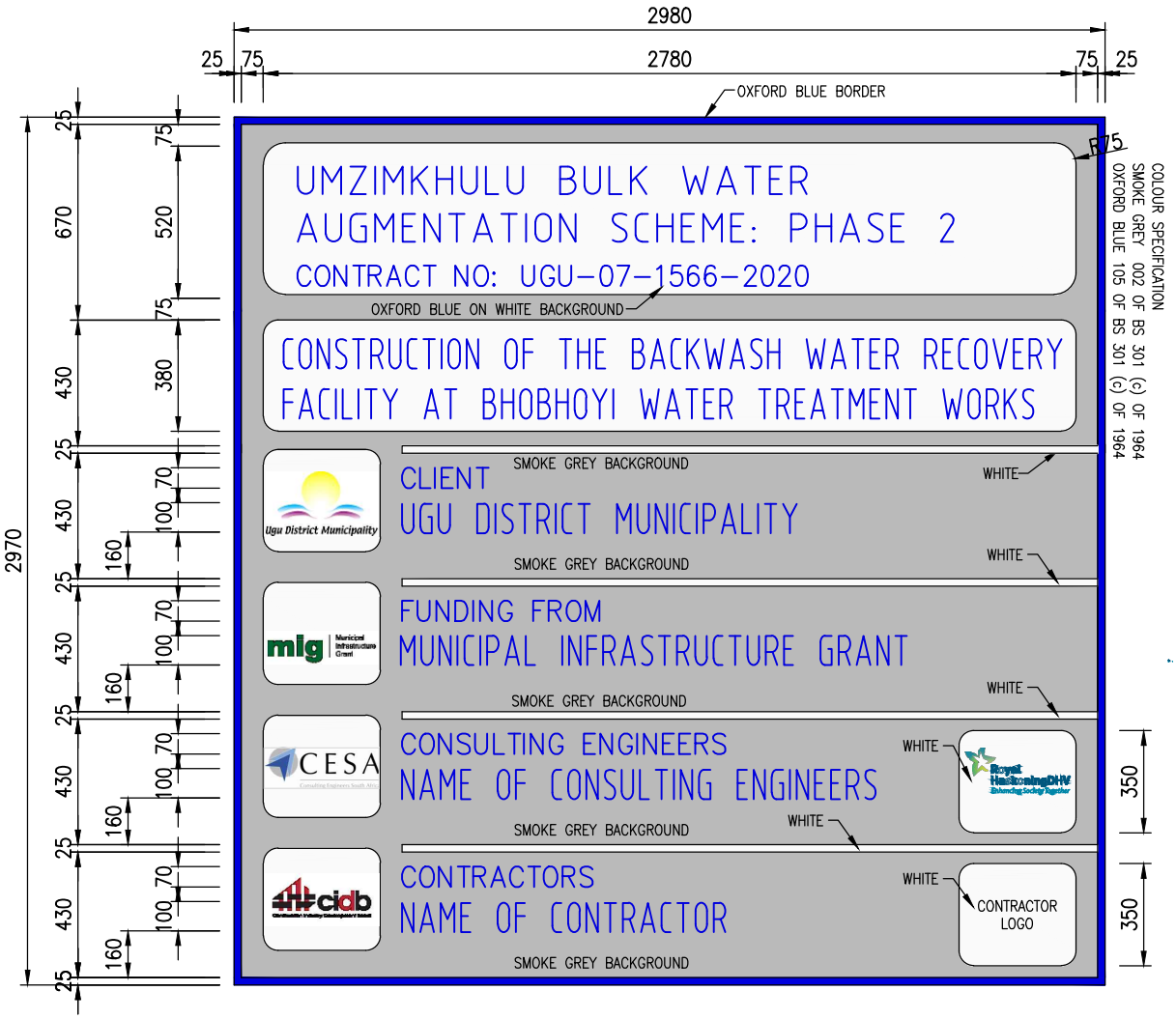
TITLE

UMZIMKHULU BULK WATER AUGMENTATION SCHEME: PHASE 2
LOCALITY MAP FOR CONTRACT UGU-07--1566-202

PROJECT No.	PROJ No:	DRAWING No.	REV
MD5775	1:50 000	SKETCH 2	△

APPROVED:	DRAWN:	DATE:	CHECKED:	DATE:
S.N.	R.W.	09/2022	S.N.	09/2022

C4.6 SITE INFORMATION: NAMEBOARD DRAWING



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TITLE UMZIMKHULU BULK WATER AUGMENTATION SCHEME: PHASE 2
NAMEBOARD FOR CONTRACT UGU-07-1566-202

PROJECT No.	SCALE	DRAWING No.		REV
MD5775	1 : 25	SKETCH 1		△
APPROVED : S.N	DRAWN S.M	DATE 09/2022	CHECKED S.N	DATE 09/2022

DRAWING SIZE : A4 SSI_AUTOCAD.CTB 12/09/2022 NAMEBOARD.DWG

C4.7 SITE INFORMATION: GEOTECHNICAL REPORT

SAVO GROUP
Consulting Pty Ltd

ROYAL HASKONING-DHV

uMzimkhulu Bulk Water Augmentation Scheme: Phase 2

Geotechnical Investigation Report
October 2022

savogroupconsulting@gmail.com

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ANNEXURE A TEST PIT PROFILES

ANNEXURE B DYNAMIC CONE PENETRATION TEST RESULTS

ANNEXURE C LABORATORY SOIL TEST RESULTS

ANNEXURE D MEDIA – TEST PITS

ANNEXURE E TOPOGRAPHY

i. INTRODUCTION

SAVO Group Consulting was appointed by Royal HaskoningDHV to conduct a geotechnical investigation for the uMzimkhulu Bulk Water Augmentation Scheme: Phase 2 which is situated under the UGU District Municipality in KwaZulu Natal.

The objective of the investigation was to establish the nature and engineering properties of the underlying soil. Including the following;

- Determine and assess the subsurface geotechnical conditions on the site.
- Confirm the geology and determine the relevant properties of the soil and rock horizons, if any, that are present on the site, including the determination of bearing capacities and sub-grade reactions.
- Formulate general foundation recommendations for the proposed structures and to quantify the parameters required for the design of the foundations, earthworks and embankments.
- Determine the excavation characteristics ("excavatability") of the materials.
- Determine the suitability of the underlying materials for backfilling and the construction of embankments.
- Determine the level of the water table and shallow groundwater conditions which may affect the construction activities and/or the permanent works.

As well as to verify the sub-soil strata that will be encountered during the construction of the proposed uMzimkhulu Bulk Water Augmentation Scheme in the area Bhobhoyi under the UGU District Municipality.

In total, thirteen (13) test spots were investigated, as directed by Royal HaskoningDHV. The test pits were profiled to a required maximum permissible depth of 1300mm. The Dynamic Cone Penetration tests were carried out to a required maximum permissible depth of 1300mm. Soil samples were retrieved from relevant test spots. These samples were sent to Shenge Soils' testing laboratory for analysis.

It must be noted that the interpretation of the overall subsurface conditions across the site is inferred from the interpolation and extrapolation of point information assimilated from the various test positions. In the unlikely event of significant variations from the inferred conditions becoming apparent during subsequent phases of the project then these must be referred to a geotechnical professional for verification.

ii. SITE DESCRIPTION AND TOPOGRAPHY

The project falls within the UGU District Municipality which comprises of a fully built-up settlement. The uMzimkhulu Bulk Water Augmentation Scheme Project is located

approximately 5km west of Port Shepstone CBD. The site can be accessed via the turn-off from N2 westly into a gravel road that passes through ABC Supermarket in the settlement of Bhoboyi. The central Global Position System (GPS) co-ordinates of the uMzimkhulu Bulk Water Augmentation Scheme Project is 30°44'10.08''S and 30°23'37.02''E. The in-situ materials on the site consists mainly of a silty sand, shale and in-situ rock at varying depths. The site is located in the Bhoboyi Water Treatment Plant. The land in the investigated site has a gentle slope from the north to south with steep access roads.

Trees are dispersed around the boundaries of the water treatment plant. The outcrop of rock was not visible. Boulders were seen on site that are suspected to have been excavated to install services for the plant. Rock at a shallow depth of 500mm below the natural ground level was observed during the investigation. This will make excavation in some areas quite difficult.



For the purposes of assisting with this investigation, Royal HaskoningDHV provided SAVO Group Consulting with Global Positioning System (GPS) co-ordinates of the study area.

iii. SITE INVESTIGATIONS

The site investigation was carried out on 02 – 07 September 2022, in order to investigate the nature and engineering properties of the underlying soil. This involved:

- The excavation of test pits, with the use of a TLB, to the required maximum permissible depth of 1300mm.
- The completion of Dynamic Cone Penetration (DCP) Tests
- The profiling of the test pits

Test Pits

The test pits were profiled to a required maximum permissible depth on 1300mm. The side walls of the test pits were excavated vertically and there was no evidence of any potential collapse within the sidewalls on most test pits during the logging process of concern. This indicates that the material encountered on most of the test pits was not too coarse. In TP2 of the proposed Grit Removal position, TP2 & TP3 of the proposed Sludge Thickener position, gravel material was encounter. The side walls of the three abovementioned test pits had a potential of collapsing due to the coarse material found.

The test pits were profiled in accordance with the standard method of profiling recommended by the Guidelines for Soil and Rock Logging in South Africa. The test pit profiling is presented as Annexure A.

Table 1 below gives the co-ordinates of the test pits profiled at uMzimkhulu Bulk Water Augmentation Scheme Project.

TABLE 1

STRUCTURE	Y CO-ORD	X CO-ORD
Balancing Tank	58 118.723	3 401 796.305
Centrifuge Building	58 121.352	3 401 766.987
Grit Removal	58 125.274	3 401 812.625
Guard House	58 006.167	3 401 746.018
Sludge Thickener	58 135.553	3 401 777.499

Dynamic Cone Penetration Testing (DCP)

The DCP tests were conducted adjacent to the above-mentioned test pit areas. The DCP tests were conducted to a required maximum permissible depth of 1300mm below existing surface. The results are presented as Annexure B.

Table 2 gives an indication of the consistency of the non-cohesive and cohesive soils according to the DCP results. It should be noted that the results are specific to our testing equipment and should be used with caution as it is only provided as a guideline.

TABLE 2
Consistencies of Cohesive and Non-Cohesive Soils

COHESIVE SOILS CLAYEY SANDS		NON-COHESIVE SOILS SANDY COLLUVIUM	
No. of blows/300mm	**Consistency**	**No. of blows/300mm**	**Consistency**
0 - 4	Very Soft	0 – 7	Very Loose
4 - 7	Soft	7 – 18	Loose
8 - 14	Firm	19 – 54	Medium Dense
15 - 28	Stiff	55 – 90	Dense
29 - 54	Very Stiff	>90	Very Dense
>54	Hard		

Material Sampling

Representative disturbed samples were retrieved from the test pits excavated. The samples were taken to Shenge Soils' Testing Lab for full indicator analysis and material classification which included the following tests:

- Particle size distribution / grading,
- Mechanical analysis,
- Determination of the atterberg limits,
- Moisture Density Relationship and
- California Bearing Ratio Analysis.

The laboratory soil test results are reported as Annexure C.

iv. GEOTECHNICAL CONSIDERATIONS

Excavatability

In terms of SANS 1200DA

'Soft excavation' shall be excavation in material that can be efficiently removed and loaded without prior ripping.

'Intermediate excavation' shall be excavation (excluding soft excavation) in material that can be efficiently ripped.

'Hard rock excavation' shall be excavation in material that cannot be efficiently removed without blasting or without wedging and splitting before removal.
Table 3 below gives the excavatability of the materials encountered at certain depths.

TABLE 3

TEST SPOT NR	DEPTH (mm)	EXCAVATABILITY	MATERIAL DESCRIPTION (as per DCP results)
Balancing Tank – TS1	0 – 1380	Intermediate Excavation	Medium Dense to Very Dense Material
Balancing Tank – TS2	0 – 370	Soft Excavation	Loose Material
	370 – 1512	Intermediate Excavation	Medium Dense to Dense Material
Balancing Tank – TS3	0 – 130	Intermediate Excavation	Medium Dense to Very Dense Material
	130 >	Hard Rock Excavation	Very Dense Material
Balancing Tank – TS4	0 – 590	Intermediate Excavation	Medium Dense to Very Dense Material
	590 >	Hard Rock Excavation	Very Dense Material
Balancing Tank – TS5	0 – 1610	Intermediate Excavation	Medium Dense to Dense Material
Facility Building – TS1	0 – 160	Intermediate Excavation	Medium Dense to Very Dense Material
	160 >	Hard Rock Excavation	Very Dense Material
Facility Building – TS2	0 – 295	Intermediate Excavation	Medium Dense to Dense Material
	295 – 820	Soft Excavation	Loose Material
	820 – 1510	Intermediate Excavation	Medium Dense to Dense Material
Facility Building – TS3	0 – 290	Intermediate Excavation	Medium Dense to Dense Material
	290 – 1120	Soft Excavation	Loose Material
	1120 – 1426	Intermediate Excavation	Medium Dense Material
Gravity Thickener – TS1	0 – 160	Intermediate Excavation	Medium Dense to Very Dense Material
	160 >	Hard Rock Excavation	Very Dense Material
Gravity Thickener – TS2	0 – 295	Intermediate Excavation	Medium Dense to Dense Material
	295 – 820	Soft Excavation	Loose Material
	820 – 1450	Intermediate Excavation	Medium Dense to Dense Material
Gravity Thickener – TS3	0 – 290	Intermediate Excavation	Medium Dense to Dense Material
	290 – 1120	Soft Excavation	Loose Material
	1120 – 1382	Intermediate Excavation	Medium Dense Material
Grit Removal – TS1	0 – 270	Intermediate Excavation	Medium Dense to Very Dense Material
	270 >	Hard Rock Excavation	Very Dense Material
Grit Removal – TS2	0 – 430	Intermediate Excavation	Medium Dense to Very Dense Material
	430 >	Hard Rock Excavation	Very Dense Material
Grit Removal – TS3	0 – 385	Intermediate Excavation	Medium Dense to Dense Material
	385 >	Hard Rock Excavation	Very Dense Material
Grit Removal – TS4	0 – 260	Intermediate Excavation	Medium Dense to Dense Material
	260 >	Hard Rock Excavation	Very Dense Material

TEST SPOT NR	DEPTH (mm)	EXCAVATABILITY	MATERIAL DESCRIPTION (as per DCP results)
Grit Removal – TS5	0 – 340	Intermediate Excavation	Medium Dense to Dense Material
	340 >	Hard Rock Excavation	Very Dense Material
Guard House – TS1	0 – 385	Intermediate Excavation	Medium Dense Material
	385 – 1425	Soft Excavation	Loose Material
Guard House – TS2	0 – 185	Intermediate Excavation	Medium Dense to Very Dense Material
	185 >	Hard Rock Excavation	Very Dense Material
Guard House – TS3	0 – 1480	Soft Excavation	Loose Material
Guard House – TS4	0 – 1450	Intermediate Excavation	Medium Dense Material
Guard House – TS5	0 – 1400	Soft Excavation	Medium Dense to Loose Material
Sludge Thickener – TS3	0 – 170	Intermediate Excavation	Medium Dense to Very Dense Material
	170 >	Hard Rock Excavation	Very Dense Material
Sludge Thickener – TS4	0 – 103	Intermediate Excavation	Medium Dense to Very Dense Material
	103 >	Hard Rock Excavation	Very Dense Material
Sludge Thickener – TS5	0 – 170	Intermediate Excavation	Medium Dense to Very Dense Material
	170 >	Hard Rock Excavation	Very Dense Material
Sludge Thickener – TS6	0 – 210	Intermediate Excavation	Medium Dense to Very Dense Material
	210 >	Hard Rock Excavation	Very Dense Material
Sludge Thickener – TS7	0 – 130	Intermediate Excavation	Medium Dense to Dense Material
	130 >	Hard Rock Excavation	Very Dense Material
Sludge Thickener – TS8	0 – 300	Intermediate Excavation	Medium Dense to Dense Material
	300 >	Hard Rock Excavation	Very Dense Material
Sludge Thickener – TS9	0 – 295	Intermediate Excavation	Medium Dense to Dense Material
	295 >	Hard Rock Excavation	Very Dense Material

Subsurface Water Conditions

Subsurface Water

At the time of the investigation, subsurface water seepage was not encountered in any of the Test Pits. (Refer to Annexure A & D). Table 4 below contains the moisture conditions that were encountered in all the test pits that were investigated.

TABLE 4

TP No	WET	VERY MOIST	MOIST	SLIGHTLY MOIST	DRY
Balancing Tank – TP1				✓	
Balancing Tank – TP2				✓	
Centrifuge Building – TP1				✓	
Centrifuge Building – TP2				✓	
Centrifuge Building – TP3				✓	
Grit Removal – TP1				✓	
Grit Removal – TP2				✓	
Guard House – TP1			✓		
Guard House – TP2			✓		
Sludge Thickener – TP1				✓	
Sludge Thickener – TP2					✓
Sludge Thickener – TP3					✓
Sludge Thickener – TP4					✓

Existing Layer Conditions

In order to assess more accurately the engineering properties of the various materials encountered on site and to provide information on their class, the extracted samples underwent laboratory testing. The following results were obtained from the retrieved disturbed samples of the test pits that were investigated. The pertinent test parameters are summarised and the soils classified in terms of the TRH 14 Guidelines for Construction Materials. These are as follows:

TABLE 5

TP	MAT. DEPTH (mm)	SHORT MATERIAL DESCRIPTION	GM	% SILT & CLAY	% LL	% PI	% MC	CBR DATA	MOD (kg/m^3)	TRH14 CLASS
Balancing Tank – TP1	500 – 1400	Lt Yellow Orange Gravel with Shale	2.43	26.8	34.8	16.2	-	-	-	-
Centrifuge Building – TP1	0 – 900	Lt Brown Gravel with Boulders	2.67	22.2	26.6	8.4	7.3	15 @ 93%	2194	G7
Centrifuge Building – TP2	0 – 800 800 – 1400	Lt Brown Gravel with Boulders. Blue, Brown Silty Sand with Gravel	2.57 2.67	34.2 25.6	28.4 28.9	9.0 9.9	- -	- -	- -	- -
Grit Removal – TP2	200 – 900	Lt Yellow Orange Cobbles and Gravel	2.60	23.6	28.1	9.5	-	-	-	-
Guard House – TP1	900 – 1500	Lt Yellow Orange Sandy Gravel	2.43	31.7	37.0	17.7	-	-	-	-
Sludge Thickener – TP1	200 – 500	Lt Brown Cobbles and Gravel	2.61	27.0	28.7	9.5	8.6	14 @ 93%	2103	G8
Sludge Thickener – TP3	150 – 850	Lt Brown Cobbles	2.69	16.3	26.6	7.8	-	-	-	-

GM – Grading Modulus
LL – Liquid Limit
PI – Plasticity Index
MOD – Moisture Density relationship
Br – Brown
CBR – California Bearing Ratio
N/P – Non-Plastic
S/P – Slightly-Plastic
MC – Moisture Content
Lt – Light

Table 6 below has the summarised hydrometer readings

TABLE 6

TP	MAT. DEPTH (mm)	SHORT MATERIAL DESCRIPTION	% SILT & CLAY	% LL	% PI	% MC	RELATIVE DENSITY (kg/m^3)	GROUP INDEX
Balancing Tank – TP2	500 – 1300	Lt Yellow Orange with Shale	12 & 23	26.0	9.0	8.5	2.515	A-6
Centrifuge Building – TP1	900 – 1600	Lt Brown Gravel with Boulders	8 & 7	28.0	12.0	10.0	2.589	A-2-6
Centrifuge Building – TP3	300 – 1500	Lt Yellow Orange Gravel with Shale	15 & 31	29.0	12.0	9.0	2.536	A-6
Grit Removal – TP1	150 – 600	Lt Brown Cobbles and Gravel	8 & 8	27.0	11.0	9.6	2.587	A-2-6

TP	MAT. DEPTH (mm)	SHORT MATERIAL DESCRIPTION	% SILT & CLAY	% LL	% PI	% MC	RELATIVE DENSITY (kg/m^3)	GROUP INDEX
Guard House – TP2	1000 -1400	Lt Yellow Orange Sandy Gravel	13 & 28	28.0	11.0	8.8	2.524	A-6
Sludge Thickener – TP2	200 – 900	Lt Brown Cobbles and Gravel	8 & 5	26.0	12.0	8.5	2.546	A-2-6
Sludge Thickener – TP4	250 – 1500	Blue, Yellow Sandy Gravel	10 & 7	28.0	12.0	8.7	2.550	A-2-6

Existing Layer Assessment

The test pits were investigated, and the materials were classified according to the TRH14 Manual through laboratory testing. Table 7 below identifies the test pits where the materials can be considered for re-use by the engineer as backfilling material.

TABLE 7

TP No	MATERIAL DEPTH (mm)	POSSIBLE RE-USE AS SELECTED LAYER MATERIAL
Centrifuge Building – TP1	0 – 900	✓
Centrifuge Building – TP2	0 – 800	✓
Sludge Thickener – TP3	150 – 850	✓

The table below identifies the test pits where the materials can be consider for re-use by the engineer as backfill material (on top of granular material) to pipelines.

TABLE 8

TP No	MATERIAL DEPTH (mm)	BEDDING MATERIAL	BLANKET MATERIAL
Guard House – TP1	0 – 1500		✓

Foundation Considerations

Having investigated the Test Pits and classified the material according to the TRH 14 Manual through laboratory testing. The site classes for single storey residential structures as per the NHBRC Manual are indicated on table 9 below. We advise that the structural engineer assess and consider designing the foundation according to recommendations below. Founding footings depths were estimated to be at a depth of between 800mm – 1300mm.

TABLE 9

TP/SITE NR	SITE CLASS	CHARACTER OF FOUNDING MATERIAL	MATERIAL DESCRIPTION	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES
Balancing Tank	H2	Expensive soils	Clayey soils that are subjected to expansion	Soil raft	Remove all or necessary parts of expansive horizon to 1.0m beyond the perimeter of the building and replace with inert backfill compacted to 93% MOD AASHTO density at -1% to 2% of optimum moisture content. Normal construction with reinforced strip footing.
Centrifuge Building	H2	Expensive soils	Clayey soils that are subjected to expansion	Soil raft	Remove all or necessary parts of expansive horizon to 1.0m beyond the perimeter of the building and replace with inert backfill compacted to 93% MOD AASHTO density at -1% to 2% of optimum moisture content. Normal construction with reinforced strip footing.
Grit Removal	C1	Compressible & Potentially Collapsible Soil	Soils are subjected to consolidation and collapse settlement	Soil raft	Remove insitu material to 1.0m beyond the perimeters of the structure to a depth of 1.5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at -1% to 2% of optimum moisture content. Normal construction with reinforced strip footing.
Guard House	C1	Compressible & Potentially Collapsible Soil	Soils are subjected to consolidation and collapse settlement	Soil raft	Remove insitu material to 1.0m beyond the perimeters of the structure to a depth of 1.5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at -1% to 2% of optimum moisture content. Normal construction with reinforced strip footing.
Sludge Thickener	C1	Compressible & Potentially Collapsible Soil	Soils are subjected to consolidation and collapse settlement	Soil raft	Remove insitu material to 1.0m beyond the perimeters of the structure to a depth of 1.5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at -1% to 2% of optimum moisture content. Normal construction with reinforced strip footing.

v. GEOLOGY

According to the 3030 Port Shepstone cartography, 1:250 000 Geological Map Series, the general area within which the site is located is underlain by the Ecca Group Shale and Sandstone. The sediments that the area is underlain by belongs to the Karoo Supergroup that is estimated to be 180 – 300 million years. This was verified by the presence of Shale in some of the test pits examined.

The area is classified as having a climatic N-value which is below 5. This indicates that the area is a humid climatic region with chemical weathering being the main form of weathering.

vi. CONCLUSION

The investigation undertaken has established the various founding conditions and material types that are likely to be encountered during construction. The test spots were assessed of the likely material to be encountered and their mechanical properties. The subsurface profiles encountered in the test pits were relatively consistent.

The encountered materials, during excavation on site, were stable. This was shown by the non-collapse of the test pit sidewalls during excavations. However, it must be noted that all excavations exceeding 1.5m must adhere to the safety regulations and must receive adequate shoring or battering. The areas that will require more emphasis on shoring are the proposed Grit Removal and Sludge Thickener structure areas. Generally, intermediate to hard excavations may be anticipated. Consideration should be given to using the following percentages for classification of excavations to a maximum depth of 1300mm:

SOFT Excavation 18%
INTERMEDIATE Excavation 37%
HARD ROCK Excavation 45%

DCP test results were used as a guide to determine the excavation conditions. The above anticipated / prevalent excavation conditions should be used as estimates only. Table 3 shows the anticipated excavation conditions at a particular depth adjacent to each test pit.

Moist conditions were primarily encountered at the bottom of the proposed Guard House test pits. Slightly moist conditions were encountered at the bottom of the Proposed Balancing Tank, Centrifuge Building and Grit Removal test pits. Dry conditions were found at the proposed Sludge Thickener test pits. Although the conditions encountered in the test pits generally do not require subsurface drainage measures at the depths examined, they should nonetheless be considered due to the structure being constructed water containing structure where water spillage is anticipated. Surface drainage measures are required as general practice to divert surface runoff from structures. Moderate moisture content was found in the material extracted from most of the test pits.

According to Table 7, material extracted from TP1 and TP2 of the proposed Centrifuge Building area and TP3 of the proposed Sludge Thickener area possessed material that can possibly be used as selected material. Table 8 shows test pit that possessed

material that can possibly be used as fill material above granular material during pipeline construction. This material is located around TP1 of the proposed Guard House area. The anticipated depth below the surface and thickness of these re-usable materials are displayed on Table 7 & 8. It must be mentioned that these materials should be periodically tested during usage in order to verify their class and acceptability.

Table 9 advises on the removal of unsuitable in-situ material and/or expensive horizon under Foundation Design and Building Procedures. The unsuitable in-situ materials and/or expensive horizon below the founding depth should be removed and replaced with gravel materials that possess G5 or G6 quality.

Please note that the above site classifications are not intended for dolomitic areas. We hope that this report meets your requirements. Please do not hesitate to contact the author should you have any queries.

Kindest Regards

vii. REFERENCES

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	-
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Balancing Tank (TP1)**
Coordinates	**Y 58 118.723, X 3 401 796.305**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description: Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ	0 - 500	Slightly moist, dusky blue with light yellowish orange particles, medium dense, intact, silty sand	Transported hill wash
= = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o	500 - 1400	Slightly moist, light yellowish orange, dense, stratified, tightly packed gravel with shale	Residual

Remarks: hole stopped @ 1400 mm (Rock, Pebble marker), disturbed sample was taken between 500 mm and 1400 mm, topsoil With some roots.

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Balancing Tank (TP2)**
Coordinates	**Y 58 118.723, X 3 401 796.305**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description: Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
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= = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o = = = = = = = = = = = o o o o o o o o o - - - - - - - - - - -	500 - 1300	Slightly moist, light yellowish orange, dense, stratified, tightly packed gravel with shale	Residual

Remarks: hole stopped @ 1300 mm, disturbed sample was taken between 500 mm and 1300 mm, topsoil with some roots.

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Cell: 062 947 1072

Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Centrifuge Building (TP1)**
Coordinates	**Y 58 121.352 X 3 401 766.987**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description: Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
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= = = = = = = = = = = o o o o o o o o = = = = = = = = = = = o o o o o o o o = = = = = = = = = = = o o o o o o o o = = = = = = = = = = = o o o o o o o o = = = = = = = = = = = o o o o o o o o = = = = = = = = = = = o o o o o o o o	900 - 1600	Slightly moist, dusky blue, medium dense, intact, silt sand with gravel	Residual

Remarks: hole was stopped @ 1600 mm, disturbed sample was taken between 900 mm and 1600 mm

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	-
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Centrifuge Building (TP2)**
Coordinates	**Y 58 121.352 X 3 401 766.987**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description: Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ ο ο ο ο ο ο ο ο ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ ο ο ο ο ο ο ο ο ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ ο ο ο ο ο ο ο ο ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ ο ο ο ο ο ο ο ο ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ ο ο ο ο ο ο ο ο ο ο ο ο ο ο ο ο ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ ο ο ο ο ο ο ο ο ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ ο ο ο ο ο ο ο ο	0 – 800	Slightly moist, light brown, medium dense, stratified, gravel with boulders and some concrete pieces	Transported (hauling from the hill)
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Remarks: hole was stopped @ 1400 mm, disturbed sample was taken between 800 mm and 1400 mm

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	-
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Centrifuge Building (TP3)**
Coordinates	**Y 58 121.352 X 3 401 766.987**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description: Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
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Remarks: hole was stopped @ 1500 mm, disturbed sample was taken between 300 mm and 1500 mm

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Grit Removal (TP1)**
Coordinates	**Y 58 125.274, X 3 401 812.625**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description: Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o	0 - 150	Slightly moist, light brow, medium dense, intact, silty sand	Transported hill wash
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Remarks: hole refused @ 600 mm, disturbed sample was taken between 150 mm and 600 mm, topsoil with vegetation.

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Grit Removal (TP2)**
Coordinates	**Y 58 125.274, X 3 401 812.625**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description: Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ	0 - 200	Slightly moist, light brow, medium dense, intact, silty sand	Transported hill wash
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Remarks: hole refused @ 900 mm, disturbed sample was taken between 200 mm and 900 mm, topsoil with vegetation.

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Guard House (TP1)**
Coordinates	**Y 58 006.167, X 3 401 746.018**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o ϕ ϕ ϕ ϕ ϕ ϕ ϕ ϕ o o o o o o o o	0 - 900	Moist, dusky blue, firm, intact, silty sand	Transported hill wash
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Remarks: hole was stopped @ 1500 mm, disturbed sample was taken between 900 mm and 1500 mm, topsoil

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With vegetation.

Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	-
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Guard House (TP2)**
Coordinates	**Y 58 006.167, X 3 401 746.018**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	Origin (Residual & Transported)
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Remarks: hole was stopped @ 1400 mm, disturbed sample was taken between 1000 mm and 1400 mm, topsoil with vegetation.

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Slidge Thickner (TP1)**
Coordinates	**Y 58 135.553, X 3 401 777.499**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description	Origin (Residual & Transported)
		Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	
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Remarks: hole Refused @ 500 mm, disturbed sample was taken between 200 mm and 500 mm, above 200 mm topsoil with vegetation.

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Slidge Thickner (TP2)**
Coordinates	**Y 58 135.553, X 3 401 777.499**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description	Origin (Residual & Transported)
		Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	
ϕ ϕ ϕ

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Slidge Thickner (TP3)**
Coordinates	**Y 58 135.553, X 3 401 777.499**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description	Origin (Residual & Transported)
		Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	
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Remarks: hole Refused @ 850 mm, disturbed sample was taken between 150 mm and 850 mm, above 150 mm topsoil with vegetation.

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Client	**Ugu District Municipality**
Project	**uMzimkhulu bulk Water Augmentation Scheme: Phase 2**
Job Card No.	**-**
Date	**05-09-2022**
Technician	**Mr S.P Sigubudu**
Position	**Slidge Thickner (TP4)**
Coordinates	**Y 58 135.553, X 3 401 777.499**

FIELD SOIL SURVEY TEST REPORT

Soil Legend	Depth (mm)	Description	Origin (Residual & Transported)
		Moisture, Colour, Consistency, Structure, Soil Type (MCCSSO)	
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Remarks: hole was stopped @ 1500 mm, disturbed sample was taken between 250 mm and 1500 mm, above 250 mm topsoil with vegetation.

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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP1
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: BALANCING TANK
GPS (X): 3 401 796.305
)ject Number: 1
Chainage: NORTH
GPS (Y): 58 118.723
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	65	13,0	16	172	G7
5	65	-	95	6,0	45	427	G6
10	95	-	125	6,0	45	427	G6
15	125	-	163	7,6	30	299	G6
20	163	-	197	6,8	35	343	G6
25	197	-	225	5,6	45	427	G5
30	225	-	255	6,0	45	427	G6
35	255	-	280	5,0	55	510	G5
40	280	-	300	4,0	75	670	G5
45	300	-	320	4,0	75	670	G5
50	320	-	338	3,6	75	670	G4
55	338	-	350	2,4	110	939	G4
60	350	-	365	3,0	110	939	G4
65	365	-	382	3,4	75	670	G4
70	382	-	395	2,6	110	939	G4
75	395	-	412	3,4	75	670	G4
80	412	-	430	3,6	75	670	G4
85	430	-	445	3,0	110	939	G4
90	445	-	466	4,2	55	510	G5
95	466	-	485	3,8	75	670	G5
100	485	-	505	4,0	75	670	G5
105	505	-	517	2,4	110	939	G4
110	517	-	535	3,6	75	670	G4
115	535	-	555	4,0	75	670	G5
120	555	-	570	3,0	110	939	G4
125	570	-	590	4,0	75	670	G5
130	590	-	605	3,0	110	939	G4
135	605	-	622	3,4	75	670	G4
140	622	-	635	2,6	110	939	G4
145	635	-	650	3,0	110	939	G4
150	650	-	665	3,0	110	939	G4
155	665	-	680	3,0	110	939	G4
160	680	-	695	3,0	110	939	G4
165	695	-	715	4,0	75	670	G5
170	715	-	735	4,0	75	670	G5
175	735	-	755	4,0	75	670	G5
180	755	-	775	4,0	75	670	G5
185	775	-	795	4,0	75	670	G5
190	795	-	815	4,0	75	670	G5
195	815	-	835	4,0	75	670	G5
200	835	-	855	4,0	75	670	G5

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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP1
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: BALANCING TANK
GPS (X): 3 401 796.305
)ject Number: 1
Chainage: NORTH
GPS (Y): 58 118.723
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
205	855	-	875				G5
210	875	-	895	4,0	75	670	G5
215	895	-	915	4,0	75	670	G5
220	915	-	935	4,0	75	670	G5
225	935	-	955	4,0	75	670	G5
230	955	-	975	4,0	75	670	G5
235	975	-	995	4,0	75	670	G5
240	995	-	1015	4,0	75	670	G5
245	1015	-	1035	4,0	75	670	G5
250	1035	-	1060	5,0	55	510	G5
255	1060	-	1080	4,0	75	670	G5
260	1080	-	1100	4,0	75	670	G5
265	1100	-	1120	4,0	75	670	G5
270	1120	-	1140	4,0	75	670	G5
275	1140	-	1160	4,0	75	670	G5
280	1160	-	1180	4,0	75	670	G5
285	1180	-	1220	8,0	30	299	G6
290	1220	-	1240	4,0	75	670	G5
295	1240	-	1260	4,0	75	670	G5
300	1260	-	1280	4,0	75	670	G5
305	1280	-	1300	4,0	75	670	G5
310	1300	-	1320	4,0	75	670	G5
315	1320	-	1340	4,0	75	670	G5
320	1340	-	1360	4,0	75	670	G5
325	1360	-	1380	4,0	75	670	G5

Remarks:

The required depht is 1,3m and DCP was STOPPED @ 1380 mm

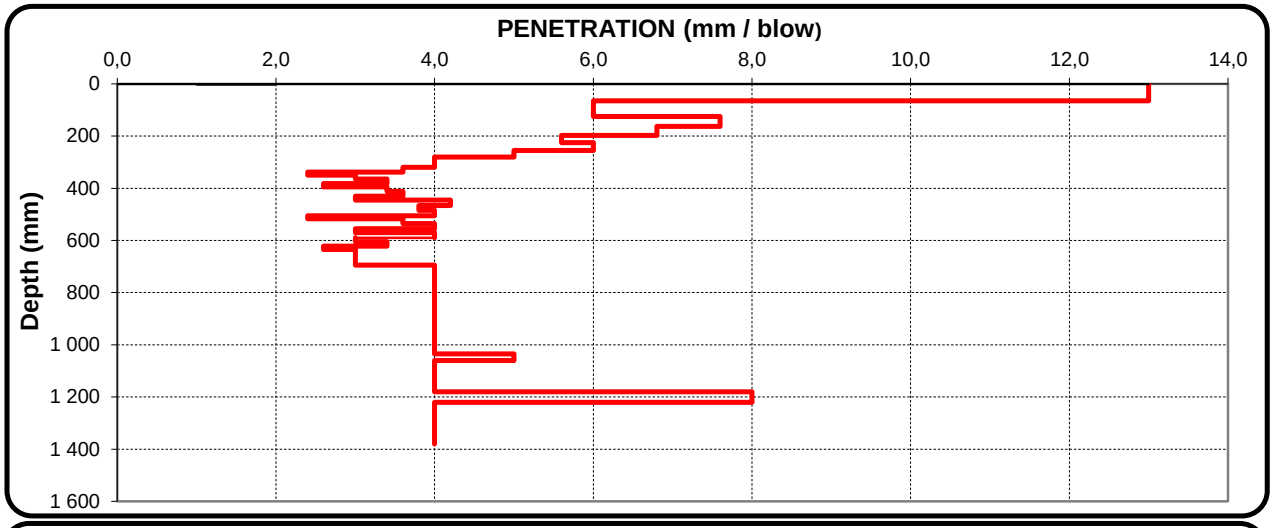
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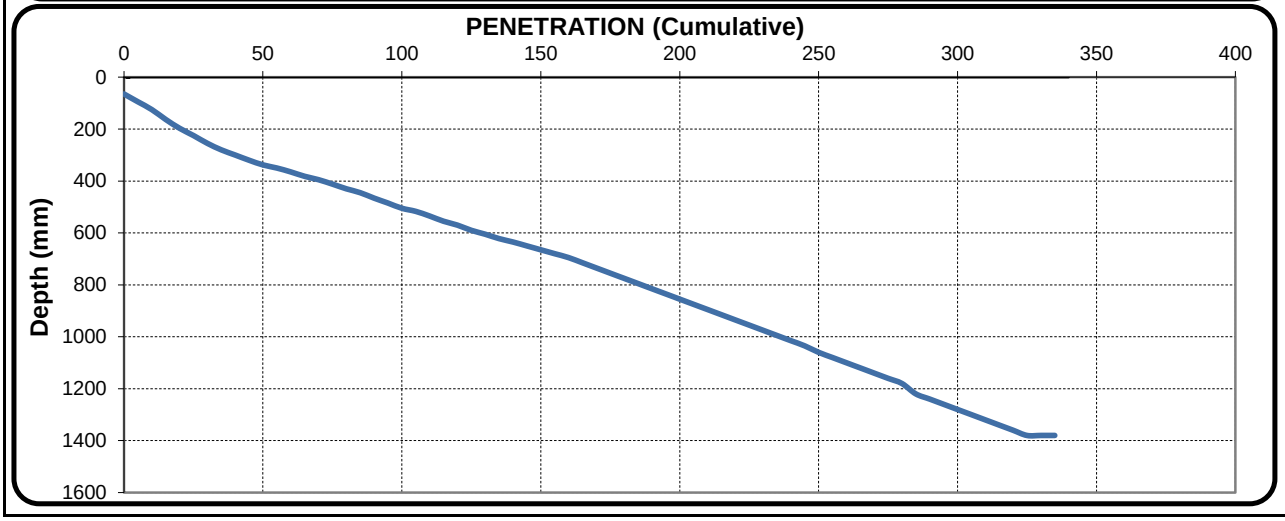
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

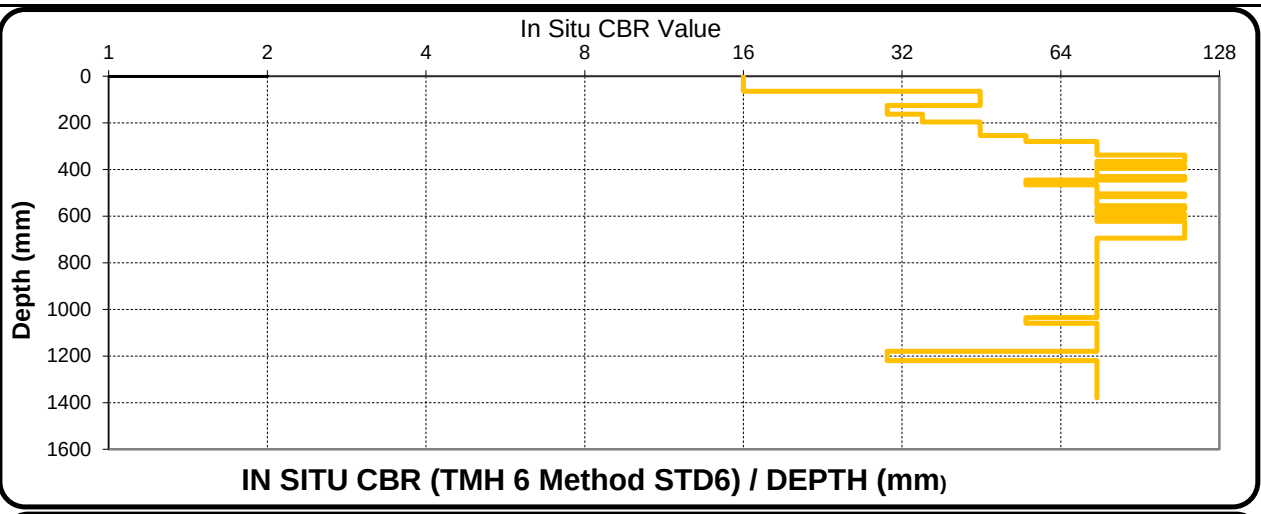




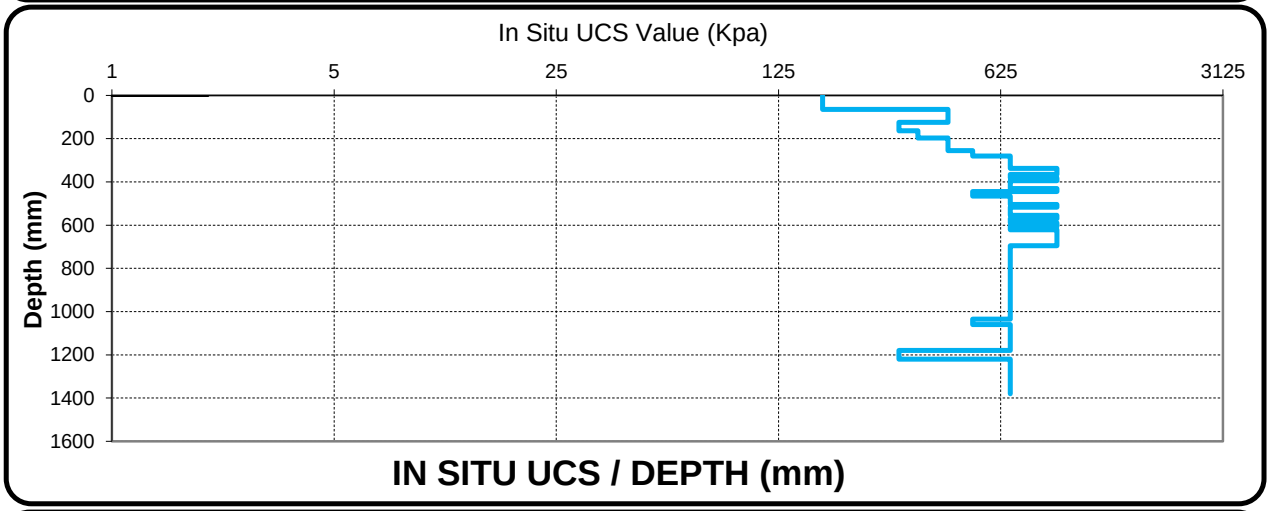
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DYNAMIC CONE PENETROMETER (DCP)

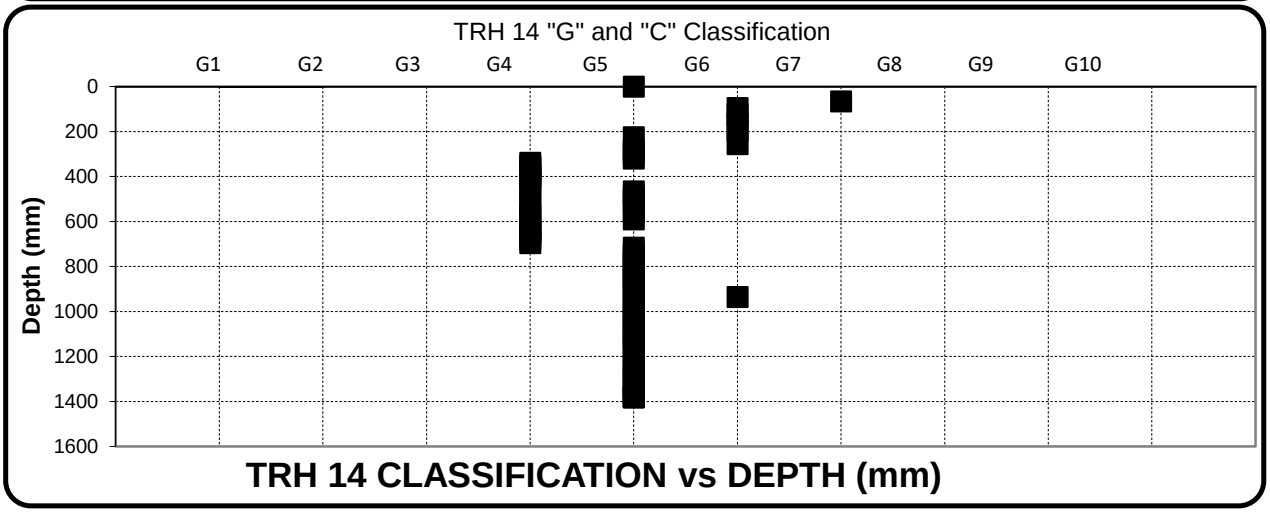
Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP2
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: BALANCING TANK
GPS (X): 3 401 796.305
)ject Number: 1
Chainage: EAST
GPS (Y): 58 118.723
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	95	-	200	21,0	8	93	G9
5	200	-	260	12,0	18	191	G7
10	260	-	325	13,0	16	172	G7
15	325	-	370	9,0	25	255	G6
20	370	-	410	8,0	30	299	G6
25	410	-	445	7,0	35	343	G6
30	445	-	485	8,0	30	299	G6
35	485	-	535	10,0	22	228	G7
40	535	-	590	11,0	20	209	G7
45	590	-	640	10,0	22	228	G7
50	640	-	695	11,0	20	209	G7
55	695	-	740	9,0	25	255	G6
60	740	-	785	9,0	25	255	G6
65	785	-	830	9,0	25	255	G6
70	830	-	860	6,0	45	427	G6
75	860	-	885	5,0	55	510	G5
80	885	-	911	5,2	45	427	G5
85	911	-	930	3,8	75	670	G5
90	930	-	950	4,0	75	670	G5
95	950	-	970	4,0	75	670	G5
100	970	-	995	5,0	55	510	G5
105	995	-	1015	4,0	75	670	G5
110	1015	-	1035	4,0	75	670	G5
115	1035	-	1055	4,0	75	670	G5
120	1055	-	1075	4,0	75	670	G5
125	1075	-	1150	15,0	14	153	G8
130	1150	-	1170	4,0	75	670	G5
135	1170	-	1190	4,0	75	670	G5
140	1190	-	1210	4,0	75	670	G5
145	1210	-	1230	4,0	75	670	G5
150	1230	-	1250	4,0	75	670	G5
155	1250	-	1270	4,0	75	670	G5
160	1270	-	1290	4,0	75	670	G5
165	1290	-	1310	4,0	75	670	G5
170	1310	-	1330	4,0	75	670	G5
175	1330	-	1350	4,0	75	670	G5
180	1350	-	1370	4,0	75	670	G5
185	1370	-	1392	4,4	55	510	G5
190	1392	-	1412	4,0	75	670	G5
195	1412	-	1432	4,0	75	670	G5
200	1432	-	1452	4,0	75	670	G5

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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP2
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: BALANCING TANK
GPS (X): 3 401 796.305
)ject Number: 1
Chainage: EAST
GPS (Y): 58 118.723
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
205	1452	-	1472				G5
210	1472	-	1492	4,0	75	670	G5
215	1492	-	1512	4,0	75	670	G5

Remarks:

The required depht is 1,3m and DCP was STOPPED @ 1512 mm

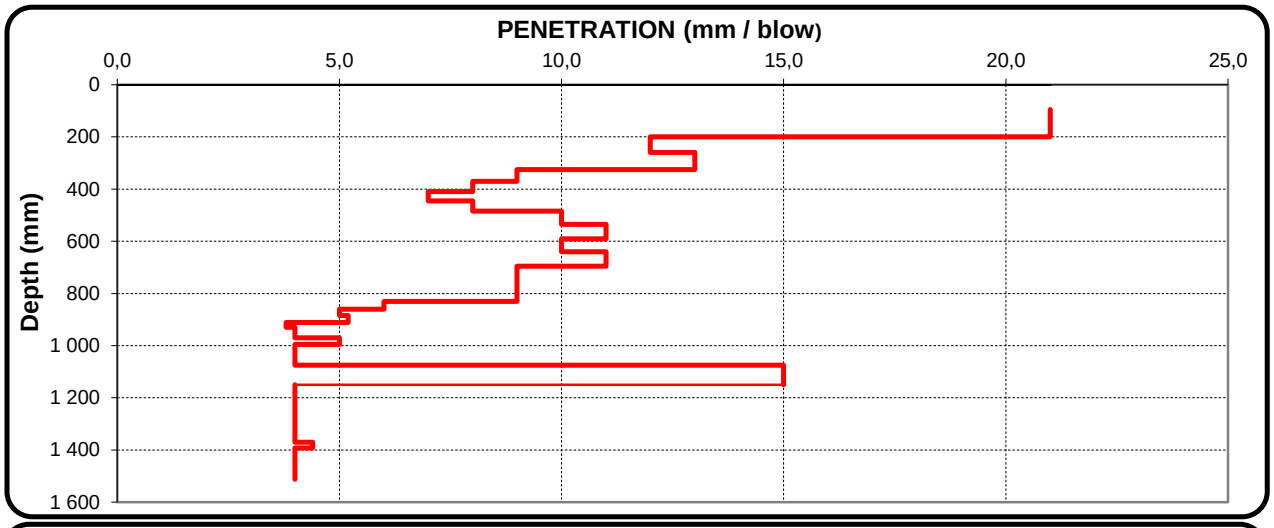
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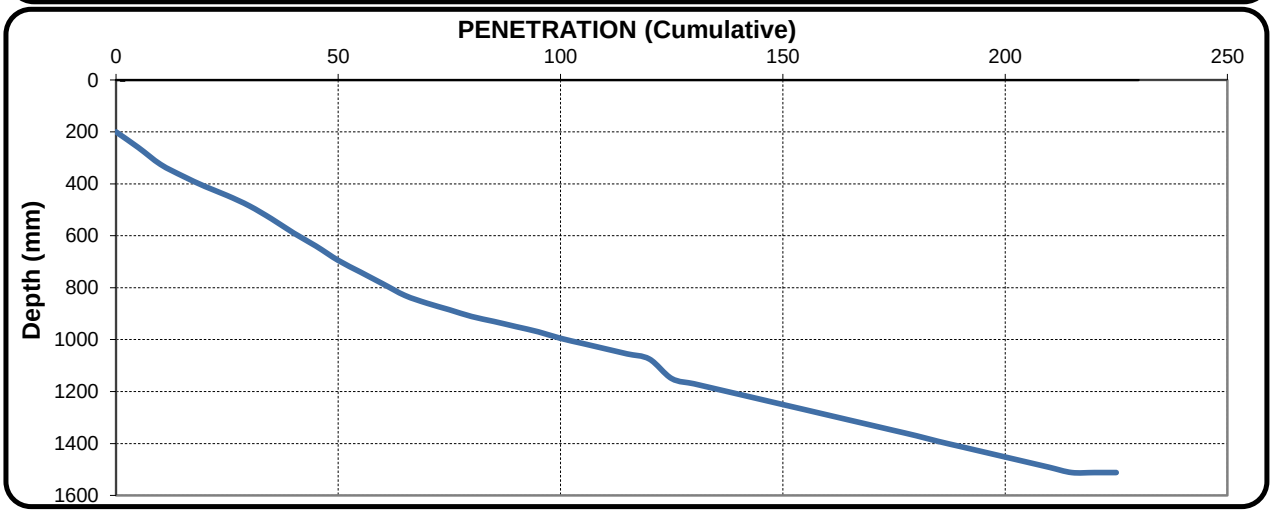
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

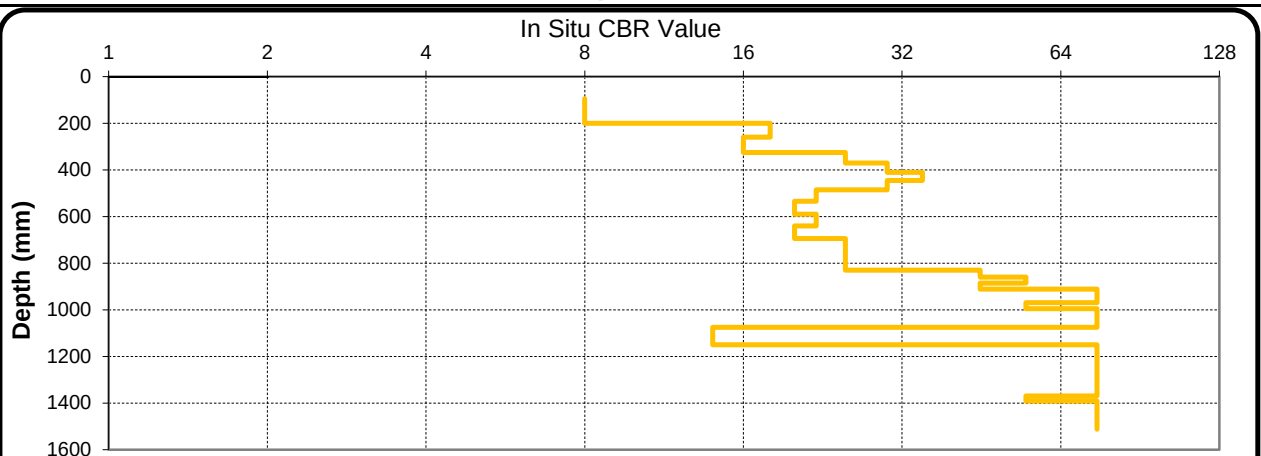




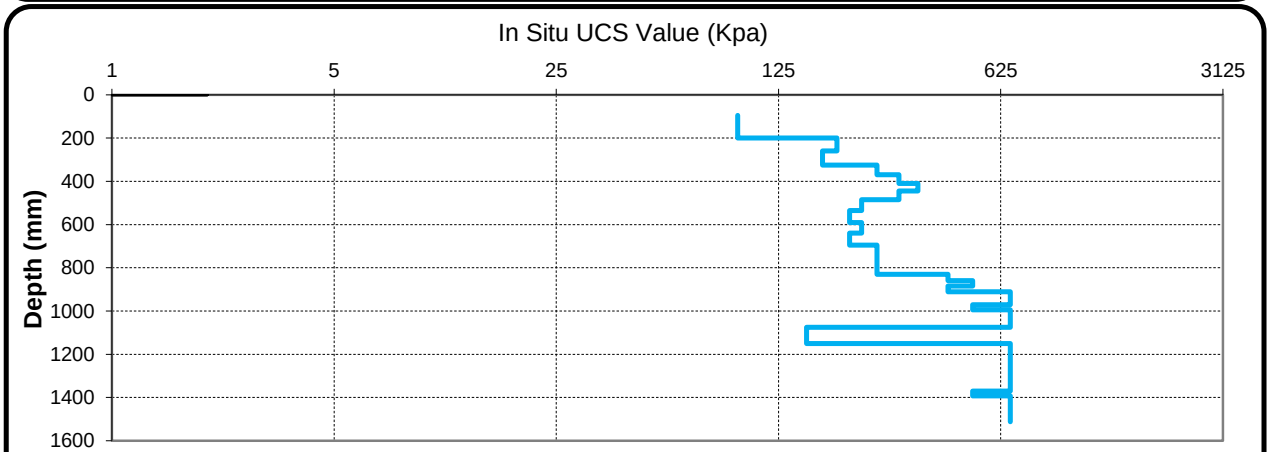
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DYNAMIC CONE PENETROMETER (DCP)

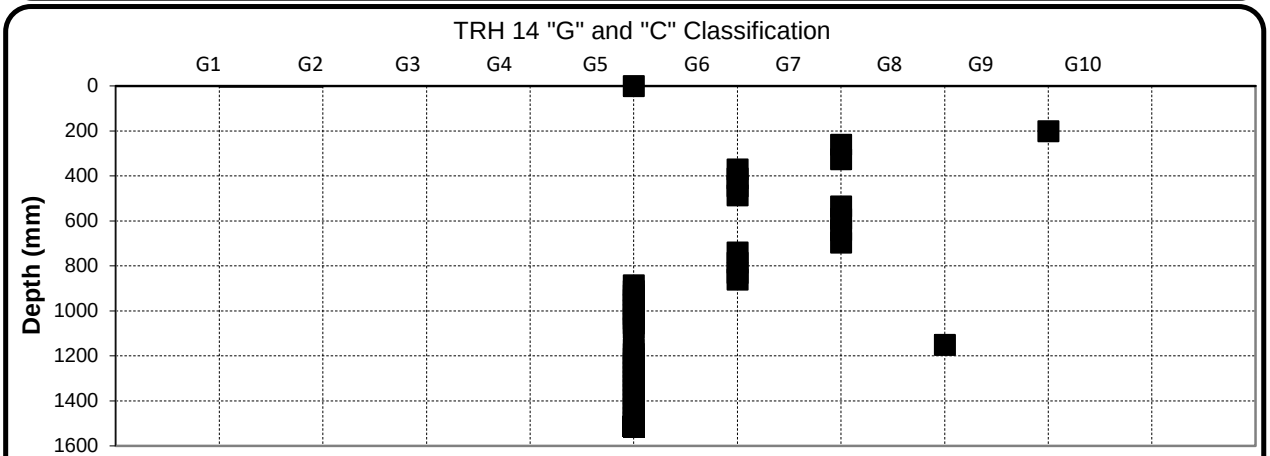
Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
oject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP3
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: BALANCING TANK
GPS (X): 3 401 796.305
)ject Number: 1
Chainage: SOUTH
GPS (Y): 58 118.723
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	15	-	85	14,0	15	163	G8
5	85	-	95	2,0	110	939	G4
10	95	-	105	2,0	110	939	G4
15	105	-	120	3,0	110	939	G4
20	120	-	125	1,0	110	939	G1
25	125	-	130	1,0	110	939	G1

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

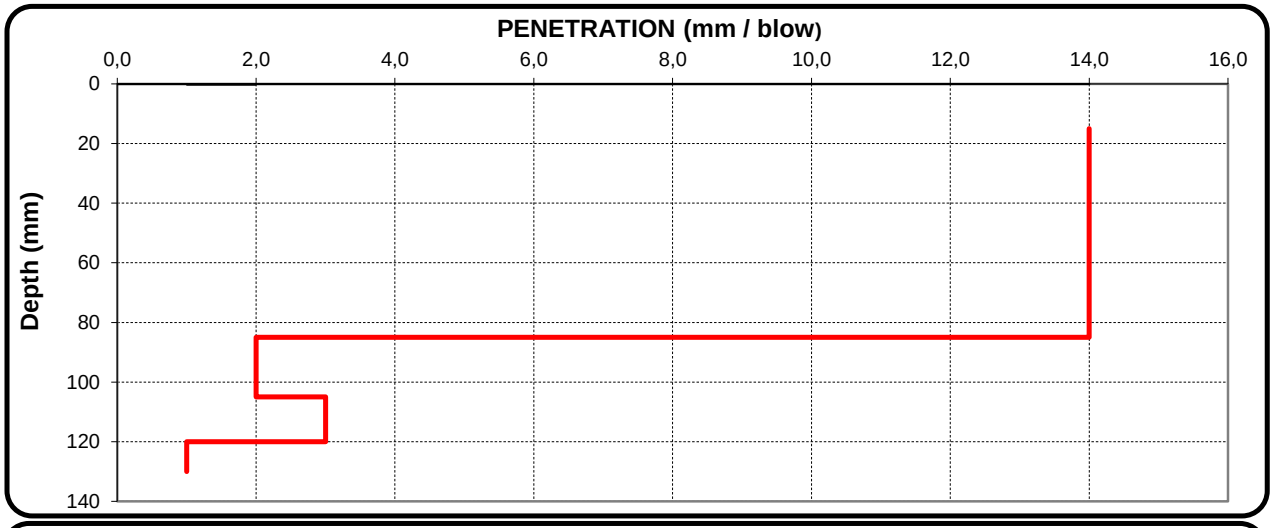
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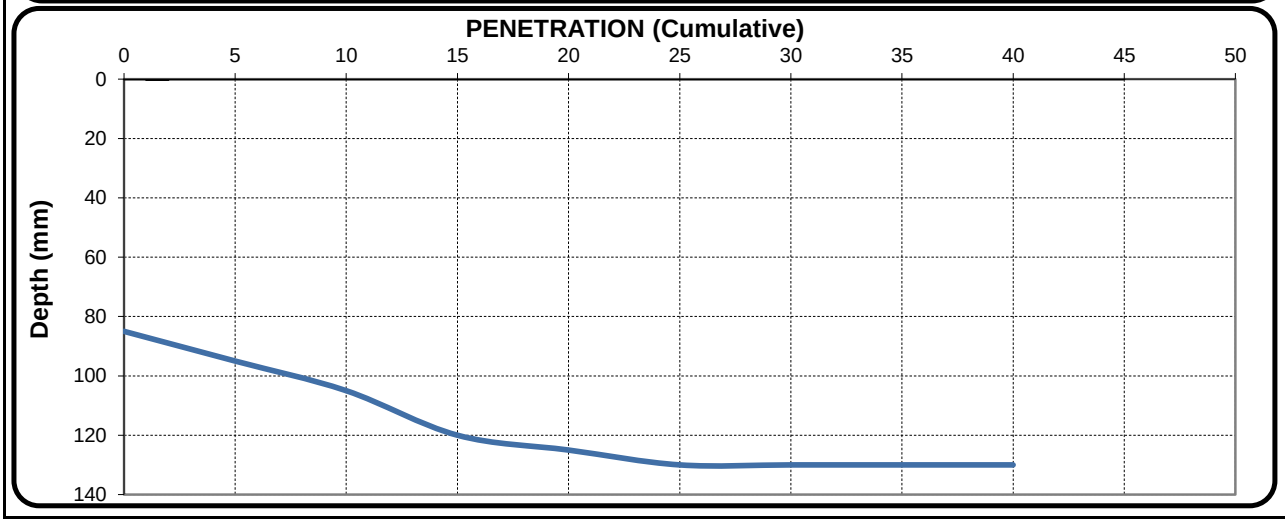
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

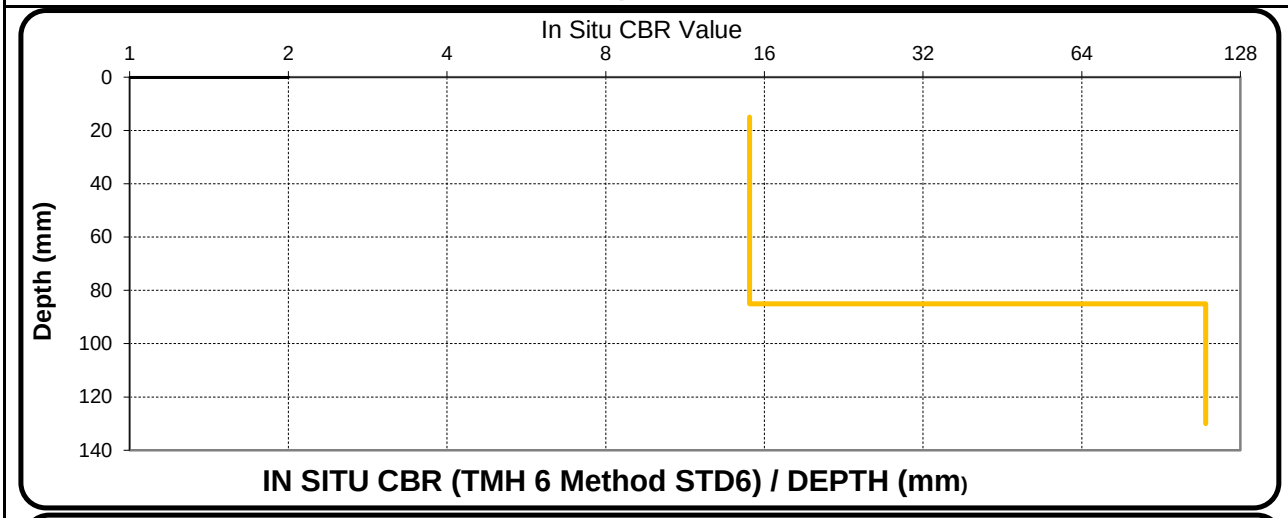




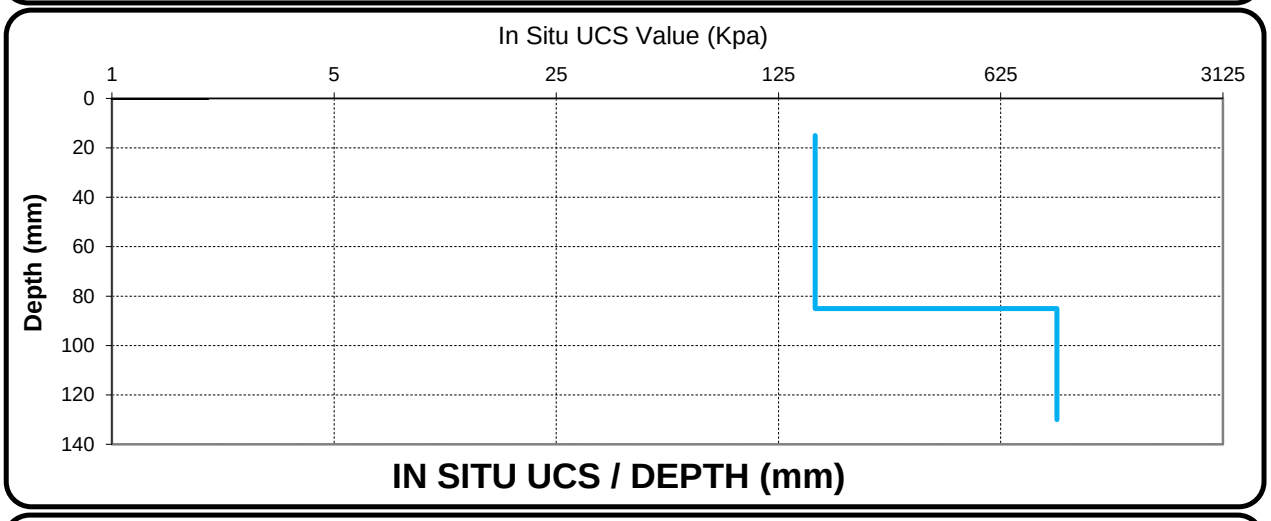
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DYNAMIC CONE PENETROMETER (DCP)

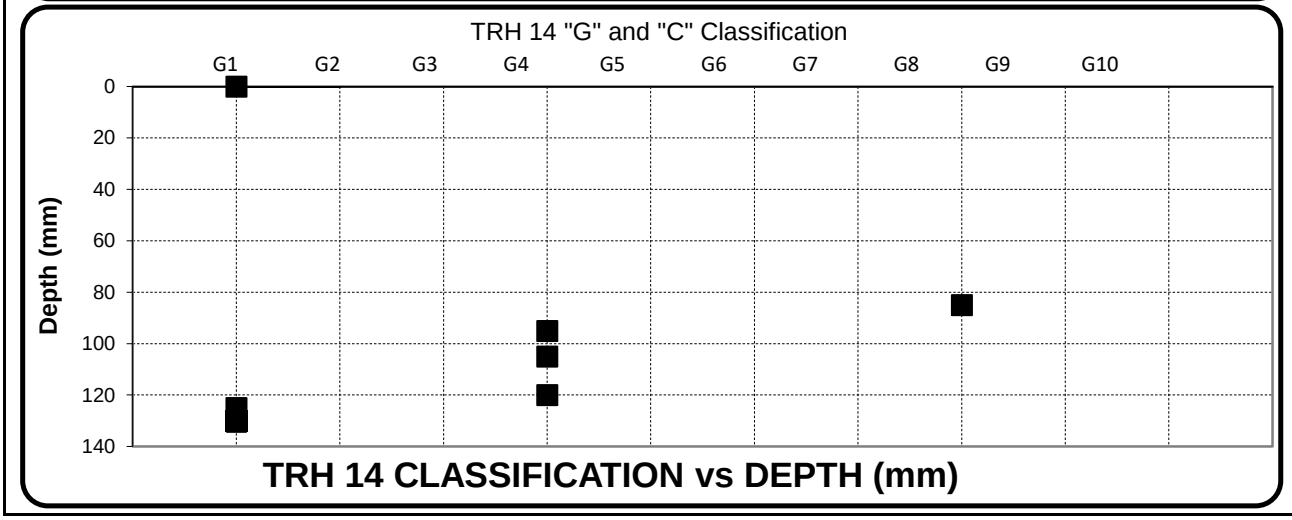
Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP4
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: BALANCING TANK
GPS (X): 3 401 796.305
)ject Number: 1
Chainage: WEST
GPS (Y): 58 118.723
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	90	18,0	11	124	G8
5	90	-	118	5,6	45	427	G5
10	118	-	140	4,4	55	510	G5
15	140	-	165	5,0	55	510	G5
20	165	-	195	6,0	45	427	G6
25	195	-	225	6,0	45	427	G6
30	225	-	247	4,4	55	510	G5
35	247	-	270	4,6	55	510	G5
40	270	-	290	4,0	75	670	G5
45	290	-	310	4,0	75	670	G5
50	310	-	325	3,0	110	939	G4
55	325	-	340	3,0	110	939	G4
60	340	-	355	3,0	110	939	G4
65	355	-	370	3,0	110	939	G4
70	370	-	390	4,0	75	670	G5
75	390	-	406	3,2	75	670	G4
80	406	-	430	4,8	55	510	G5
85	430	-	450	4,0	75	670	G5
90	450	-	470	4,0	75	670	G5
95	470	-	485	3,0	110	939	G4
100	485	-	505	4,0	75	670	G5
105	505	-	515	2,0	110	939	G4
110	515	-	530	3,0	110	939	G4
115	530	-	540	2,0	110	939	G4
120	540	-	550	2,0	110	939	G4
125	550	-	560	2,0	110	939	G4
130	560	-	570	2,0	110	939	G4
135	570	-	580	2,0	110	939	G4
140	580	-	585	1,0	110	939	G1
145	585	-	590	1,0	110	939	G1

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

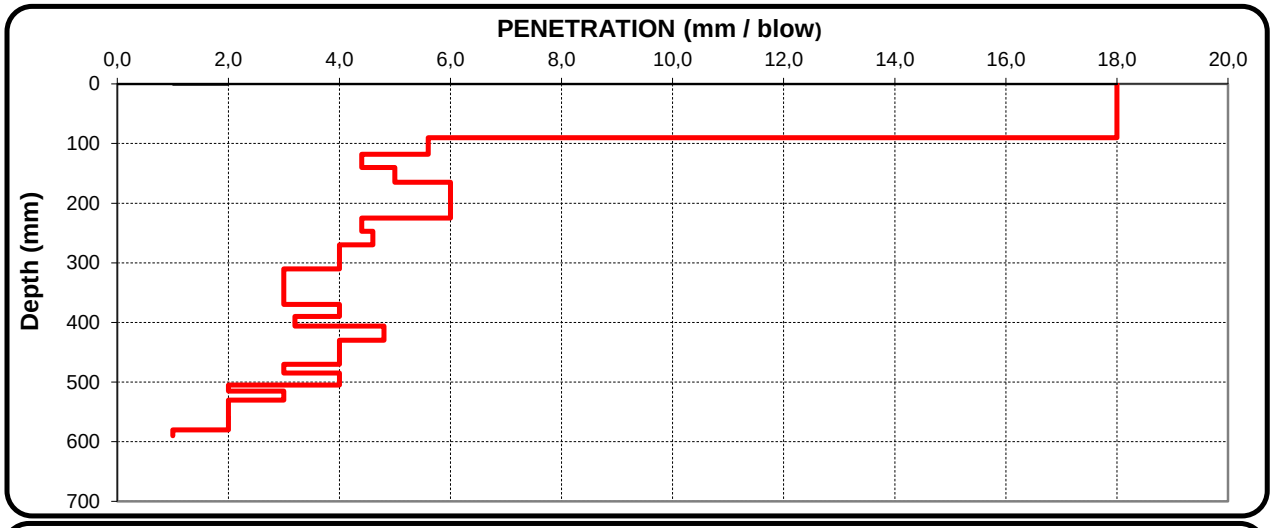
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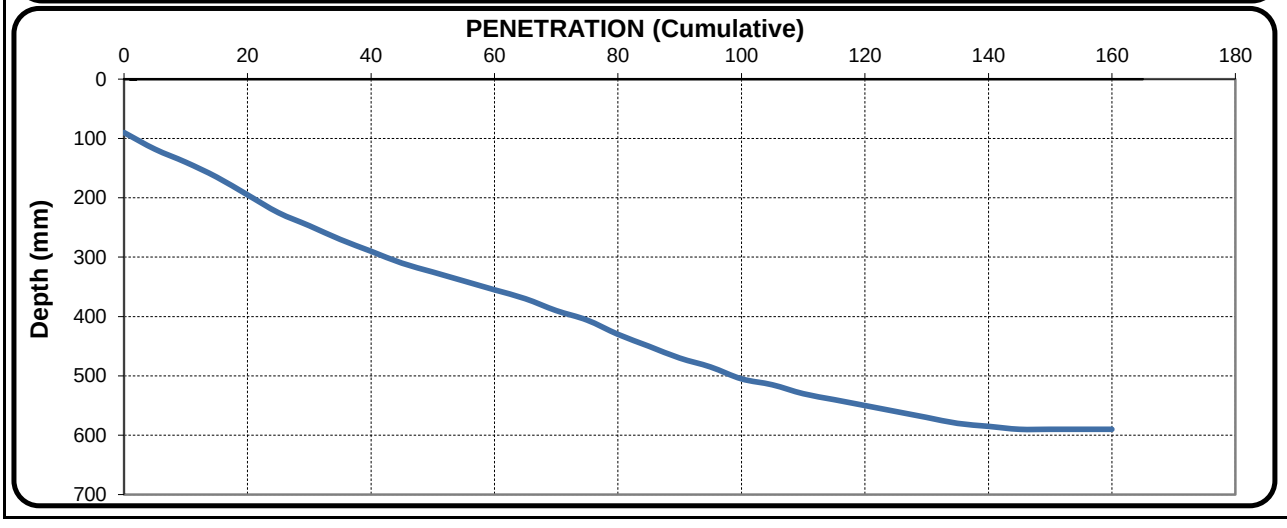
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

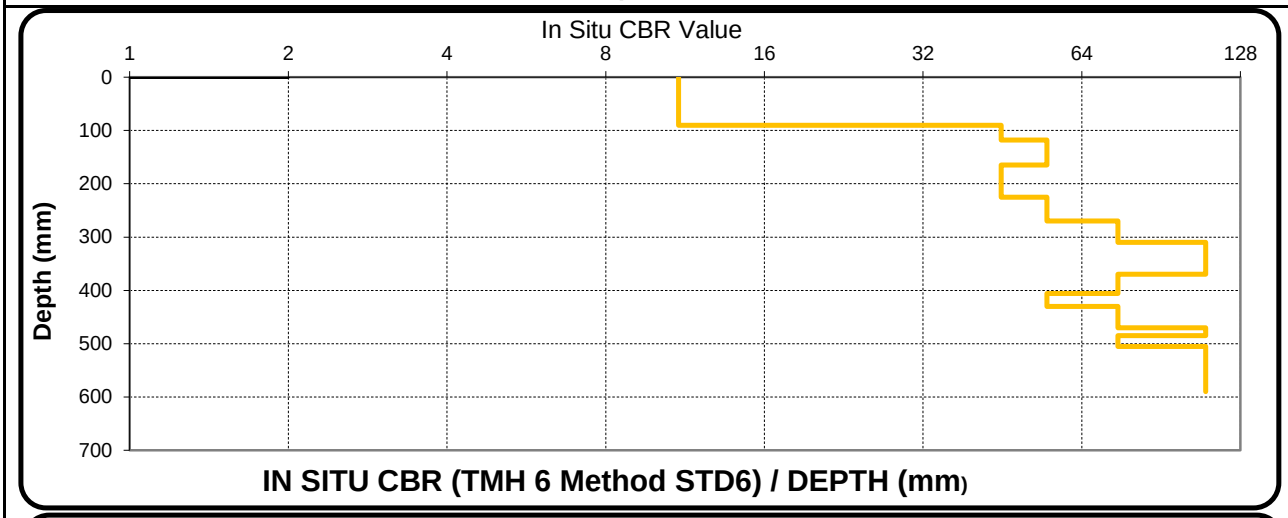




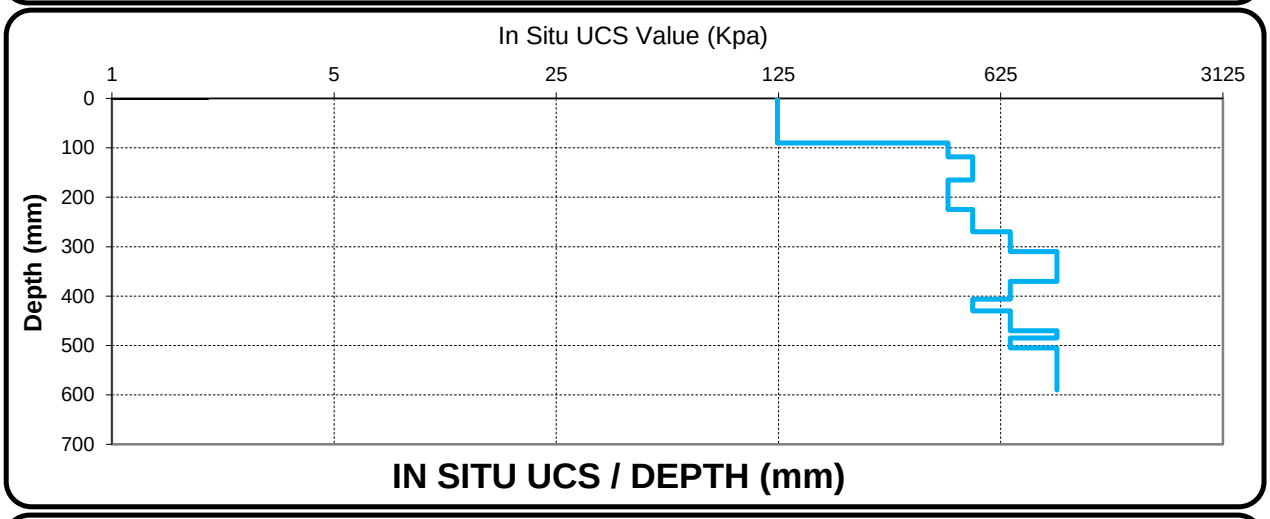
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DYNAMIC CONE PENETROMETER (DCP)

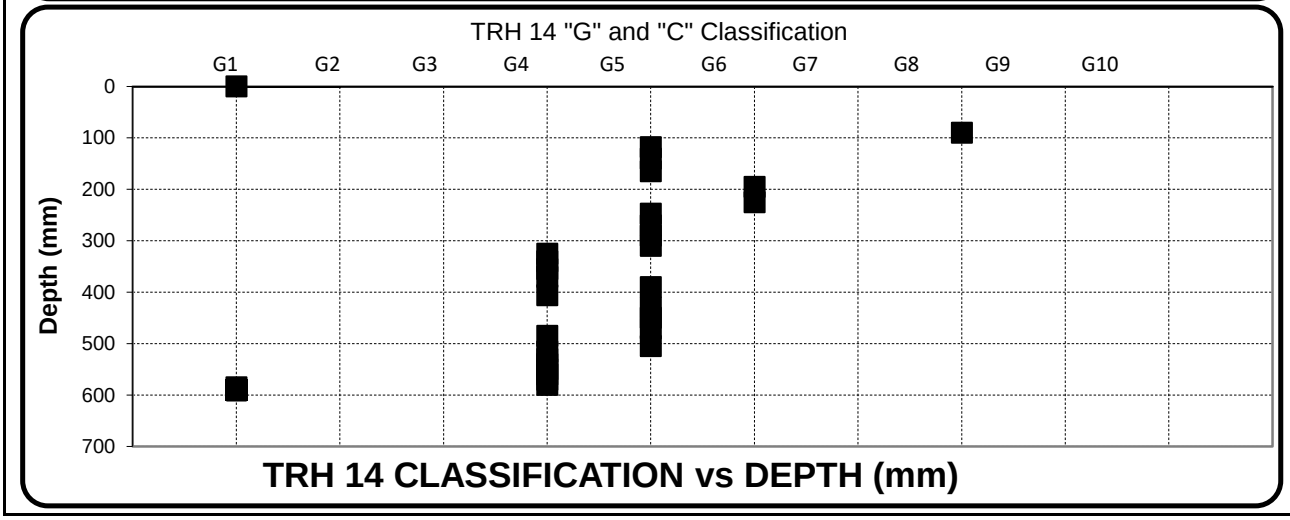
Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP5
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: BALANCING TANK
GPS (X): 3 401 796.305
)ject Number: 1
Chainage: NORTH WEST
GPS (Y): 58 118.723
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	70	14,0	15	163	G8
5	70	-	90	4,0	75	670	G5
10	90	-	115	5,0	55	510	G5
15	115	-	150	7,0	35	343	G6
20	150	-	195	9,0	25	255	G6
25	195	-	215	4,0	75	670	G5
30	215	-	245	6,0	45	427	G6
35	245	-	270	5,0	55	510	G5
40	270	-	295	5,0	55	510	G5
45	295	-	320	5,0	55	510	G5
50	320	-	335	3,0	110	939	G4
55	335	-	345	2,0	110	939	G4
60	345	-	360	3,0	110	939	G4
65	360	-	375	3,0	110	939	G4
70	375	-	385	2,0	110	939	G4
75	385	-	405	4,0	75	670	G5
80	405	-	425	4,0	75	670	G5
85	425	-	445	4,0	75	670	G5
90	445	-	455	2,0	110	939	G4
95	455	-	480	5,0	55	510	G5
100	480	-	500	4,0	75	670	G5
105	500	-	530	6,0	45	427	G6
110	530	-	580	10,0	22	228	G7
115	580	-	635	11,0	20	209	G7
120	635	-	690	11,0	20	209	G7
125	690	-	730	8,0	30	299	G6
130	730	-	780	10,0	22	228	G7
135	780	-	825	9,0	25	255	G6
140	825	-	855	6,0	45	427	G6
145	855	-	880	5,0	55	510	G5
150	880	-	910	6,0	45	427	G6
155	910	-	940	6,0	45	427	G6
160	940	-	965	5,0	55	510	G5
165	965	-	980	3,0	110	939	G4
170	980	-	1005	5,0	55	510	G5
175	1005	-	1045	8,0	30	299	G6
180	1045	-	1065	4,0	75	670	G5
185	1065	-	1085	4,0	75	670	G5
190	1085	-	1165	16,0	13	143	G8
195	1165	-	1185	4,0	75	670	G5
200	1185	-	1195	2,0	110	939	G4

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP5
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: BALANCING TANK
GPS (X): 3 401 796.305
)ject Number: 1
Chainage: NORTH WEST
GPS (Y): 58 118.723
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
205	1195	-	1220	5,0	55	510	G5
210	1220	-	1240	4,0	75	670	G5
215	1240	-	1260	4,0	75	670	G5
220	1260	-	1285	5,0	55	510	G5
225	1285	-	1295	2,0	110	939	G4
230	1295	-	1320	5,0	55	510	G5
235	1320	-	1350	6,0	45	427	G6
240	1350	-	1385	7,0	35	343	G6
245	1385	-	1395	2,0	110	939	G4
250	1395	-	1430	7,0	35	343	G6
255	1430	-	1455	5,0	55	510	G5
260	1455	-	1465	2,0	110	939	G4
265	1465	-	1490	5,0	55	510	G5
270	1490	-	1510	4,0	75	670	G5
275	1510	-	1550	8,0	30	299	G6
280	1550	-	1580	6,0	45	427	G6
285	1580	-	1610	6,0	45	427	G6

Remarks:

The required depht is 1,3m and DCP was STOPPED @ 1610 mm

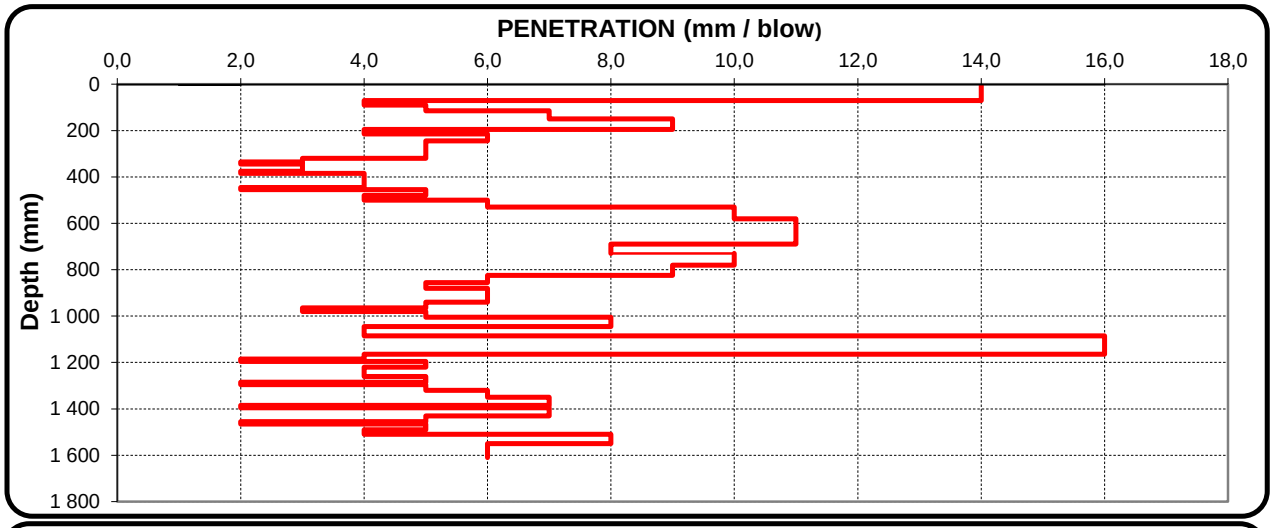
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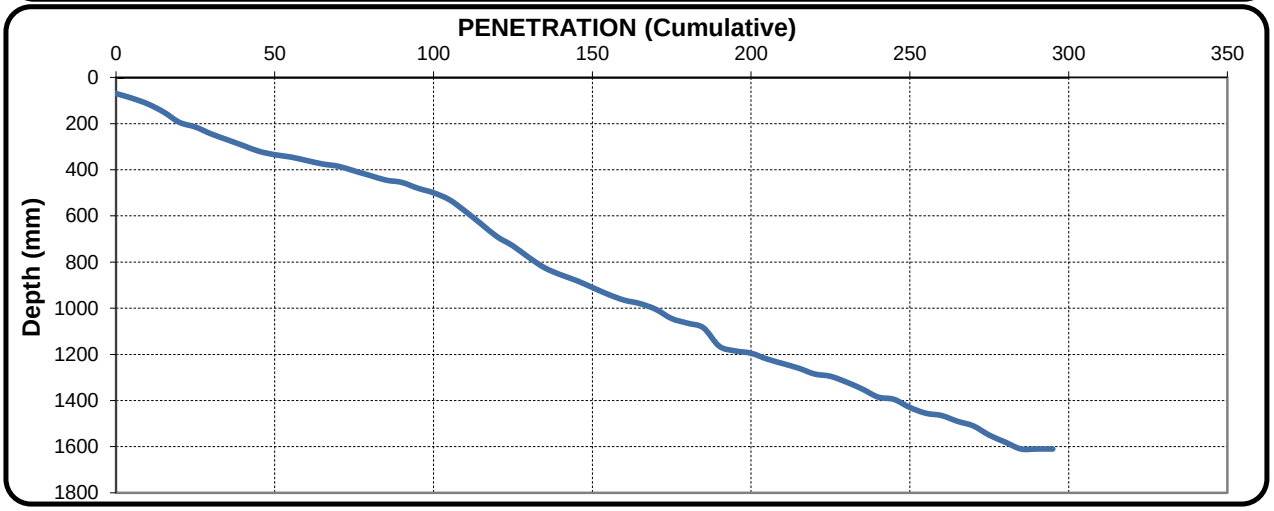
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP5	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

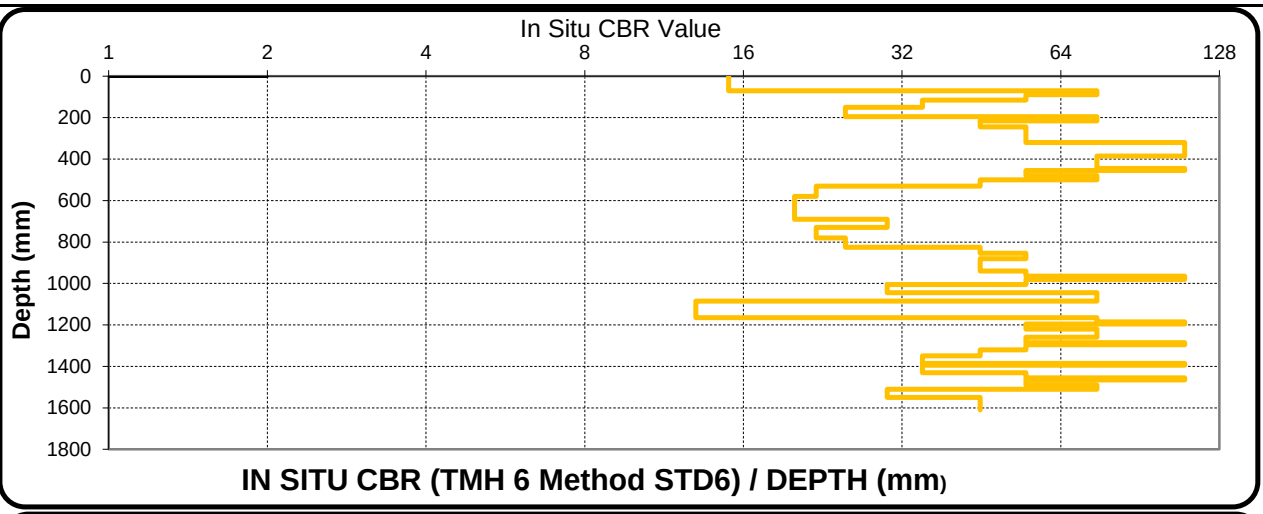




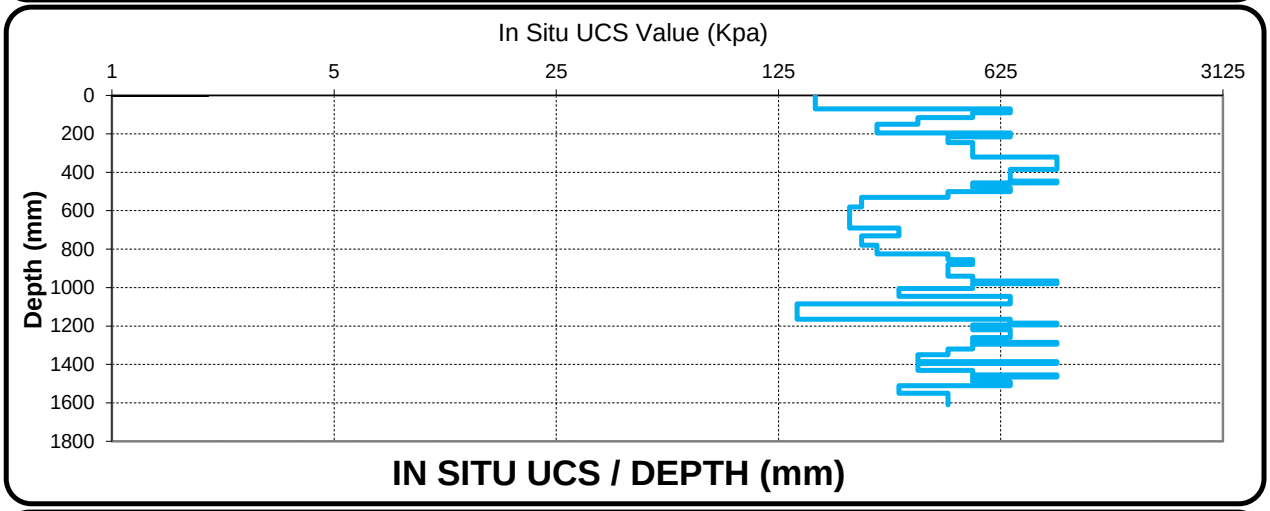
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DYNAMIC CONE PENETROMETER (DCP)

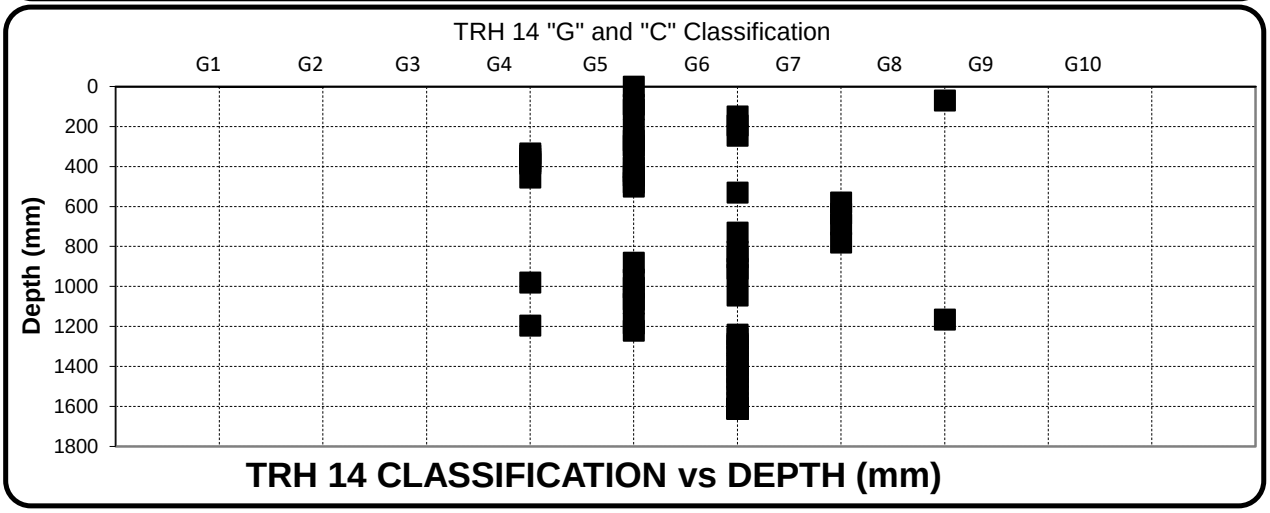
Client :	Ugu District Municipality	**Testpit No:**	TP5	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	BALANCING TANK	**GPS (X):**	3 401 796.305
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58 118.723
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP1
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: FACILITY BUILDING
GPS (X): 3 401 766.987
)ject Number: 1
Chainage: NORTH
GPS (Y): 58 121. 352
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	40	8,0	30	299	G6
5	40	-	60	4,0	75	670	G5
10	60	-	75	3,0	110	939	G4
15	75	-	86	2,2	110	939	G4
20	86	-	97	2,2	110	939	G4
25	97	-	110	2,6	110	939	G4
30	110	-	125	3,0	110	939	G4
35	125	-	135	2,0	110	939	G4
40	135	-	145	2,0	110	939	G4
45	145	-	152	1,4	110	939	G2
50	152	-	155	0,6	110	939	G1
55	155	-	160	1,0	110	939	G1

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	FACILITY BUILDING	**GPS (X):**	3 401 766.987
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 121. 352
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

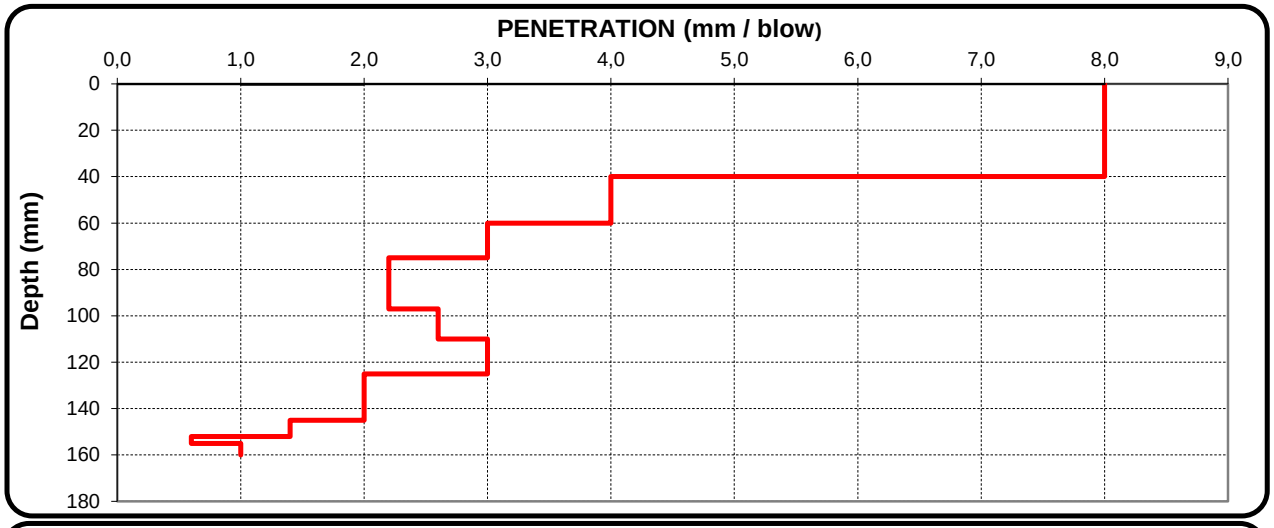
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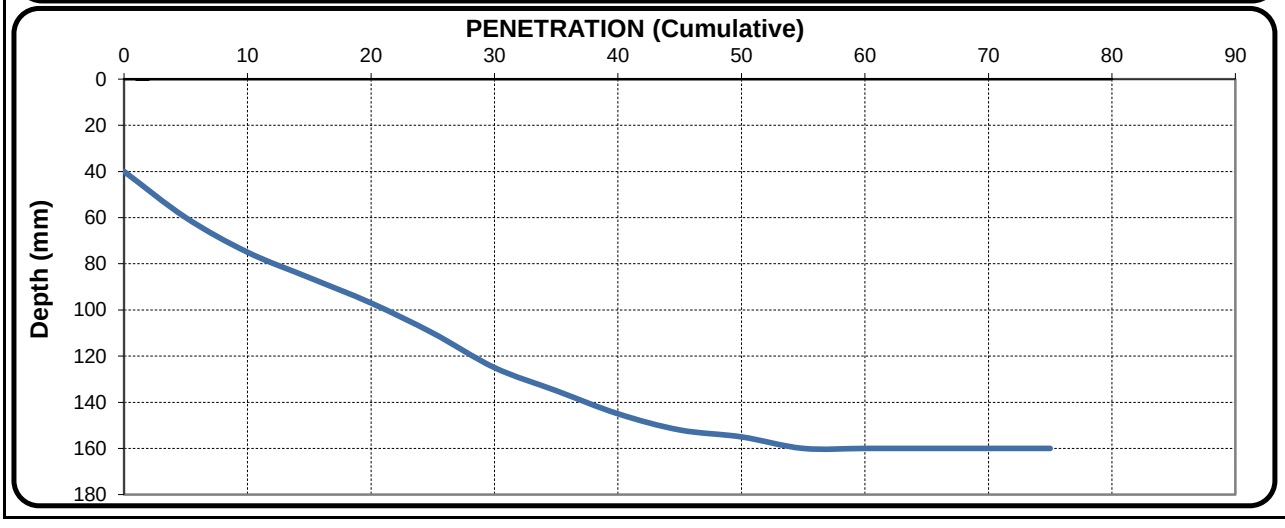
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	FACILITY BUILDING	**GPS (X):**	3 401 766.987
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 121. 352
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

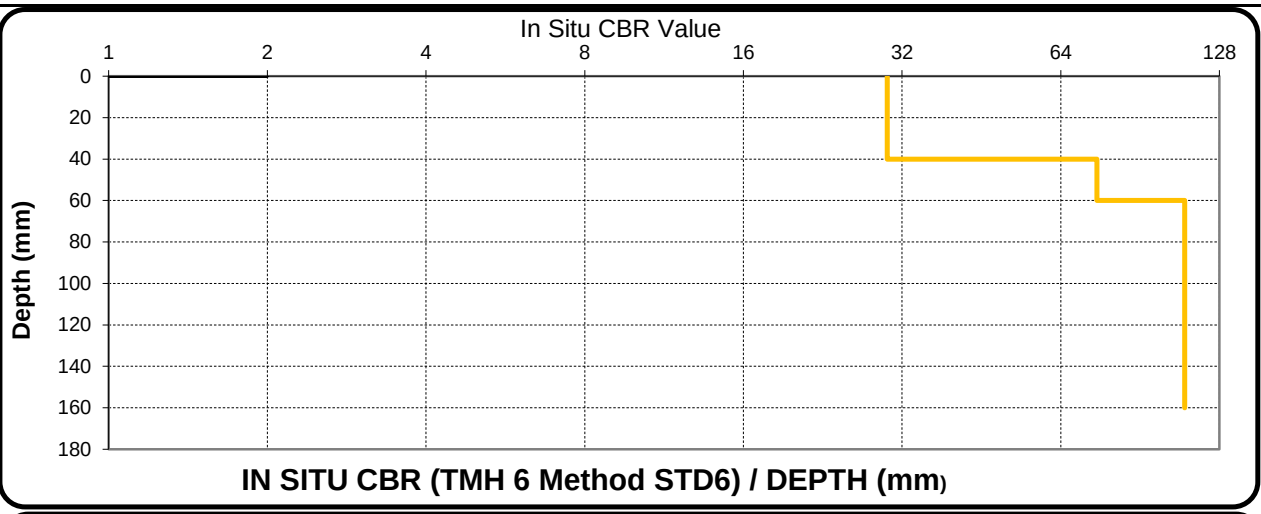




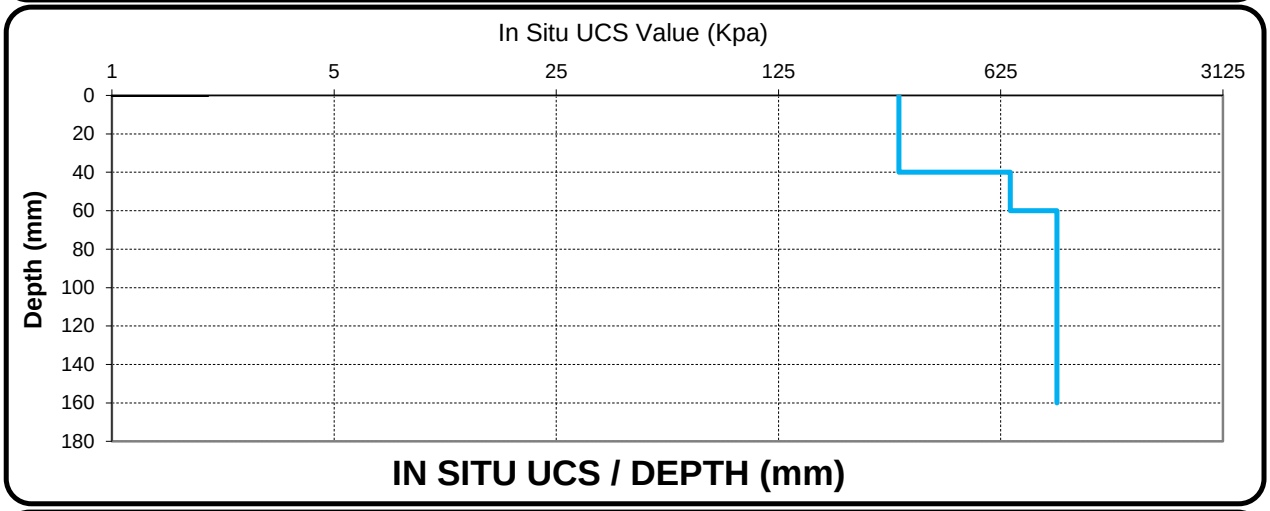
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DYNAMIC CONE PENETROMETER (DCP)

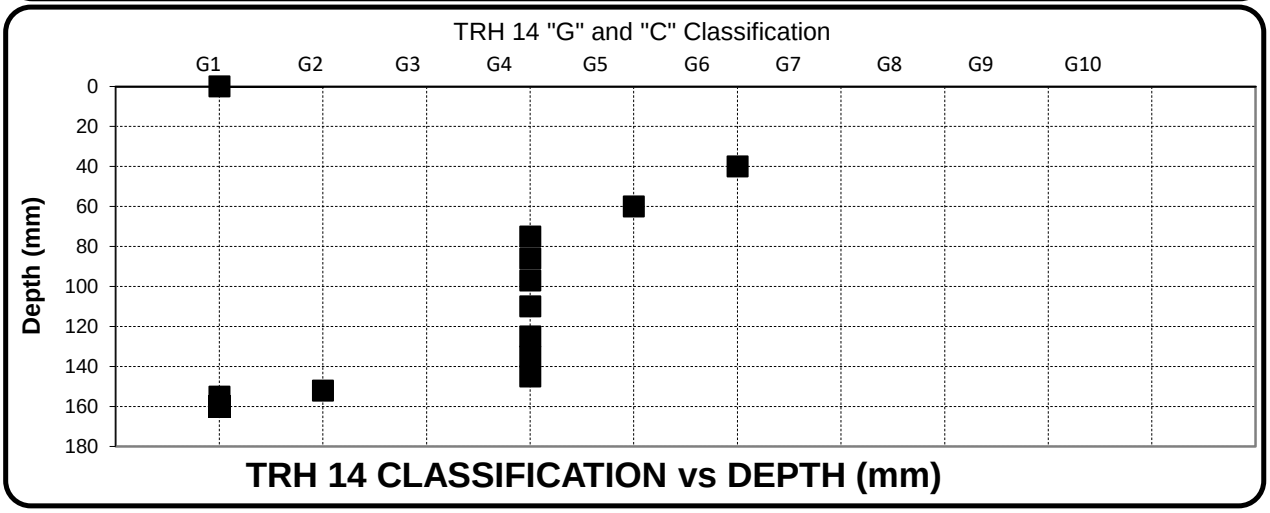
Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	FACILITY BUILDING	**GPS (X):**	3 401 766.987
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 121. 352
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP2
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: FACILITY BUILDING
GPS (X): 3 401 766.987
)ject Number: 1
Chainage: NORTH
GPS (Y): 58 121. 352
Job no. : Ugu-07-1566-2020
Offset: EAST
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	40	8,0	30	299	G6
5	40	-	65	5,0	55	510	G5
10	65	-	85	4,0	75	670	G5
15	85	-	100	3,0	110	939	G4
20	100	-	110	2,0	110	939	G4
25	110	-	125	3,0	110	939	G4
30	125	-	142	3,4	75	670	G4
35	142	-	160	3,6	75	670	G4
40	160	-	175	3,0	110	939	G4
45	175	-	195	4,0	75	670	G5
50	195	-	215	4,0	75	670	G5
55	215	-	250	7,0	35	343	G6
60	250	-	295	9,0	25	255	G6
65	295	-	345	10,0	22	228	G7
70	345	-	445	20,0	8	93	G9
75	445	-	555	22,0	8	93	G9
80	555	-	630	15,0	14	153	G8
85	630	-	740	22,0	8	93	G9
90	740	-	820	16,0	13	143	G8
95	820	-	865	9,0	25	255	G6
100	865	-	900	7,0	35	343	G6
105	900	-	930	6,0	45	427	G6
110	930	-	965	7,0	35	343	G6
115	965	-	995	6,0	45	427	G6
120	995	-	1025	6,0	45	427	G6
125	1025	-	1055	6,0	45	427	G6
130	1055	-	1090	7,0	35	343	G6
135	1090	-	1125	7,0	35	343	G6
140	1125	-	1155	6,0	45	427	G6
145	1155	-	1185	6,0	45	427	G6
150	1185	-	1215	6,0	45	427	G6
155	1215	-	1245	6,0	45	427	G6
160	1245	-	1280	7,0	35	343	G6
165	1280	-	1305	5,0	55	510	G5
170	1305	-	1325	4,0	75	670	G5
175	1325	-	1350	5,0	55	510	G5
180	1350	-	1370	4,0	75	670	G5
185	1370	-	1390	4,0	75	670	G5
190	1390	-	1410	4,0	75	670	G5
195	1410	-	1430	4,0	75	670	G5
200	1430	-	1450	4,0	75	670	G5

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP2
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: FACILITY BUILDING
GPS (X): 3 401 766.987
)ject Number: 1
Chainage: NORTH
GPS (Y): 58 121. 352
Job no. : Ugu-07-1566-2020
Offset: EAST
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
205	1450	-	1470				G5
210	1470	-	1490	4,0	75	670	G5
215	1490	-	1510	4,0	75	670	G5

Remarks:

The required depht is 1,3m and DCP was STOPPED @ 1510 mm

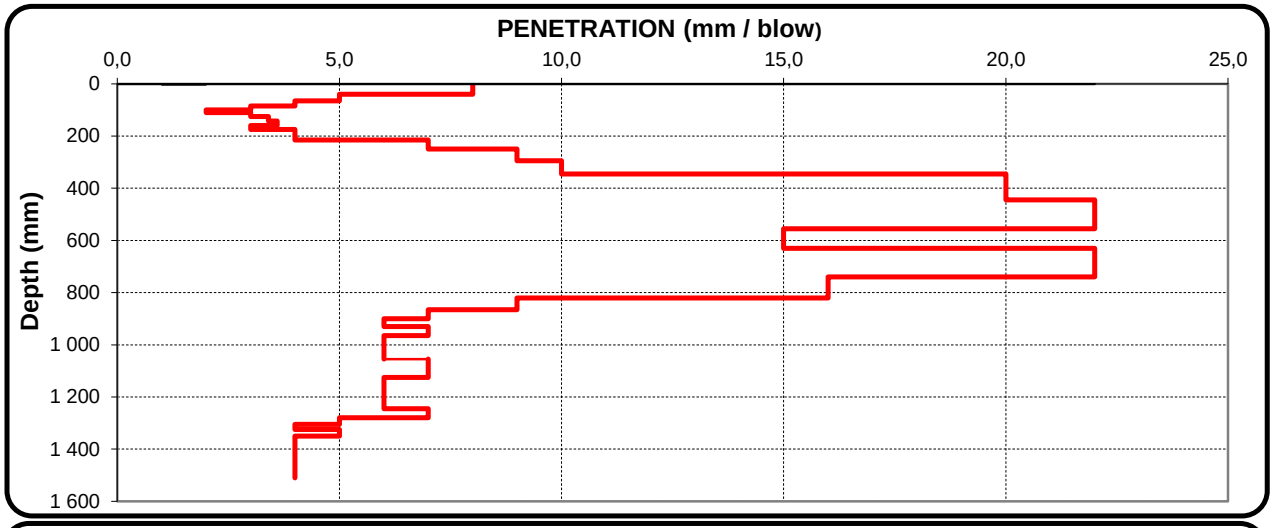
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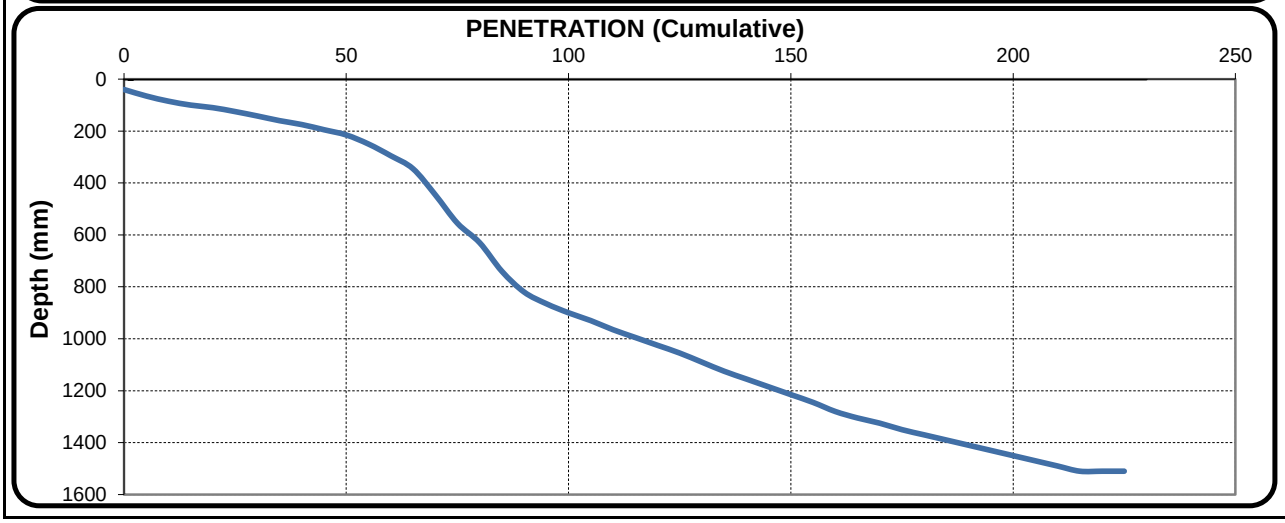
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	FACILITY BUILDING	**GPS (X):**	3 401 766.987
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 121. 352
Job no. :	Ugu-07-1566-2020	**Offset:**	EAST	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

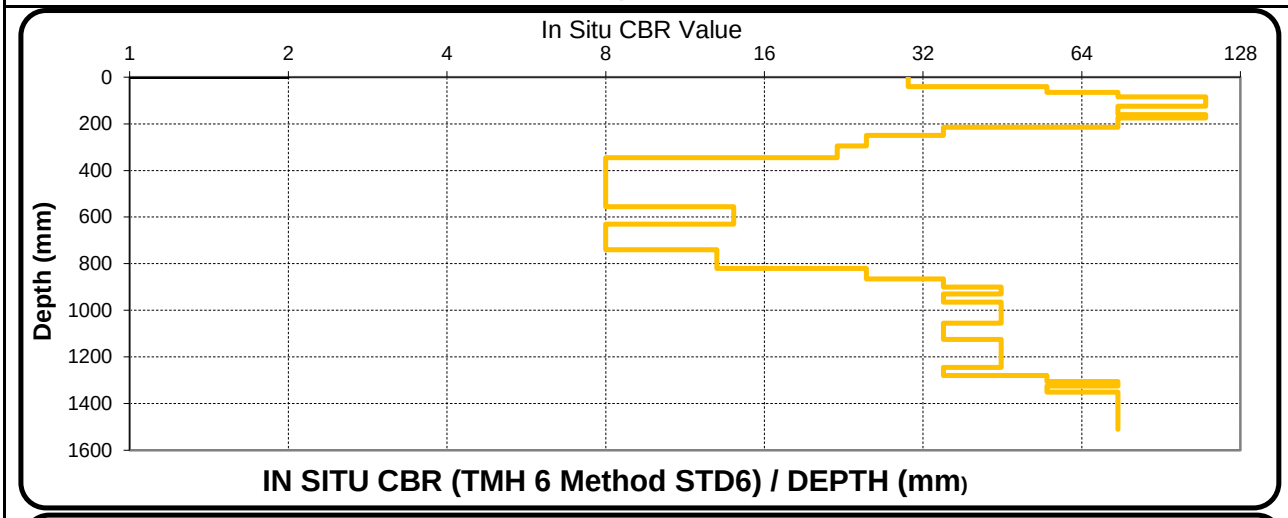




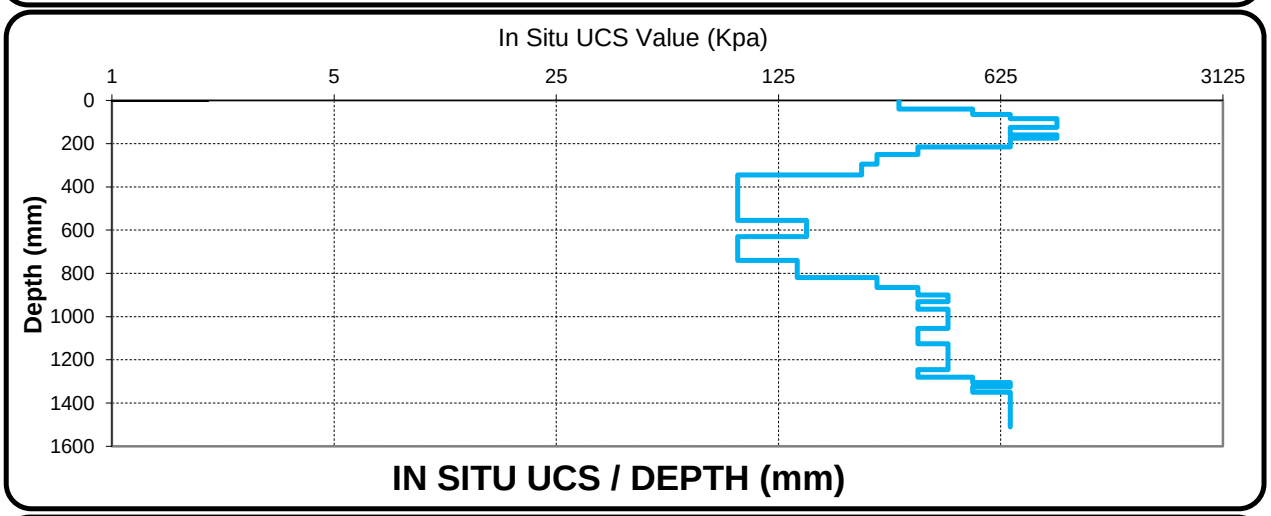
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DYNAMIC CONE PENETROMETER (DCP)

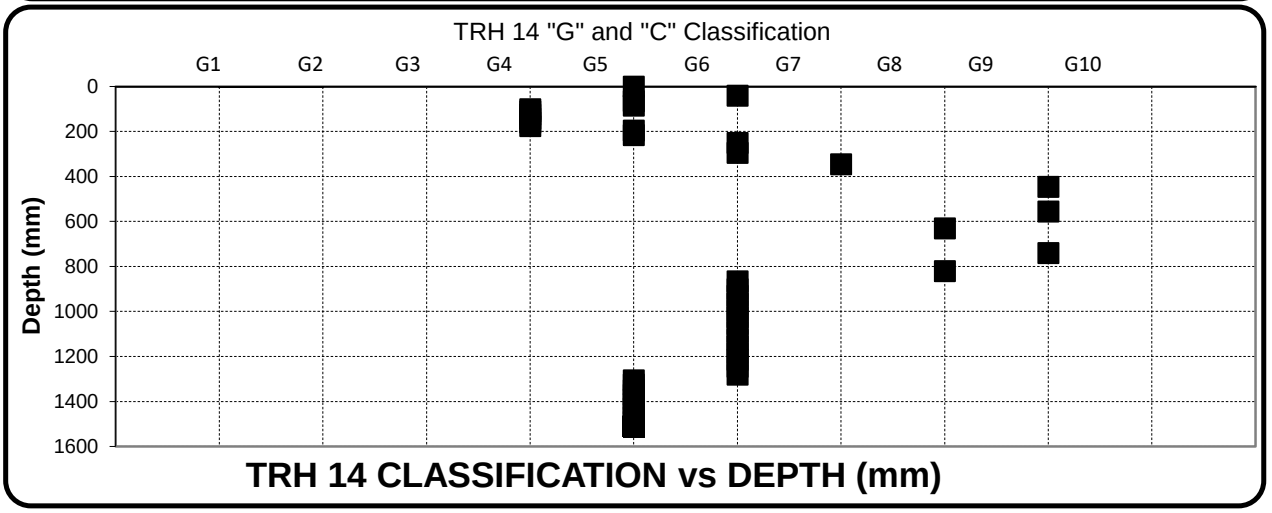
Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	FACILITY BUILDING	**GPS (X):**	3 401 766.987
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 121. 352
Job no. :	Ugu-07-1566-2020	**Offset:**	EAST	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP3
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: FACILITY BUILDING
GPS (X): 3 401 766.987
)ject Number: 1
Chainage: SOUTH
GPS (Y): 58 121. 352
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	40	8,0	30	299	G6
5	40	-	62	4,4	55	510	G5
10	62	-	81	3,8	75	670	G5
15	81	-	95	2,8	110	939	G4
20	95	-	110	3,0	110	939	G4
25	110	-	130	4,0	75	670	G5
30	130	-	150	4,0	75	670	G5
35	150	-	165	3,0	110	939	G4
40	165	-	187	4,4	55	510	G5
45	187	-	215	5,6	45	427	G5
50	215	-	245	6,0	45	427	G6
55	245	-	290	9,0	25	255	G6
60	290	-	340	10,0	22	228	G7
65	340	-	400	12,0	18	191	G7
70	400	-	490	18,0	11	124	G8
75	490	-	620	26,0	6	73	G10
80	620	-	775	31,0	5	62	G10
85	775	-	815	8,0	30	299	G6
90	815	-	925	22,0	8	93	G9
95	925	-	1120	39,0	3	39	G10
100	1120	-	1160	8,0	30	299	G6
105	1160	-	1190	6,0	45	427	G6
110	1190	-	1225	7,0	35	343	G6
115	1225	-	1280	11,0	20	209	G7
120	1280	-	1320	8,0	30	299	G6
125	1320	-	1335	3,0	110	939	G4
130	1335	-	1348	2,6	110	939	G4
135	1348	-	1365	3,4	75	670	G4
140	1365	-	1382	3,4	75	670	G4
145	1382	-	1426	8,8	25	255	G6

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	FACILITY BUILDING	**GPS (X):**	3 401 766.987
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 121. 352
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

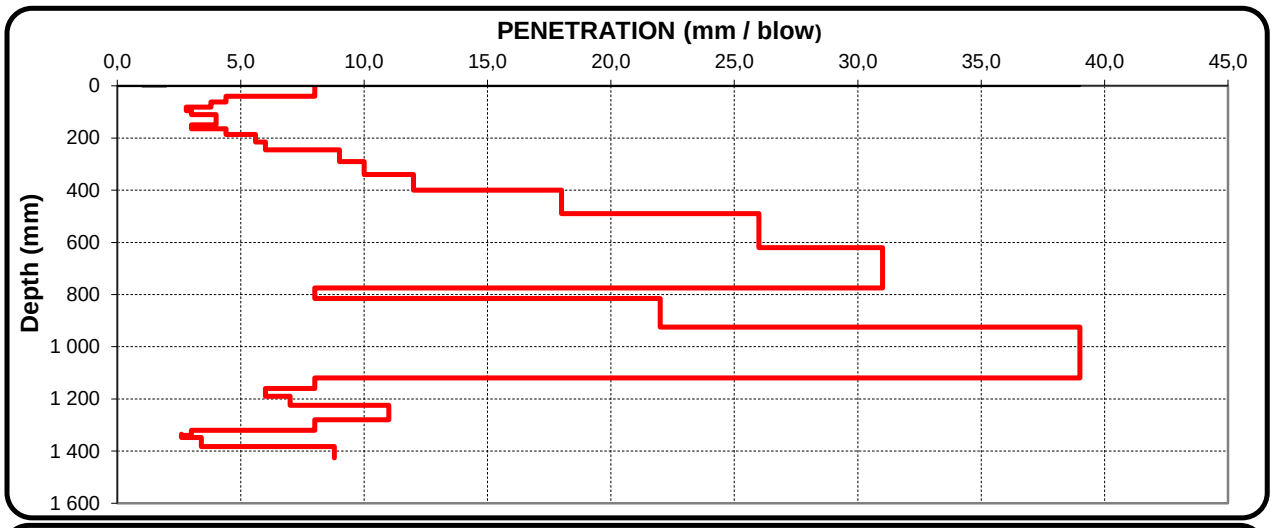
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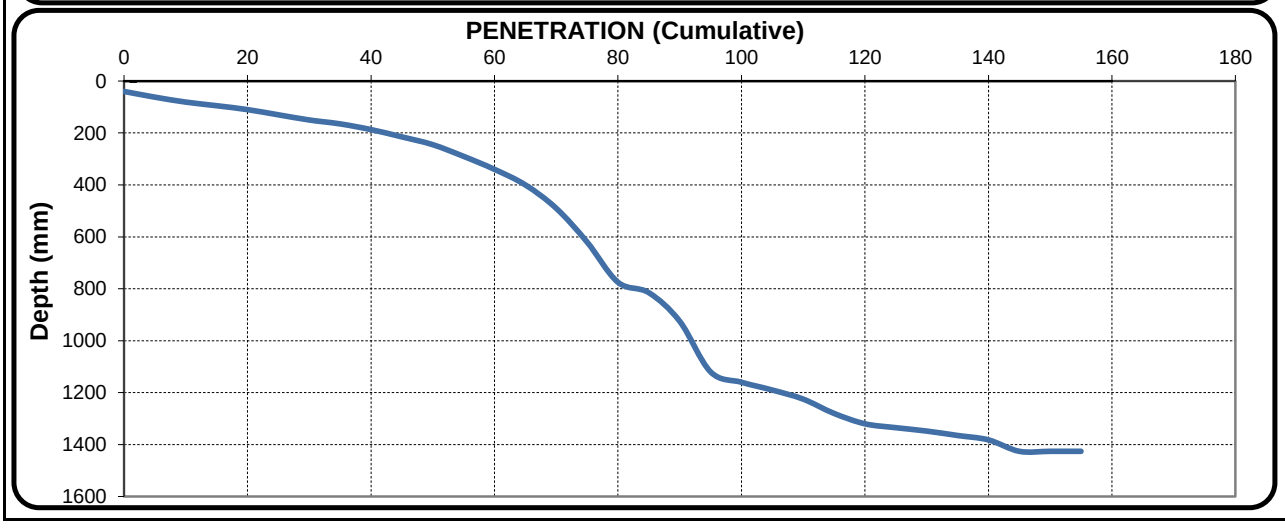
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	FACILITY BUILDING	**GPS (X):**	3 401 766.987
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 121. 352
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

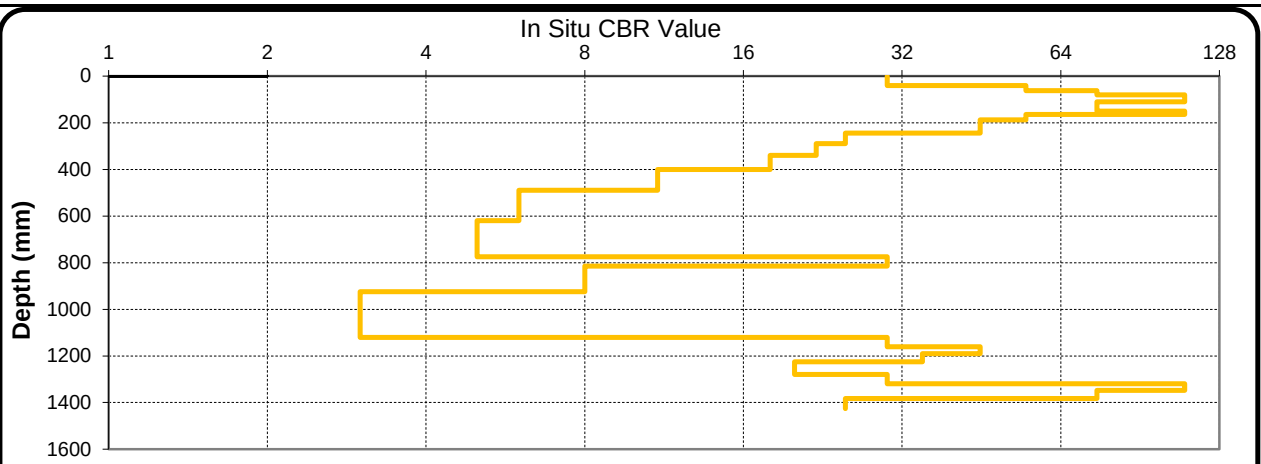




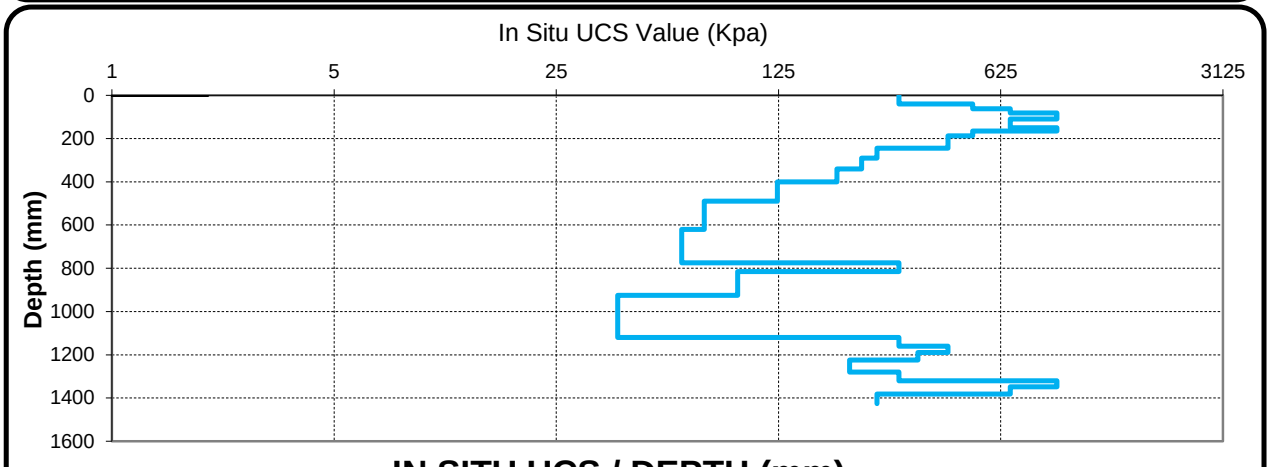
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DYNAMIC CONE PENETROMETER (DCP)

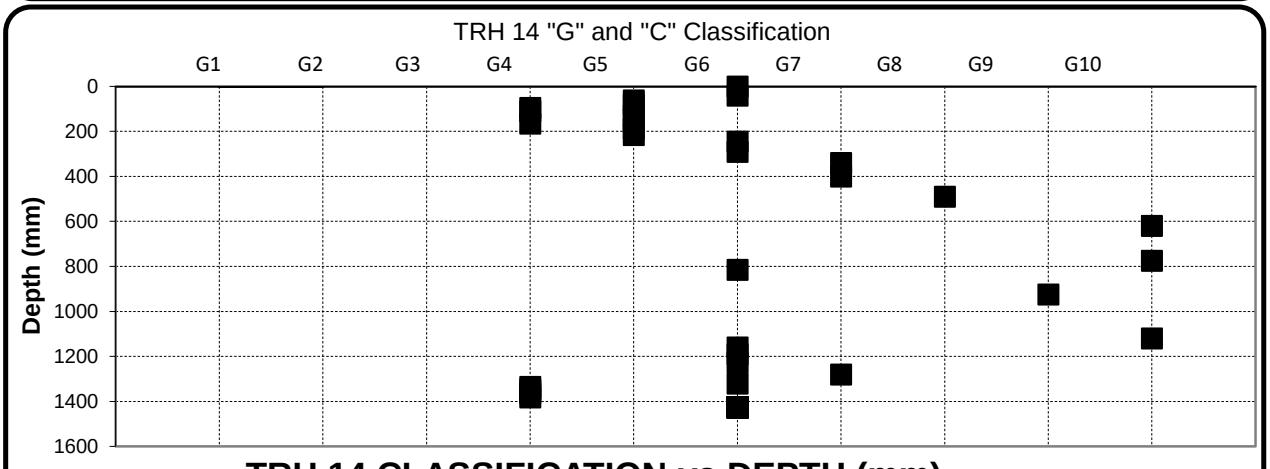
Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	FACILITY BUILDING	**GPS (X):**	3 401 766.987
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 121. 352
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP1
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GRAVITY THICKNER
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: NORTH
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	40	8,0	30	299	G6
5	40	-	60	4,0	75	670	G5
10	60	-	75	3,0	110	939	G4
15	75	-	86	2,2	110	939	G4
20	86	-	97	2,2	110	939	G4
25	97	-	110	2,6	110	939	G4
30	110	-	125	3,0	110	939	G4
35	125	-	135	2,0	110	939	G4
40	135	-	145	2,0	110	939	G4
45	145	-	152	1,4	110	939	G2
50	152	-	155	0,6	110	939	G1
55	155	-	160	1,0	110	939	G1

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

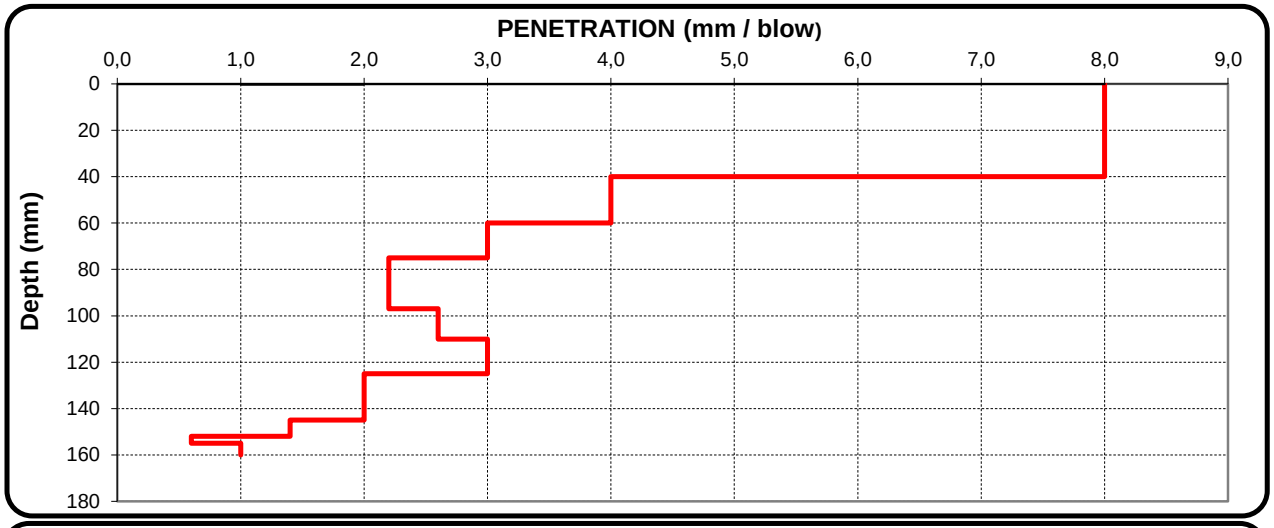
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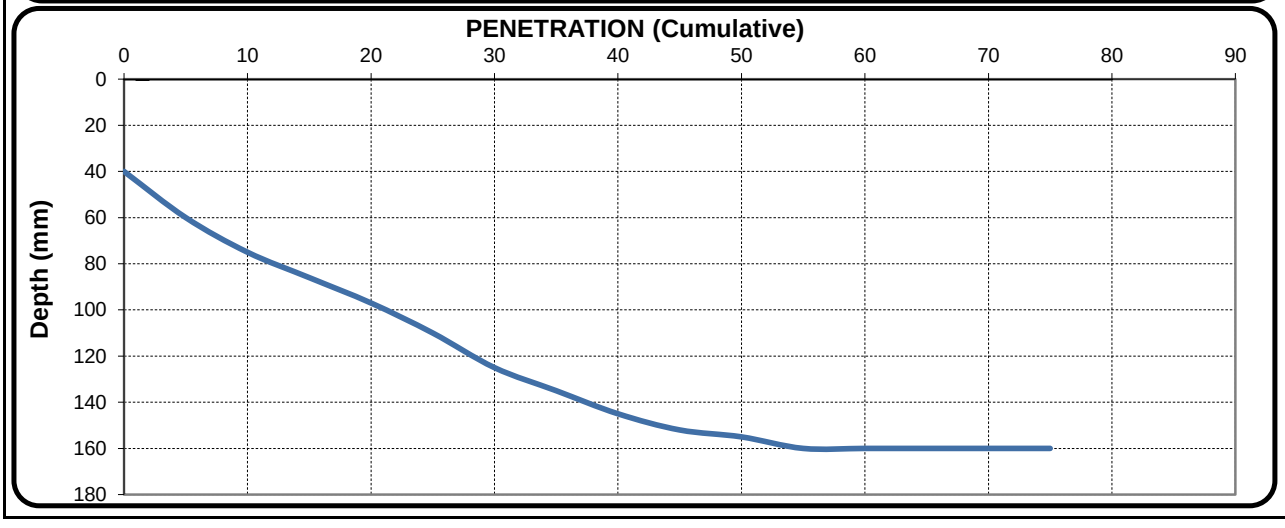
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

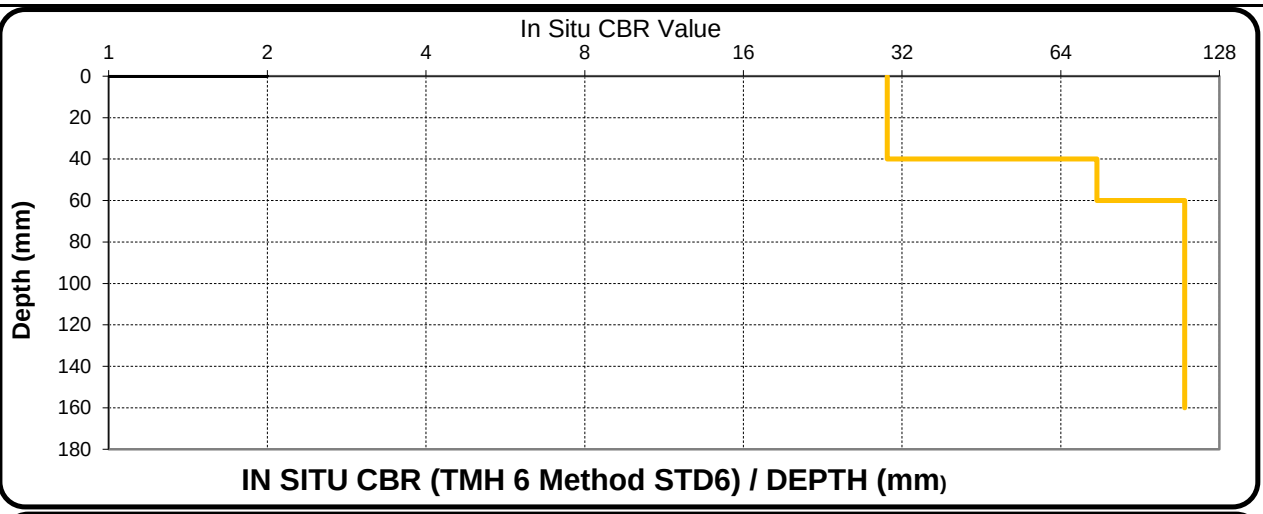




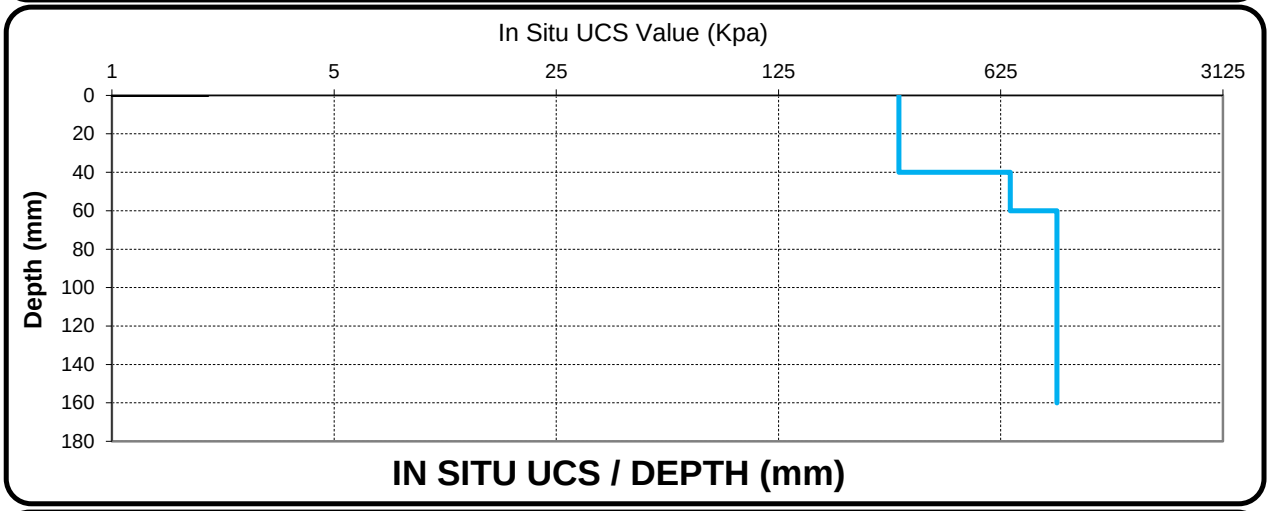
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DYNAMIC CONE PENETROMETER (DCP)

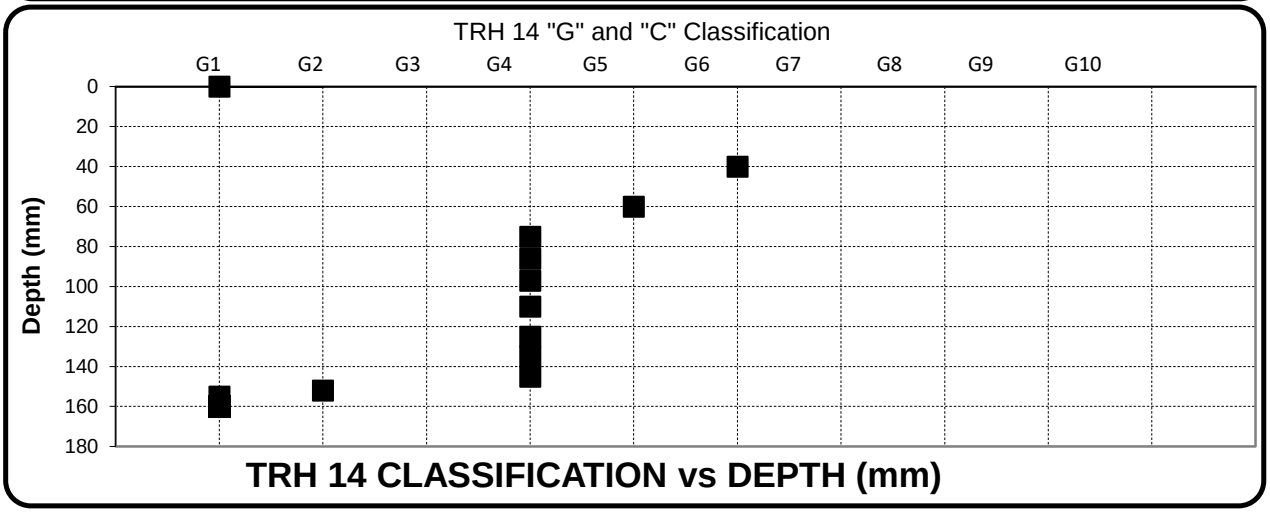
Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP2
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GRAVITY THICKNER
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: EAST
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	40	8,0	30	299	G6
5	40	-	65	5,0	55	510	G5
10	65	-	85	4,0	75	670	G5
15	85	-	100	3,0	110	939	G4
20	100	-	110	2,0	110	939	G4
25	110	-	125	3,0	110	939	G4
30	125	-	142	3,4	75	670	G4
35	142	-	160	3,6	75	670	G4
40	160	-	175	3,0	110	939	G4
45	175	-	195	4,0	75	670	G5
50	195	-	215	4,0	75	670	G5
55	215	-	250	7,0	35	343	G6
60	250	-	295	9,0	25	255	G6
65	295	-	345	10,0	22	228	G7
70	345	-	445	20,0	8	93	G9
75	445	-	555	22,0	8	93	G9
80	555	-	630	15,0	14	153	G8
85	630	-	740	22,0	8	93	G9
90	740	-	820	16,0	13	143	G8
95	820	-	865	9,0	25	255	G6
100	865	-	900	7,0	35	343	G6
105	900	-	930	6,0	45	427	G6
110	930	-	965	7,0	35	343	G6
115	965	-	995	6,0	45	427	G6
120	995	-	1025	6,0	45	427	G6
125	1025	-	1055	6,0	45	427	G6
130	1055	-	1090	7,0	35	343	G6
135	1090	-	1125	7,0	35	343	G6
140	1125	-	1155	6,0	45	427	G6
145	1155	-	1185	6,0	45	427	G6
150	1185	-	1215	6,0	45	427	G6
155	1215	-	1245	6,0	45	427	G6
160	1245	-	1280	7,0	35	343	G6
165	1280	-	1305	5,0	55	510	G5
170	1305	-	1325	4,0	75	670	G5
175	1325	-	1350	5,0	55	510	G5
180	1350	-	1370	4,0	75	670	G5
185	1370	-	1390	4,0	75	670	G5
190	1390	-	1410	4,0	75	670	G5
195	1410	-	1430	4,0	75	670	G5
200	1430	-	1450	4,0	75	670	G5

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				
205	1450	-				

Remarks:

The required depht is 1,3m and DCP was stopped @ 1450 mm

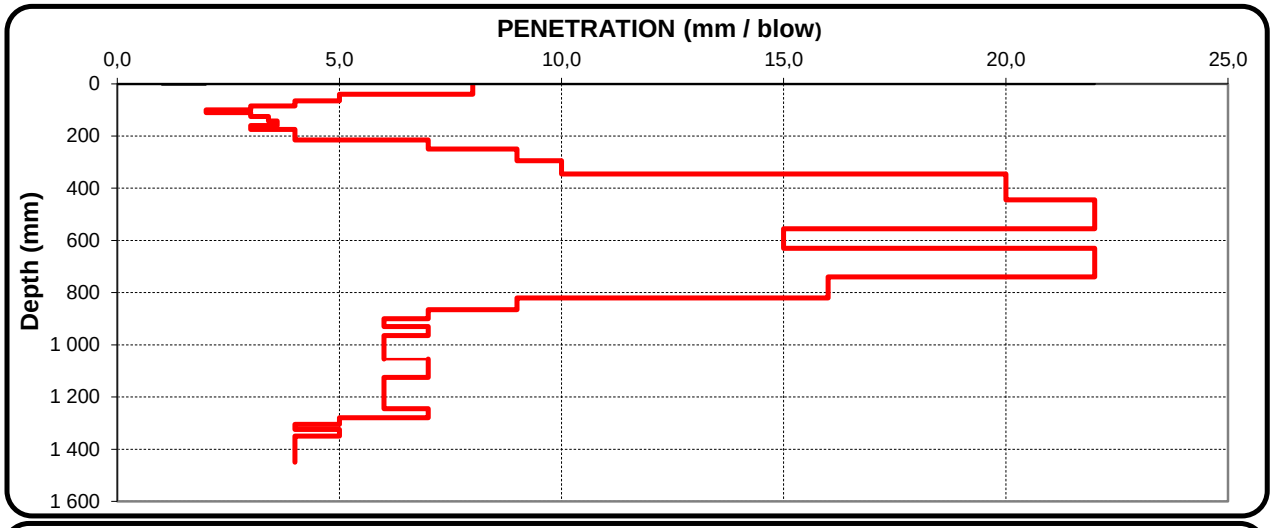
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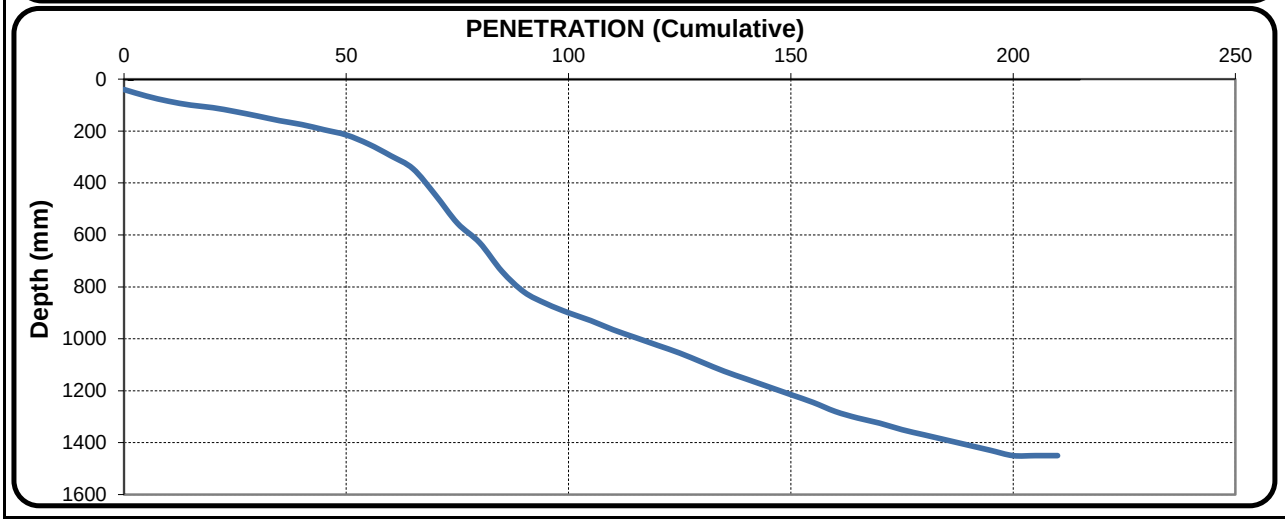
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

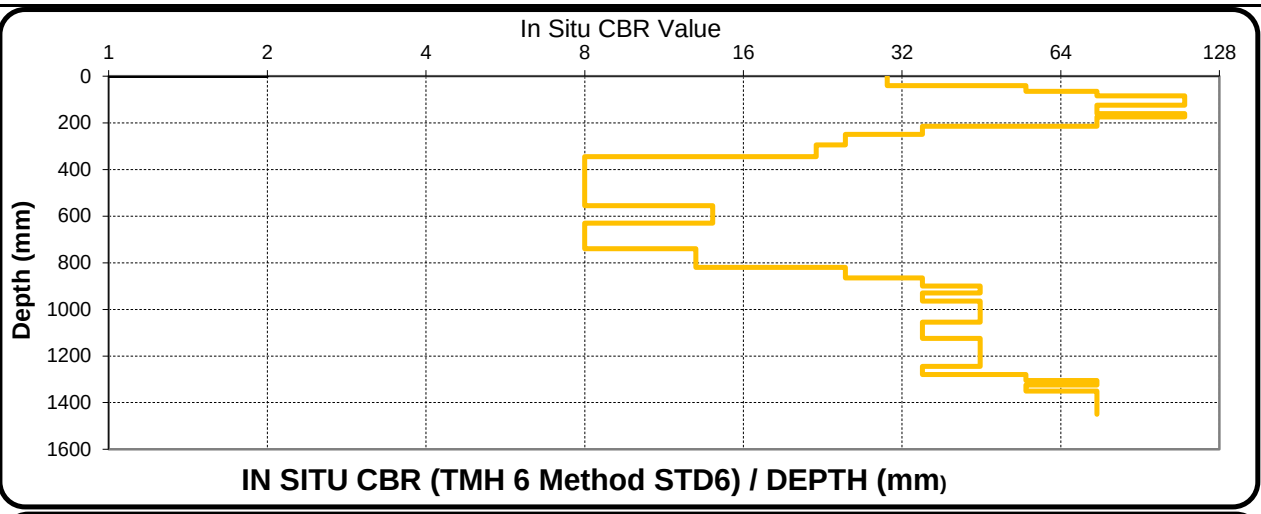




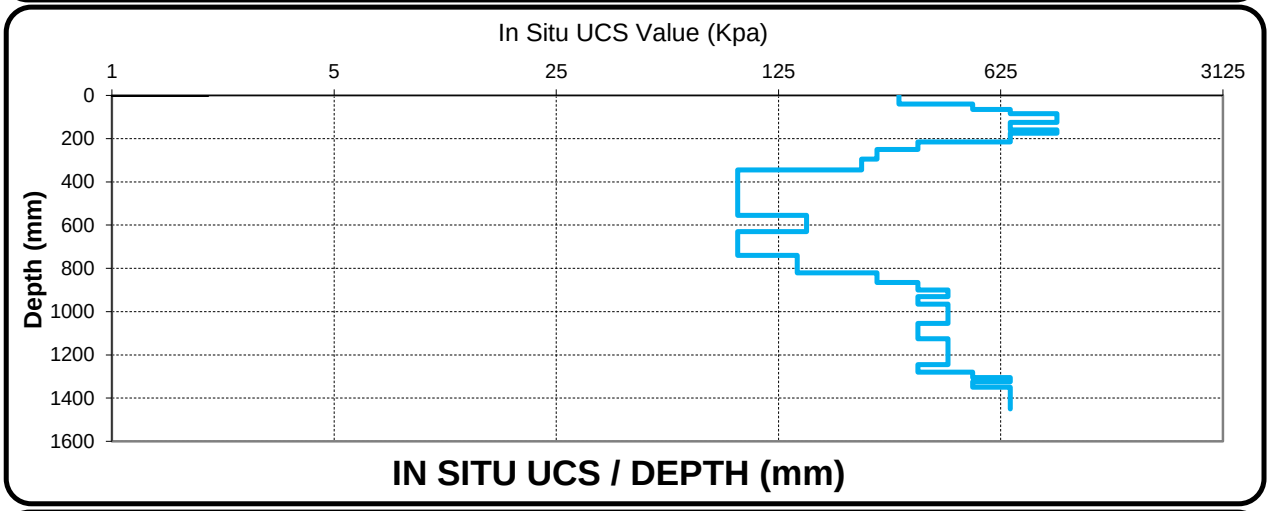
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DYNAMIC CONE PENETROMETER (DCP)

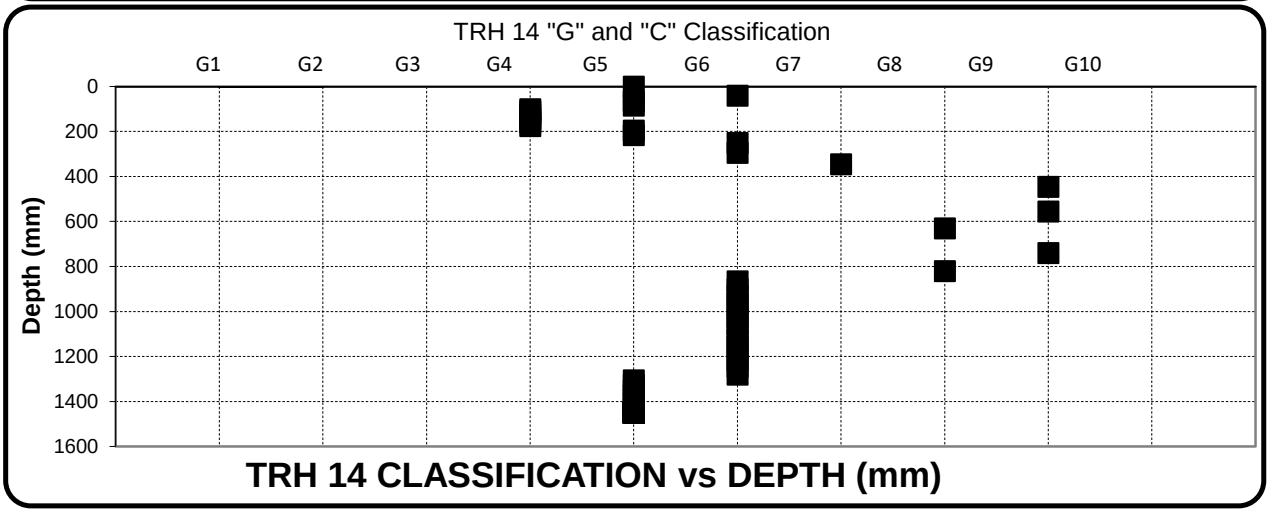
Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP3
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GRAVITY THICKNER
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: SOUTH
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	40	8,0	30	299	G6
5	40	-	62	4,4	55	510	G5
10	62	-	81	3,8	75	670	G5
15	81	-	95	2,8	110	939	G4
20	95	-	110	3,0	110	939	G4
25	110	-	130	4,0	75	670	G5
30	130	-	150	4,0	75	670	G5
35	150	-	165	3,0	110	939	G4
40	165	-	187	4,4	55	510	G5
45	187	-	215	5,6	45	427	G5
50	215	-	245	6,0	45	427	G6
55	245	-	290	9,0	25	255	G6
60	290	-	340	10,0	22	228	G7
65	340	-	400	12,0	18	191	G7
70	400	-	490	18,0	11	124	G8
75	490	-	620	26,0	6	73	G10
80	620	-	775	31,0	5	62	G10
85	775	-	815	8,0	30	299	G6
90	815	-	925	22,0	8	93	G9
95	925	-	1120	39,0	3	39	G10
100	1120	-	1160	8,0	30	299	G6
105	1160	-	1190	6,0	45	427	G6
110	1190	-	1225	7,0	35	343	G6
115	1225	-	1280	11,0	20	209	G7
120	1280	-	1320	8,0	30	299	G6
125	1320	-	1335	3,0	110	939	G4
130	1335	-	1348	2,6	110	939	G4
135	1348	-	1365	3,4	75	670	G4
140	1365	-	1382	3,4	75	670	G4

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

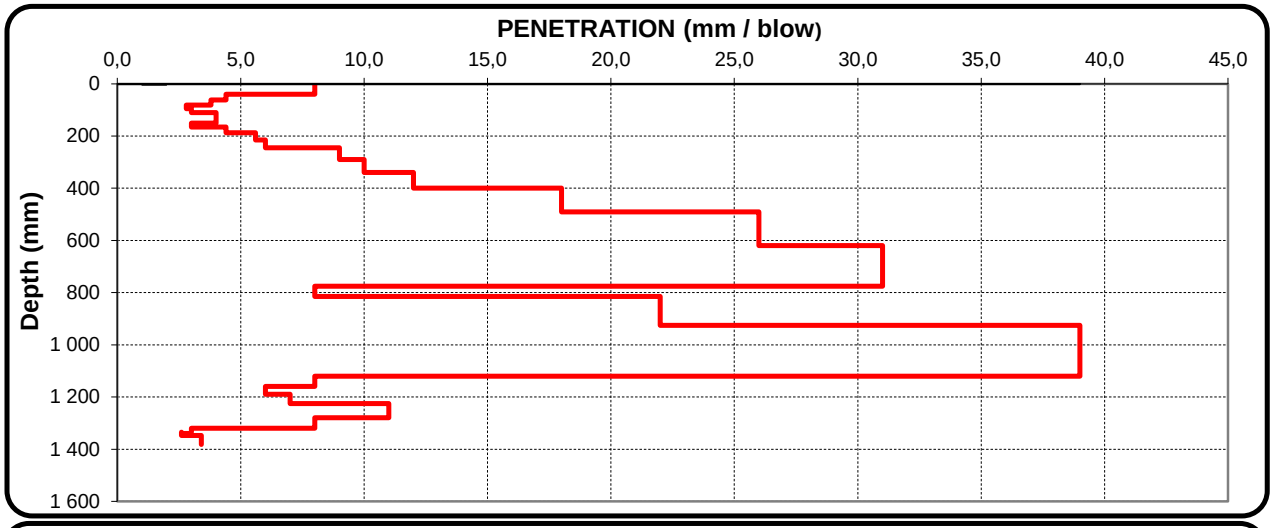
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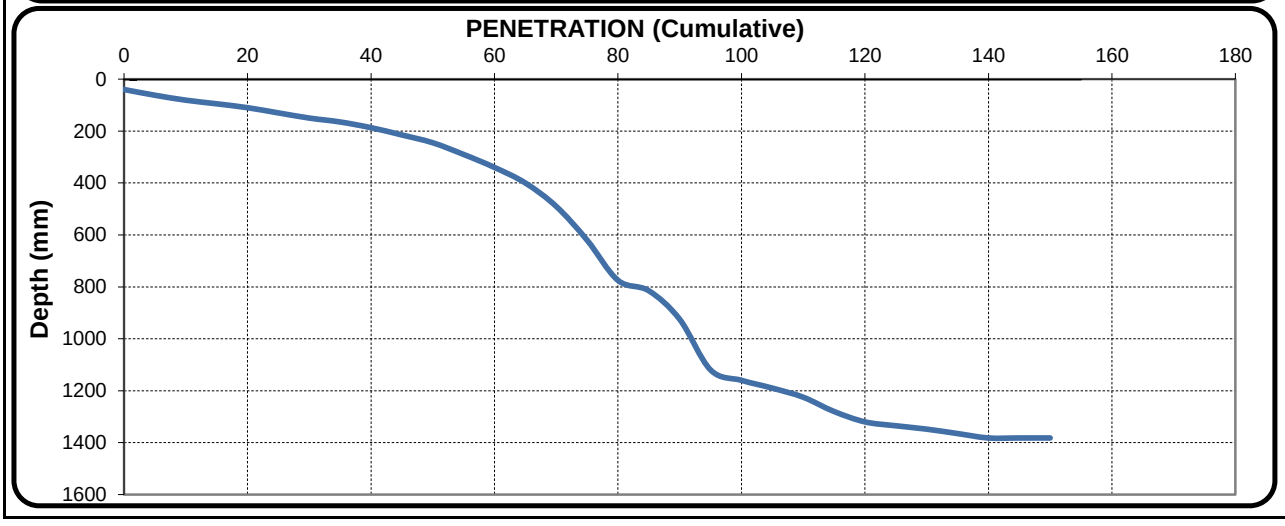
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

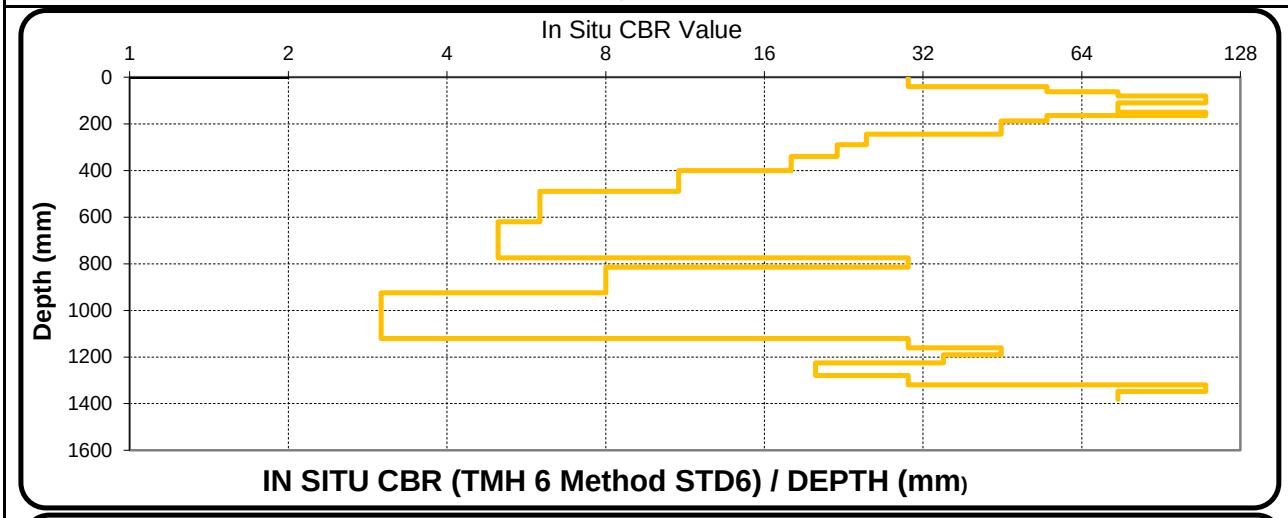




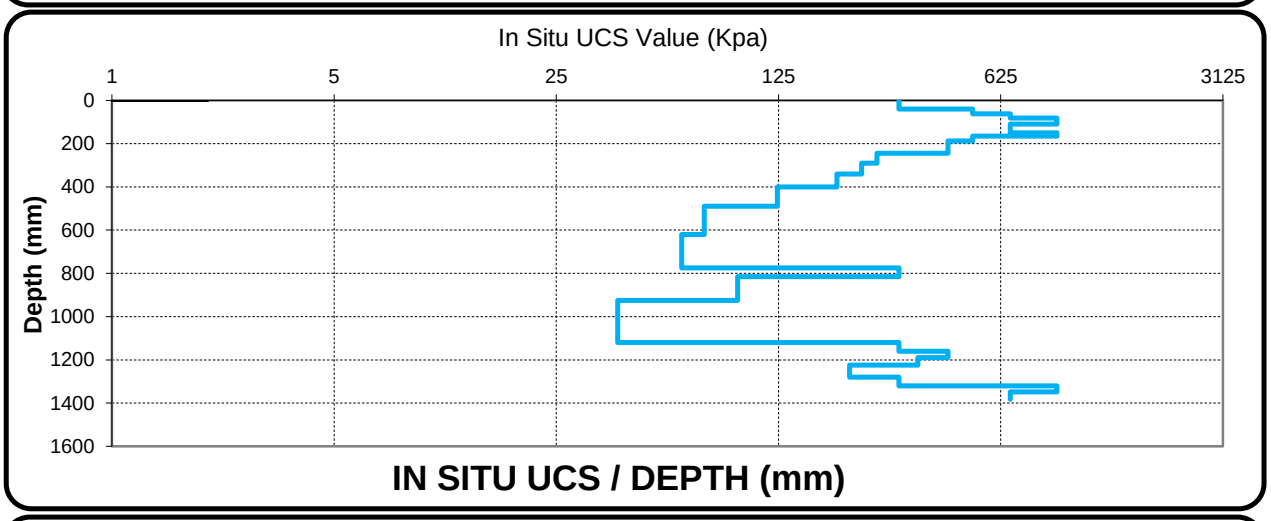
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DYNAMIC CONE PENETROMETER (DCP)

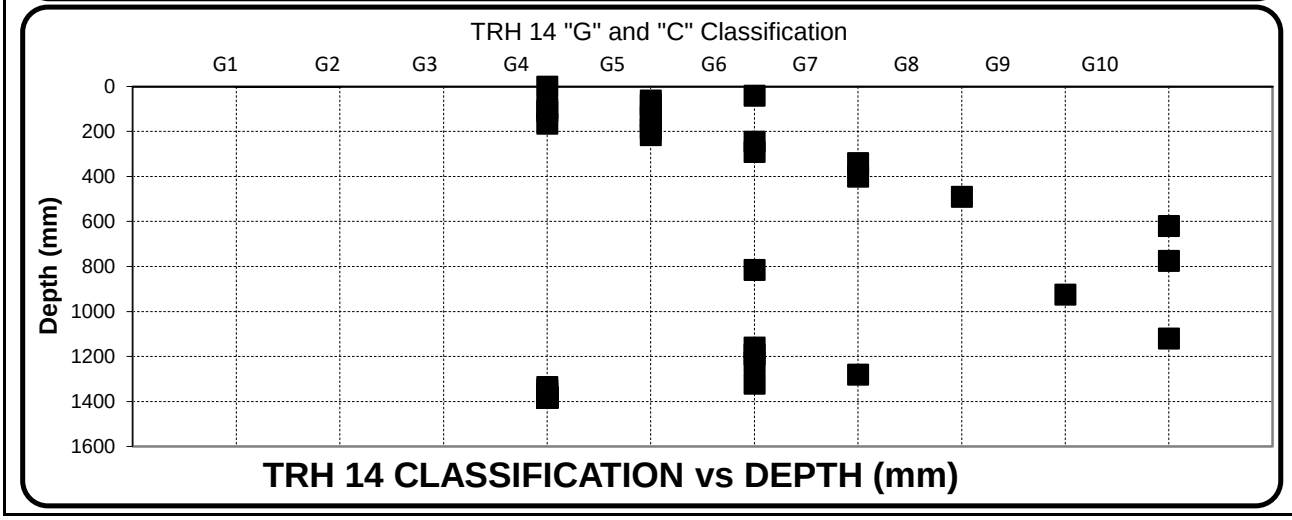
Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRAVITY THICKNER	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP1
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GRIT REMOVAL
GPS (X): 3 401 812.625
)ject Number: 1
Chainage: NORTH
GPS (Y): 58 125.274
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	75	15,0	14	153	G8
5	75	-	118	8,6	25	255	G6
10	118	-	140	4,4	55	510	G5
15	140	-	165	5,0	55	510	G5
20	165	-	185	4,0	75	670	G5
25	185	-	215	6,0	45	427	G6
30	215	-	235	4,0	75	670	G5
35	235	-	260	5,0	55	510	G5
40	260	-	265	1,0	110	939	G1
45	265	-	270	1,0	110	939	G1

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

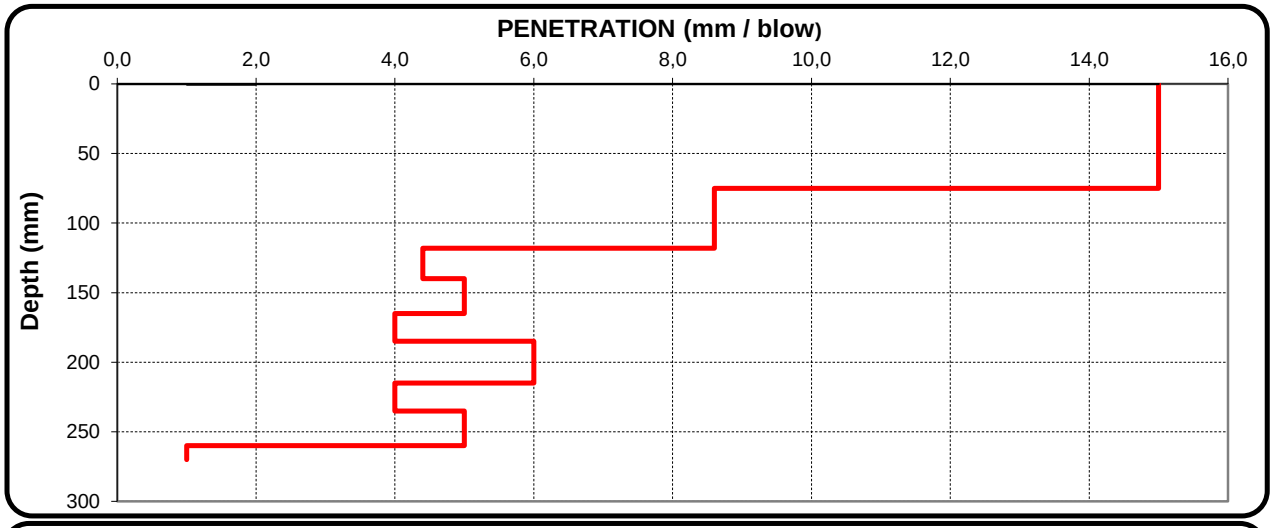
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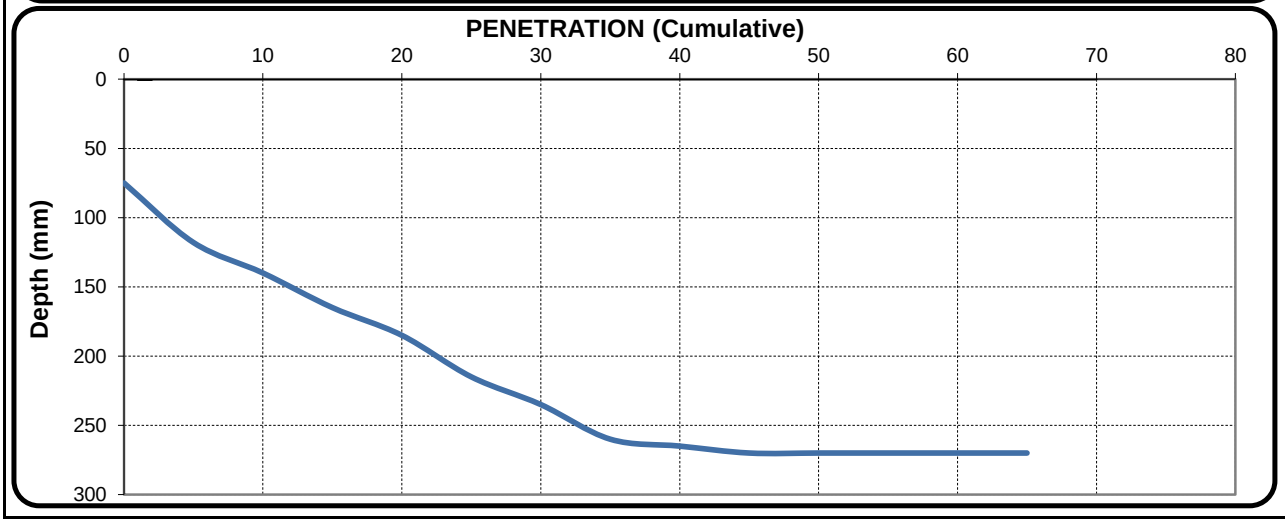
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

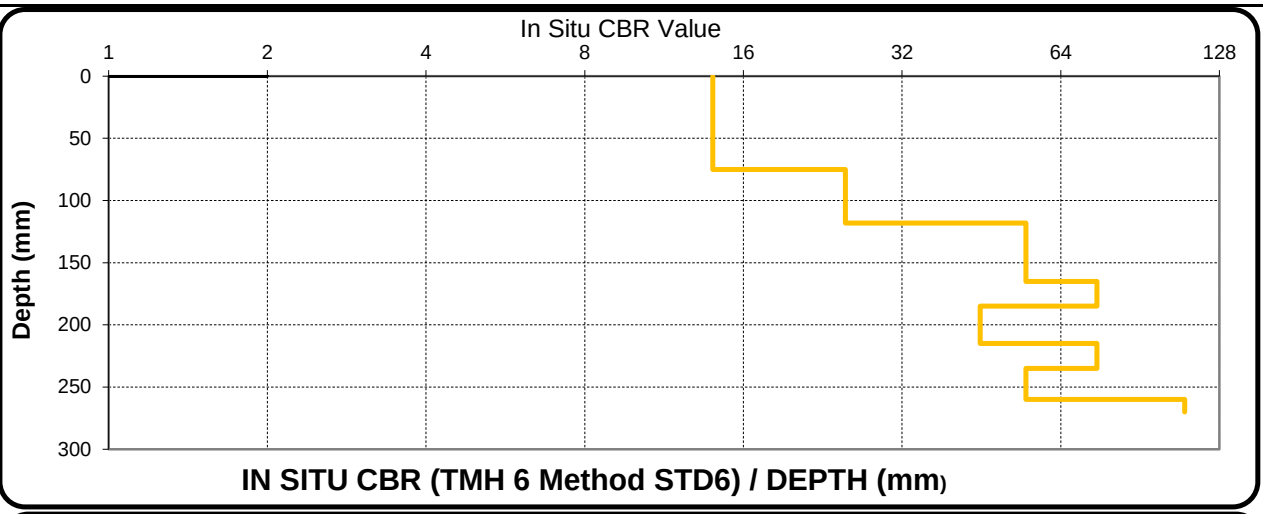




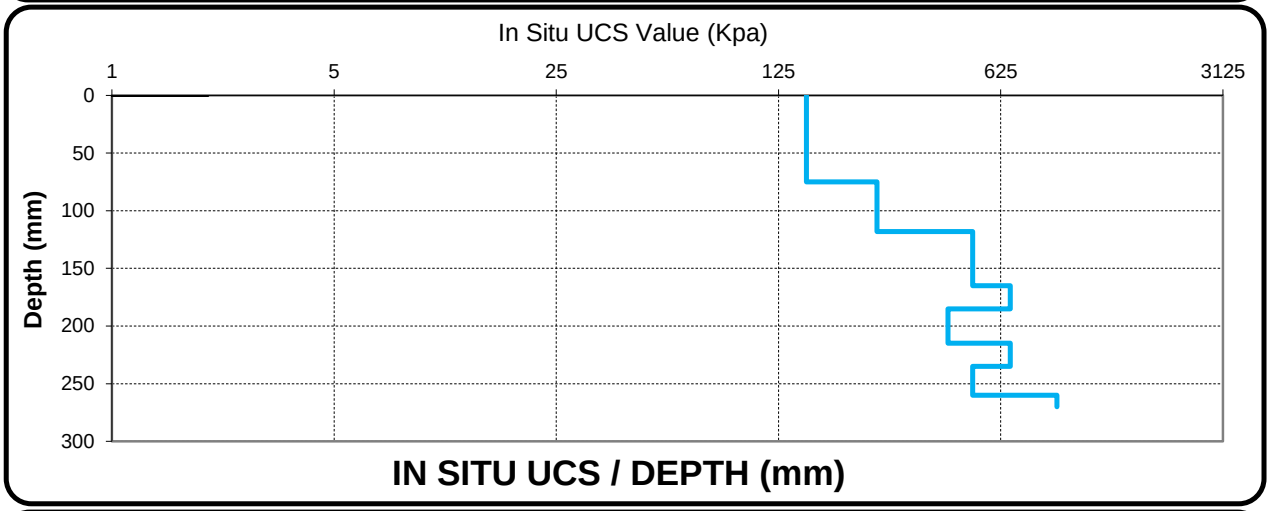
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DYNAMIC CONE PENETROMETER (DCP)

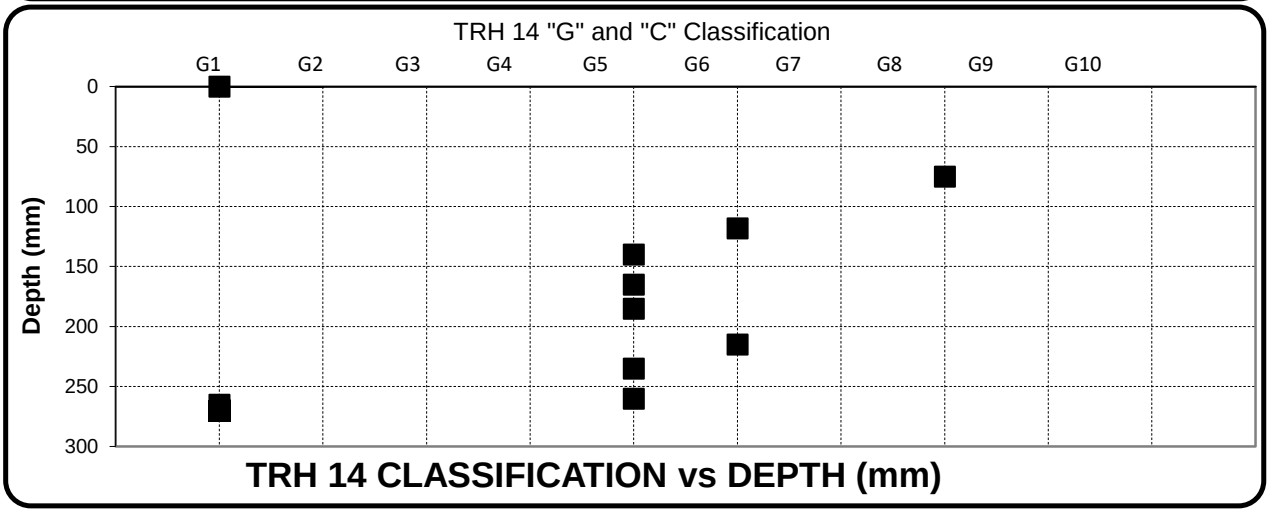
Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	NORTH	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP2
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GRIT REMOVAL
GPS (X): 3 401 812.625
)ject Number: 1
Chainage: EAST
GPS (Y): 58 125.274
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	75	15,0	14	153	G8
5	75	-	105	6,0	45	427	G6
10	105	-	135	6,0	45	427	G6
15	135	-	155	4,0	75	670	G5
20	155	-	170	3,0	110	939	G4
25	170	-	190	4,0	75	670	G5
30	190	-	205	3,0	110	939	G4
35	205	-	222	3,4	75	670	G4
40	222	-	240	3,6	75	670	G4
45	240	-	255	3,0	110	939	G4
50	255	-	274	3,8	75	670	G5
55	274	-	290	3,2	75	670	G4
60	290	-	307	3,4	75	670	G4
65	307	-	325	3,6	75	670	G4
70	325	-	345	4,0	75	670	G5
75	345	-	355	2,0	110	939	G4
80	355	-	375	4,0	75	670	G5
85	375	-	395	4,0	75	670	G5
90	395	-	415	4,0	75	670	G5
95	415	-	420	1,0	110	939	G1
100	420	-	430	2,0	110	939	G4

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

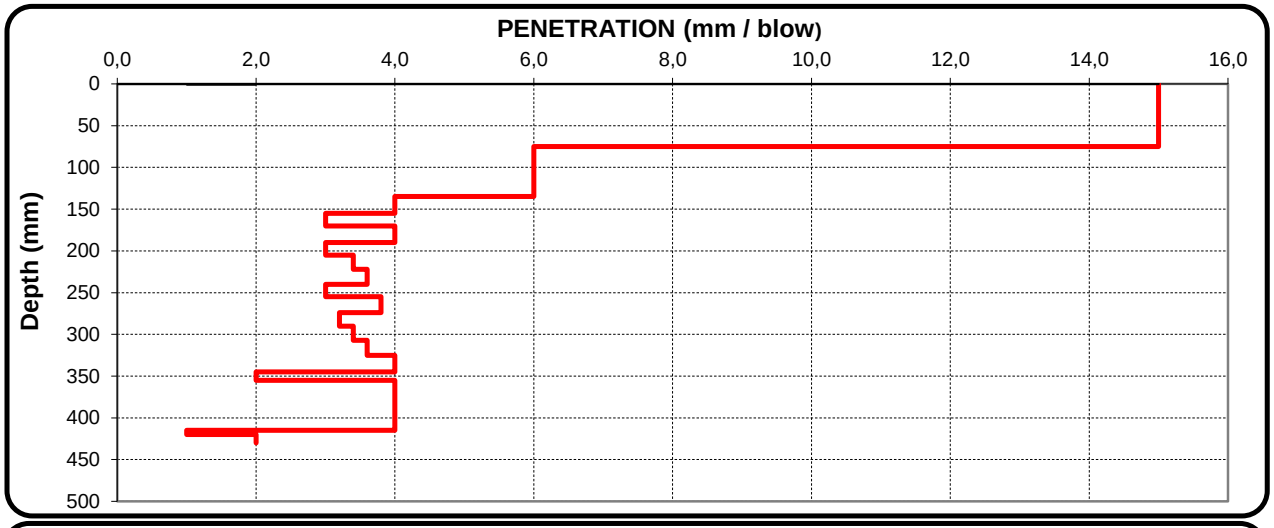
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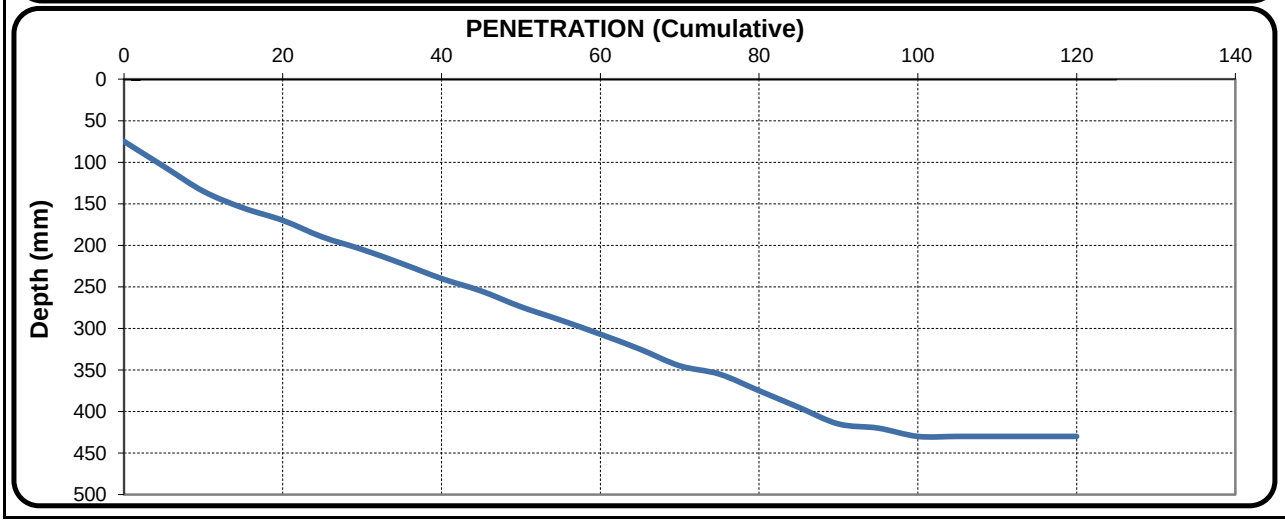
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

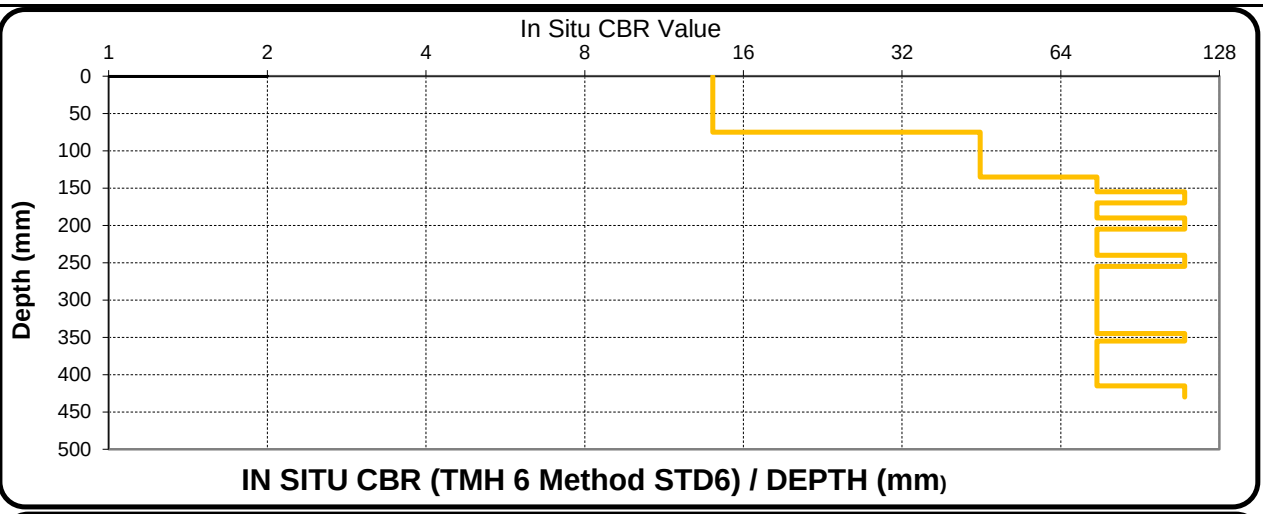




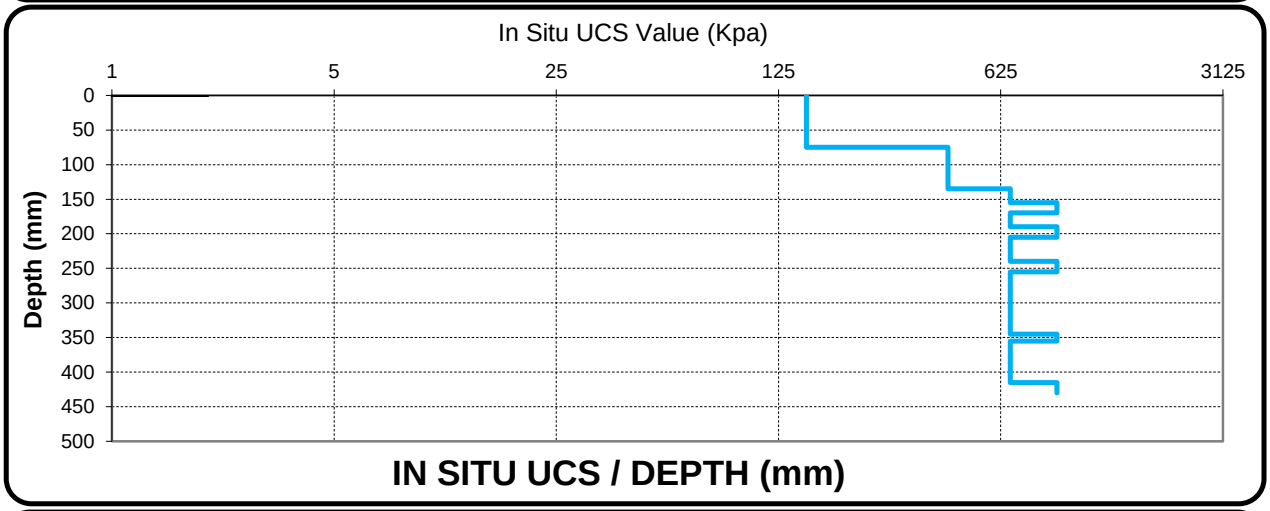
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DYNAMIC CONE PENETROMETER (DCP)

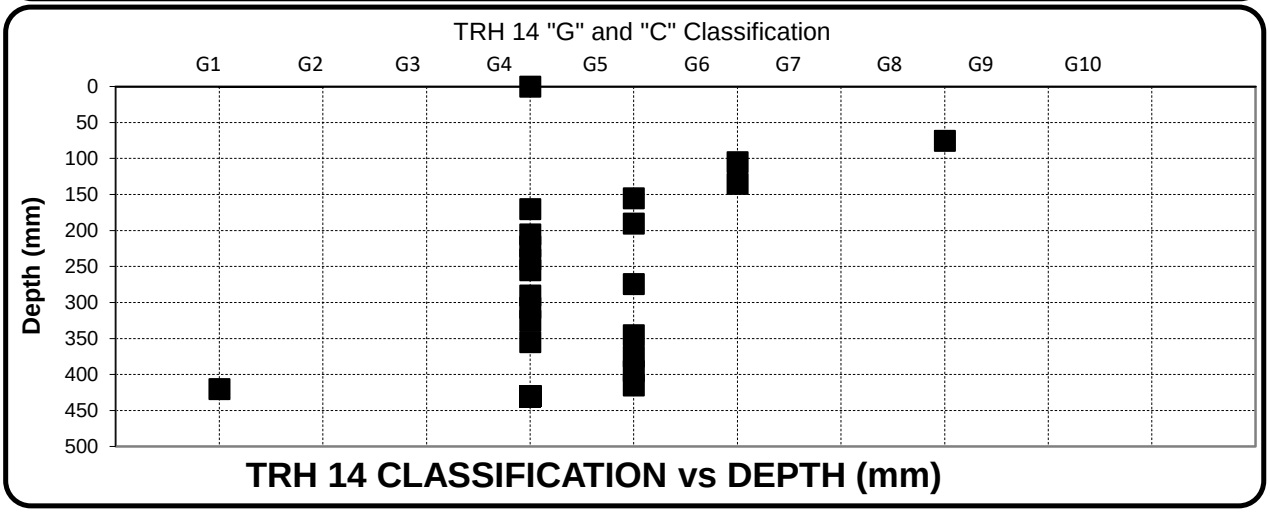
Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP3
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GRIT REMOVAL
GPS (X): 3 401 812.625
)ject Number: 1
Chainage: SOUTH
GPS (Y): 58 125.274
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	60	12,0	18	191	G7
5	60	-	90	6,0	45	427	G6
10	90	-	110	4,0	75	670	G5
15	110	-	140	6,0	45	427	G6
20	140	-	160	4,0	75	670	G5
25	160	-	185	5,0	55	510	G5
30	185	-	200	3,0	110	939	G4
35	200	-	210	2,0	110	939	G4
40	210	-	220	2,0	110	939	G4
45	220	-	235	3,0	110	939	G4
50	235	-	260	5,0	55	510	G5
55	260	-	280	4,0	75	670	G5
60	280	-	295	3,0	110	939	G4
65	295	-	310	3,0	110	939	G4
70	310	-	325	3,0	110	939	G4
75	325	-	335	2,0	110	939	G4
80	335	-	360	5,0	55	510	G5
85	360	-	385	5,0	55	510	G5

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

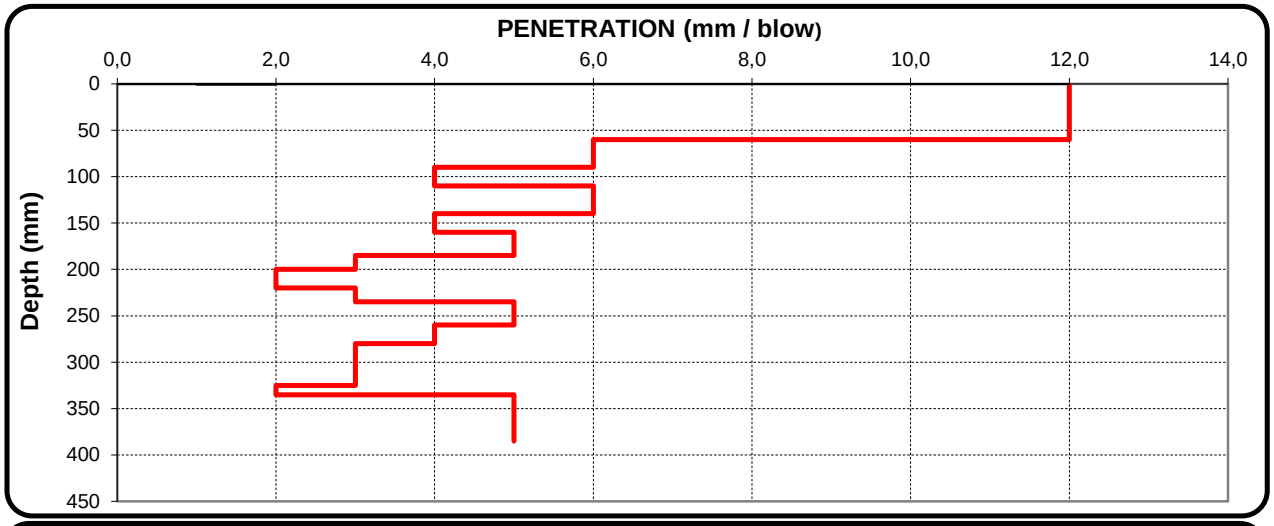
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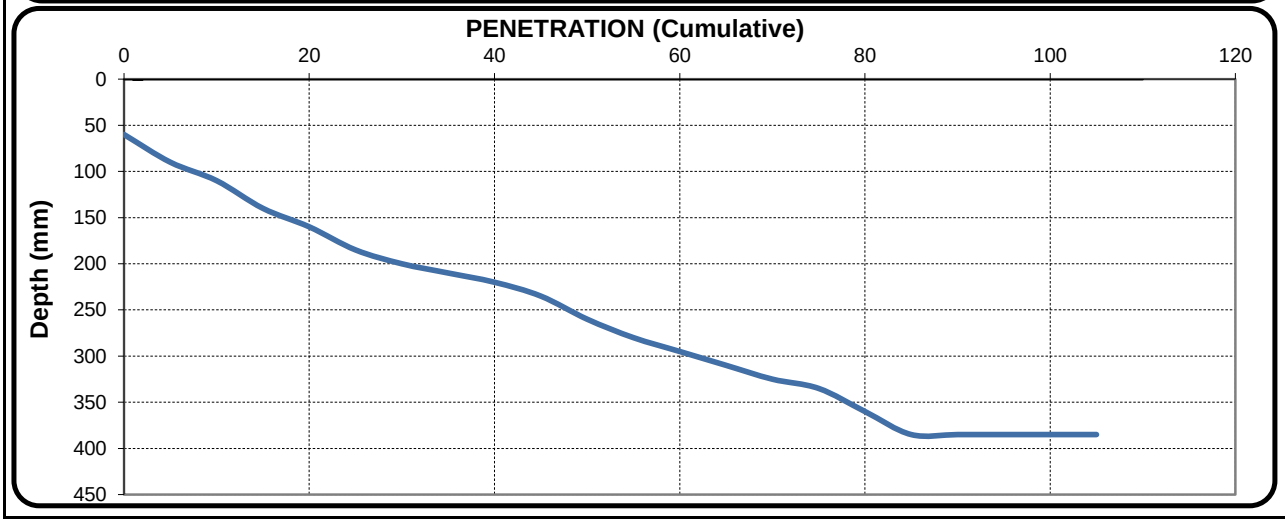
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

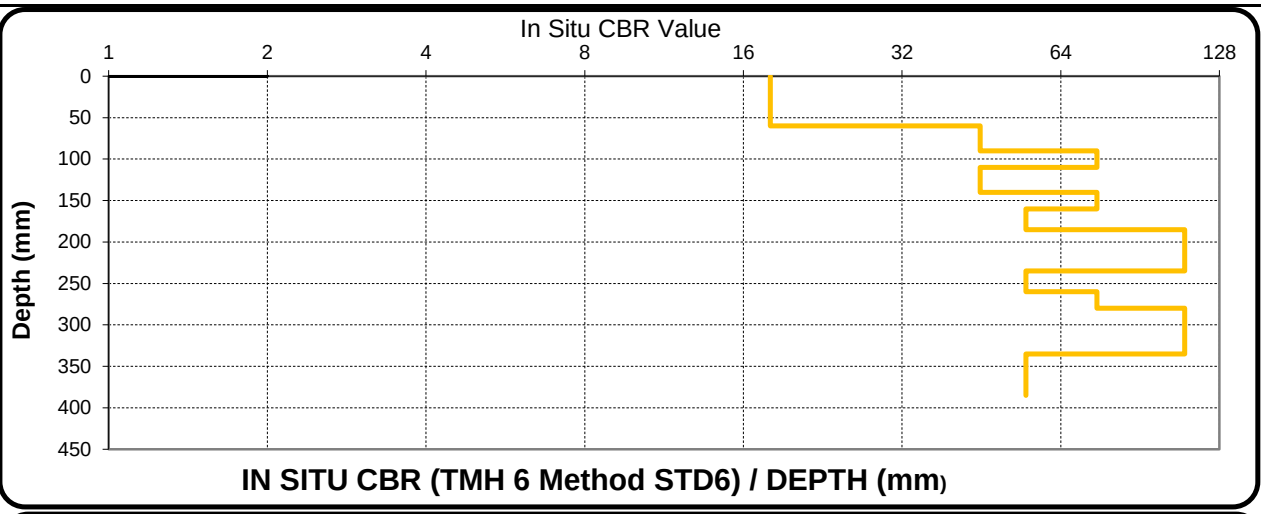




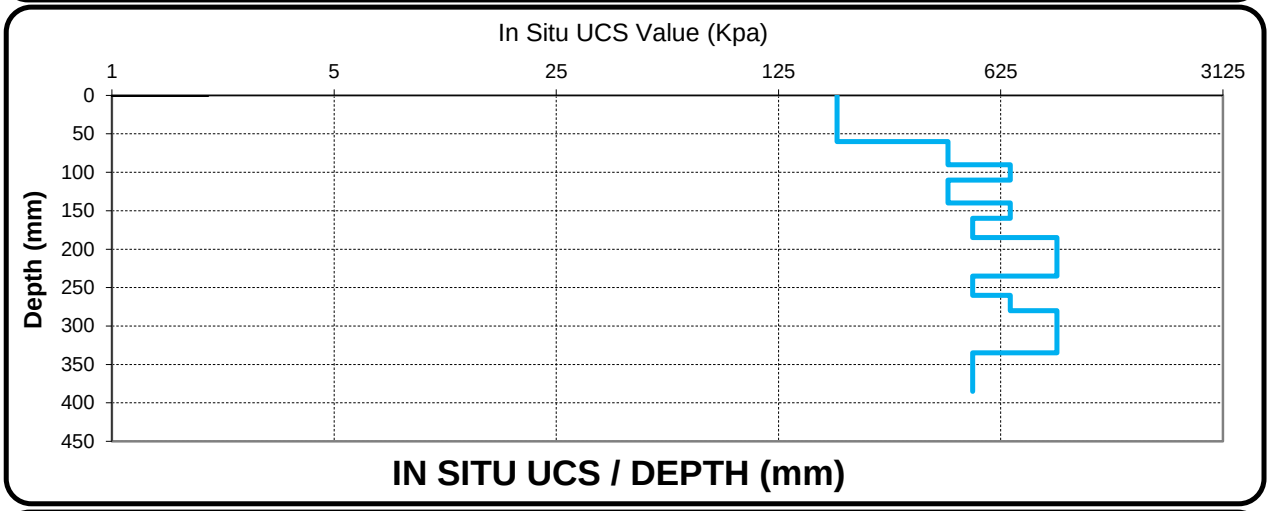
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DYNAMIC CONE PENETROMETER (DCP)

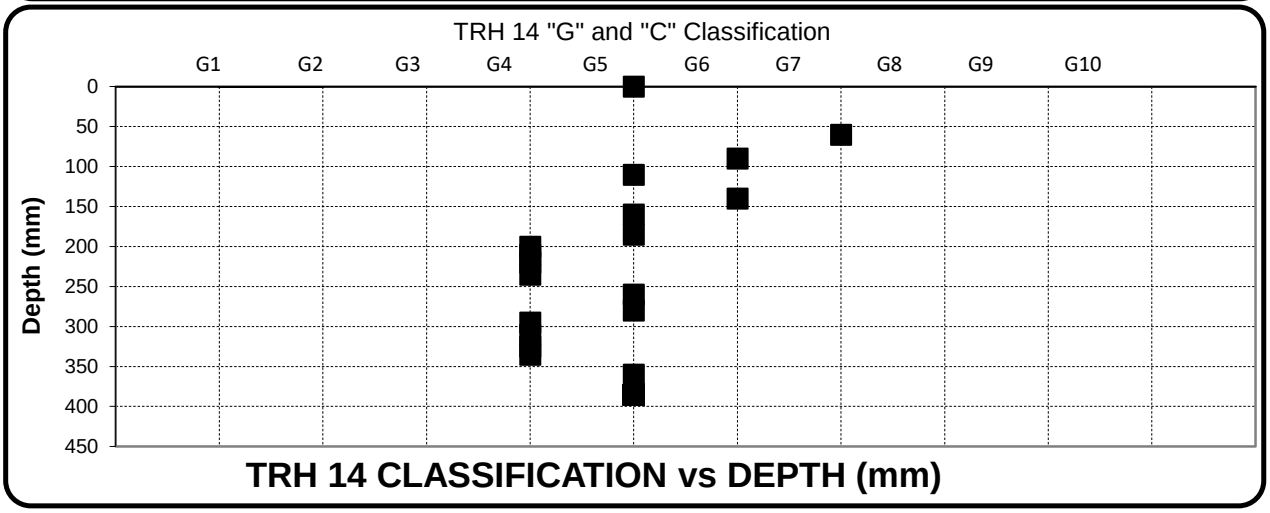
Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP4
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GRIT REMOVAL
GPS (X): 3 401 812.625
)ject Number: 1
Chainage: WEST
GPS (Y): 58 125.274
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	60	12,0	18	191	G7
5	60	-	100	8,0	30	299	G6
10	100	-	120	4,0	75	670	G5
15	120	-	150	6,0	45	427	G6
20	150	-	175	5,0	55	510	G5
25	175	-	200	5,0	55	510	G5
30	200	-	210	2,0	110	939	G4
35	210	-	235	5,0	55	510	G5
40	235	-	245	2,0	110	939	G4
45	245	-	260	3,0	110	939	G4

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

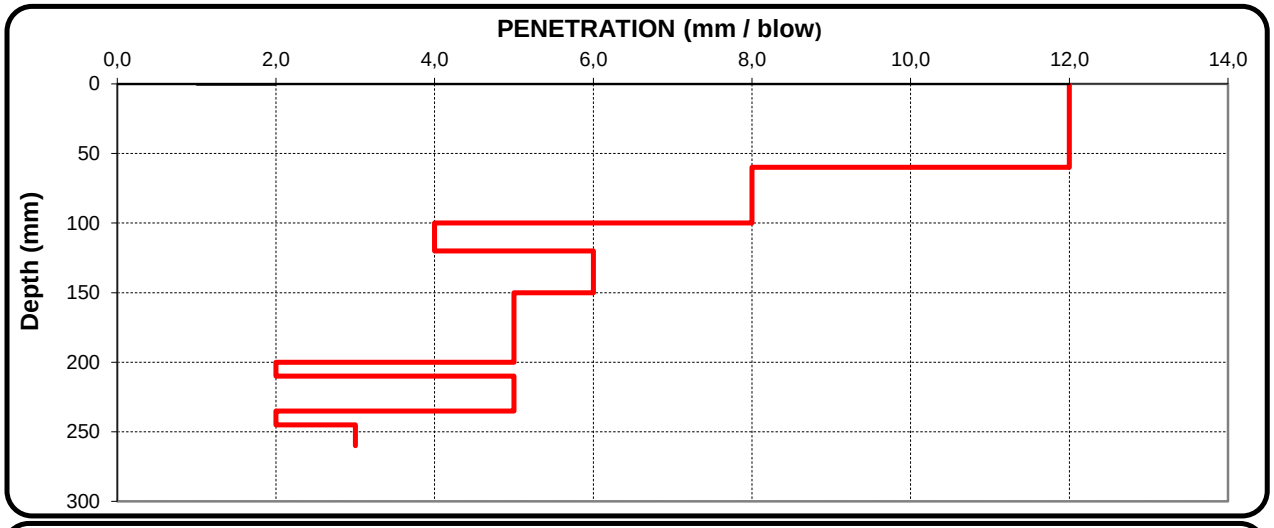
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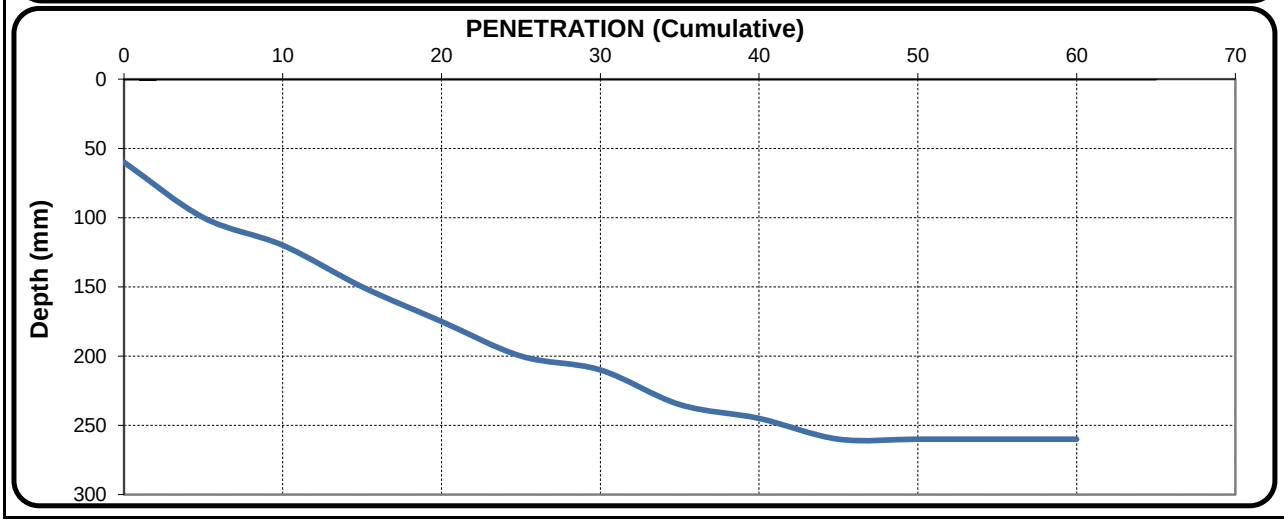
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

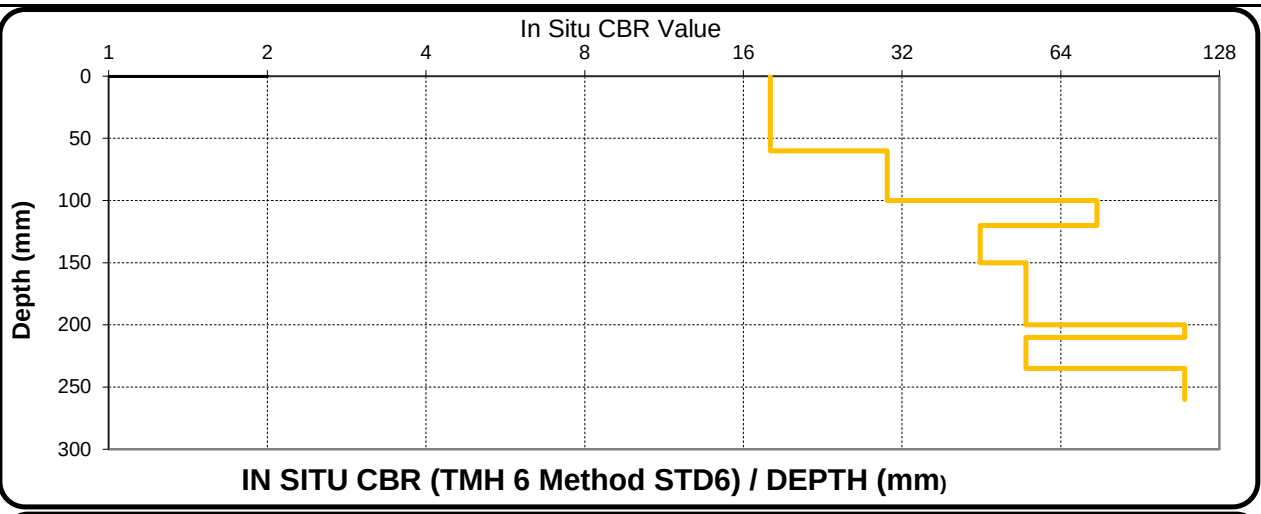




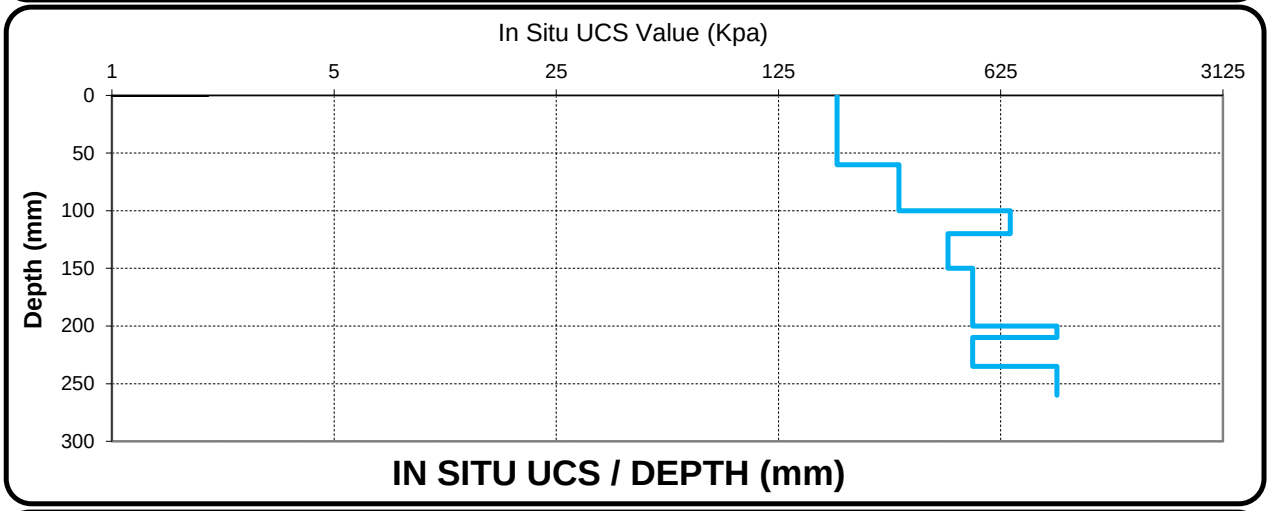
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DYNAMIC CONE PENETROMETER (DCP)

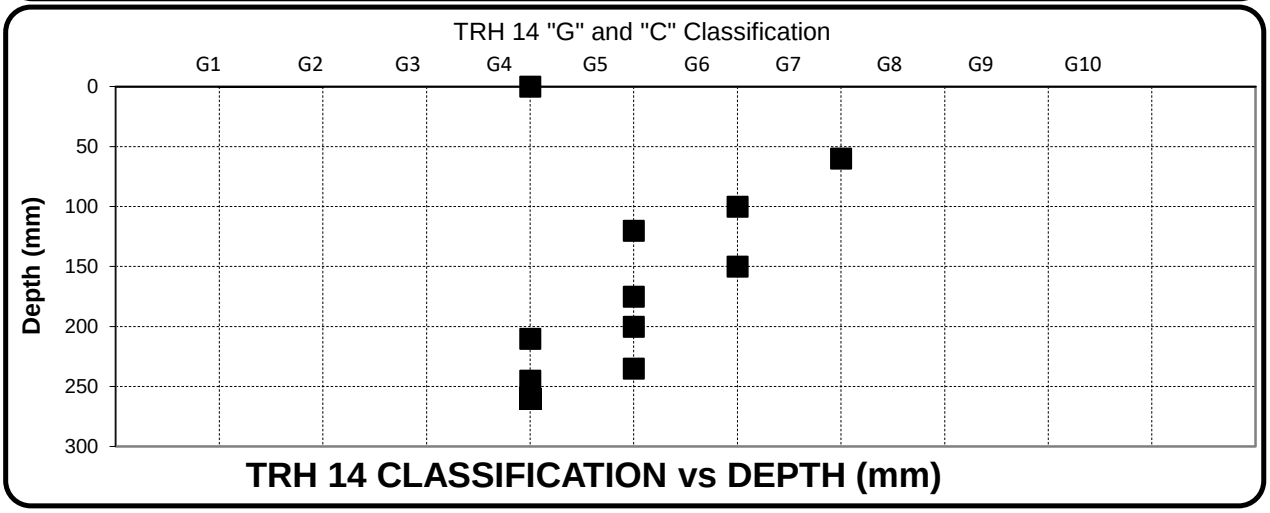
Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP5
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GRIT REMOVAL
GPS (X): 3 401 812.625
)ject Number: 1
Chainage: NORTH WEST
GPS (Y): 58 125.274
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	70	14,0	15	163	G8
5	70	-	90	4,0	75	670	G5
10	90	-	120	6,0	45	427	G6
15	120	-	160	8,0	30	299	G6
20	160	-	165	1,0	110	939	G1
25	165	-	190	5,0	55	510	G5
30	190	-	205	3,0	110	939	G4
35	205	-	215	2,0	110	939	G4
40	215	-	225	2,0	110	939	G4
45	225	-	245	4,0	75	670	G5
50	245	-	265	4,0	75	670	G5
55	265	-	275	2,0	110	939	G4
60	275	-	285	2,0	110	939	G4
65	285	-	300	3,0	110	939	G4
70	300	-	330	6,0	45	427	G6
75	330	-	340	2,0	110	939	G4

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP5	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

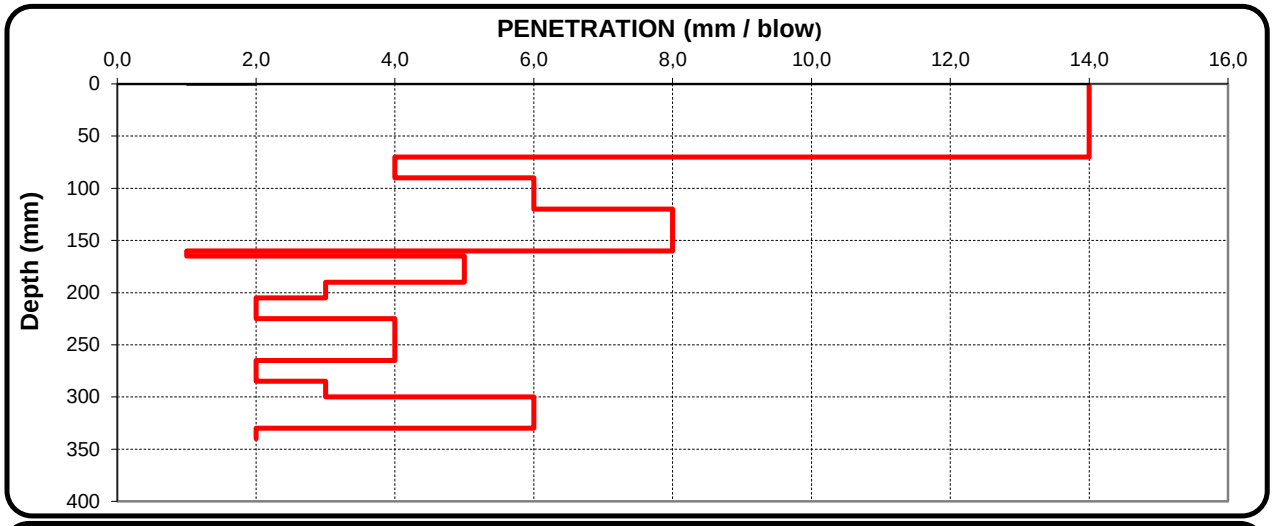
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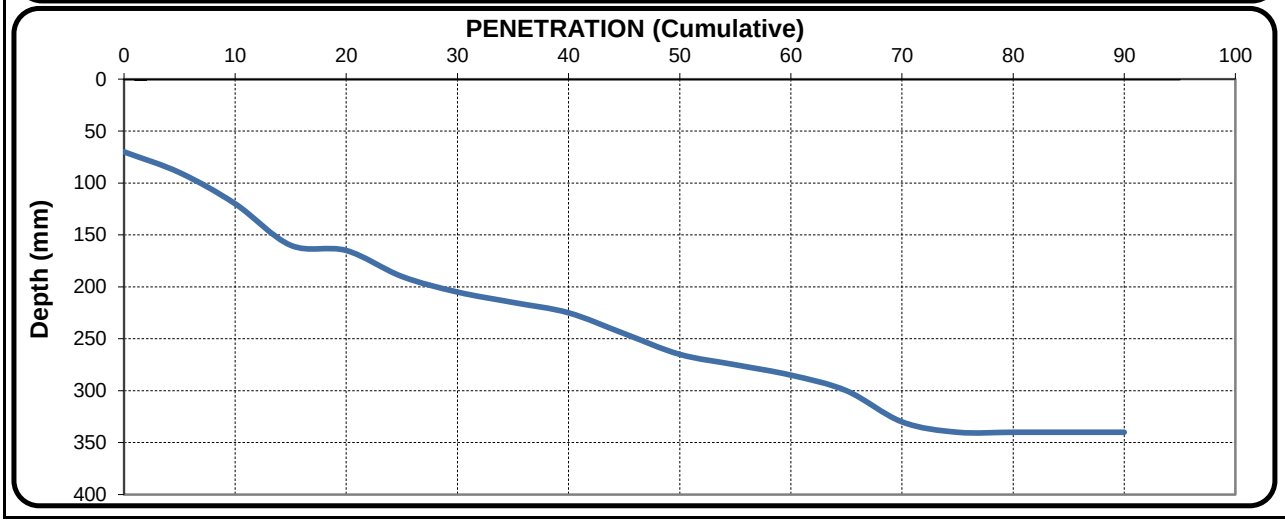
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP5	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

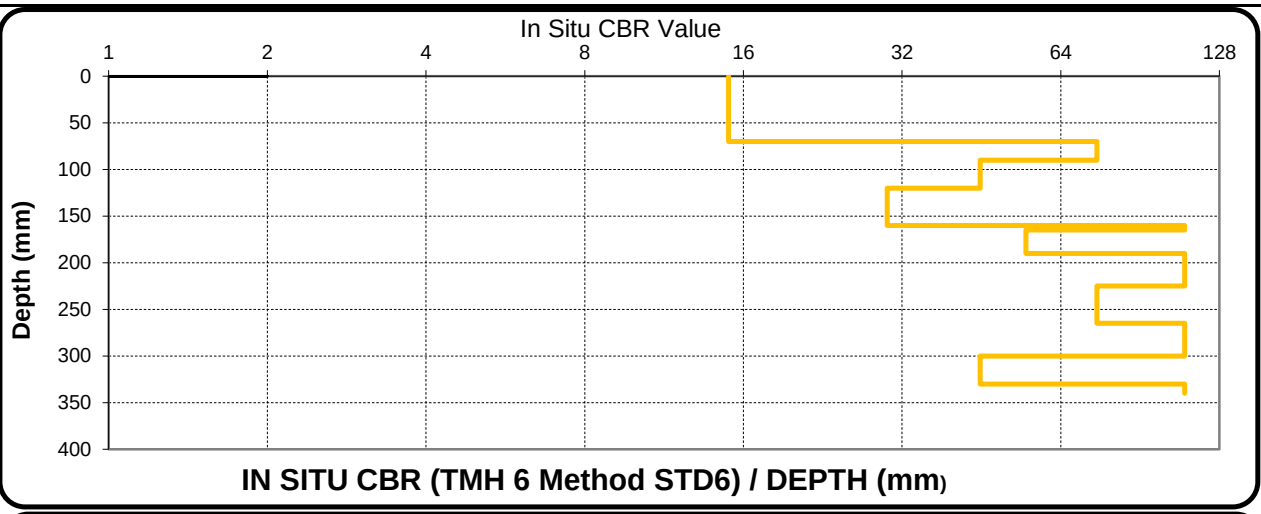




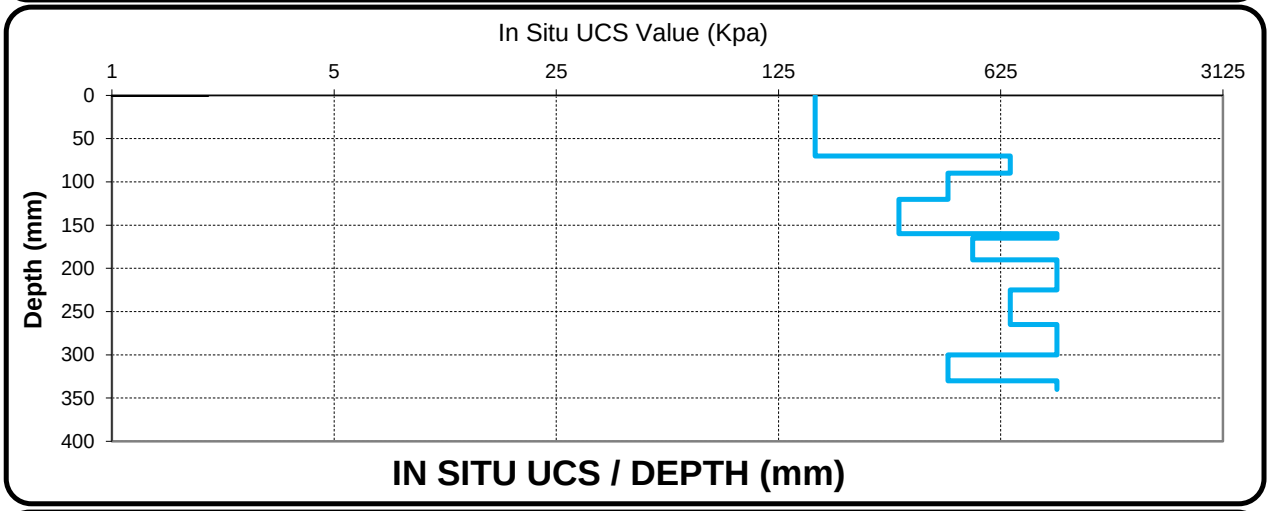
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DYNAMIC CONE PENETROMETER (DCP)

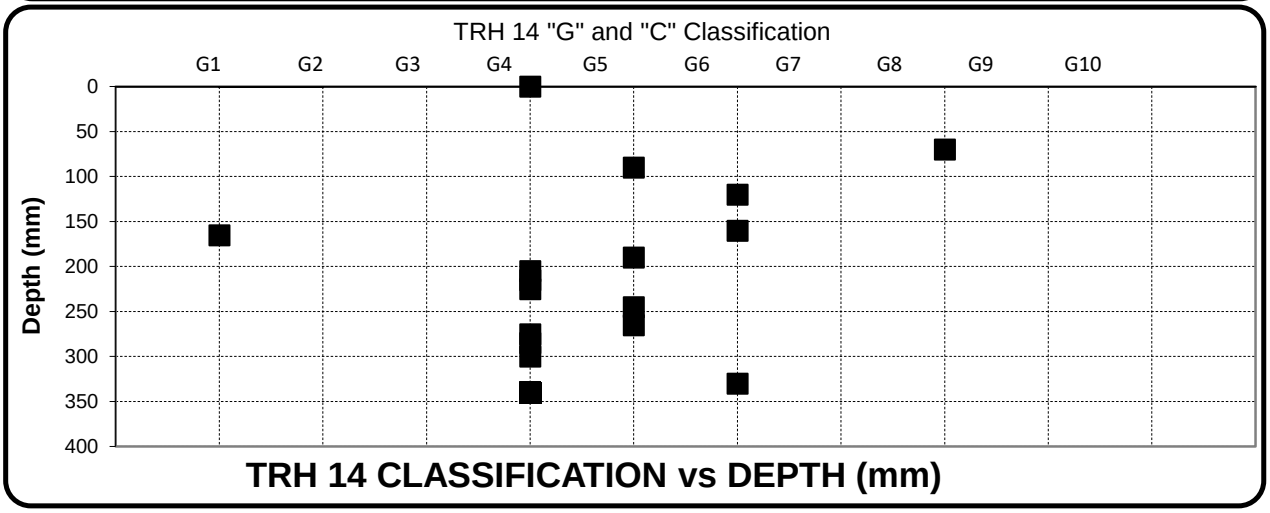
Client :	Ugu District Municipality	**Testpit No:**	TP5	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GRIT REMOVAL	**GPS (X):**	3 401 812.625
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58 125.274
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP1
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GUARD HOUSE
GPS (X): 3 401 746.018
)ject Number: 1
Chainage: NORHT
GPS (Y): 58 006.167
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	105	21,0	8	93	G9
5	105	-	140	7,0	35	343	G6
10	140	-	165	5,0	55	510	G5
15	165	-	190	5,0	55	510	G5
20	190	-	220	6,0	45	427	G6
25	220	-	255	7,0	35	343	G6
30	255	-	290	7,0	35	343	G6
35	290	-	325	7,0	35	343	G6
40	325	-	350	5,0	55	510	G5
45	350	-	385	7,0	35	343	G6
50	385	-	440	11,0	20	209	G7
55	440	-	515	15,0	14	153	G8
60	515	-	645	26,0	6	73	G10
65	645	-	825	36,0	4	51	G10
70	825	-	960	27,0	6	73	G10
75	960	-	1120	32,0	5	62	G10
80	1120	-	1225	21,0	8	93	G9
85	1225	-	1335	22,0	8	93	G9
90	1335	-	1425	18,0	11	124	G8

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	NORHT	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

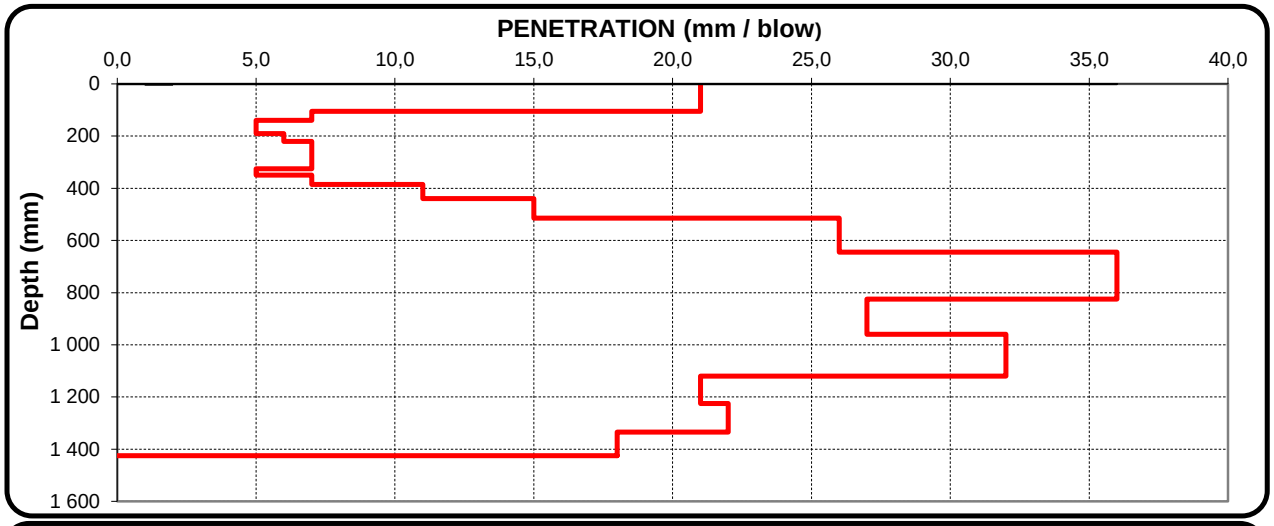
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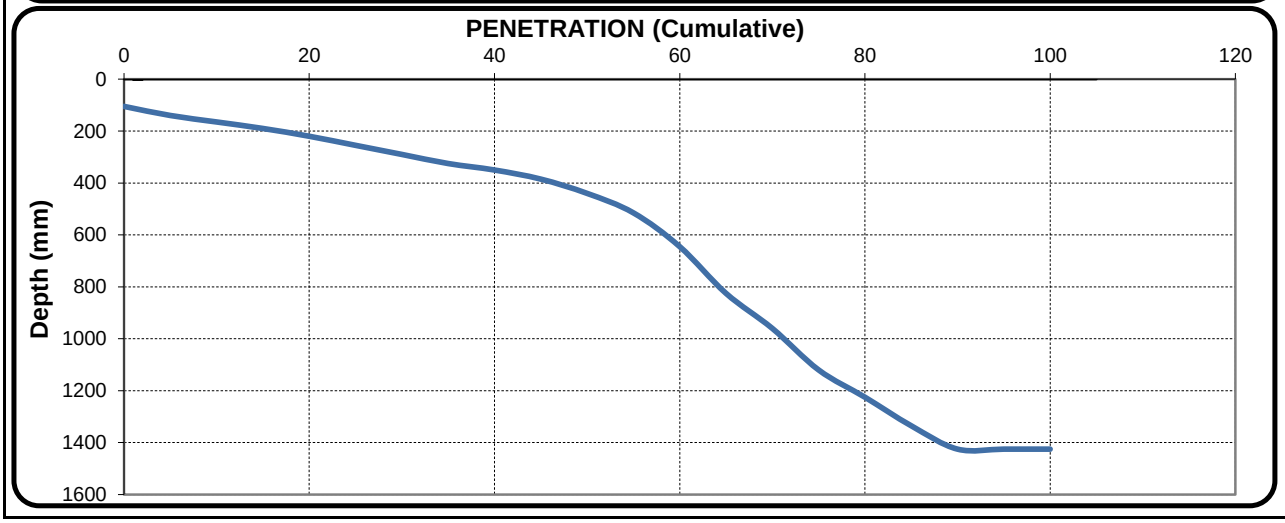
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	NORHT	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

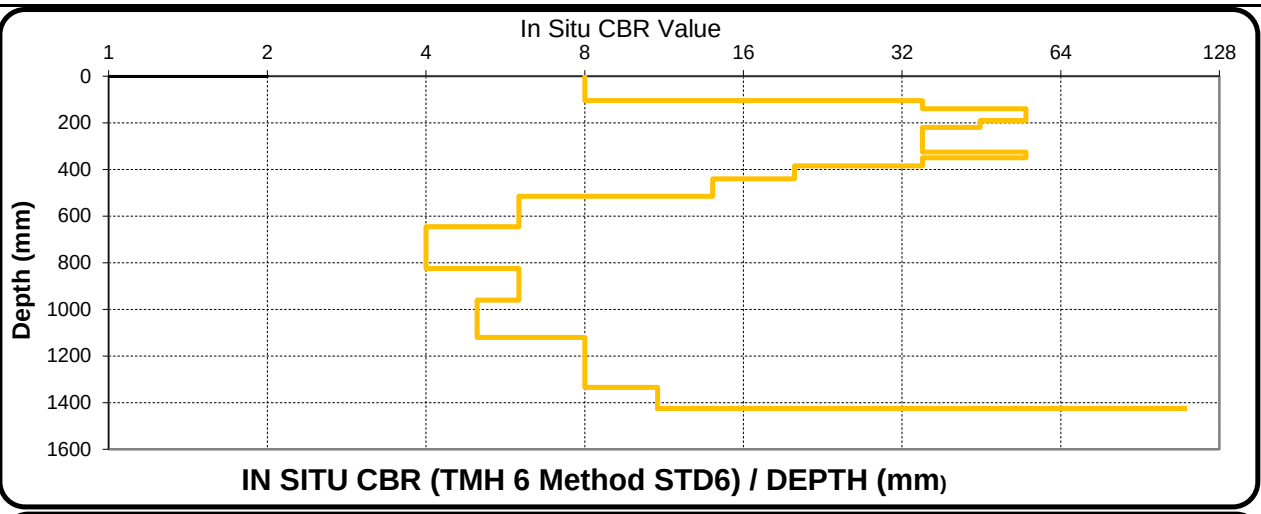




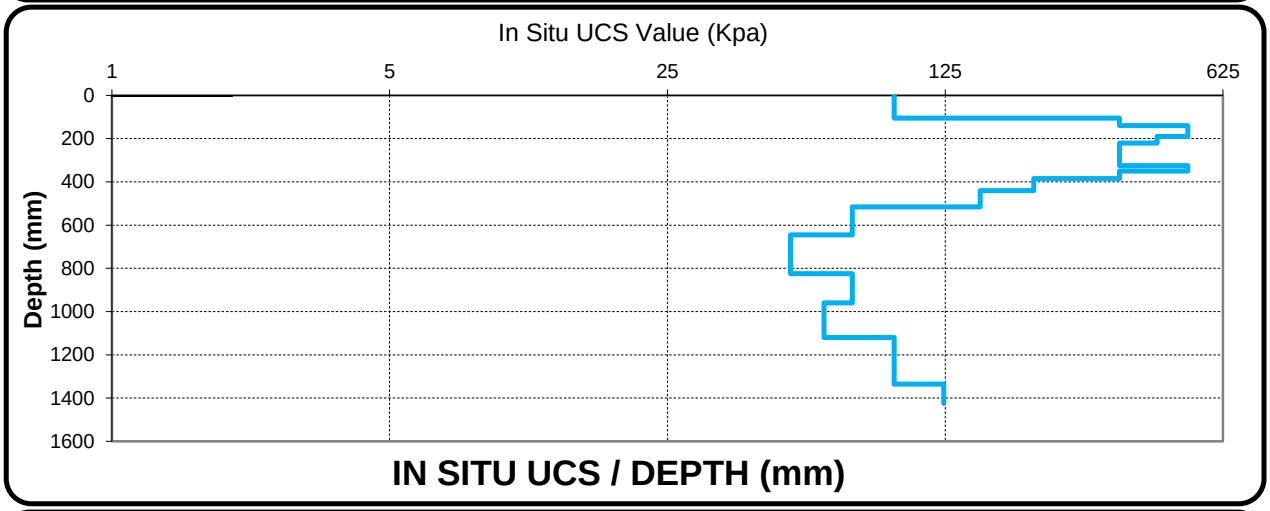
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DYNAMIC CONE PENETROMETER (DCP)

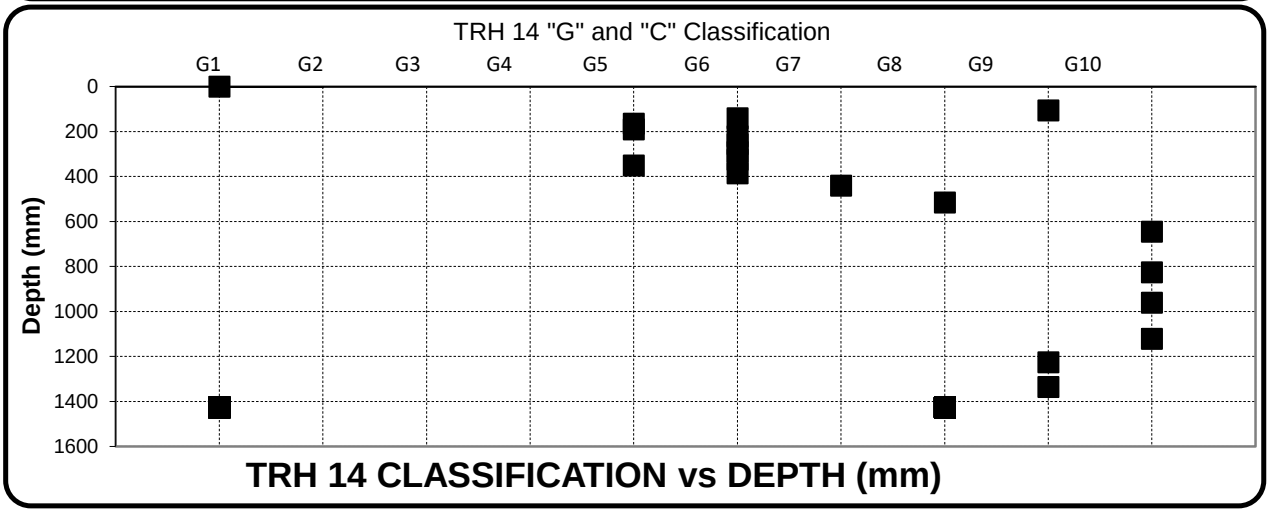
Client :	Ugu District Municipality	**Testpit No:**	TP1	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	NORHT	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP2
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GUARD HOUSE
GPS (X): 3 401 746.018
)ject Number: 1
Chainage: EAST
GPS (Y): 58 006.167
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	60	12,0	18	191	G7
5	60	-	150	18,0	11	124	G8
10	150	-	157	1,4	110	939	G2
15	157	-	175	3,6	75	670	G4
20	175	-	180	1,0	110	939	G1
25	180	-	185	1,0	110	939	G1

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

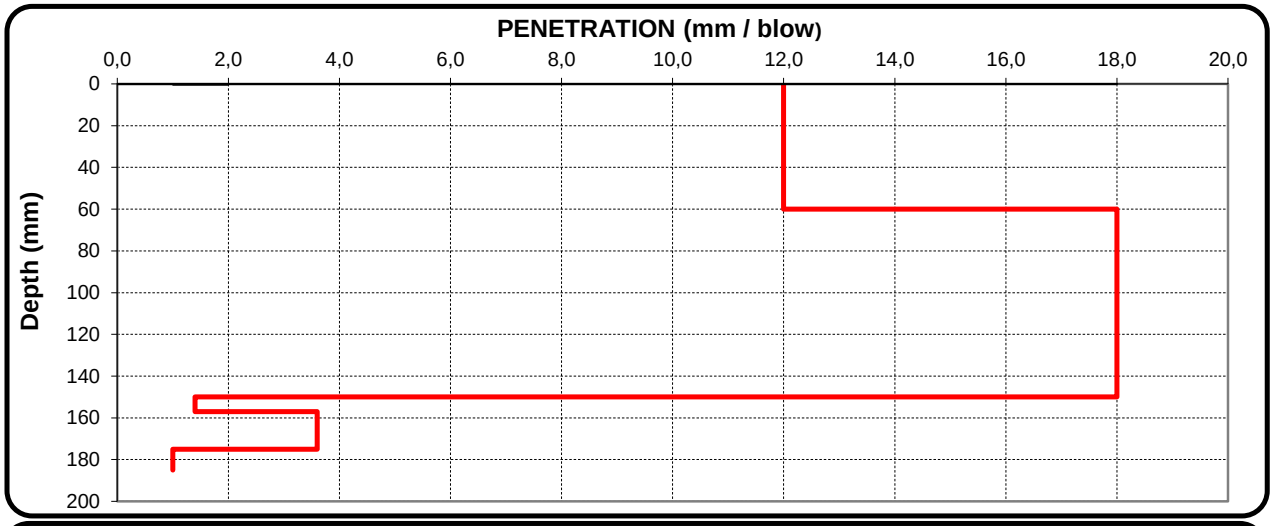
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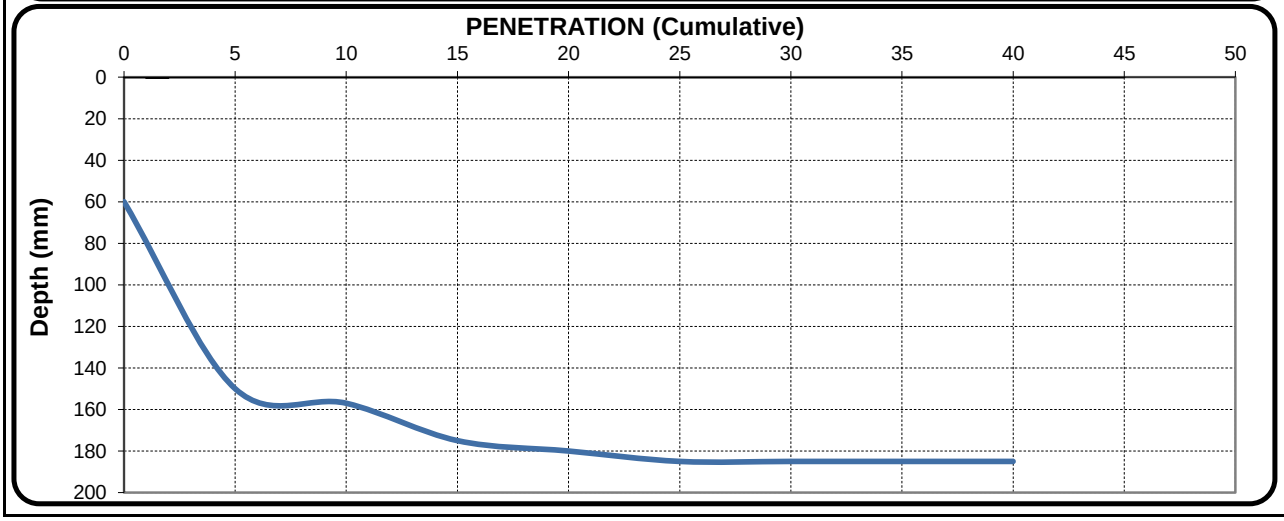
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

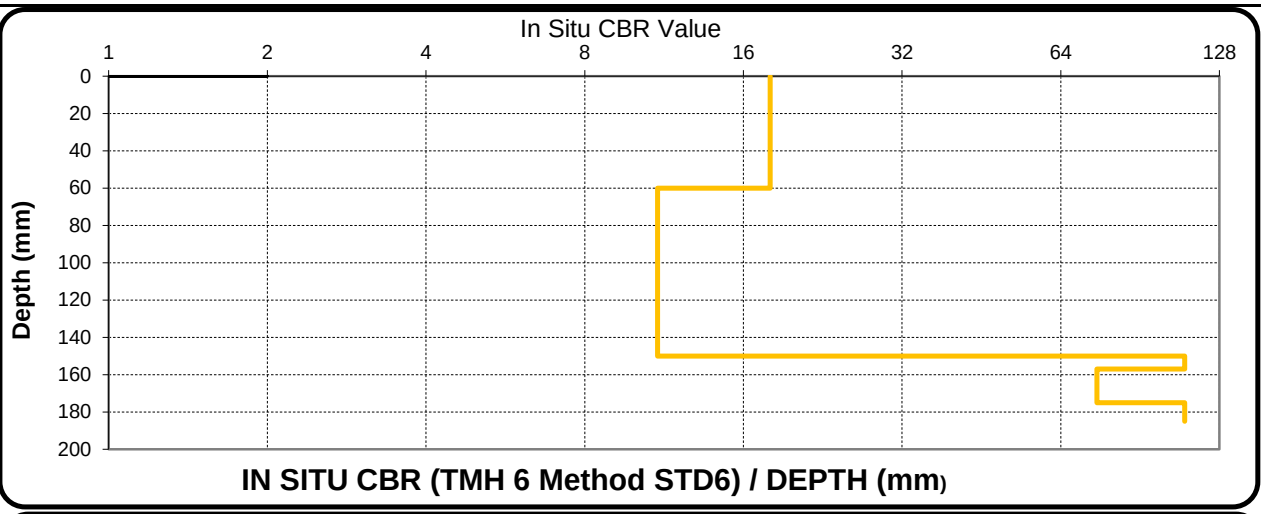




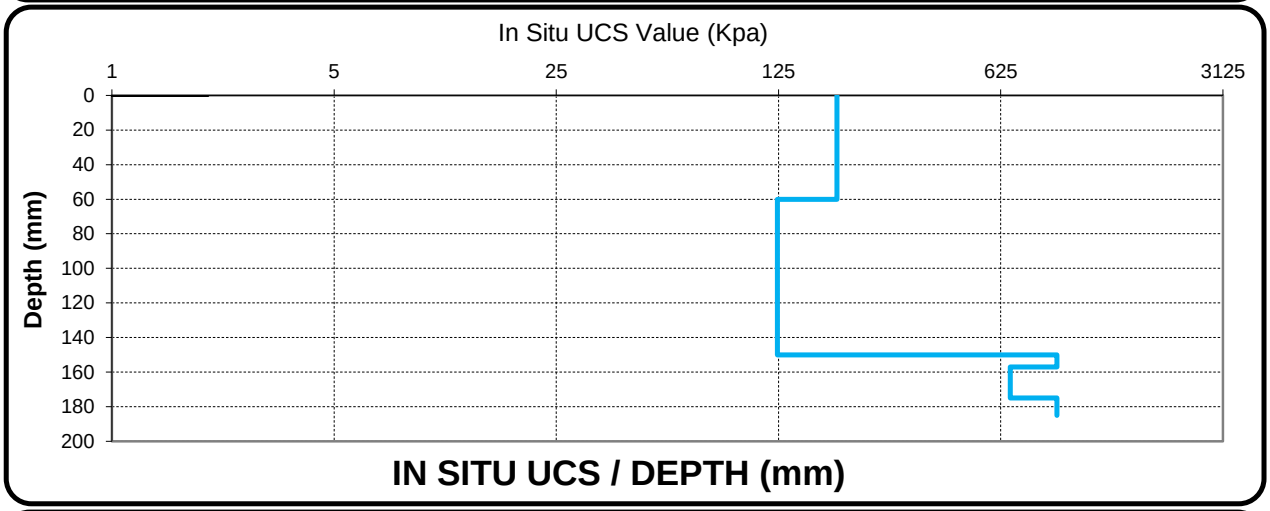
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DYNAMIC CONE PENETROMETER (DCP)

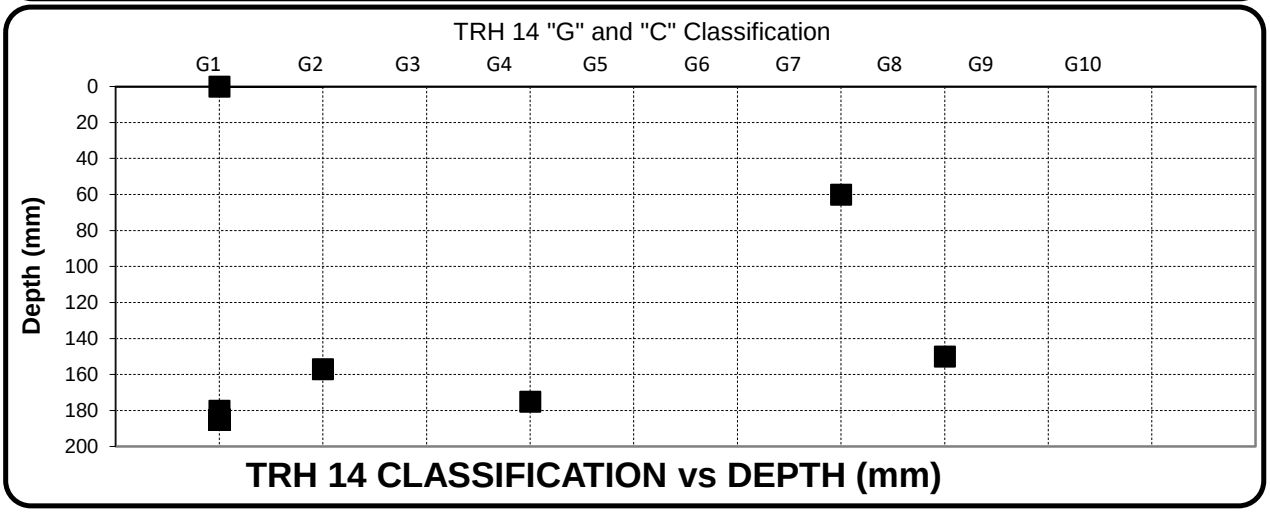
Client :	Ugu District Municipality	**Testpit No:**	TP2	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	EAST	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP3
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GUARD HOUSE
GPS (X): 3 401 746.018
)ject Number: 1
Chainage: South
GPS (Y): 58 006.167
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	85	17,0	12	134	G8
5	85	-	160	15,0	14	153	G8
10	160	-	230	14,0	15	163	G8
15	230	-	300	14,0	15	163	G8
20	300	-	370	14,0	15	163	G8
25	370	-	460	18,0	11	124	G8
30	460	-	555	19,0	8	93	G9
35	555	-	670	23,0	7	83	G9
40	670	-	825	31,0	5	62	G10
45	825	-	935	22,0	8	93	G9
50	935	-	1025	18,0	11	124	G8
55	1025	-	1135	22,0	8	93	G9
60	1135	-	1255	24,0	7	83	G9
65	1255	-	1385	26,0	6	73	G10
70	1385	-	1480	19,0	8	93	G9

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	South	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

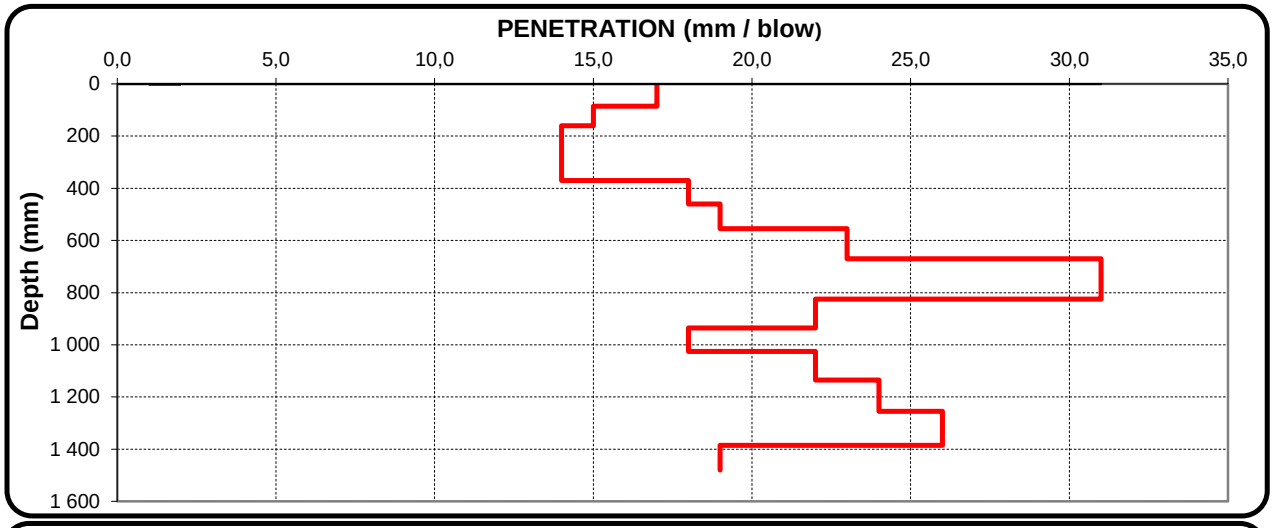
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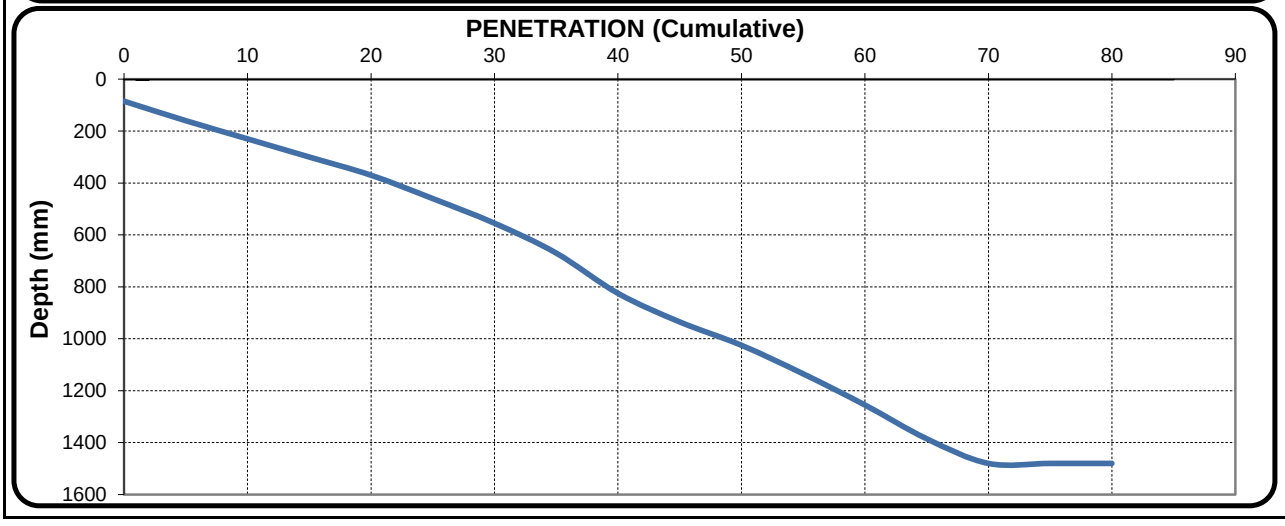
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	South	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

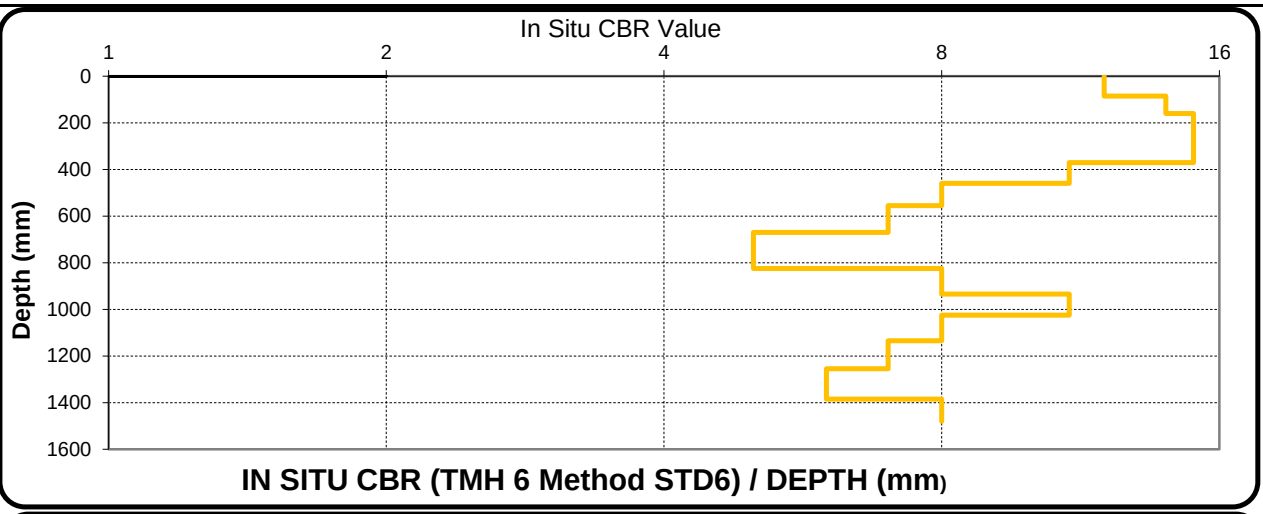




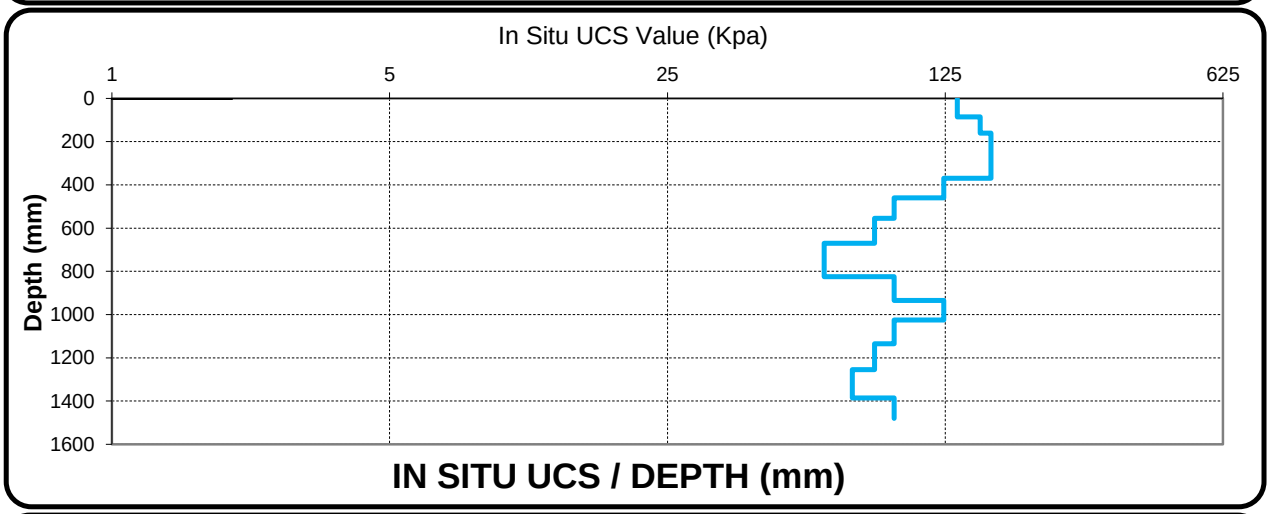
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DYNAMIC CONE PENETROMETER (DCP)

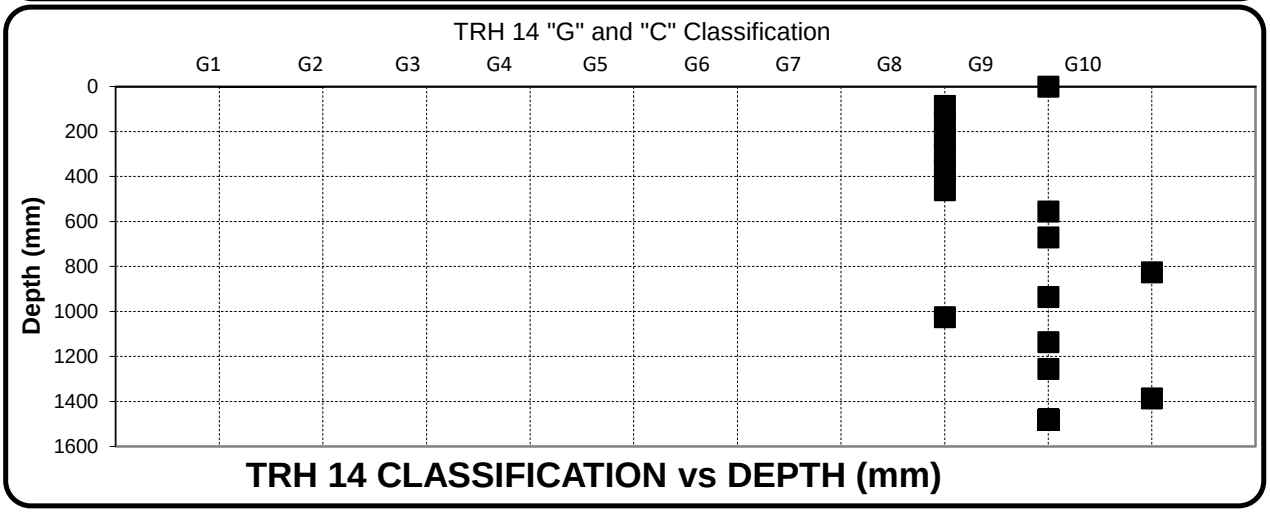
Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	South	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP4
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GUARD HOUSE
GPS (X): 3 401 746.018
)ject Number: 1
Chainage: WEST
GPS (Y): 58 006.167
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	70	14,0	15	163	G8
5	70	-	130	12,0	18	191	G7
10	130	-	155	5,0	55	510	G5
15	155	-	180	5,0	55	510	G5
20	180	-	210	6,0	45	427	G6
25	210	-	245	7,0	35	343	G6
30	245	-	285	8,0	30	299	G6
35	285	-	310	5,0	55	510	G5
40	310	-	340	6,0	45	427	G6
45	340	-	375	7,0	35	343	G6
50	375	-	400	5,0	55	510	G5
55	400	-	460	12,0	18	191	G7
60	460	-	490	6,0	45	427	G6
65	490	-	520	6,0	45	427	G6
70	520	-	590	14,0	15	163	G8
75	590	-	620	6,0	45	427	G6
80	620	-	680	12,0	18	191	G7
85	680	-	730	10,0	22	228	G7
90	730	-	770	8,0	30	299	G6
95	770	-	810	8,0	30	299	G6
100	810	-	840	6,0	45	427	G6
105	840	-	870	6,0	45	427	G6
110	870	-	900	6,0	45	427	G6
115	900	-	930	6,0	45	427	G6
120	930	-	960	6,0	45	427	G6
125	960	-	1100	28,0	6	73	G10
130	1100	-	1130	6,0	45	427	G6
135	1130	-	1180	10,0	22	228	G7
140	1180	-	1220	8,0	30	299	G6
145	1220	-	1290	14,0	15	163	G8
150	1290	-	1330	8,0	30	299	G6
155	1330	-	1390	12,0	18	191	G7
160	1390	-	1450	12,0	18	191	G7

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

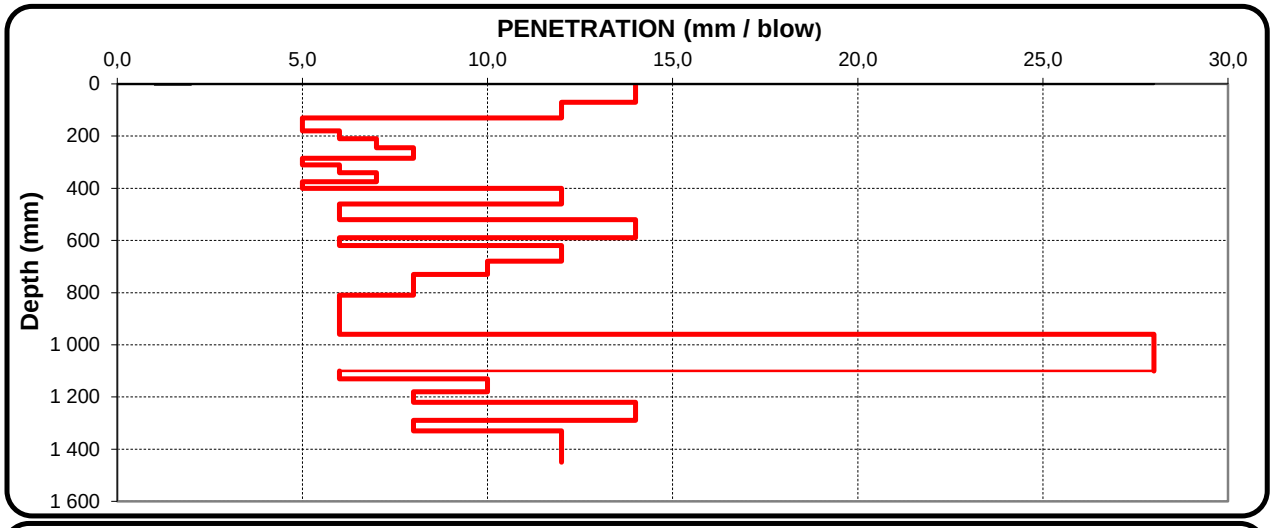
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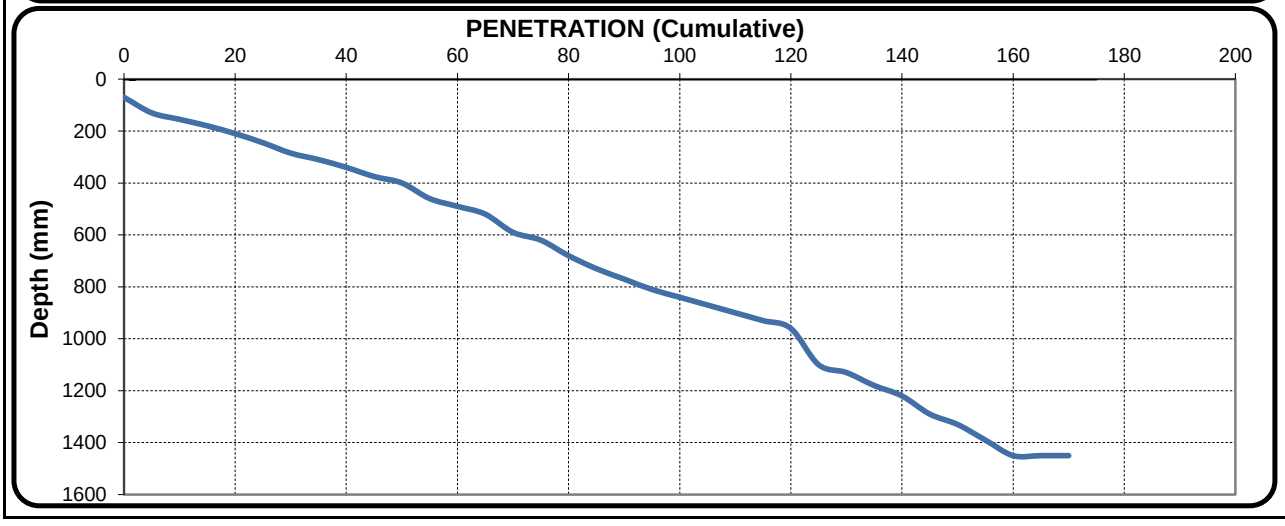
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

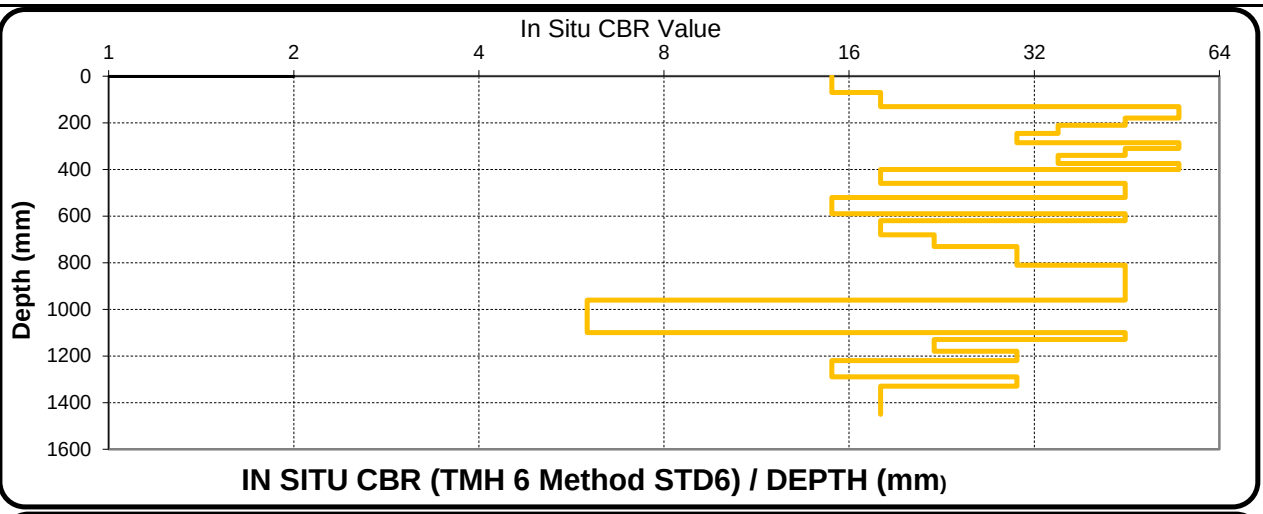




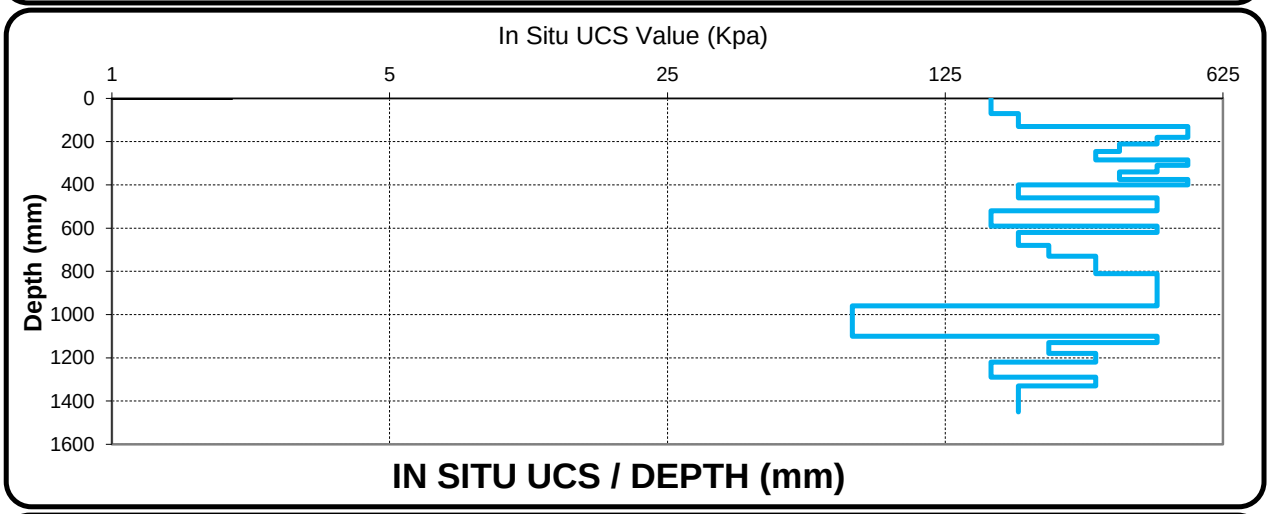
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DYNAMIC CONE PENETROMETER (DCP)

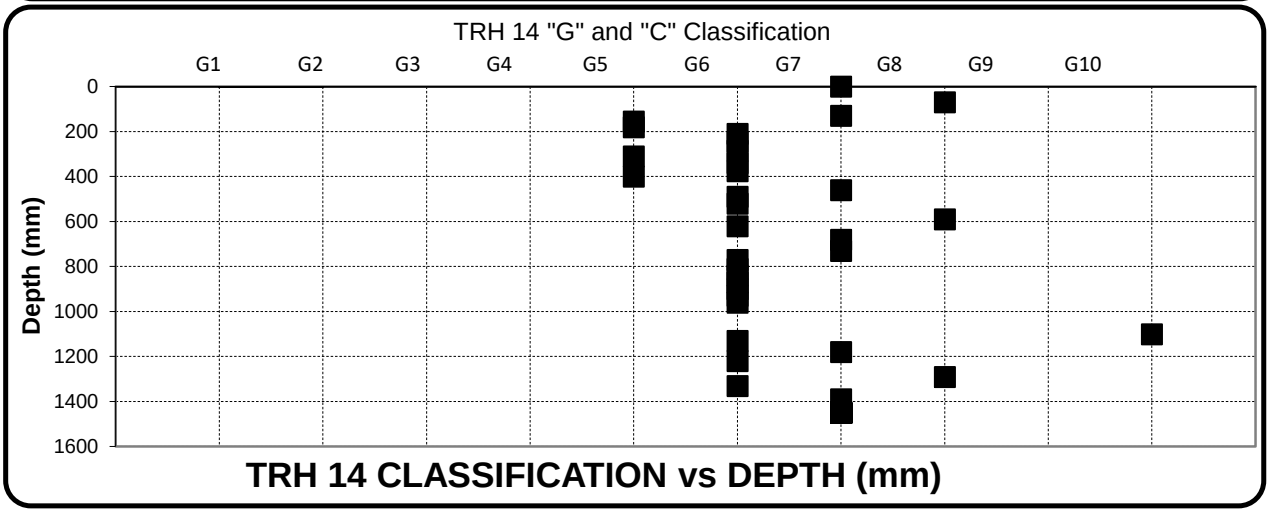
Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	3 401 746.018
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58 006.167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP5
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: GUARD HOUSE
GPS (X): 401898,693
)ject Number: 1
Chainage: NORTH WEST
GPS (Y): 58006,167
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 03/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	70	14,0	15	163	G8
5	70	-	140	14,0	15	163	G8
10	140	-	200	12,0	18	191	G7
15	200	-	270	14,0	15	163	G8
20	270	-	350	16,0	13	143	G8
25	350	-	410	12,0	18	191	G7
30	410	-	490	16,0	13	143	G8
35	490	-	530	8,0	30	299	G6
40	530	-	630	20,0	8	93	G9
45	630	-	700	14,0	15	163	G8
50	700	-	780	16,0	13	143	G8
55	780	-	810	6,0	45	427	G6
60	810	-	910	20,0	8	93	G9
65	910	-	1010	20,0	8	93	G9
70	1010	-	1100	18,0	11	124	G8
75	1100	-	1190	18,0	11	124	G8
80	1190	-	1240	10,0	22	228	G7
85	1240	-	1310	14,0	15	163	G8
90	1310	-	1400	18,0	11	124	G8

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP5	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	401898,693
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58006,167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

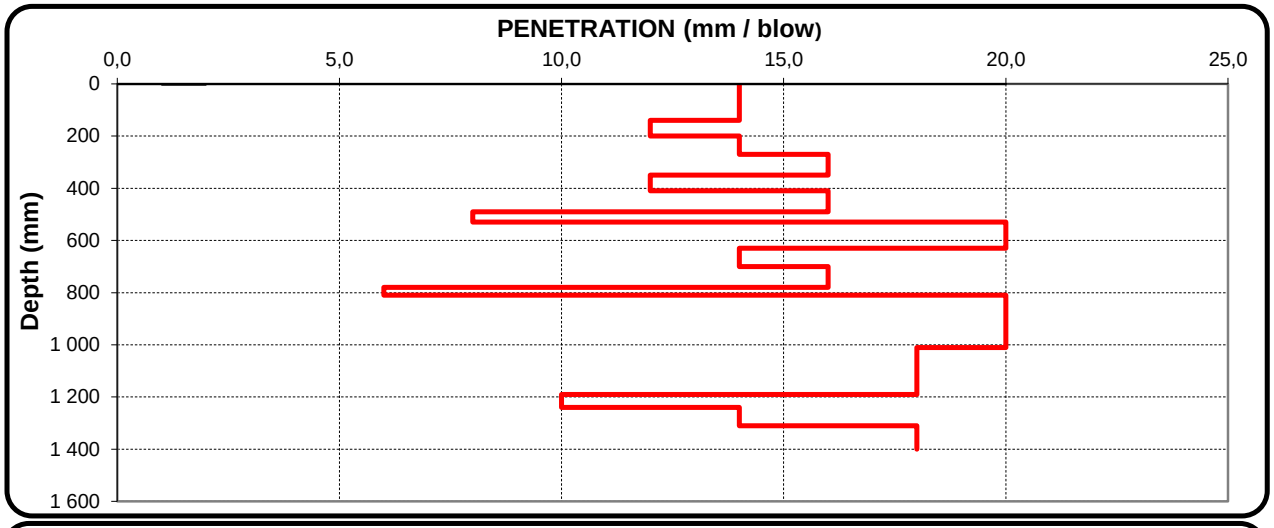
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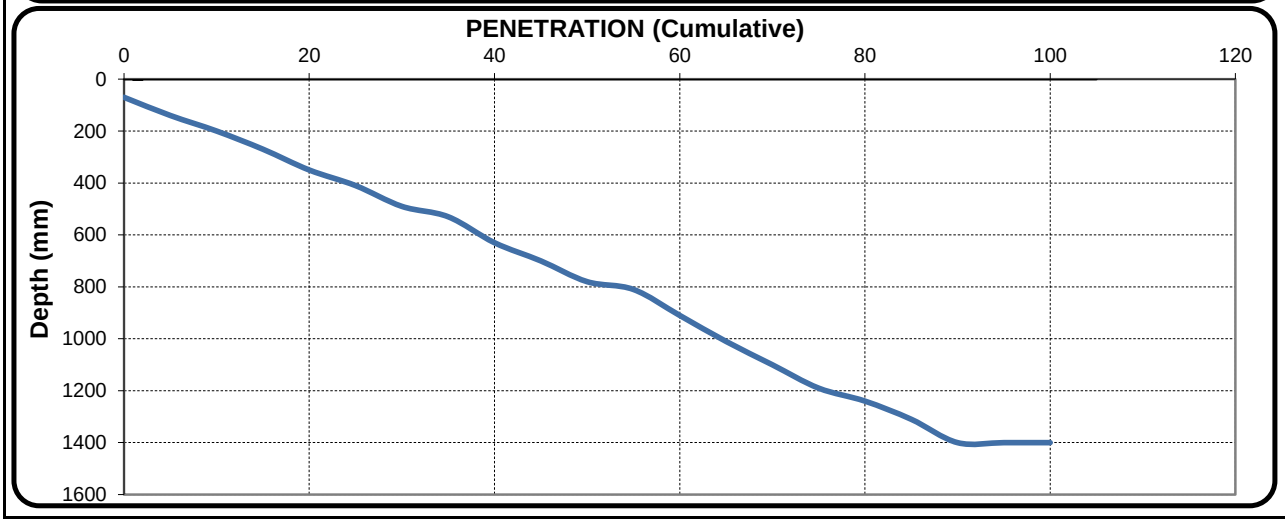
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP5	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	401898,693
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58006,167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

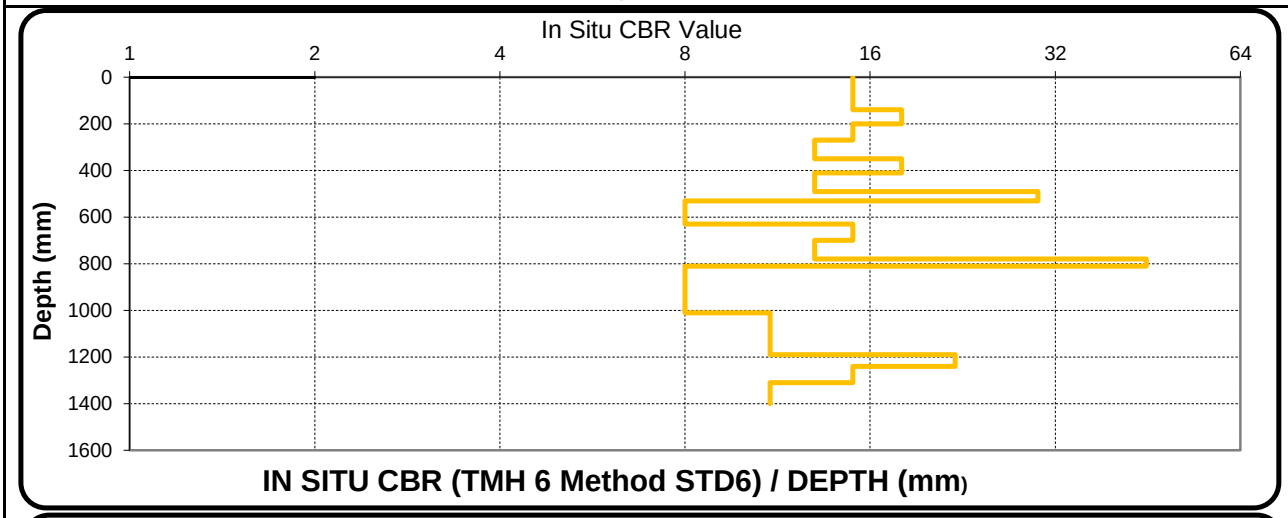




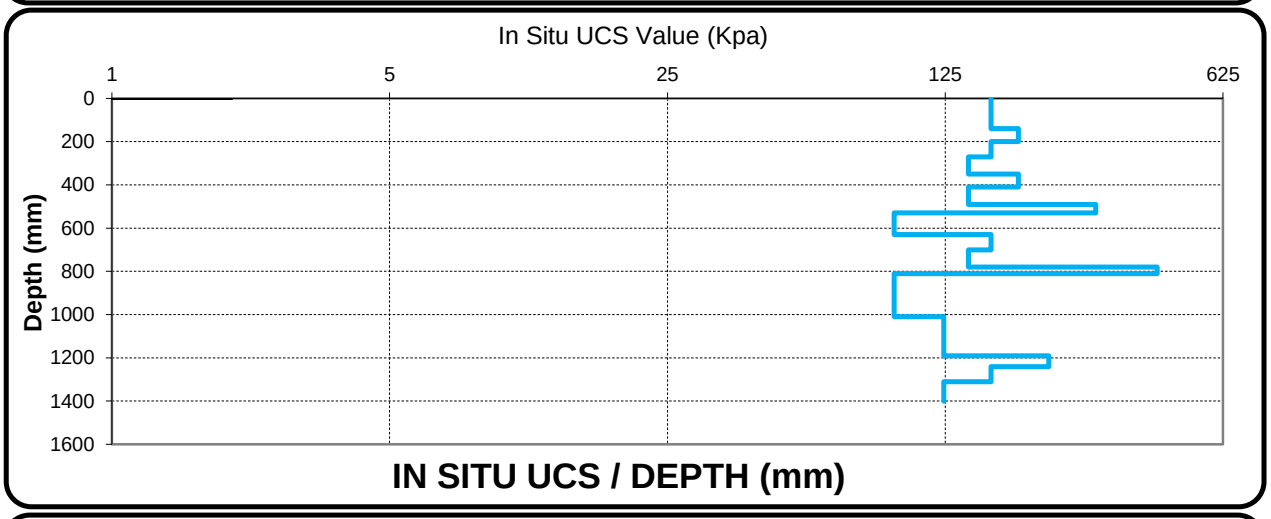
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DYNAMIC CONE PENETROMETER (DCP)

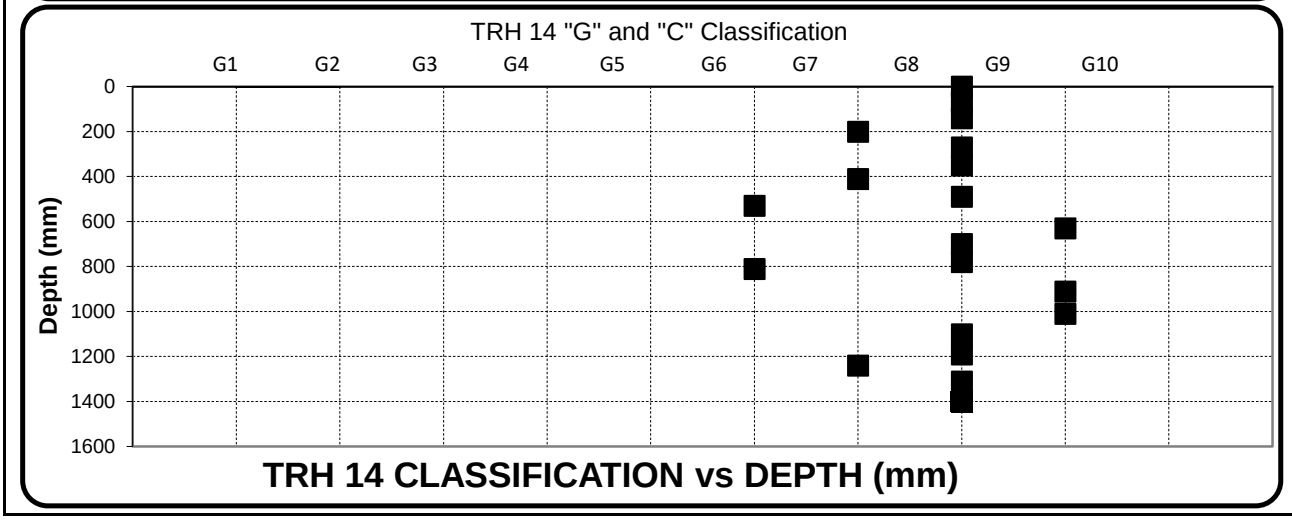
Client :	Ugu District Municipality	**Testpit No:**	TP5	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	GUARD HOUSE	**GPS (X):**	401898,693
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58006,167
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	03/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP3
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: SLUDGE THICKENEF
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: SOUTH
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	70	14,0	15	163	G8
5	70	-	110	8,0	30	299	G6
10	110	-	130	4,0	75	670	G5
15	130	-	145	3,0	110	939	G4
20	145	-	160	3,0	110	939	G4
25	160	-	165	1,0	110	939	G1
30	165	-	170	1,0	110	939	G1

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

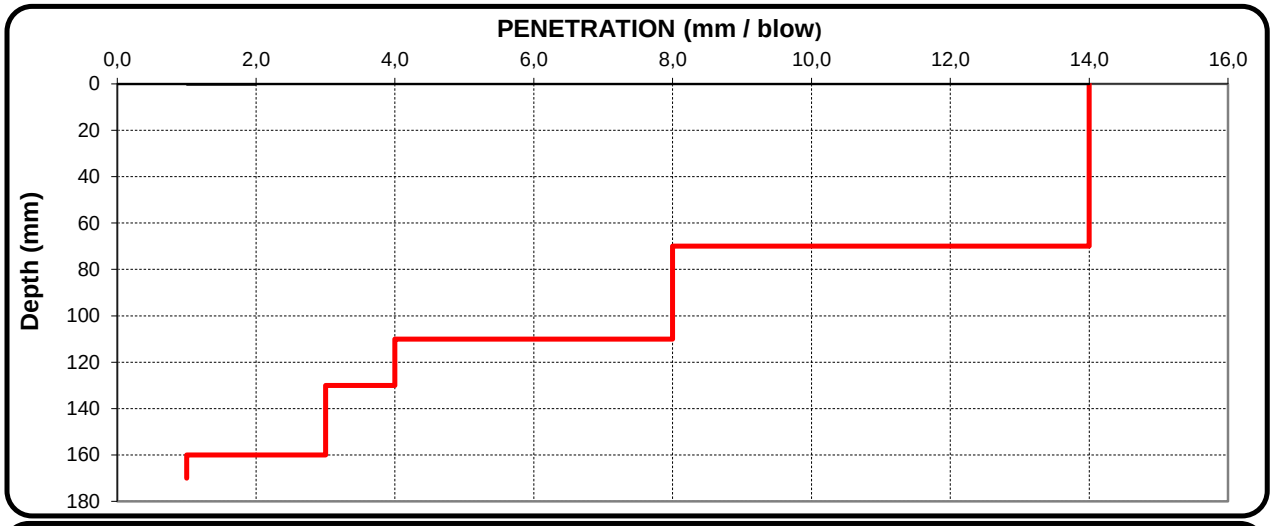
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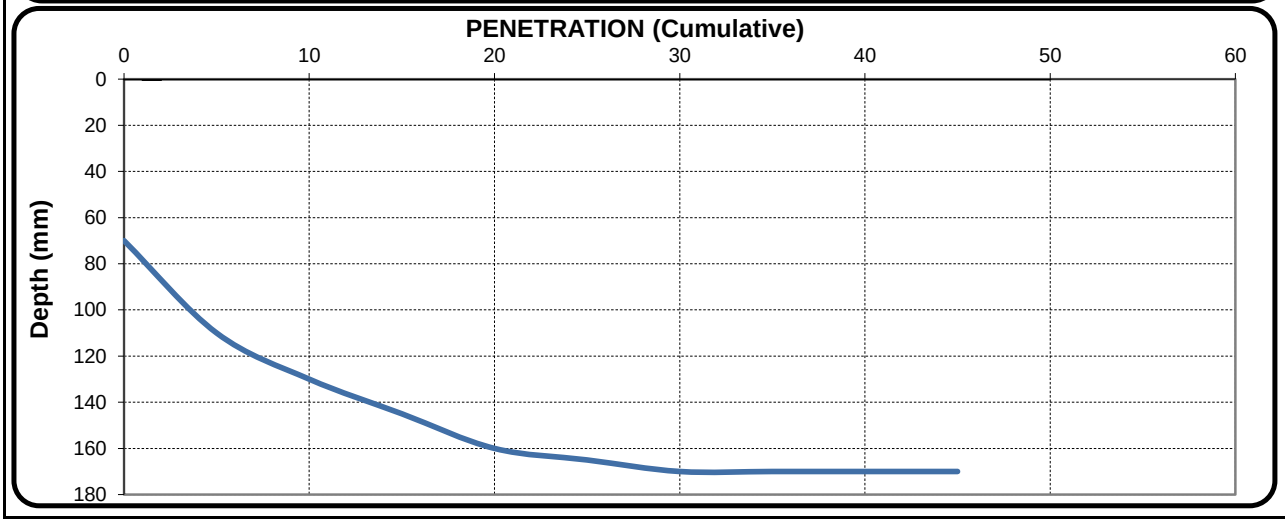
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

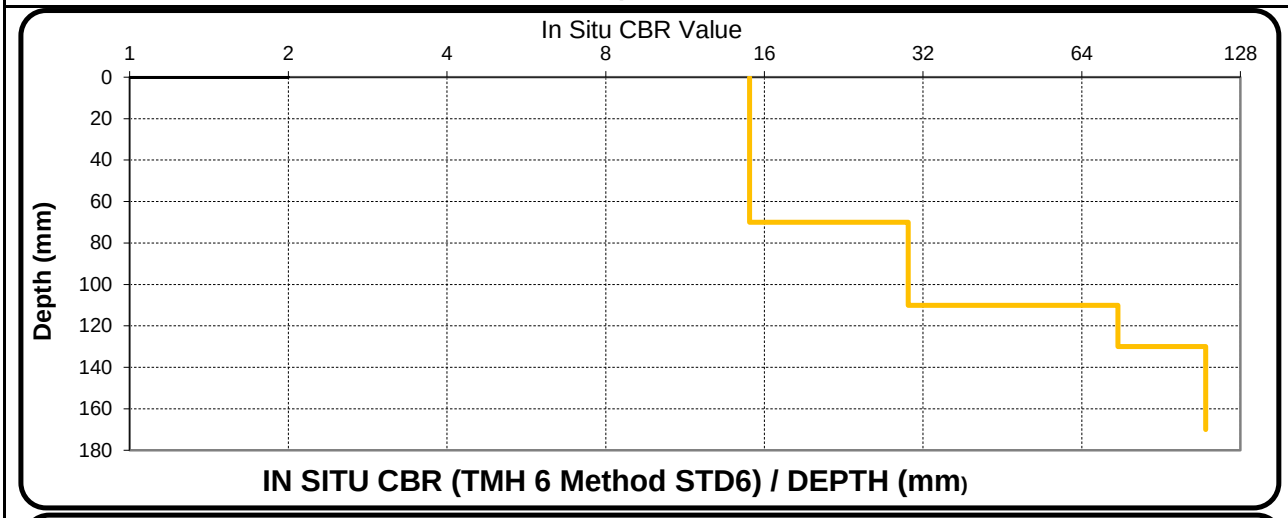




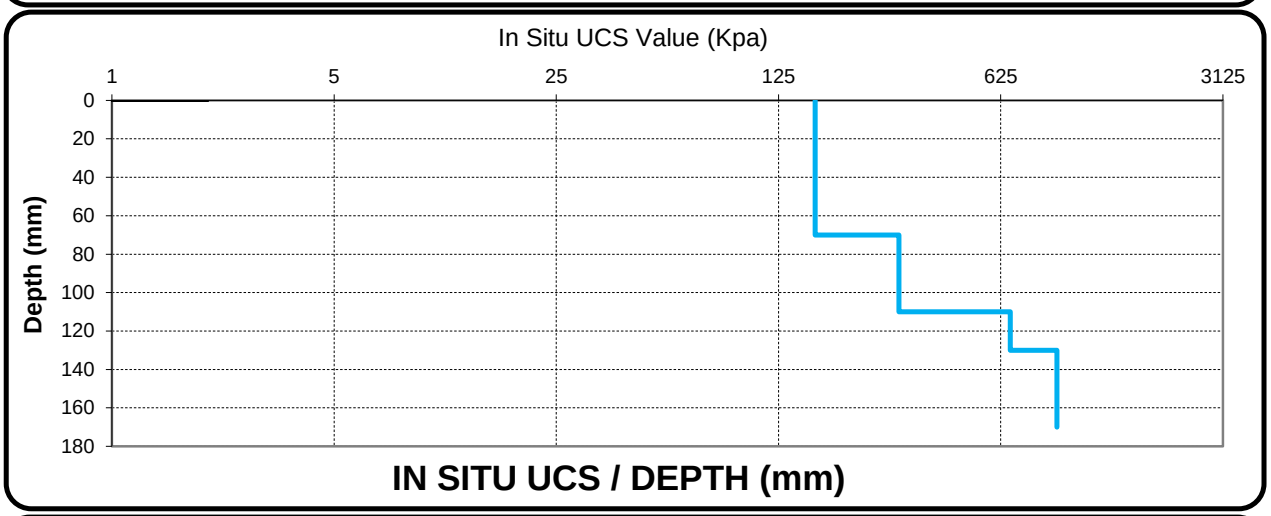
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DYNAMIC CONE PENETROMETER (DCP)

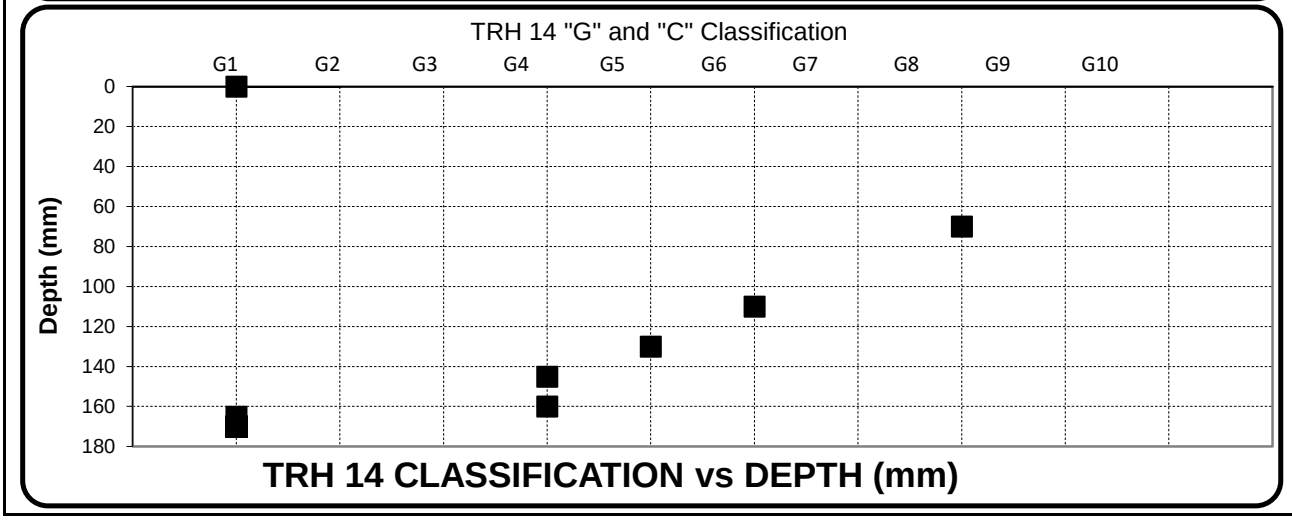
Client :	Ugu District Municipality	**Testpit No:**	TP3	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

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DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP4
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: SLUDGE THICKENEF
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: WEST
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	70	14,0	15	163	G8
5	70	-	90	4,0	75	670	G5
10	90	-	95	1,0	110	939	G1
15	95	-	100	1,0	110	939	G1
20	100	-	103	0,6	110	939	G1

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

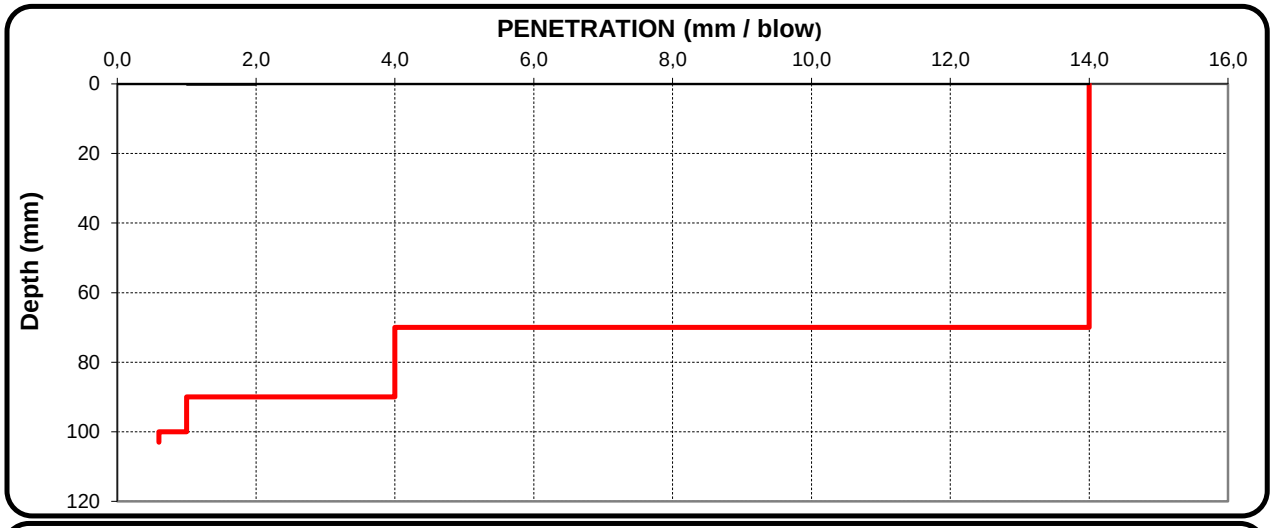
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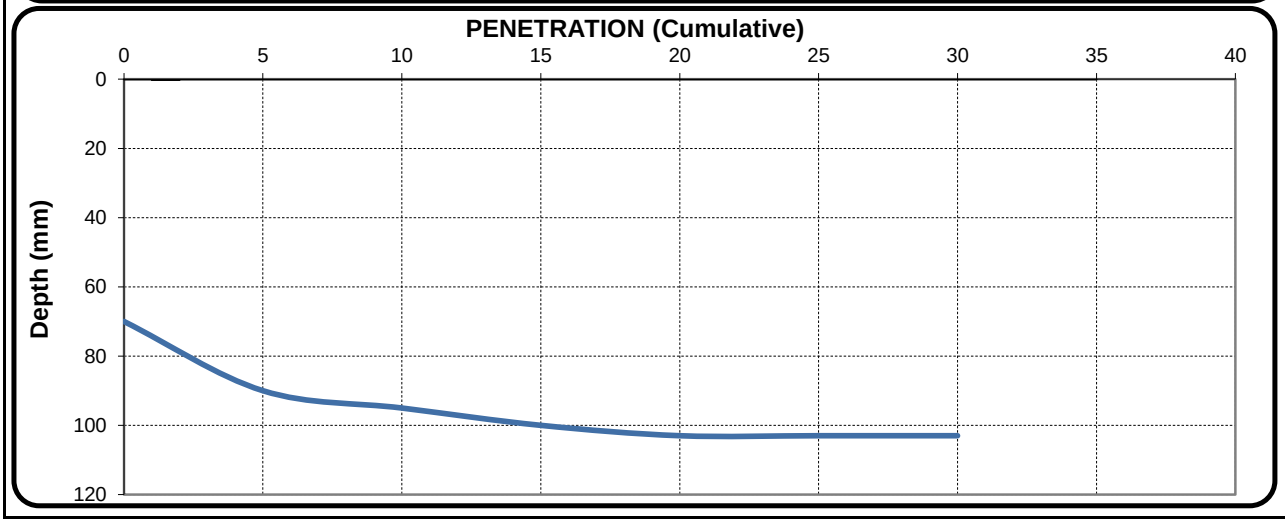
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

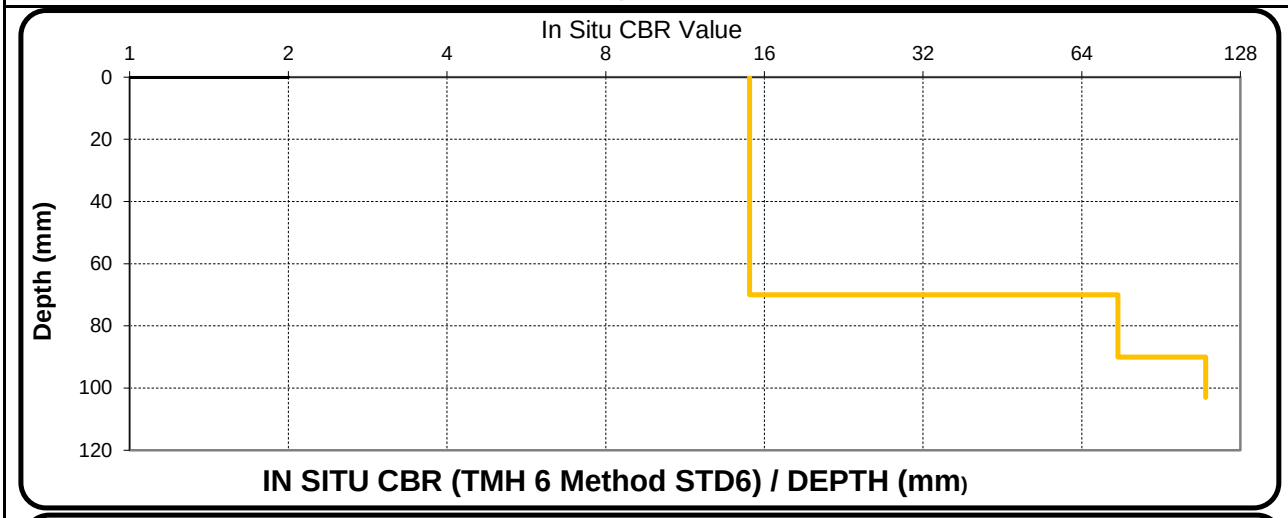




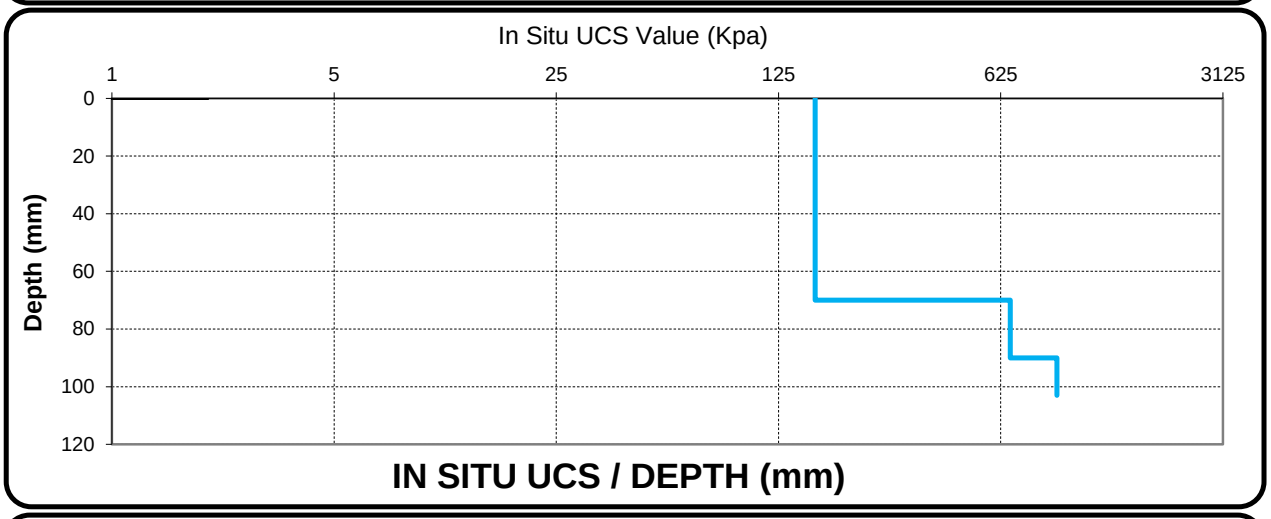
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DYNAMIC CONE PENETROMETER (DCP)

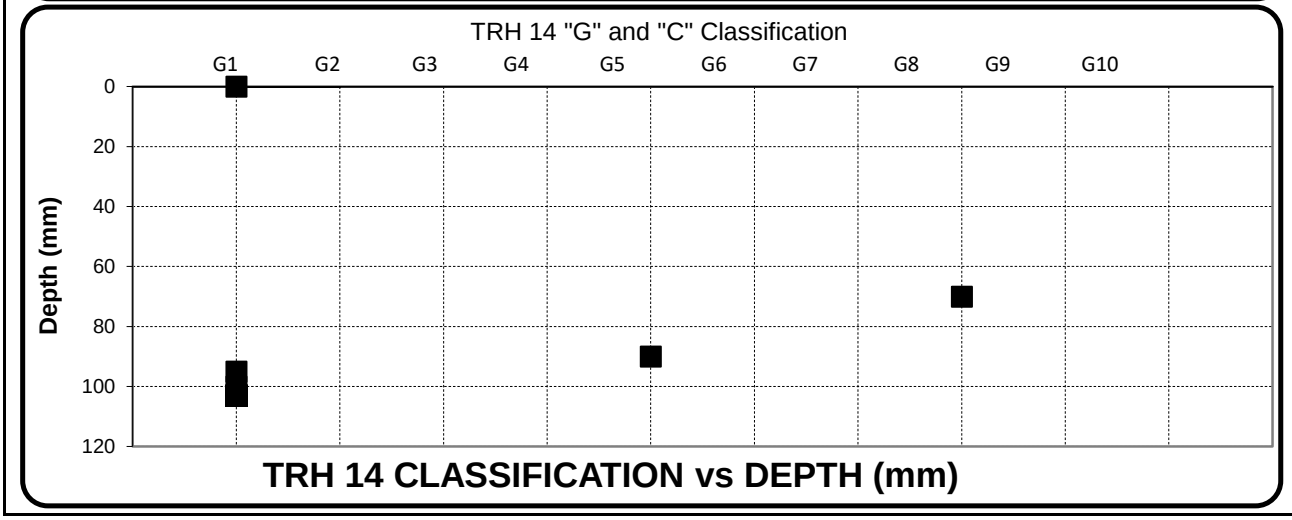
Client :	Ugu District Municipality	**Testpit No:**	TP4	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP6
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: SLUDGE THICKENEF
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: SOUTH EAST
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	50	10,0	22	228	G7
5	50	-	80	6,0	45	427	G6
10	80	-	100	4,0	75	670	G5
15	100	-	120	4,0	75	670	G5
20	120	-	160	8,0	30	299	G6
25	160	-	180	4,0	75	670	G5
30	180	-	200	4,0	75	670	G5
35	200	-	210	2,0	110	939	G4

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP6	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH EAST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

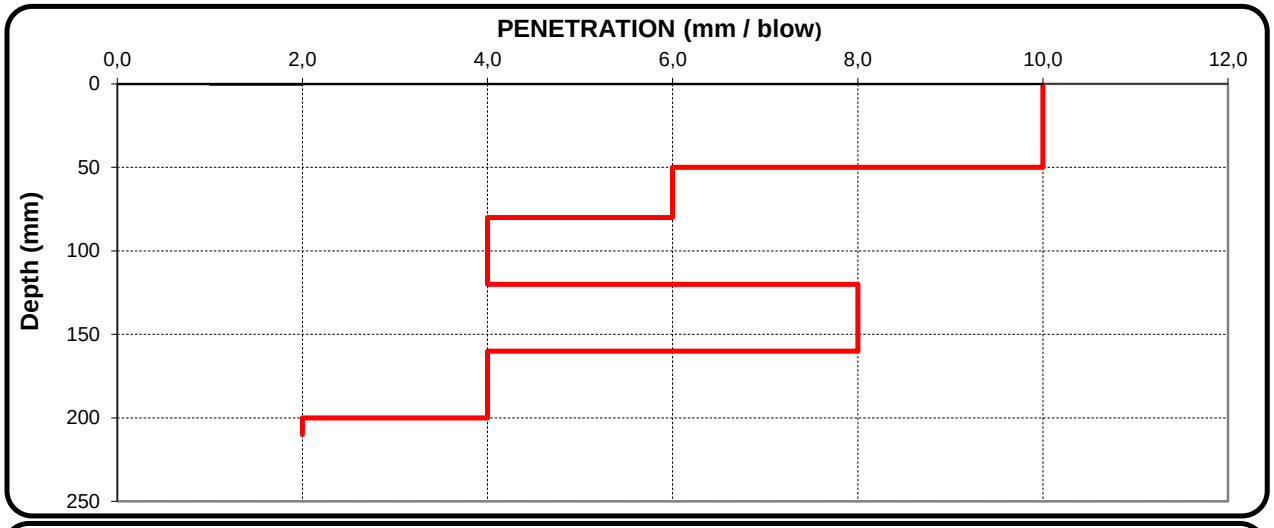
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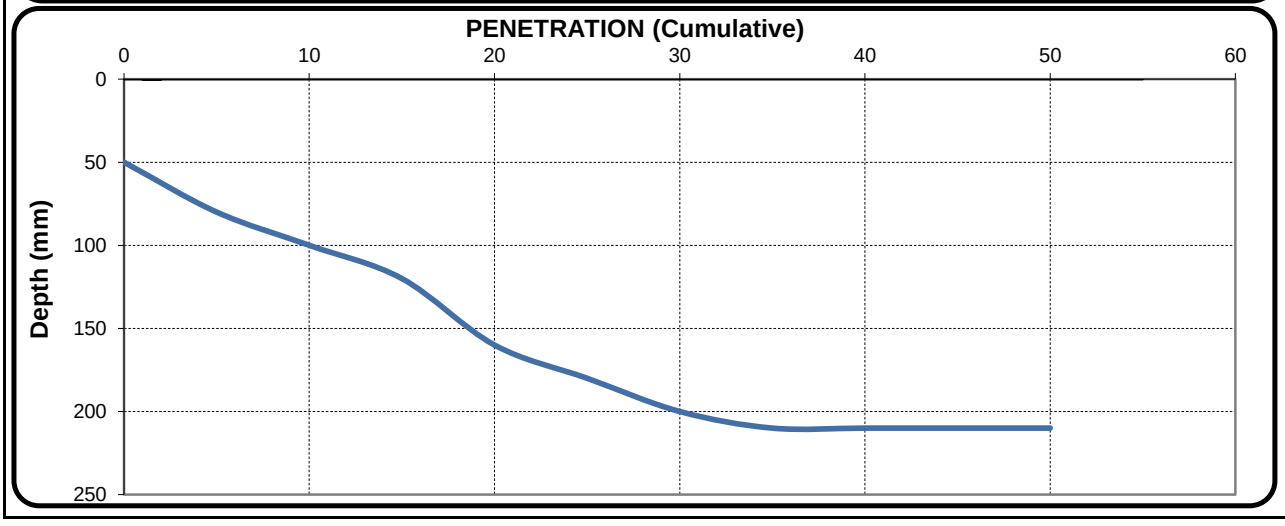
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP6	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH EAST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm) From	to	Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification

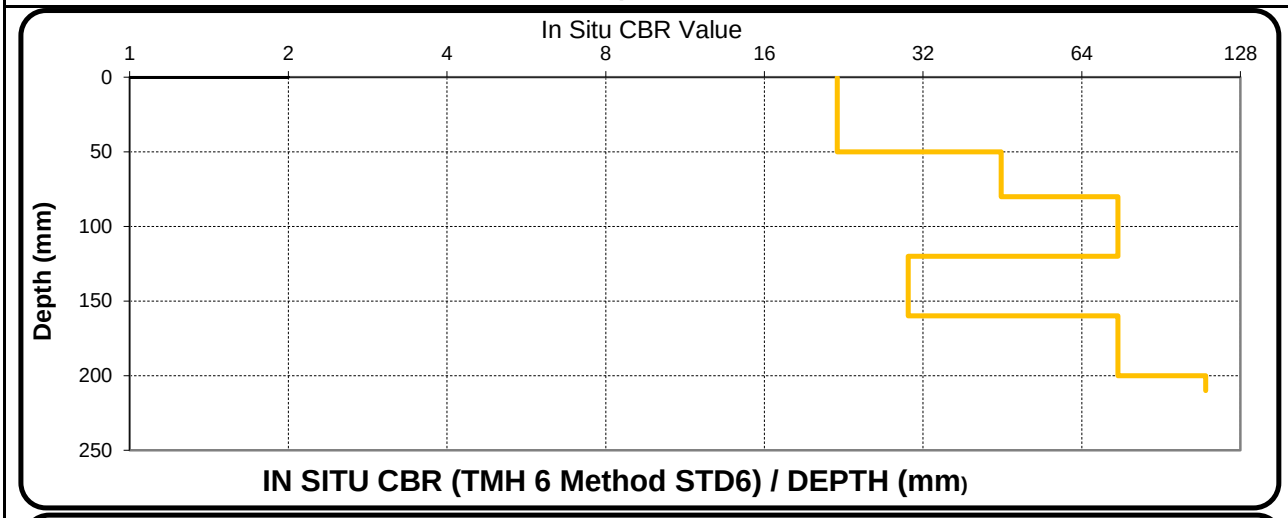




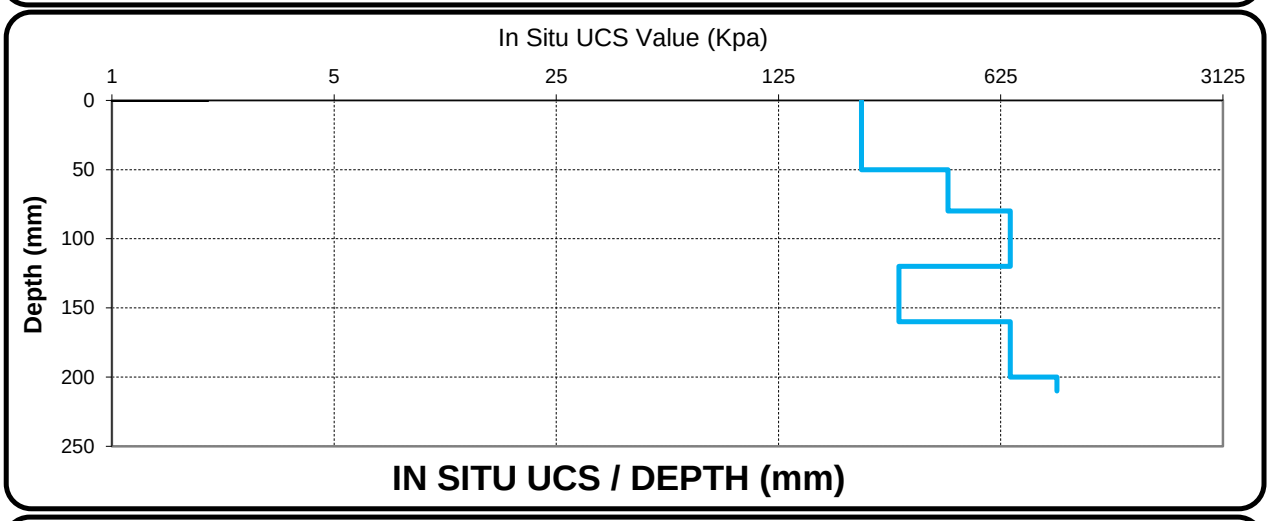
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DYNAMIC CONE PENETROMETER (DCP)

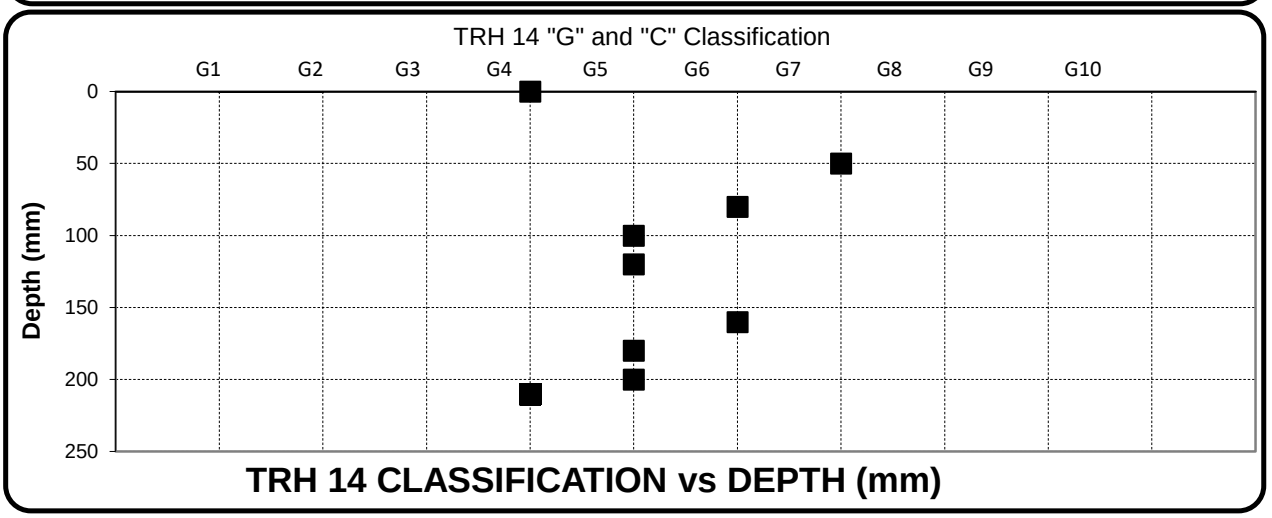
Client :	Ugu District Municipality	**Testpit No:**	TP6	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH EAST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP7
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: SLUDGE THICKENEF
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: NORTH WEST
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	60	12,0	18	191	G7
5	60	-	80	4,0	75	670	G5
10	80	-	100	4,0	75	670	G5
15	100	-	110	2,0	110	939	G4
20	110	-	120	2,0	110	939	G4
25	120	-	130	2,0	110	939	G4

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP7	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

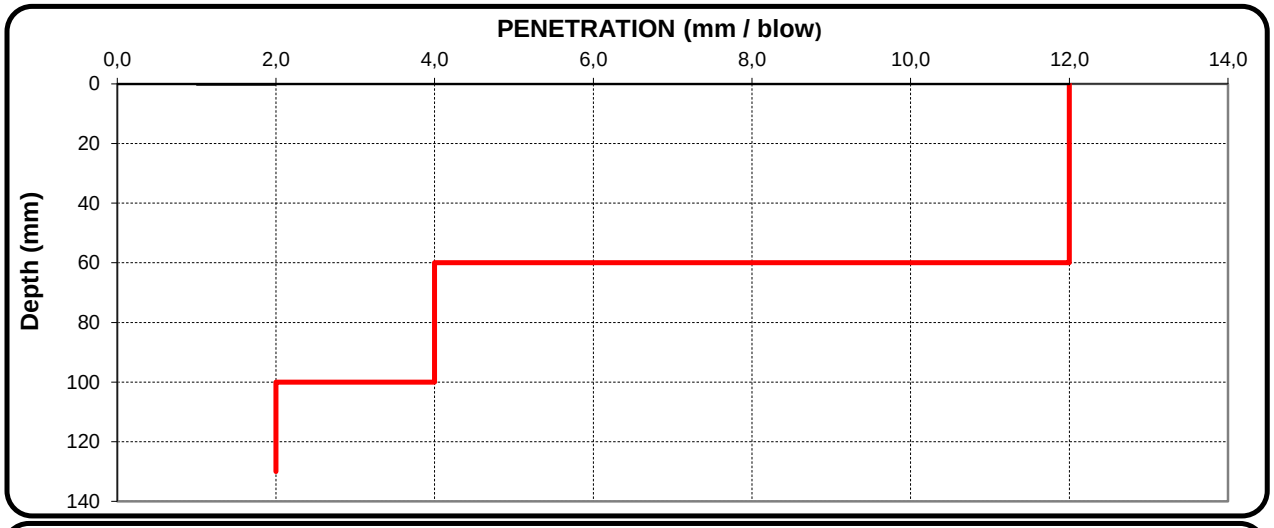
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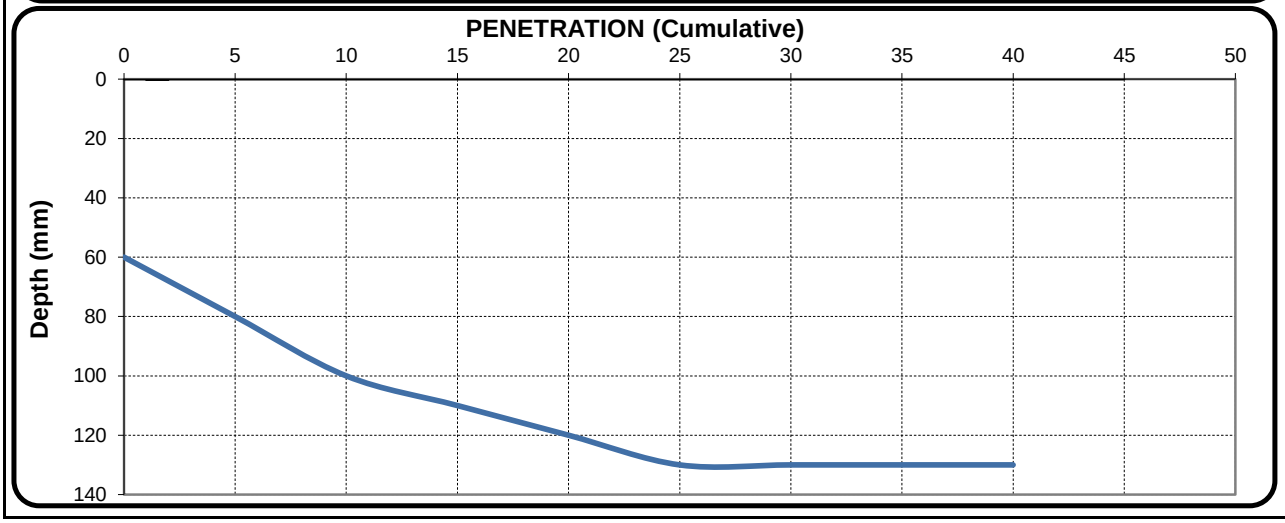
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP7	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

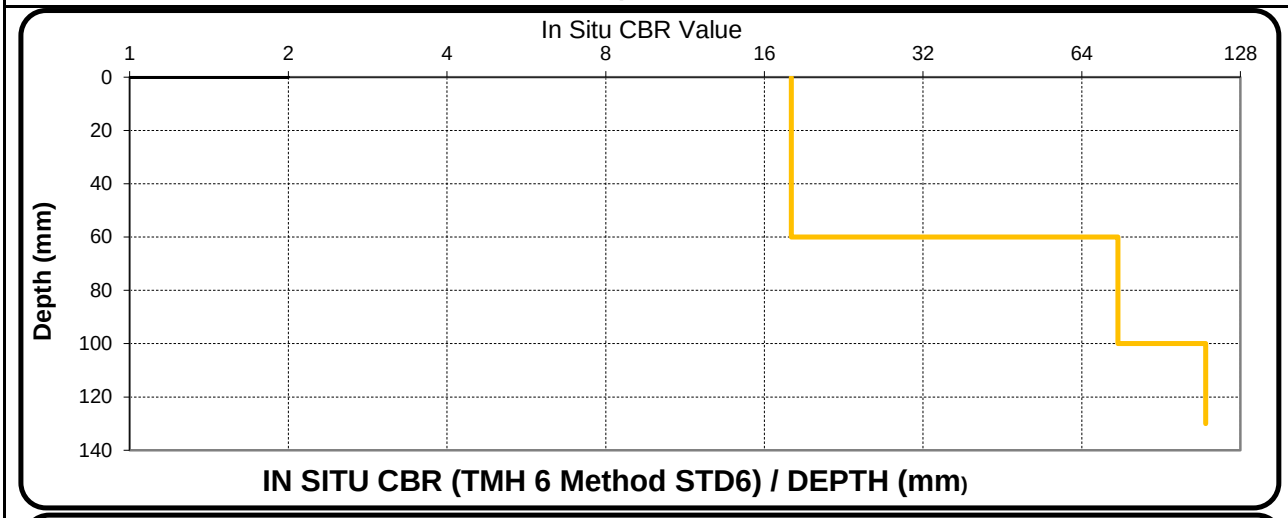




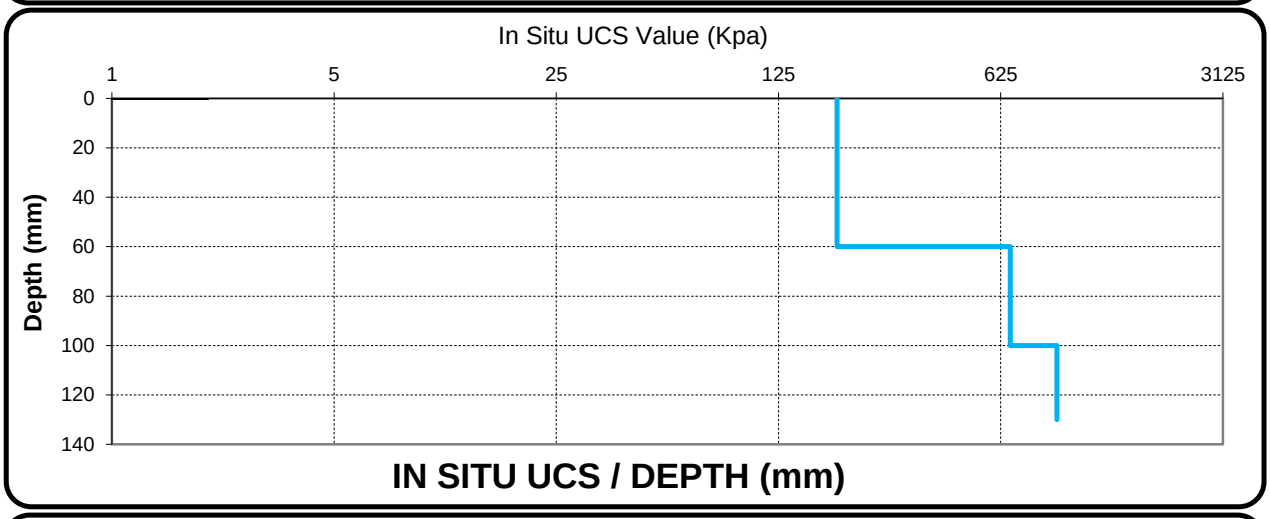
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DYNAMIC CONE PENETROMETER (DCP)

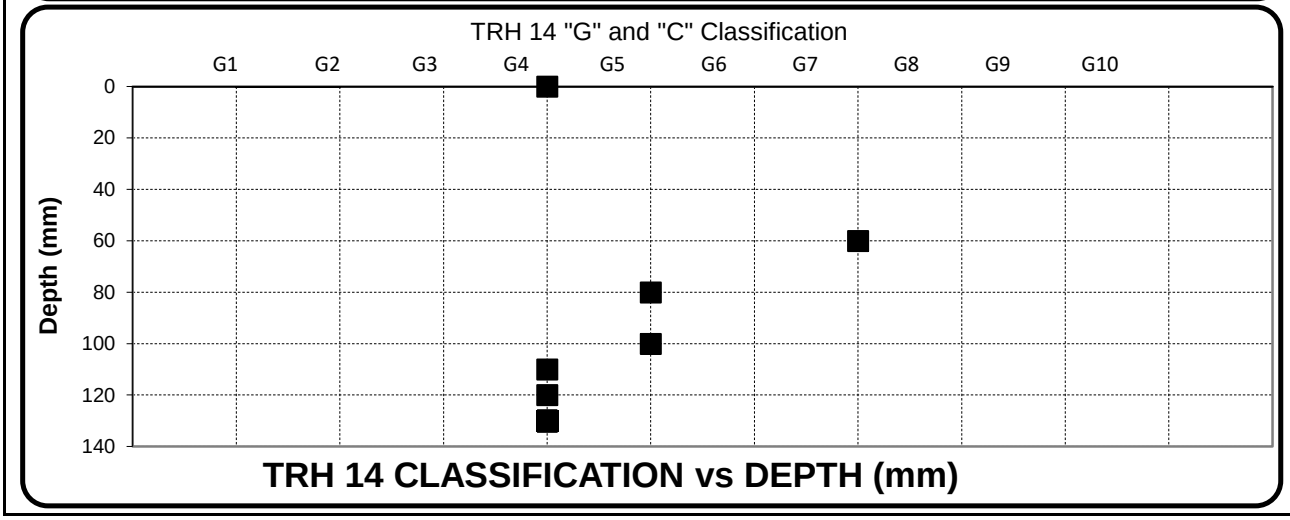
Client :	Ugu District Municipality	**Testpit No:**	TP7	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	NORTH WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP8
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: SLUDGE THICKENEF
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: SOUTH WEST
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	70	14,0	15	163	G8
5	70	-	90	4,0	75	670	G5
10	90	-	130	8,0	30	299	G6
15	130	-	140	2,0	110	939	G4
20	140	-	170	6,0	45	427	G6
25	170	-	185	3,0	110	939	G4
30	185	-	195	2,0	110	939	G4
35	195	-	210	3,0	110	939	G4
40	210	-	230	4,0	75	670	G5
45	230	-	250	4,0	75	670	G5
50	250	-	285	7,0	35	343	G6
55	285	-	300	3,0	110	939	G4

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DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP8	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

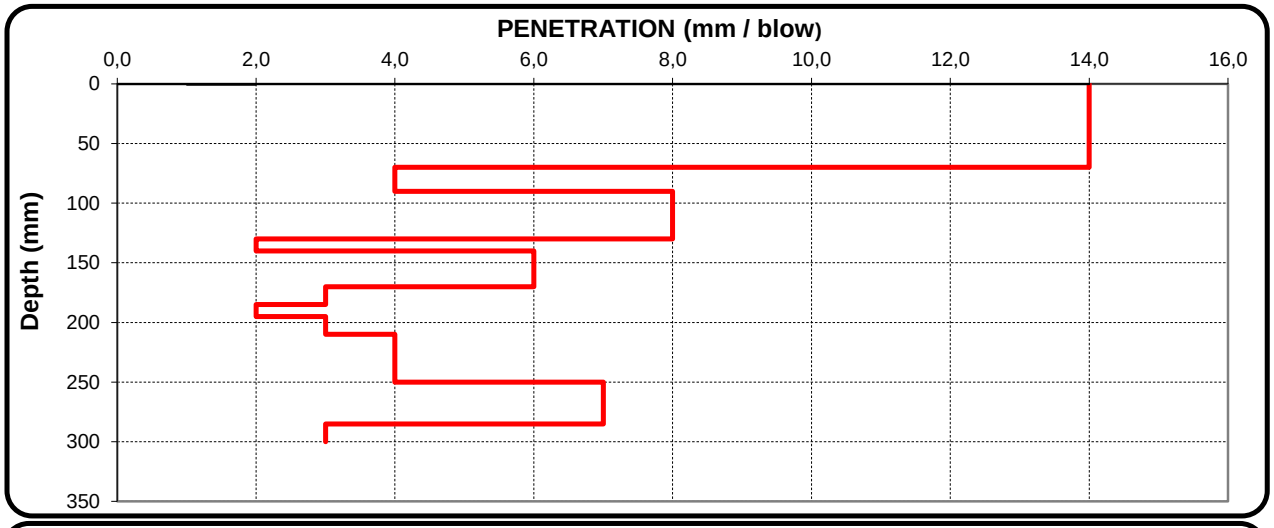
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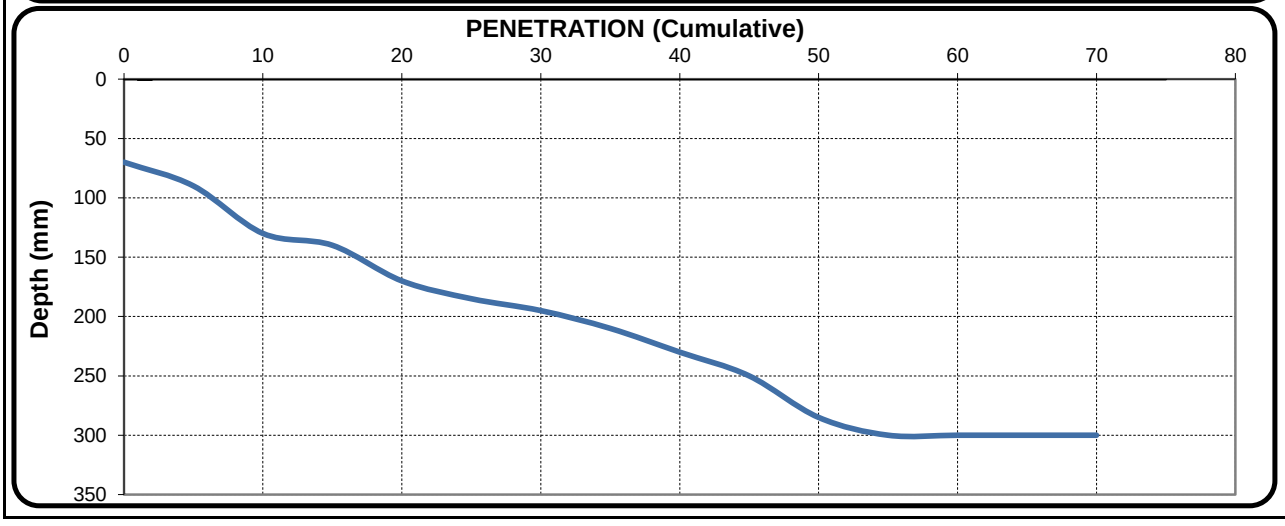
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP8	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

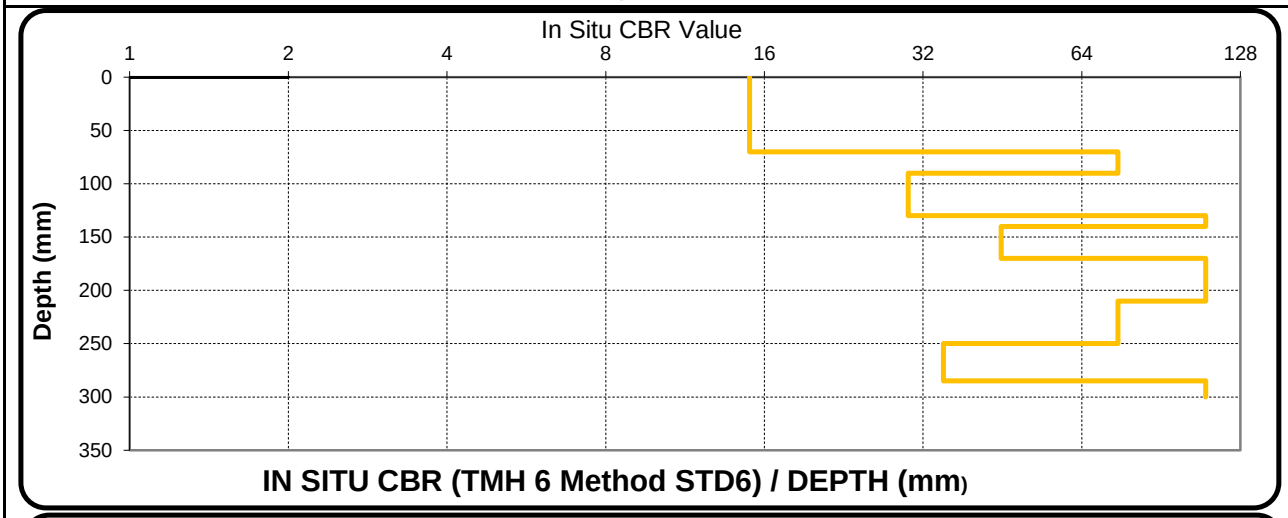




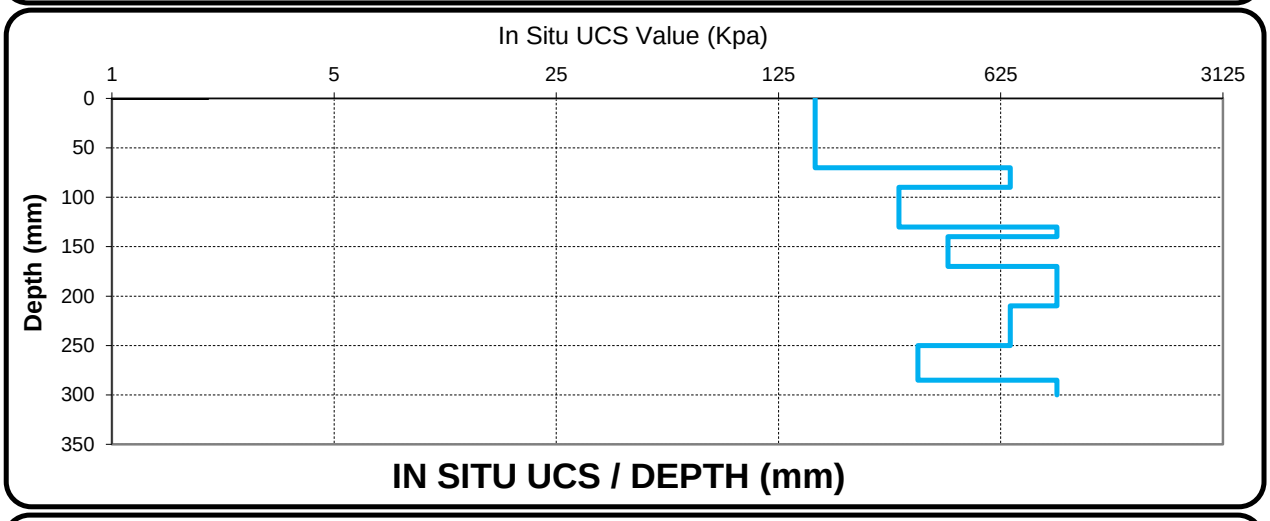
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DYNAMIC CONE PENETROMETER (DCP)

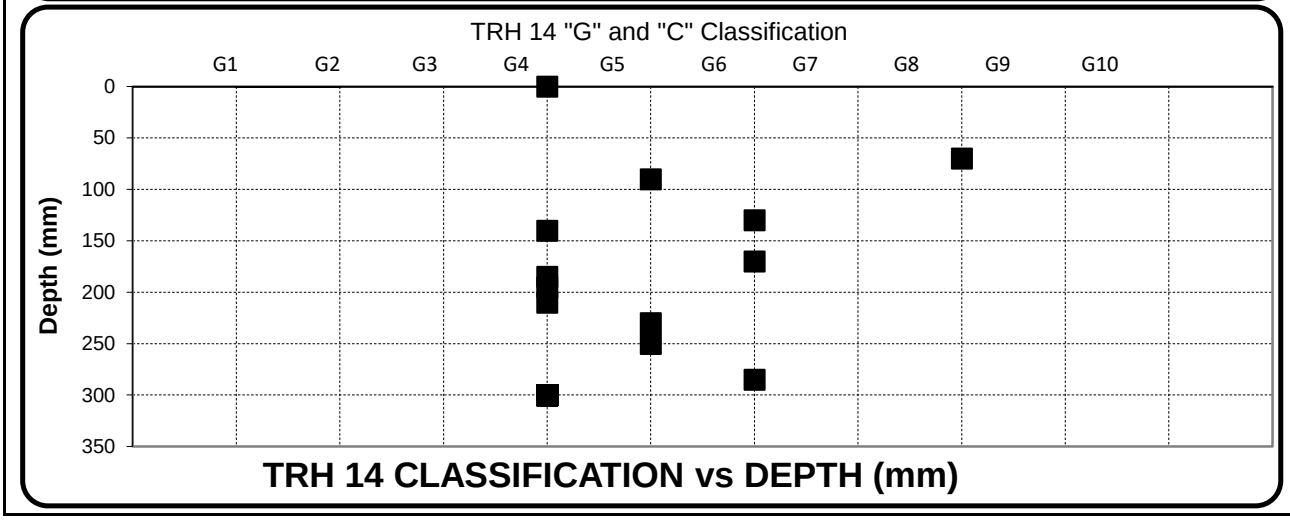
Client :	Ugu District Municipality	**Testpit No:**	TP8	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	SOUTH WEST	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client : Ugu District Municipality
Testpit No: TP9
Lane: N/A
roject Name : uMzimkhulu bulk Water A
Section No.: SLUDGE THICKENEF
GPS (X): 3 401 777.499
)ject Number: 1
Chainage: CENTER
GPS (Y): 58135,553
Job no. : Ugu-07-1566-2020
Offset: N/A
Date: 04/09/2022
Blow Interval 5
Start Depth : 0

Number of Blows	Penetration readings (fieldwork - mm)			Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From		to				
0	0	-	55	11,0	20	209	G7
5	55	-	85	6,0	45	427	G6
10	85	-	100	3,0	110	939	G4
15	100	-	135	7,0	35	343	G6
20	135	-	155	4,0	75	670	G5
25	155	-	180	5,0	55	510	G5
30	180	-	200	4,0	75	670	G5
35	200	-	220	4,0	75	670	G5
40	220	-	235	3,0	110	939	G4
45	235	-	255	4,0	75	670	G5
50	255	-	275	4,0	75	670	G5
55	275	-	295	4,0	75	670	G5

SAVO GROUP
Consulting Pty Ltd

DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP9	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	CENTER	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

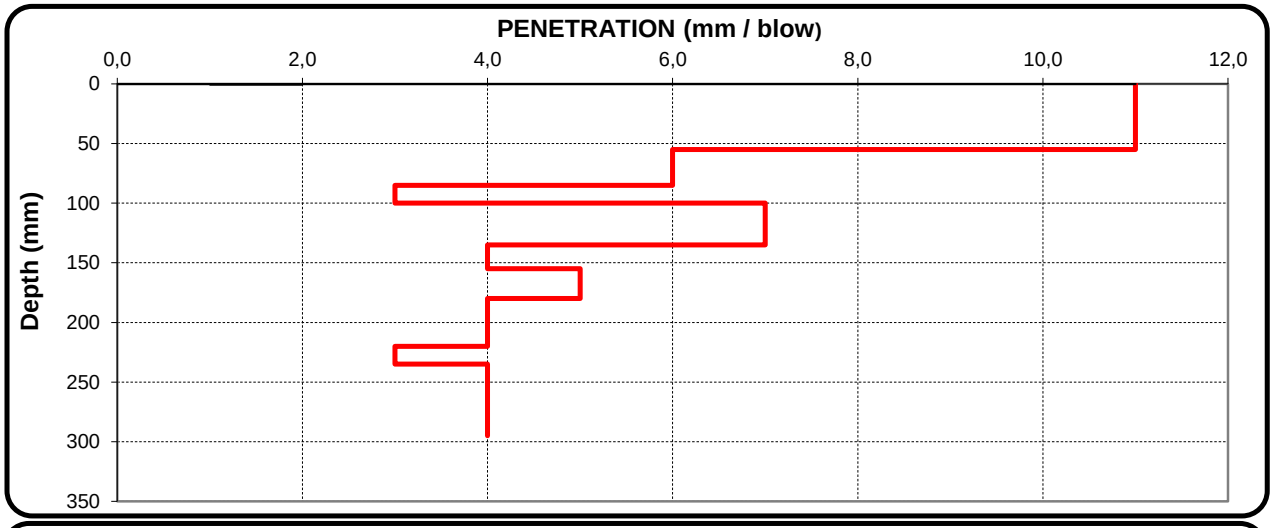
SAVO GROUP
Consulting Pty Ltd

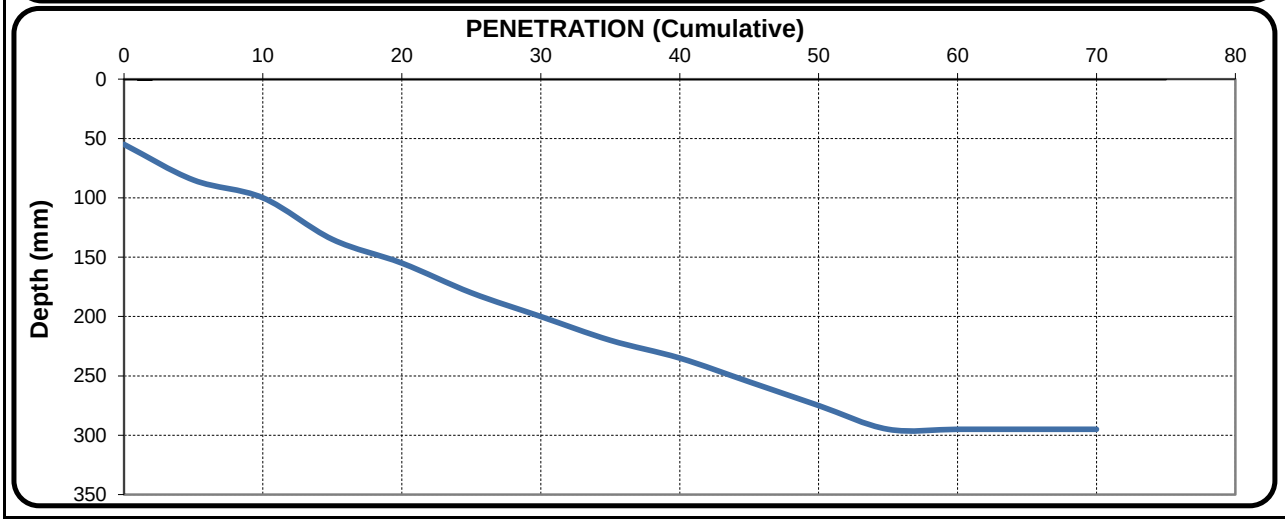
DYNAMIC CONE PENETROMETER (DCP)

Client :	Ugu District Municipality	**Testpit No:**	TP9	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	CENTER	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		

Defined Layers

Number of Blows	Penetration readings (fieldwork - mm)		Penetration Rate (mm/blow)	In situ CBR	UCS (Kpa)	TRH 14 Classification
	From	to				

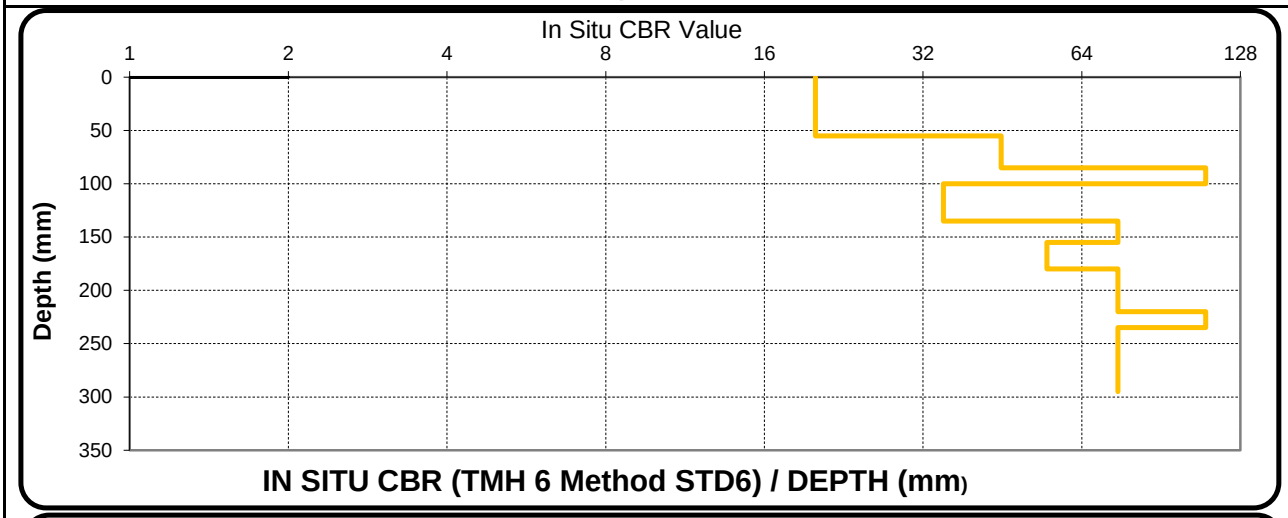




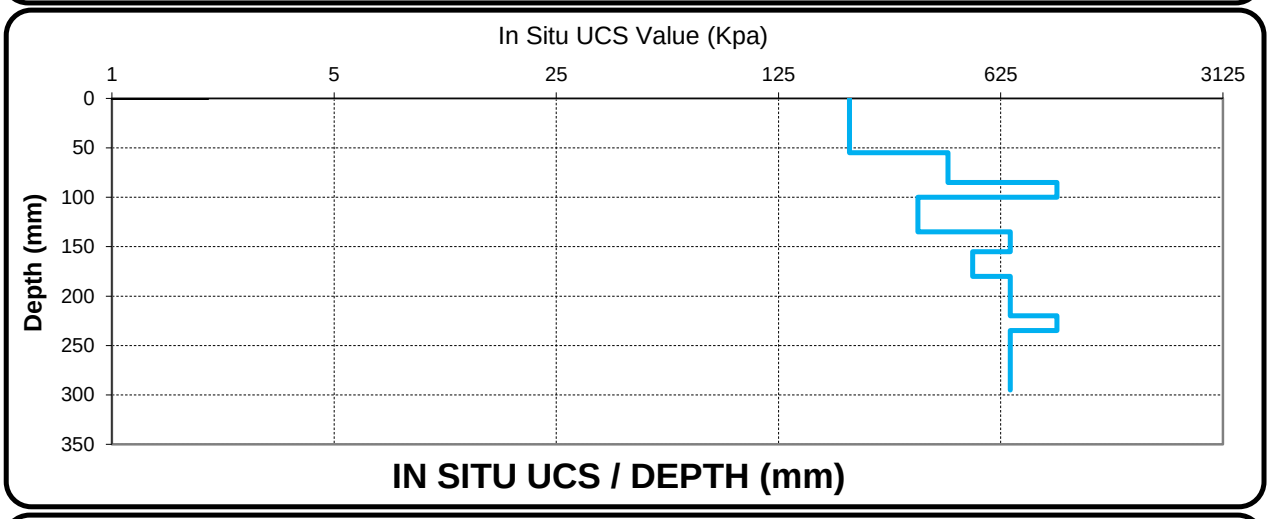
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DYNAMIC CONE PENETROMETER (DCP)

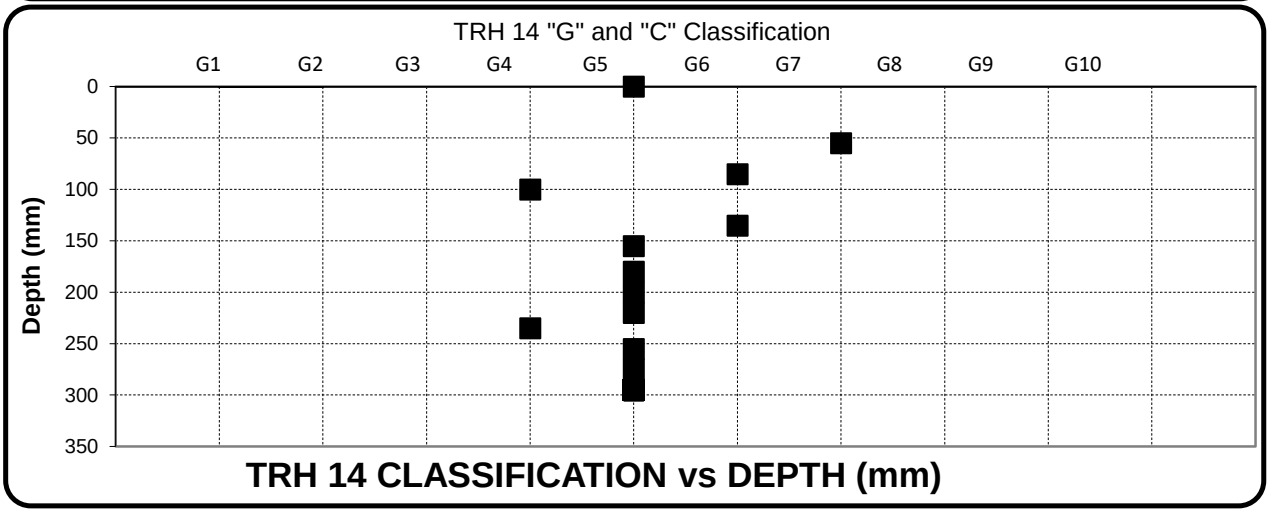
Client :	Ugu District Municipality	**Testpit No:**	TP9	**Lane:**	N/A
roject Name :	uMzimkhulu bulk Water A	**Section No.:**	SLUDGE THICKENEF	**GPS (X):**	3 401 777.499
)ject Number:	1	**Chainage:**	CENTER	**GPS (Y):**	58135,553
Job no. :	Ugu-07-1566-2020	**Offset:**	N/A	**Date:**	04/09/2022
Blow Interval	5	**Start Depth :**	0		



IN SITU CBR (TMH 6 Method STD6) / DEPTH (mm)



IN SITU UCS / DEPTH (mm)



TRH 14 CLASSIFICATION vs DEPTH (mm)

SHENGE SOIL DESIGN LABORATORY

Reg. No: 2003/048635/23
Tax. No: 4860212424

Tel: 034 9801588
Fax: 034-9833629
Cell: 072 3373 109
Email: buthelezishengesoil@telkomsa.net

P.O.Box 2428
Vryheid,
3100

MATERIAL PROPERTIES TEST REPORT

CLIENT: Royal Haskoning DHV
PROJECT: Umzimkhulu Bulk Water Augmentation Scheme
DATE: 05/09/2022

TMH 1: Methods used 1A, 1B, A2, A3 &A5
Classified as per Colto
REPORT NO: A0208

LABORATORY & FIELD DATA			
SAMPLE NUMBER	B0208		
FIELD AND PIT NUMBER	TP 1		
POSITION IN FIED	Centrifuge Building		
DEPTH FROM SURFACE(mm)	0 - 900		
SAMPLE DISCRIPTION	Lt.Br.Gravel +		
	Boulders		
SIEVE ANALYSIS			
63.0 mm			
53.0 mm	100		
37.5 mm	83.9		
26.5 mm	73.1		
19.0 mm	65.2		
13.2 mm	50.2		
4.75 mm	32.9		
2.0 mm	20.2		
0.425mm	9.1		
0.075mm	4.5		
GRADING MODULUS	2.665		
MECHANICAL ANALYSIS			
COARSE SAND	55.0		
COARSE FINE SAND	7.2		
MEDIAM FINE SAND	4.0		
FINE FINE' SAND	11.6		
SILTY AND CLAY	22.2		
SOIL COSTANTS			
LIQUID LIMIT	26.6		
PLASTICITY INDEX	8.4		
LINEAR SHRINKAGE	4.5		
CLASSIFICATION (GROUP INDEX)	**G7**		
CALIFORNIA BEARING RATIO			
OPTIMUM MOISTURE CONTENT %	7.3		
MAXIMUM DRY DENSITY KG/M^3	2194		
CBR AT 100% COMPACTION	26.2		
98% COMPACTION	22.2		
95% COMPACTION	17.3		
93% COMPACTION	14.5		
90% COMPACTION	11.3		
MAXIMUM SWELL %	0.89		
SUITABILITY			
TRH 14 CLASSIFICATION (1985)			
GRADING BASE COARSE			
GRAVEL BASE COURSE			
SELECTED SUBGRADE			
SHOULDERS			
FILL			
10% FACT			
FLAKINESS INDEX			

SHENGE SOIL DESIGN LABORATORY

Reg. No: 2003/048635/23
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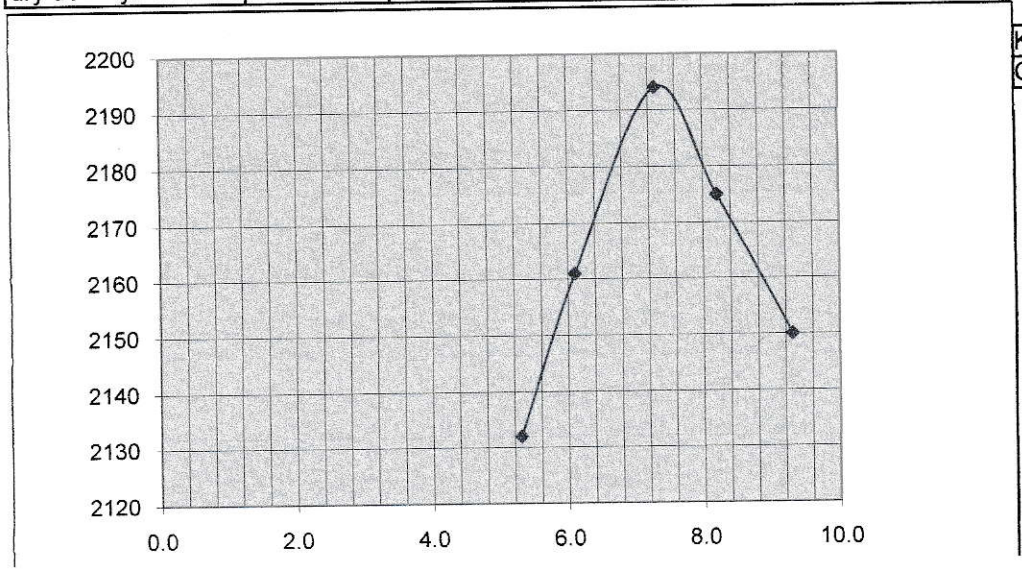
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Cell: 072 3373 109
Email: buthelezishengesoil@telkomsa.net

P.O.Box 2428
Vryheid,
3100

MAXIMUM DRY AND OPTIMUM MOISTURE CONTENT

TMH 1-METHOD A7 **REPORT NO:A0208**

Date:05/09/2022			Client: Royal Haskoning DHV			
Chainage & Layer: 0 - 900		TP 1	Project:	Umzimkhulu Bulk Water Augmentation Scheme		
Sample No:B0208	Mod,Cbr& Ind.					
mould no:16	Centrifuge Building					
			Material description:Lt.Br.Gravel + Boulders			
mass mould	4800	kg	vol mould	2336		
water %	4	5	7	9	11	
Water add	280	350	490	630	770	
mould wet mat	10044	10166	10299	10297	10289	
mass wet mat (kg)	5244	5366	5499	5497	5489	
wet dens (kg/m3)	2158	2188	2221	2199	2176	
bottle no	T6	T7	T8	T9	T10	
bottle + wet mat	728.7	731.1	729.9	725.6	726.1	
bottle + dry mat	696.5	694.2	686.4	677.4	672	
mass bottle	90	90	90	90	90	
mass moisture	32.2	36.9	43.5	48.2	54.1	
Mass dry mat	606.5	604.2	596.4	587.4	582	
moisture %	**5.3**	**6.1**	**7.3**	**8.2**	**9.3**	
dry density	**2132**	**2161**	**2194**	**2175**	**2150**	



KG/M^3	2194
OMC	7.3

SHENGE SOIL DESIGN LABORATORY

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Email: buthelezishengesoil@telkomsa.net

P.O.Box 2428
Vryheid,
3100

Client: Royal Haskoning DHV
Project: Umzimkhulu Bulk Augmentation Scheme
Report No: A001
Date Received: 05/09/2022

HYDROMETER ANALYSIS TEST REPORT

Laboratory No:	H67	H68	H69	H70	H71
Field No:	TP 1	TP 2	TP 2	TP 2	TP 1
Position	Grit Removal Tank	Sludge Thickener	Guard House	Balancing Tank	Centrifuge Building
Depth (m)	150-600	200-900	1000-1400	500- 1300	900 - 1600
Material Description	Lt.Brown Gravel	Lt.Brown Gobbles	Lt.Yell. Orange Gravel	Light Yell Orange Gravel	Dusky Blue
Stabilizing Agent	Natural	Natural	Natural		Natural

Sieve Analysis (Wet Preparation) SANA 3001: GR 1

Sieve Aperture						
	75.0 mm	100	100	100	100	100
	63.0 mm	100	100	100	100	100
	50.0 mm	100	100	100	100	100
	37.5 mm	100	100	100	100	100
	28.0 mm	100	100	100	100	100
	20.0 mm	96	97	100	100	98
	14.0 mm	87	94	100	95	89
	5.0 mm	68	76	93	86	71
	2.0 mm	55	59	84	78	58
	0.425 mm	39	35	76	65	42
	0.075 mm	25	22	47	49	29

***Hydrometer Analysis (ASTM – D422)**

Sieve Aperture						
	0.060 mm	25	22	45	46	28
	0.050 mm	20	18	45	45	23
	0.026 mm	19	17	43	44	21
	0.005 mm	17	13	37	35	19
	0.0015 mm	13	9	31	29	15

Soil Mortar Analysis SANS 3001: GR 1

Coarse Sand	%	29	40	9	8	26
Fine Sand	%	54	46	50	45	47
Silt	%	8	8	13	12	8
Clay	%	8	5	28	23	7

Atterberg Limits SANS 3001: GR 10 – GR 12

Liquid Limit	%	27	26	28	26	28
Plasticity Index	%	11	12	11	9	12
Linear Shrinkage	%	5.7	5.7	5.8	5.6	59
Equivalent PI	%	4.29	4.20	8.36	8.04	4.30
Relative Density	kg / m3	2.587	2.546	2.524	2.515	2.589
Moisture Content	%	9.6	8.5	8.8	8.5	10.0

Unified (ASTM D2487)	-	-	-	-	-
Classification (Group Index)	A-2-6	A-2-6	A-6	A-6	A-2-6

SIGNATURE FOR SSDL

COMPANY STAMP

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Client: Royal Haskoning DHV
Project: Umzimkhulu Bulk Augmentation Scheme
Date Received: 05/09/2022

Report No: A001

HYDROMETER ANALYSIS TEST REPORT

Laboratory No:		H72	H73			
Field No:		TP 3	TP 4			
Position		Centrifuge Building	Sludge Thickener			
Depth (m)		300-1500	250-1500			
Material Description		Lt.Yell.Orange Gravel + Shale	Dusky Blue + Yell. Gravel			
Stabilizing Agent		Natural	Natural			
Sieve Analysis (Wet Preparation) SANA 3001: GR 1						
Sieve Aperture	75.0 mm	100	100			
	63.0 mm	100	100			
	50.0 mm	100	100			
	37.5 mm	100	100			
	28.0 mm	100	100			
	20.0 mm	100	100			
	14.0 mm	100	99			
	5.0 mm	96	88			
	2.0 mm	88	79			
	0.425 mm	79	59			
	0.075 mm	50	30			
***Hydrometer Analysis (ASTM – D422)**						
Sieve Aperture	**0.060 mm**	**48**	**29**			
	0.050 mm	**47**	**25**			
	0.026 mm	**45**	**22**			
	0.005 mm	**39**	**18**			
	0.0015 mm	**33**	**13**			
Soil Mortar Analysis SANS 3001: GR 1						
Coarse Sand	**%**	**11**	**29**			
Fine Sand	**%**	**52**	**46**			
Silt	**%**	**15**	**10**			
Clay	**%**	**31**	**7**			
Atterberg Limits SANS 3001: GR 10 – GR 12						
Liquid Limit	**%**	**29**	**28**			
Plasticity Index	**%**	**12**	**12**			
Linear Shrinkage	**%**	**5.9**	**5.8**			
Equivalent PI	**%**	**8.44**	**4.51**			
Relative Density	**kg / m3**	**2.536**	**2.550**			
Moisture Content	**%**	**9.0**	**8.7**			
Unified (ASTM D2487)		-	-			
Classification (Group Index)		**A-6**	**A-2-6**			

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MATERIAL PROPERTIES TEST REPORT

CLIENT: Royal Haskoning DHV
PROJECT: Umzimkhulu Bulk Water Augmentation Scheme
DATE: 05/09/2022

TMH 1: Methods used 1A, 1B, A2, A3 &A5
Classified as per Colto
REPORT NO: A0201

LABORATORY & FIELD DATA			
SAMPLE NUMBER	B0201		
FIELD AND PIT NUMBER	TP 1		
POSITION IN FIED	Balancing Tank		
DEPTH FROM SURFACE(mm)	500 - 1400		
SAMPLE DISCRIPTION	Lt. Yell. Orange		
	Gravel		
SIEVE ANALYSIS			
63.0 mm			
53.0 mm			
37.5 mm			
26.5 mm			
19.0 mm	100		
13.2 mm	86.0		
4.75 mm	68.2		
2.0 mm	33.5		
0.425mm	14.3		
0.075mm	9.0		
GRADING MODULUS	2.432		
MECHANICAL ANALYSIS			
COARSE SAND	57.3		
COARSE FINE SAND	7.5		
MEDIAM FINE SAND	3.8		
FINE FINE' SAND	4.5		
SILTY AND CLAY	26.8		
SOIL COSTANTS			
LIQUID LIMIT	34.8		
PLASTICITY INDEX	16.2		
LINEAR SHRINKAGE	7.7		
CLASSIFICATION (GROUP INDEX)			
CALIFORNIA BEARING RATIO			
OPTIMUM MOISTURE CONTENT %			
MAXIMUM DRY DENSITY KG/M^3			
CBR AT 100% COMPACTION			
98% COMPACTION			
95% COMPACTION			
93% COMPACTION			
90% COMPACTION			
MAXIMUM SWELL %			
SUITABILITY			
TRH 14 CLASSIFICATION (1985)			
GRADING BASE COARSE			
GRAVEL BASE COURSE			
SELECTED SUBGRADE			
SHOULDERS			
FILL			
10% FACT			
FLAKINESS INDEX			

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MATERIAL PROPERTIES TEST REPORT

CLIENT: Royal Haskoning DHV
PROJECT: Umzimkhulu Bulk Water Augmentation Scheme
DATE: 05/09/2022

TMH 1: Methods used 1A, 1B, A2, A3 &A5
Classified as per Colto
REPORT NO: A0202

LABORATORY & FIELD DATA			
SAMPLE NUMBER	B0202		
FIELD AND PIT NUMBER	TP 1		
POSITION IN FIED	Guard House		
DEPTH FROM SURFACE(mm)	900 - 1500		
SAMPLE DISCRIPTION	Lt.Yell.Orange		
	Gravel		
SIEVE ANALYSIS			
63.0 mm			
53.0 mm			
37.5 mm			
26.5 mm	99.9		
19.0 mm	90.8		
13.2 mm	77.2		
4.75 mm	48.5		
2.0 mm	28.2		
0.425mm	13.4		
0.075mm	8.9		
GRADING MODULUS	2.432		
MECHANICAL ANALYSIS			
COARSE SAND	52.5		
COARSE FINE SAND	7.7		
MEDIAM FINE SAND	3.5		
FINE FINE' SAND	4.7		
SILTY AND CLAY	31.7		
SOIL COSTANTS			
LIQUID LIMIT	37.0		
PLASTICITY INDEX	17.7		
LINEAR SHRINKAGE	8.1		
CLASSIFICATION (GROUP INDEX)			
CALIFORNIA BEARING RATIO			
OPTIMUM MOISTURE CONTENT %			
MAXIMUM DRY DENSITY KG/M^3			
CBR AT 100% COMPACTION			
98% COMPACTION			
95% COMPACTION			
93% COMPACTION			
90% COMPACTION			
MAXIMUM SWELL %			
SUITABILITY			
TRH 14 CLASSIFICATION (1985)			
GRADING BASE COARSE			
GRAVEL BASE COURSE			
SELECTED SUBGRADE			
SHOULDERS			
FILL			
10% FACT			
FLAKINESS INDEX			

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MATERIAL PROPERTIES TEST REPORT

CLIENT: Royal Haskoning DHV
PROJECT: Umzimkhulu Bulk Water Augmentation Scheme
DATE: 05/09/2022

TMH 1: Methods used 1A, 1B, A2, A3 &A5
Classified as per Colto
REPORT NO: A0203

LABORATORY & FIELD DATA			
SAMPLE NUMBER	B0203		
FIELD AND PIT NUMBER	TP 2		
POSITION IN FIED	Centrifuge Building		
DEPTH FROM SURFACE(mm)	0- 800		
SAMPLE DISCRIPTION	Lt.Br.Gravel + Boulders		
SIEVE ANALYSIS			
63.0 mm			
53.0 mm	99.9		
37.5 mm	92.9		
26.5 mm	75.6		
19.0 mm	56.4		
13.2 mm	44.7		
4.75 mm	34.1		
2.0 mm	21.3		
0.425mm	14.9		
0.075mm	7.3		
GRADING MODULUS	2.565		
MECHANICAL ANALYSIS			
COARSE SAND	30.0		
COARSE FINE SAND	17.1		
MEDIAM FINE SAND	7.8		
FINE FINE' SAND	10.9		
SILTY AND CLAY	34.2		
SOIL COSTANTS			
LIQUID LIMIT	28.4		
PLASTICITY INDEX	9.0		
LINEAR SHRINKAGE	4.4		
CLASSIFICATION (GROUP INDEX)			
CALIFORNIA BEARING RATIO			
OPTIMUM MOISTURE CONTENT %			
MAXIMUM DRY DENSITY KG/M^3			
CBR AT 100% COMPACTION			
98% COMPACTION			
95% COMPACTION			
93% COMPACTION			
90% COMPACTION			
MAXIMUM SWELL %			
SUITABILITY			
TRH 14 CLASSIFICATION (1985)			
GRADING BASE COARSE			
GRAVEL BASE COURSE			
SELECTED SUBGRADE			
SHOULDERS			
FILL			
10% FACT			
FLAKINESS INDEX			

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MATERIAL PROPERTIES TEST REPORT

CLIENT: Royal Haskoning DHV
PROJECT: Umzimkhulu Bulk Water Augmentation Scheme
DATE: 05/09/2022

TMH 1: Methods used 1A, 1B, A2, A3 &A5
Classified as per Colto
REPORT NO: A0204

LABORATORY & FIELD DATA			
SAMPLE NUMBER	B0204		
FIELD AND PIT NUMBER	TP 2		
POSITION IN FIED	Grit Removal Tank		
DEPTH FROM SURFACE(mm)	200 - 500		
SAMPLE DISCRIPTION	Lt.Br.Gobbles		
SIEVE ANALYSIS			
63.0 mm			
53.0 mm	100		
37.5 mm	92.3		
26.5 mm	85.3		
19.0 mm	70.9		
13.2 mm	48.2		
4.75 mm	35.0		
2.0 mm	22.6		
0.425mm	11.9		
0.075mm	5.3		
GRADING MODULUS	2.602		
MECHANICAL ANALYSIS			
COARSE SAND	47.3		
COARSE FINE SAND	10.7		
MEDIAM FINE SAND	6.0		
FINE FINE` SAND	12.3		
SILTY AND CLAY	23.6		
SOIL COSTANTS			
LIQUID LIMIT	28.1		
PLASTICITY INDEX	9.5		
LINEAR SHRINKAGE	5.0		
CLASSIFICATION (GROUP INDEX)			
CALIFORNIA BEARING RATIO			
OPTIMUM MOISTURE CONTENT %			
MAXIMUM DRY DENSITY KG/M^3			
CBR AT 100% COMPACTION			
98% COMPACTION			
95% COMPACTION			
93% COMPACTION			
90% COMPACTION			
MAXIMUM SWELL %			
SUITABILITY			
TRH 14 CLASSIFICATION (1985)			
GRADING BASE COARSE			
GRAVEL BASE COURSE			
SELECTED SUBGRADE			
SHOULDERS			
FILL			
10% FACT			
FLAKINESS INDEX			

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MATERIAL PROPERTIES TEST REPORT

CLIENT: Royal Haskoning DHV
PROJECT: Umzimkhulu Bulk Water Augmentation Scheme
DATE: 05/09/2022

TMH 1: Methods used 1A, 1B, A2, A3 &A5
Classified as per Colto
REPORT NO: A0205

LABORATORY & FIELD DATA			
SAMPLE NUMBER	B0205		
FIELD AND PIT NUMBER	TP 2		
POSITION IN FIED	Centrifuge Building		
DEPTH FROM SURFACE(mm)	800 - 1400		
SAMPLE DISCRIPTION	Dusky Blue		
SIEVE ANALYSIS			
63.0 mm			
53.0 mm	99.9		
37.5 mm	92.6		
26.5 mm	79.1		
19.0 mm	62.0		
13.2 mm	42.1		
4.75 mm	28.4		
2.0 mm	19.0		
0.425mm	9.1		
0.075mm	4.9		
GRADING MODULUS	2.670		
MECHANICAL ANALYSIS			
COARSE SAND	52.1		
COARSE FINE SAND	7.1		
MEDIAM FINE SAND	3.9		
FINE FINE` SAND	11.3		
SILTY AND CLAY	25.6		
SOIL COSTANTS			
LIQUID LIMIT	28.9		
PLASTICITY INDEX	9.9		
LINEAR SHRINKAGE	4.5		
CLASSIFICATION (GROUP INDEX)			
CALIFORNIA BEARING RATIO			
OPTIMUM MOISTURE CONTENT %			
MAXIMUM DRY DENSITY KG/M^3			
CBR AT 100% COMPACTION			
98% COMPACTION			
95% COMPACTION			
93% COMPACTION			
90% COMPACTION			
MAXIMUM SWELL %			
SUITABILITY			
TRH 14 CLASSIFICATION (1985)			
GRADING BASE COARSE			
GRAVEL BASE COURSE			
SELECTED SUBGRADE			
SHOULDERS			
FILL			
10% FACT			
FLAKINESS INDEX			

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MATERIAL PROPERTIES TEST REPORT

CLIENT: Royal Haskoning DHV
PROJECT: Umzimkhulu Bulk Water Augmentation Scheme
DATE: 05/09/2022

TMH 1: Methods used 1A, 1B, A2, A3 &A5
Classified as per Colto
REPORT NO: A0206

LABORATORY & FIELD DATA			
SAMPLE NUMBER	B0206		
FIELD AND PIT NUMBER	TP 3		
POSITION IN FIED	Sludge Thickener		
DEPTH FROM SURFACE(mm)	150 – 850		
SAMPLE DISCRIPTION	Lt. Brown Gobbles		
SIEVE ANALYSIS			
63.0 mm			
53.0 mm			
37.5 mm	100.1		
26.5 mm	82.5		
19.0 mm	69.9		
13.2 mm	53.9		
4.75 mm	34.4		
2.0 mm	20.4		
0.425mm	6.9		
0.075mm	3.3		
GRADING MODULUS	2.694		
MECHANICAL ANALYSIS			
COARSE SAND	66.2		
COARSE FINE SAND	6.5		
MEDIAM FINE SAND	3.4		
FINE FINE' SAND	7.6		
SILTY AND CLAY	16.3		
SOIL COSTANTS			
LIQUID LIMIT	26.6		
PLASTICITY INDEX	7.8		
LINEAR SHRINKAGE	3.8		
CLASSIFICATION (GROUP INDEX)			
CALIFORNIA BEARING RATIO			
OPTIMUM MOISTURE CONTENT %			
MAXIMUM DRY DENSITY KG/M^3			
CBR AT 100% COMPACTION			
98% COMPACTION			
95% COMPACTION			
93% COMPACTION			
90% COMPACTION			
MAXIMUM SWELL %			
SUITABILITY			
TRH 14 CLASSIFICATION (1985)			
GRADING BASE COARSE			
GRAVEL BASE COURSE			
SELECTED SUBGRADE			
SHOULDERS			
FILL			
10% FACT			
FLAKINESS INDEX			

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MATERIAL PROPERTIES TEST REPORT

CLIENT: Royal Haskoning DHV
PROJECT: Umzimkhulu Bulk Water Augmentation Scheme
DATE: 05/09/2022

TMH 1: Methods used 1A, 1B, A2, A3 &A5
Classified as per Colto
REPORT NO: A0207

LABORATORY & FIELD DATA			
SAMPLE NUMBER	B0207		
FIELD AND PIT NUMBER	TP 1		
POSITION IN FIED	Sludge Thickener		
DEPTH FROM SURFACE(mm)	200 - 500		
SAMPLE DISCRIPTION	Lt.Br.Gobbles +		
	Gravel		
SIEVE ANALYSIS			
63.0 mm			
53.0 mm	99.9		
37.5 mm	92.2		
26.5 mm	80.9		
19.0 mm	68.2		
13.2 mm	49.7		
4.75 mm	32.5		
2.0 mm	21.5		
0.425mm	11.9		
0.075mm	5.8		
GRADING MODULUS	2.608		
MECHANICAL ANALYSIS			
COARSE SAND	44.7		
COARSE FINE SAND	11.2		
MEDIAM FINE SAND	5.3		
FINE FINE' SAND	11.8		
SILTY AND CLAY	27.0		
SOIL COSTANTS			
LIQUID LIMIT	28.7		
PLASTICITY INDEX	9.5		
LINEAR SHRINKAGE	4.4		
CLASSIFICATION (GROUP INDEX)	**G8**		
CALIFORNIA BEARING RATIO			
OPTIMUM MOISTURE CONTENT %	8.6		
MAXIMUM DRY DENSITY KG/M^3	2103		
CBR AT 100% COMPACTION	25.3		
98% COMPACTION	21.3		
95% COMPACTION	16.4		
93% COMPACTION	13.9		
90% COMPACTION	10.6		
MAXIMUM SWELL %	1.09		
SUITABILITY			
TRH 14 CLASSIFICATION (1985)			
GRADING BASE COARSE			
GRAVEL BASE COURSE			
SELECTED SUBGRADE			
SHOULDERS			
FILL			
10% FACT			
FLAKINESS INDEX			

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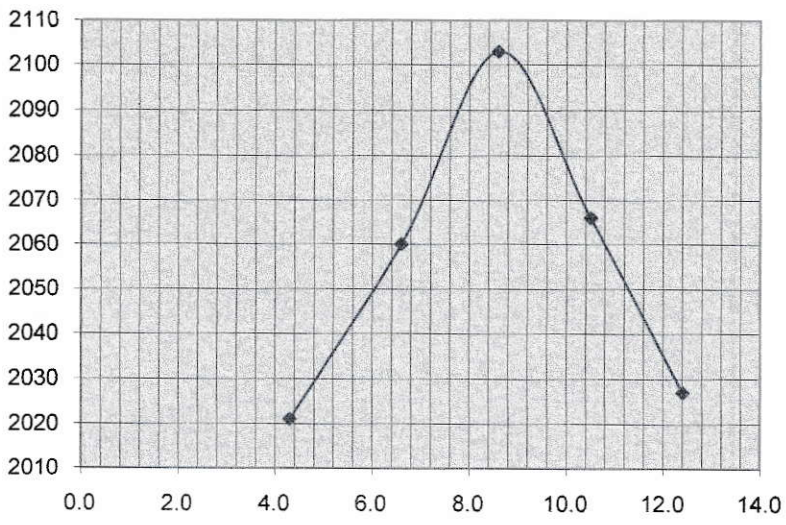
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MAXIMUM DRY AND OPTIMUM MOISTURE CONTENT

TMH 1-METHOD A7 **REPORT NO:A0207**

Date:05/09/2022			Client: Royal Haskoning DHV			
Chainage & Layer: 200 - 500		TP 1	Project:	Umzimkhulu Bulk Water Augmentation Scheme		
Sample No:B0207	Mod,Cbr& Ind.					
mould no:16	Sludge Thickener					
			Material description:Lt.Br.Gobbles + Gravel			
mass mould	4800	kg	vol mould	2336		
water %	3	5	7	9	11	
Water add	210	350	490	630	770	
mould wet mat	9734	9929	10135	10132	10122	
mass wet mat (kg)	4924	5129	5335	5332	5322	
wet dens (kg/m3)	2046	2091	2134	2094	2052	
bottle no	T1	T2	T3	T4	T5	
bottle + wet mat	730.1	729.6	729.1	727.8	729.6	
bottle + dry mat	703.7	690	678.5	667.2	659	
mass bottle	90	90	90	90	90	
mass moisture	26.4	39.6	50.6	60.6	70.6	
Mass dry mat	613.7	600	588.5	577.2	569	
moisture %	**4.3**	**6.6**	**8.6**	**10.5**	**12.4**	
dry density	**2021**	**2060**	**2103**	**2066**	**2027**	



KG/M^3	2103
OMC	8.6

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Photos for the Proposed Balance Tank

Photo.1 Excavated Depth & description of the test hole.



Photo.2 Measuring depths of the layers



Photo.3 Excavated material between 0 to 500mm in depth.



Photo.4 Excavated material between 500 & 1400 mm in depth.



Photo.5 Excavated Depth & description of the test hole.



Photo.6 Measuring depths of the layers.



Photo.7 Excavated material between 0 to 500mm in depth.



Photo.8 Excavated material between 500 & 1300 mm in depth.



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Photos for test pits (Centrifuge Building)

Photo.1 Excavated Depth & description of the test hole.



Photo.2 Measuring depths of the layers.



Photo.3 Excavated material between 0 to 900 mm in depth.



Photo.4 Excavated material between 900 & 1600 mm in depth.



Photo.5 Excavated Depth & description of the test hole.



Photo.6 Measuring depths of the layers.



Photo.7 Excavated material between 0 to 800 mm in depth



Photo.8 Excavated material between 800 & 1400 mm in depth.



Photo.9 Excavated Depth & description of the test hole.

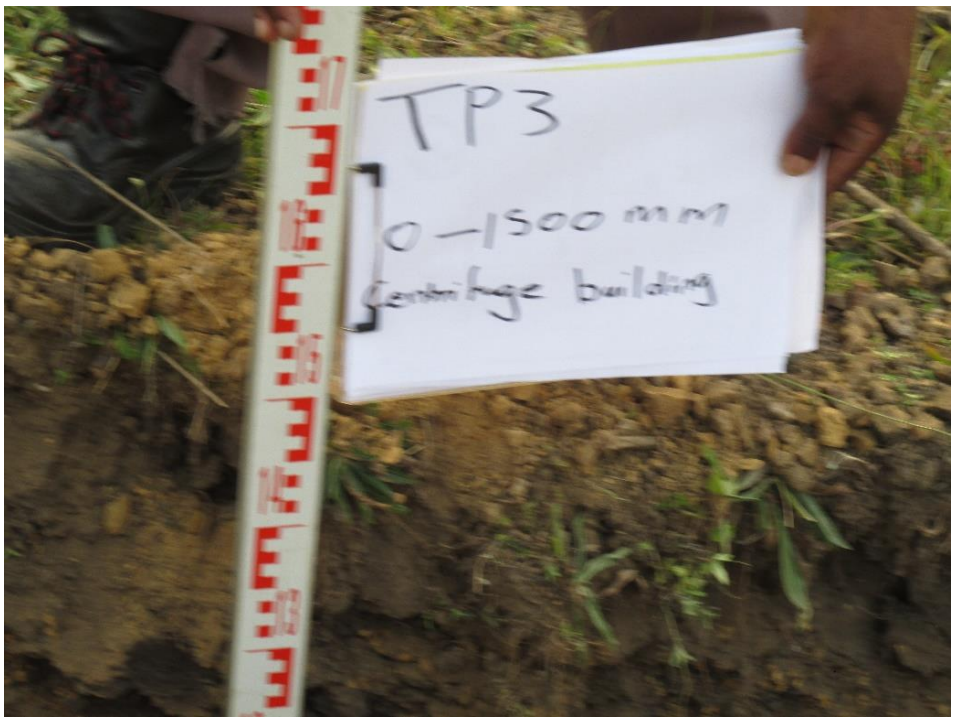


Photo.10 Measuring depths of the layers.



Photo.11 Excavated material between 0 to 300 mm in depth.



Photo.12 Excavated material between 300 & 1500 mm in depth.



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Photos for test pit Grit Removal

Photo.1 Excavated Depth & description of the test hole.



Photo.2 Measuring depths of the layers.



Photo.3 Excavated material between 0 to 150 mm in depth.



Photo.4 Excavated material between 150 & 600 mm in depth.



Photo.5 Excavated Depth & description of the test hole.



Photo.6 Measuring depths of the layers.



Photo.7 Excavated material between 0 to 200 mm in depth.



Photo.8 Excavated material between 200 & 900 mm in depth.



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Photos for test pits (Guard House)

Photo.1 Excavated Depth & description of the test hole.



Photo.2 Measuring depths of the layers.



Photo.3 Excavated material between 0 to 900mm in depth.



Photo.4 Excavated material between 900 & 1500 mm in depth.

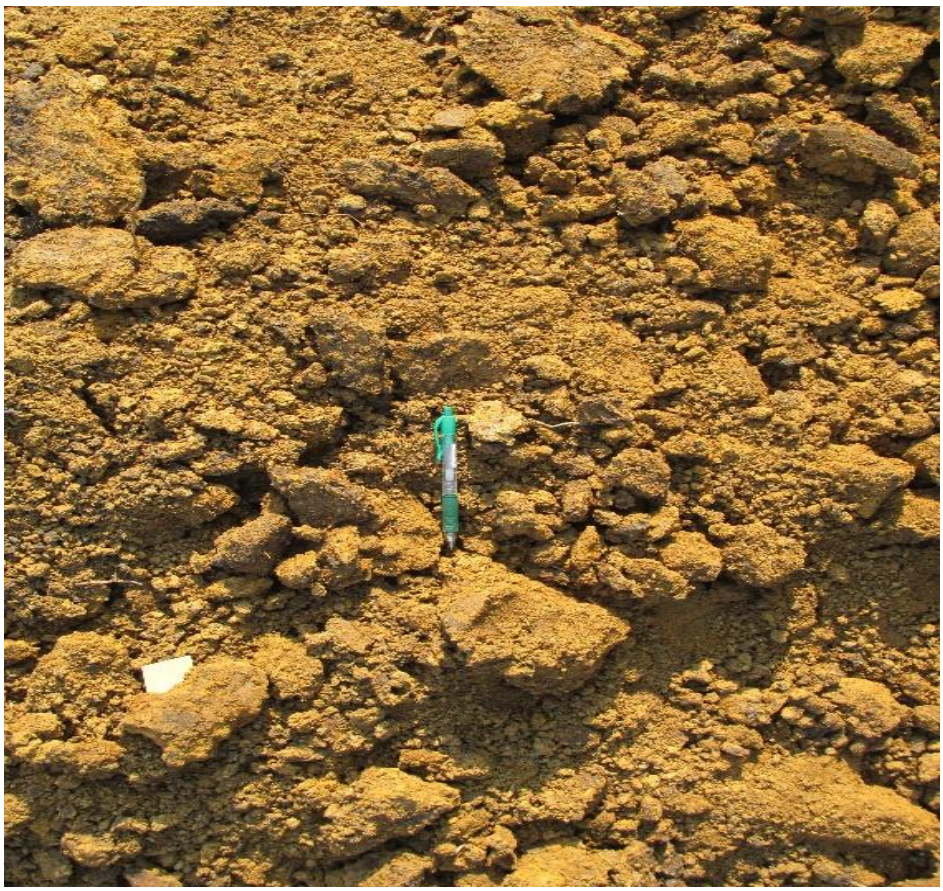


Photo.5 Excavated Depth & description of the test hole.



Photo.6 Measuring depths of the layers.



Photo.7 Excavated material between 0 to 1000mm in depth.



Photo.8 Excavated material between 1000 & 1400 mm in depth.



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Photos for test pit (Sludge Thickener)

Photo.1 Excavated Depth & description of the test hole.



Photo.2 Measuring depths of the layers.



Photo.3 Excavated material between 0 to 200mm in depth.



Photo.4 Excavated material between 200 & 500 mm in depth.



Photo.5 Excavated Depth & description of the test hole.

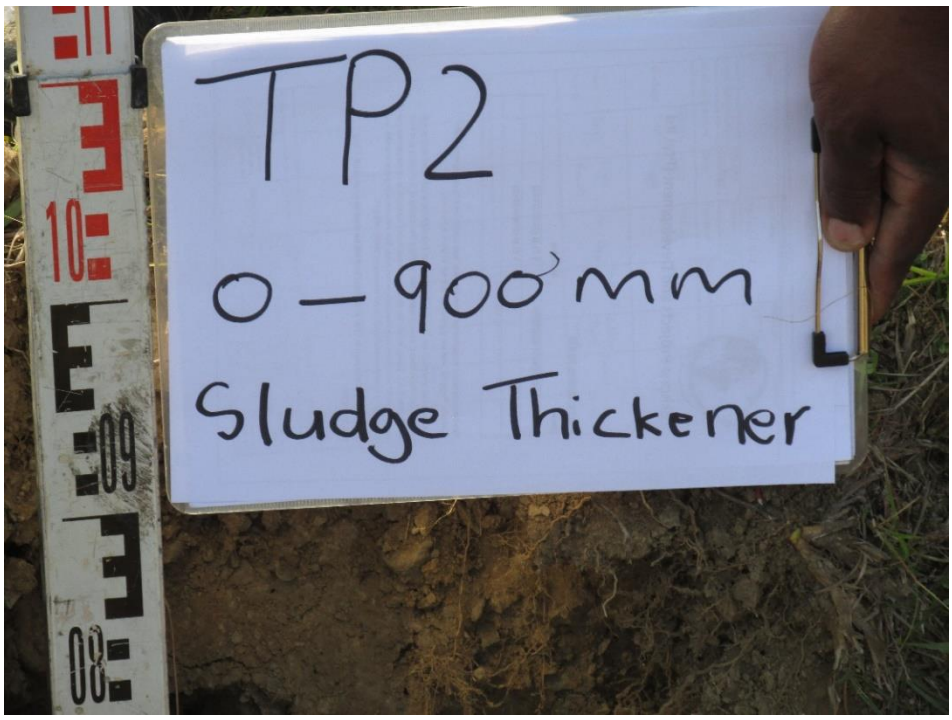


Photo.6 Measuring depths of the layers.



Photo.7 Excavated material between 200 to 900 mm in depth.



Photo.8 Excavated Depth & description of the test hole.



Photo.9 Measuring depths of the layers.



Photo.10 Excavated material between 150 to 850mm in depth.



Photo.11 Excavated Depth & description of the test hole.



Photo.12 Measuring depths of the layers.



Photo.13 Excavated material between 0 to 250mm in depth.



Photo.14 Excavated material between 250 & 1500 mm in depth.





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PROJECT: UMzimkhulu Bulk Water	
CLIENT: Royal HaskoningDHV	
DATE: Oct 2022	**FIGURE**: 1 of 1
DRAWN: A Mlangeni	**REVISION**: 00
CHECKED: L Dlamini	**NOTE**: n/a

Image sourced from Google Earth

Latitude	: S 30° 44’ 10.08’’
Longitude	: E 30° 23’ 37.02’’
Scale	: As indicated

C4.8 SITE INFORMATION: ENVIRONMENTAL PLAN

STANDARD ENVIRONMENTAL SPECIFICATION FOR CONSTRUCTION (SES)

Indaloenhle

Reg No. 2014/043185/07

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1 SCOPE

This Specification (SES) covers the requirements for controlling the impact on the environment of construction activities. The SES is applicable to all construction activities undertaken within the Royal HaskoningDHV construction projects that are undertaken outside the IDZ.

2 INTERPRETATION

2.1 SUPPORTING SPECIFICATIONS

Where the Standard Environmental Specification (SES) is required for a project the following supporting specifications shall, where applicable, form part of the Contract Documents:

(a) Project Environmental Specification (PES);

(b) Standard Vegetation Specification (SVS);

(c) Project Vegetation Specification (PVS) and;

(d) Colto or Fidic Equivalent Specification.

2.2 APPLICATION

This SES contains clauses that are generally applicable to the undertaking of civil engineering works as it is necessary to impose pro-active controls on the extent to which the construction activities impact on the environment. Interpretations and variations of the SES are set out in the Project Specification.

In the event of any difference or discrepancy between the provisions of this Specification and the provisions of the Project Specification then the provisions of the Project Specification shall prevail.

2.3 DEFINITIONS

For the purposes of this SES, the definitions and abbreviations given in the applicable specifications listed in 2.1 and the following definitions and abbreviations shall apply:

2.3.1 RHDHV:

Means Royal haskoningDHV

2.3.2 Cement laden water:

Means water containing cement or concrete arising from the Contractor's activities.

2.3.3 Contaminated water:

Means water contaminated by the Contractor's activities such as with hazardous substances, hydrocarbons, paints, solvents and runoff from plant, workshop or personnel wash areas but excludes water containing cement/ concrete or silt.

2.3.4 Environment:

Means the surroundings within which human beings exist and these comprise of:

(i) The land, water and atmosphere of the earth;

(ii) Micro-organisms, plant and animal life;

(iii) Any part or combination of (i) and (ii) and the interrelationships among and between them; and

(iv) The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

2.3.5 His:

Means his or her, as applicable.

2.3.6 Method Statement:

Is a written submission by the Contractor to the Engineer in response to the Specifications or to a request by the Engineer, setting out the plant (construction equipment), materials, labour and method the Contractor proposes using to carry out an activity, identified by the relevant specification or the Engineer when requesting the Method Statement. The Method Statement shall be in such detail that the Engineer is able to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications.

The Method Statement shall cover applicable details with regard to:

- Construction procedures;
- Materials and equipment to be used;
- Getting the equipment to and from Site;
- How the equipment/ materials will be moved while on Site;
- How and where materials will be stored;
- The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur;
- Timing and location of activities;
- Compliance/ non-compliance with the Specifications; and

• Any other information deemed necessary by the Engineer.

2.3.7 Potentially hazardous substance:

Is a substance, which, in the reasonable opinion of the Engineer, can have a deleterious effect on the environment. Hazardous Chemical Substances are defined in the Regulations for Hazardous Chemical Substances published in terms of the Occupational Health and Safety Act.

2.3.8 Reasonable:

Means, unless the context indicates otherwise, reasonable in the opinion of the Engineer, after he has consulted with CDC Safety, Health & Environment Business Unit.

2.3.9 Silt laden water:

Means water containing sand and silt arising from the Contractor's activities and/or as a result of natural run-off.

2.3.10 Site:

This is the area in the possession of the Contractor for the construction of the Works. Where the area is not demarcated, it will include all adjacent areas, which are reasonably required for the activities for the Contractor, and approved for such use by the Engineer.

2.3.11 Solid waste:

Means all solid waste, including construction debris, chemical waste, excess cement/ concrete, wrapping materials, timber, tins, cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

3. MATERIALS

3.1 MATERIALS HANDLING, USE AND STORAGE

The Contractor shall ensure that any delivery drivers are informed of all procedures and restrictions (including "no go" areas) required to comply with the Specifications. The Contractor shall ensure that these delivery drivers are supervised during off loading, by someone with an adequate understanding of the requirements of the Specifications.

Materials shall be appropriately secured to ensure safe passage between destinations. Loads including, but not limited to sand, stone chip, fine vegetation, refuse, paper and cement, shall have appropriate cover to prevent them spilling from the vehicle during transit. The Contractor shall be responsible for any clean-up resulting from the failure by his employees or suppliers to properly secure transported materials.

All manufactured and/ or imported material shall be stored within the Contractor's camp, and, if so required by the Project Specification, out of the rain. All lay down areas outside of the construction camp shall be subject to the Engineer's approval.

Imported gravel, fill, soil and sand materials shall be free of weeds, alien invasive seed matter, plant material, litter and contaminants and shall be obtained from sources approved by the Engineer. A Method Statement detailing the source and methods to ensure compliance with this specification shall be submitted to the Engineer.

3.2 STOCKPILING

Any stockpiling of gravel, cut, fill or any other material including spoil shall be in areas approved by the Engineer within the defined working area.

The Contractor shall ensure that the material does not blow or wash away. If the stockpiled material is in danger of being washed or blown away, the Contractor shall spray it with Dustex or cover it with a suitable material, such as hessian or plastic. Stockpiles of topsoil shall not be covered with plastic.

No stockpiling of any material shall be allowed within the 100m of any residential areas or 20m of any "no go" area.

3.3 SOLID WASTE MANAGEMENT

No on-site burning, burying or dumping of any waste materials, litter or refuse shall occur. The Contractor shall provide vermin and weatherproof bins with lids of sufficient number and capacity to store the solid waste produced on a daily basis. The lids shall be kept firmly on the bins at all times.

Bins shall not be allowed to become overfull and shall be emptied at least once a day. The waste from bins may be temporarily stored on Site in a central waste area that is weatherproof and scavenger-proof, and which the Engineer has approved.

Recyclable waste shall be disposed of into separate skips/bins and removed off-site for recycling.

All solid waste shall be disposed of off-site at an approved landfill Site. The Contractor shall supply the Engineer with the appropriate disposal certificates.

The Contractor must facilitate the re-use of cleared trees and bush (e.g. by allowing controlled wood cutting and removal of wood). Cleared vegetation may only be burnt when no other form of re-use (e.g. chipping or composting) is practical or economical. Burning of cleared

vegetation may only take place in a safe area (e.g. borrow pit) after permission has been obtained from all the relevant authorities and the Fire Department has been informed. The Contractor must ensure that cleared trees and wood are removed from the Site within 45 days of Site clearance.

The Contractor shall submit a solid waste management Method Statement to the Engineer.

3.4 WATER USE

All source of water for construction purposes must be approved by the Engineer in writing before any such sources can be used to obtain water.

3.5 HAZARDOUS SUBSTANCES

The transportation and handling of hazardous substances must comply with the provisions of the Hazardous Substances Act (Act No.187 of 1993) and associated regulations as well as SABS 0228 and SABS 0229. The Contractor shall also comply with all other applicable regional and local legislation and regulations with regard to the transport, use and disposal of hazardous substances. Hazardous chemical substances (as defined in the Regulations for Hazardous Chemical Substances) used during construction shall be stored in secondary containers. The relevant Material Safety Data Sheets (MSDS) shall be available on Site. Procedures detailed in the MSDSs shall be followed in the event of an emergency situation. The Contractor shall be responsible for the training and education of all personnel on Site who will be handling hazardous materials about their proper use, handling and disposal.

If potentially hazardous substances are to be stored or used on Site, the Contractor shall submit a Method Statement to the Engineer detailing the substances / materials to be used, together with the transport, storage, handling and disposal procedures for the substances.

3.6 CONTAMINATED WATER

Potential pollutants of any kind and in any form shall be kept, stored, and used in such a manner that any escape can be contained and that the water table is not endangered. Water containing such pollutants as chemicals, washing detergents, sewerage, fuels, paints and solvents and hydrocarbons shall be contained and discharged into an impermeable storage facility for removal from the site or for recycling. This particularly applies to runoff from fuel depots/workshops/truck washing areas. The Contractor may direct contaminated water

into a sewerage main, provided that authorisation has been obtained from the local authority and that the Engineer has provided written permission for this action.

Wash down areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas are not polluted. The Contractor shall notify the Engineer immediately of any pollution incidents on Site.

The Contractor shall submit a Method Statement to the Engineer detailing how the contaminated water will be managed on Site.

3.7 CEMENT AND CONCRETE BATCHING

The proposed location of batching areas (including the location of cement stores and sand and aggregate stockpiles) shall be indicated on the Site layout plan and approved by the Engineer. Batching areas shall not be located within 150m of any River or any "no go" areas, unless written approval has been granted by the Engineer.

All wastewater generated from the operation and cleaning of concrete batching equipment and other sources of concrete shall be passed through a concrete wastewater settlement system as depicted in the appropriate drawing. The water from this system shall not be allowed to flow into any "no go" area or water course but must permeate through the ground before it reaches any such water course. The accumulated sludge in the settlement system must be regularly cleaned out and appropriately disposed of as solid waste.

The Contractor shall ensure that minimal water is used for washing of concrete batching equipment.

Used cement bags shall be disposed of in weatherproof bins on site to prevent the generation of windblown cement dust and the bags from blowing away.

During construction, the contractor must ensure that concrete is mixed on mortar boards, all visible remains of concrete are removed and disposed of as waste and that all surplus aggregate is removed.

A Method Statement detailing all actions to be taken to comply with the cement and batching requirements shall be submitted to the Engineer.

4 PLANT

4.1 FUEL (PETROL AND DIESEL) AND OIL

4.1.1 Fuel Storage

Fuel can be stored on site. The location of the fuel storage area will be approved by the Engineer and will be situated at least 100m away from any major drainage systems, residential areas or "no go" areas. All necessary approvals with respect to fuel storage and dispensing shall be obtained from the appropriate authorities. Symbolic safety signs depicting "No Smoking", "No Naked Lights" and "Danger" conforming to the requirement of SABS 1186 shall be prominently displayed in and around the fuel storage area. There shall be adequate fire-fighting equipment at the fuel storage area.

The Contractor shall ensure that all liquid fuels and oils are stored in tanks with lids, which are kept firmly shut and under lock and key at all times. The capacity of the tank shall be clearly displayed and the product contained within the tank clearly identified using the emergency information system detailed in SABS 0232 part 1. Fuel storage tanks shall have a capacity not exceeding 9000 litres and shall be kept on site only for as long as fuel is needed for construction activities, on completion of which they shall be removed.

Tanks on site shall not be linked or joined via any pipe work, but shall remain as separate entities. The tanks shall be situated on a smooth impermeable base with a bund. The volume inside the bund shall be 110% of the total capacity of the largest storage tank. The base may be constructed of concrete, or of plastic sheeting with impermeable joints with a layer of sand over to prevent perishing. The impermeable lining shall extend to the crest of the bund. The floor of the bund shall be sloped to enable any spilled fuel and/or fuel contaminated water to be removed. Appropriate material, approved by the Engineer that absorbs/ breaks-down or encapsulates minor hydrocarbon spillage and which is effective in water shall be installed in the sump.

The tanks and bunded areas shall be covered by a roofed structure, as detailed in the appropriate drawing, to prevent the bunded area from filling up with rain water. This structure shall be constructed in such a way, and to the approval of the Engineer, to ensure that it is not dislodged by wind. If any water does collect in the bunded area it shall be removed within a day of this occurring and taken off Site to a disposal site approved by the Engineer, and the material that absorbs/ breaks-down or encapsulates minor hydrocarbon spillage shall be replenished.

Only empty and externally clean tanks may be stored on the bare ground. Empty and externally dirty tanks shall be sealed and stored on an area where the ground has been protected.

Adequate precautions shall be provided to prevent spillage during the filling of any tank and during the dispensing of the contents. The dispensing mechanism for the fuel storage tanks shall be stored in a waterproof container when not in use.

A Method Statement shall be submitted to the Engineer detailing the design, location and construction of the fuel storage area as well as for the filling and dispensing from storage tanks and for the type of absorbing/ breaking-down or encapsulating material to be used.

4.1.2 Refuelling

Where reasonably practical, plant shall be refuelled at a designated re-fuelling area/depot or at a workshop as applicable. If this is not reasonably practical, then the surface under the refuelling area shall be protected and appropriately bunded against pollution to the reasonable satisfaction of the Engineer prior to any refuelling activities.

If fuel is dispensed from 200 litre drums, the proper dispensing equipment shall be used, and the drum shall not be tipped in order to dispense fuel. The Contractor shall ensure that the appropriate fire-fighting equipment is present during refuelling operations.

The Contractor shall ensure that there is always a supply of absorbent material readily available to absorb/breakdown or where possible, be designed to encapsulate minor hydrocarbon spillages. The quantities of such materials shall be able to handle a minimum of 200 ℓ of hydrocarbon liquid spill. Prior to any refuelling or maintenance activities, the Engineer must approve this material.

4.1.3 Used oil and hydrocarbon contaminated materials

Used oil shall be stored at a central location on Site prior to removal off Site for disposal at an approved disposal or recycling site.

Old oil filters and oil, petrol and diesel-soaked material shall be treated as hazardous waste. The Contractor shall remove all oil, petrol, and diesel-soaked sand immediately and shall dispose of it as hazardous waste or treat it on site with material that breaks-down or encapsulates such spillages as approved by the Engineer.

4.2 ABLUTION FACILITIES

Washing, whether of the person or of personal effects, and acts of excretion and urination are strictly prohibited other than at the facilities provided. The Contractor shall provide the necessary ablution facilities for all his personnel prior to the commencement of work and shall ensure that his personnel make use of the facilities.

Toilet facilities shall be supplied by the Contractor for the workers at a ratio of at least 1 toilet per 15 workers in areas approved by the Engineer. Every 1-man urinal will be taken as supplying the equivalent of 5 men in addition to the 15 men per toilet on site. No toilets will be erected within 100m of any residential areas, within 20m of the edge of the Site, within 50m of any "no go" areas or any major drainage systems. Toilets shall be situated within 200m of any area where work is taking place in numbers sufficient to meet the ratio depicted above for the workers in the area. Mobile toilets (e.g. trailer mounted) should be considered for Sites, where workers may be expected to cover large distances every day.

The facilities shall be maintained in a hygienic state and serviced regularly. Toilet paper shall be provided. Temporary/ portable toilets shall be secured to the ground to prevent them toppling due to wind or any other cause, to the satisfaction of the Engineer.

Discharge into the environment and burial of waste is strictly prohibited. The Contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that the contents are removed from the Site. Toilets shall be emptied before the Contractors' holidays or any other temporary site closure.

4.3 EATING AREAS

The Contractor shall designate eating area/s, subject to the approval of the Engineer. No cooking is allowed outside of the Contractor's camp area on Site.

At meal times all workers must eat in designated eating areas. More than one area may be required for large Sites. These areas shall have shade for the workers. The eating areas may be in existing structures or in temporary/ transportable structures that shall be well constructed using wood or metal for the frame and screened on the top and sides with shade cloth/ canvas or other material to the satisfaction of the Engineer. These areas shall be well demarcated and in locations approved by the Engineer and shall not be within 100m of any "no go" areas or any major drainage systems, on or adjacent to the Site.

Sufficient bins as specified in Section 3.3 of this ES shall be present in these areas. All disposable food packaging must be disposed of in the bins after every meal.

The feeding or leaving of food for animals is strictly prohibited.

4.4 SITE STRUCTURES

All site establishment components (as well as equipment) shall be positioned to limit visual intrusion on neighbours and the size of the land area disturbed. The type and colour of roofing and cladding materials to the Contractor's temporary structures shall be selected to reduce reflection.

The Contractor shall supply and maintain adequate and suitable sheds for the storage of materials. Sheds for the storage of materials that may deteriorate or corrode if exposed to the weather shall be weatherproof, adequately ventilated and provided with raised floors.

4.5 LIGHTS

The Contractor shall ensure that any lighting installed on the Site for his activities does not interfere with road traffic or cause a reasonably avoidable disturbance to the surrounding community or other users of the area.

4.6 WORKSHOP, EQUIPMENT MAINTENANCE AND STORAGE

Where practical, all maintenance of equipment and vehicles on Site shall be performed in a workshop. If it is necessary to do maintenance outside of the workshop area, the Contractor shall obtain the approval of the Engineer prior to commencing such activities. No maintenance, including emergency maintenance, of plant can take place within 50m of any "no go" area or drainage system.

The Contractor shall ensure that in his workshop and other plant maintenance facilities, including those areas where, after obtaining the Engineer's approval, the Contractor carries out emergency plant maintenance, there is no contamination of the soil or vegetation. The workshop shall have a smooth impermeable (concrete or thick plastic covered with sand) floor. The floor shall be bunded and sloped towards an oil trap or sump to contain any spillages. When servicing equipment, drip trays shall be used to collect the waste oil and other lubricants. Drip trays shall also be provided in construction areas for stationary plant (such as compressors) and for "parked" plant (such as scrapers, loaders, vehicles).

All vehicles and equipment shall be kept in good working order and serviced regularly. Leaking equipment shall be repaired immediately or removed from the Site.

The washing of equipment shall be restricted to urgent or preventative maintenance requirements only. All washing shall be undertaken in the workshop or maintenance areas, and these areas must be equipped with a suitable impermeable floor and sump/oil trap. The

use of detergents for washing shall be restricted to low phosphate and nitrate containing and low sudsing-type detergents.

A Method Statement must be submitted to the Engineer detailing the design of the bunding of the workshop and how run-off from the workshop will be managed as well as how drip trays used under plant will be managed.

4.7 NOISE

The Contractor shall take precautions to minimise noise generated on Site (e.g. Install and maintain silencers on machinery).

The Contractor shall comply with the Noise Induced Hearing Loss Regulations published under the Occupational Health and Safety Act.

Appropriate directional and intensity settings are to be maintained on all hooters and sirens.

No amplified music shall be allowed on Site. The use of radios, tape recorders, compact disc players, television sets etc shall not be permitted unless the volume is kept sufficiently low as to avoid any intrusion on members of the public within range. The Contractor shall not use sound amplification equipment on Site unless in emergency situations.

4.8 DUST CONTROL

The Contractor shall be responsible for the continued control of dust arising from his operations. The Contractor shall inform the Engineer 48 hours in advance of anticipated 'unavoidable' dust generating activities. The Contractor shall take all reasonable measures to minimize the generation of dust as a result of construction activities to the satisfaction of the Engineer. Appropriate dust suppression measures include: spraying or dampening with water, using a commercial dust binder (such as Hydropam or Dustex), rotovating straw bales, planting of open cleared space and the scheduling of dustgenerating activities. If the conditions are such that the Contractor cannot satisfactorily dampen the dust, then the Engineer may halt operations until such time as the conditions are more suitable for lower dust generating construction.

Damping of all gravel haul and access roads with water must be ongoing and special attention must be given to roads close to residential areas. Should dust still be a problem on any specific road, the allowable speed will be reduced to 20km/h. If dust is still a problem the road should be treated with a commercial dust binder, as required, to form a cohesive layer that will control the dust on the road.

Areas that are to have the topsoil stripped for construction purposes must be limited and only stripped when work is about to take place.

Other activities and situations that may result in a dust nuisance include: site clearance and other earth moving operations, open cleared space, stockpiles of topsoil or sand and activities associated with concrete batching plants.

A Method Statement detailing how dust will be managed for different operations on the site must be submitted to the Engineer for his approval before any work that could result in dust being generated is undertaken.

5. CONSTRUCTION

5.1 METHOD STATEMENTS

The following Method Statements, as well as any required by the Project Specification, shall be provided by the Contractor and submitted with the tender for reviewing prior to the awarding of a Contract.

5.1.1 Solid waste management (Clause 3.3)

Expected solid waste types, quantities, methods and frequency of collection and disposal as well as location of disposal sites.

5.1.2 Contaminated water (Clause 3.6)

Methods of minimising, controlling, collecting and disposing of contaminated water.

5.1.3 Contractors SHE Officer (Clause 5.2)

The name and letter of appointment of the Contractors SHE Officer must be given to the Engineer and the terms of reference for the work to be undertaken by the SHE Officer must be detailed including time on site, CV, roles and responsibility, interaction with the Contractor and environmental offices, etc.

5.1.4 Site division (Clause 5.4)

The location, layout and method of establishment of the construction camp (including all buildings, offices, lay down yards, vehicle wash areas, fuel storage areas, batching areas and other infrastructure required for the running of the project)

5.1.5 Emergency procedures (Clause 5.10)

Emergency procedures for fire and accidental leaks and spillages of hazardous substances (including fuel and oil). Include details of risk reduction measures to be implemented including firefighting equipment, fire prevention procedures and spill kits (materials and compounds used to reduce the extent of spills and to breakdown or encapsulate hydrocarbons).

Other Method Statements that will be required during the course of construction are to be provided by the Contractor a minimum of 20 days prior to commencement of the works or activities to which they apply (no work can commence on site before these Method Statements have been approved):

5.1.6 Importing of material (Clause 3.1)

Detail the source of any gravel, soil, aggregate or sand imported onto site and precautions taken to ensure no vegetative contamination.

5.1.7 Hazardous substances (Clause 3.5)

Details of any hazardous substances / materials to be used, together with the transport, storage, handling and disposal procedures for the substances.

5.1.8 Cement and concrete batching (Clause 3.7)

Location, layout and preparation of cement/ concrete mixing areas including the methods employed for the mixing of concrete and particularly the containment of runoff water from such areas and the method of transportation of concrete.

5.1.9 Fuel storage and use (Clause 4.1)

The design, location and construction of the fuel storage area as well as for the filling and dispensing from storage tanks.

5.1.10 Workshop and drip trays (Clause 4.6)

Location, layout, design and pollution control for Workshop as well as management of drip trays under plant. 5.1.11 Dust (Clause 4.8)

Details on the methods for managing dust on the site.

5.1.12 Environmental awareness training (Clause 5.3)

Number, dates, trainer and logistics for the initial awareness courses for the Contractor's employees and for the management Staff.

5.1.13 Access Routes (Clause 5.7)

Details, including a drawing, showing where and how the access points and routes will be located and managed.

Any additional Method Statements as required by the Engineer or the Project Specification must be provided by the Contractor. The Contractor shall not commence the activity until the Method Statement has been approved in writing and shall, except in the case of emergency activities, allow a period of 20 working days for approval of the Method Statement.

The Engineer may require changes to a Method Statement if the proposal does not comply with the specification or if, in the reasonable opinion of the Engineer, the proposal may result

in, or carries a greater than reasonable risk of, damage to the environment in excess of that permitted by the Specifications or any legislation.

Approved Method Statements shall be readily available on the Site and shall be communicated to all relevant personnel and subcontractors. The Contractor shall carry out the Works in accordance with the approved Method Statement. Approval of the Method Statement shall not absolve the Contractor from any of his obligations or responsibilities in terms of the Contract. No claim for delay or additional cost incurred by the Contractor shall be entertained due to inadequacy of a Method Statement.

Details of the following appointments are required within 7 days of commencing work on site:

5.1.14 Assistants to the Contractor's SHE Officer (Clause 5.2)

The name and appointment letter of the three assistants to the Contractor's SHE Officer must be given to the Engineer and the work to be undertaken by these assistants must be detailed including time allocated to these roles and their responsibility and interaction with the Contractors SHE Officer.

5.1.15 Fire Officer (Clause 5.9)

The name and appointment letter of the Fire Officer must be given to the Engineer.

5.2 CONTRACTOR'S SHE OFFICER AND ASSISTANTS

The Contractor shall appoint a Contractor's SHE Officer who shall be responsible for undertaking a daily site inspection to monitor compliance with this Specification and the relevant Project Specification. The Contractor shall submit the name of the Contractor's SHE Officer as well as a Method Statement detailing his CV, roles and responsibilities to the Engineer for his approval before work can commence on site.

The Contractor will also appoint reliable staff, who will assist and report to the Contractor's SHE Officer, to the following positions:

- Litter Assistant to ensure that the site is cleaned every day and that dustbins are not overflowing and litter does not blow off the site into the surrounding areas.
- Hydrocarbon and Contaminated Water Assistant to ensure that any hydrocarbon spills or leaks are dealt with immediately, vehicles are not leaking hydrocarbons on site, there is no pollution of any water course/ drainage system on or adjacent to site due to any construction activities, all stationary plant has bunds around them that are kept in good working order, the fuel storage and refuelling area is free of spills and leaks of hydrocarbons and any other issues

to do with hydrocarbon house keeping on site. He will also ensure that no contaminated water is escaping onto the site and that the toilets are kept in a clean and good working condition.

• Demarcation and Dust Assistant to ensure that all fencing and demarcation is in place when it is required and that such fencing or demarcation is in good order on a daily basis. This person will also be responsible to ensure that excessive dust is not generated from the construction area and will ensure that the roads are watered and other areas dampened where necessary and any other actions taken to limit dust generation from site.

These appointments will be made within the first 7 days of work commencing on site and will be given to the Engineer in writing.

5.3 ENVIRONMENTAL AWARENESS TRAINING

Environmental awareness training courses shall be run for all personnel on site. Two types of course shall be run, one for the Contractor's and Subcontractor's management and one for all site staff and labourers. Courses shall be run in the morning during normal working hours at a suitable venue provided by the Contractor. All attendees shall remain for the duration of the course and sign an attendance register on completion that clearly indicates participant's names, a copy of which shall be handed to the Engineer.

The size of each session shall be limited to 30 people. The Contractor shall allow for sufficient sessions to train all personnel. Subsequent sessions shall be run for any new personnel coming onto site. A Method Statement with respect to the organisation of these courses shall be submitted.

Notwithstanding the specific provisions of this clause it is incumbent upon the Contractor to convey the sentiments of the EMP to all personnel and Subcontractors involved with the Works.

5.3.1 Training course for management and foremen

The environmental awareness training course for management shall include all management staff and foremen. The course, which will be presented by the Engineer's SHE Coordinator, will be of approximately one-hour duration. The initial course shall be undertaken not less than 7 days prior to commencement of work on site. Subsequent courses shall be held as and when required.

5.3.2 Training course for site staff and labour

The environmental awareness training course for site staff and labour shall be presented by the Contractor's SHE Officer from material provided by the Engineer unless otherwise required by the Project Specification. The course will be approximately one-hour long. The course shall be

run not more than 7 days after commencement of work on site with sufficient sessions to accommodate all available personnel. Subsequent courses shall be held as and when required.

5.4 SITE DIVISION

The Contractor shall restrict all his activities, materials, equipment and personnel to within the area specified. A Method Statement detailing the location, layout and method of establishment of the construction camp (including all buildings, offices, lay down yards, vehicle wash areas, fuel storage areas, batching areas and other infrastructure required for the running of the project) shall be submitted to the Engineer. No accommodation for any staff is permitted on the Site.

5.5 SITE DEMARCATION

As required by the Project Specification, the Contractor shall erect and maintain permanent and / or temporary fences of the type and in the locations directed by the Engineer. Such fences shall, if so specified, be erected before undertaking designated activities.

5.6 "NO GO" AREAS

If so required by the Project Specification, certain areas within or next to the Site shall be "no go" areas. The Contractor shall ensure that, insofar as he has the authority, no person, machinery, equipment or materials enter the "no go" areas at any time.

5.7 ACCESS ROUTES/ HAUL ROADS

On the Site and, if so required by the Project Specification, within such distance of the Site as may be stated, the Contractor shall control the movement of all vehicles and plant including that of his suppliers so that they remain on designated routes, are distributed so as not to cause an undue concentration of traffic and that all relevant laws are complied with. In addition, such vehicles and plant shall be so routed and operated as to minimise disruption to regular users of the routes not on the Site. On gravel or earth roads on Site and within 500m of the Site, the vehicles of the Contractor and his suppliers shall not exceed a speed of 45 km/hr or as directed by the Engineer.

The Contractor shall supply the Engineer with a Method Statement detailing the location and management of all access points and roads.

5.8 CONSTRUCTION PERSONNEL INFORMATION POSTERS

The Contractor shall erect and maintain information posters for the information of his employees depicting actions to be taken to ensure compliance with the Environmental Specifications. Construction personnel information posters shall be laminated and erected in all eating areas, workshops and site offices. The Contractor shall ensure that the construction personnel information posters are not damaged in any way, and shall replace them if any part becomes illegible.

Examples of these posters will be supplied to the Contractor by the Engineer in electronic format.

5.9 FIRE CONTROL

The Contractor shall take all the necessary precautions to ensure that fires are not started as a result of his activities on Site. No open fires shall be permitted on the Site, with the exception of burning of cleared vegetation after approval by the Engineer and relevant authorities. Any fires that occur shall be reported to the Engineer immediately. Smoking shall not be permitted in those areas where there is a fire hazard. Such areas shall include the workshop and fuel storage areas and any areas where the vegetation or other material is such as to support the rapid spreading of an initial flame.

The Contractor shall appoint a Fire Officer who shall be responsible for ensuring immediate and appropriate actions in the event of a fire and shall ensure that employees are aware of the procedures to be followed. The Contractor shall forward the name of the Fire Officer to the Engineer for his approval within 7 days of being on site.

The Contractor shall ensure that there is basic fire-fighting equipment available on Site at all times. This shall include at least rubber beaters when working in urban open spaces and natural areas, and at least one fire extinguisher of the appropriate type when welding or other "hot" activities are undertaken. The Contractor shall be liable for any expenses incurred by any organisations called to assist with fighting fires that were started as a result of his activities or personnel, and for any cost relating to the rehabilitation of burnt areas, or consequential damages.

5.10 EMERGENCY PROCEDURES

Emergency procedures, including the names and contact details of responsible personnel and emergency services shall be made available to all staff and shall be clearly displayed at

relevant locations at the Site. The Contractor shall advise the Engineer of any emergencies on Site, together with a record of action taken, within 24 hours of the emergency occurring.

Telephone numbers of emergency services shall also be posted conspicuously in the Contractor's office near the telephone.

The Contractor shall submit a Method Statement covering the procedures for the following emergencies:

5.10.1 Fire:

The Contractor shall advise the relevant authority of a fire as soon as one starts and shall not wait until he can no longer control it. The Contractor shall ensure that his employees are aware of the procedures to be followed in the event of a fire.

5.10.2 Accidental leaks and spillages:

The Contractor shall ensure that his employees are aware of the procedures to be followed for dealing with spills and leaks, which shall include notifying the Engineer and the relevant authorities. The Contractor shall ensure that all the necessary materials and equipment for dealing with spills and leaks are available on Site at all times. Treatment and remediation of the spill areas shall be undertaken to the reasonable satisfaction of the Engineer.

In the event of a hydrocarbon spill, the source of the spillage shall be isolated and the spillage contained. The area shall be cordoned off and secured. The Contractor shall ensure that there is always a supply of absorbent material readily available to absorb/ breakdown or where possible, be designed to encapsulate minor hydrocarbon spillages. The quantities of such materials shall be able to handle a minimum of 200 ℓ of hydrocarbon liquid spill.

Any spills must be cleared and the contaminated soil/sludge disposed of in an appropriate manner, approved by the Engineer, or at a licensed hazardous waste disposal site.

5.11 COMMUNITY RELATIONS

If so required by the Project Specification, the Contractor shall erect and maintain information boards in the positions, quantities, designs and dimensions specified. Such boards shall include contact details for complaints by members of the public in accordance with details provided by the Engineer.

The Contractor shall keep a "Complaints Register" on Site. The Register shall contain all contact details of the person who made the complaint, and information regarding the complaint itself and note the date and time that the complaint was resolved.

The Engineer shall be responsible for responding to queries and/or complaints and may request assistance from the Contractor's Management Staff.

5.12 PROTECTION OF NATURAL FEATURES

The Contractor shall not deface, paint, damage or mark any natural features (e.g. rock formations) situated in or around the Site for survey or other purposes unless agreed beforehand with the Engineer. Any features affected by the Contractor in contravention of this clause shall be restored / rehabilitated to the satisfaction of the Engineer.

The Contractor shall not permit his employees to make use of any natural water sources (e.g. springs, streams, and open water bodies) for the purposes of swimming, personal washing and the washing of machinery or clothes.

5.13 PROTECTION OF FLORA AND FAUNA

Except to the extent necessary for the carrying out of the Works, flora shall not be removed, damaged or disturbed nor shall any vegetation be planted. The search and rescue of rare, endemic or endangered species prior to Site clearance must be carried out in accordance with the Vegetation Specifications. The removal and stockpiling of topsoil must also be carried out in accordance with the Vegetation Specifications. Trapping, poisoning and/or shooting of animals is strictly forbidden. No domestic pets or livestock are permitted on Site.

5.14 STORMWATER MANAGEMENT

Natural run-off must be diverted to stormwater drains where these are available. The Contractor shall take appropriate measures to prevent sand, silt and silt-laden waters from entering stormwater drains, or any surface water course. The Contractor shall take reasonable measures to control the erosive effects of stormwater runoff particularly where excavation and construction activities form temporary channels. Suitable energy breaking devices, cut-off drains, diversions and retention ponds shall be employed to ensure that storm water runoff from the Site is dissipated and does not exceed the capacity of the surrounding stormwater system and excessive suspended solids are settled before they enter the stormwater system or any surface water course.

If required in the Project Specification, the Contractor shall submit a Method Statement to the Engineer detailing how stormwater will be managed on Site.

5.15 EROSION AND SEDIMENTATION CONTROL

The Contractor shall take all reasonable measures to limit erosion and sedimentation due to construction activities and shall, in addition, comply with such detailed measures as may be required by the Project Specification.

Where erosion and/or sedimentation, whether on or off the Site, occurs despite the Contractor complying with the foregoing, rectification shall be carried out in accordance with details

specified by the Engineer. Where erosion and/or sedimentation occurs due to the fault of the Contractor, rectification shall be carried out to the reasonable requirements of the Engineer and at the expense of the Contractor.

5.16 AESTHETICS

The Contractor shall take reasonable measures to ensure that construction activities do not have an unreasonable impact on the aesthetics of the area.

5.17 RECREATION

If so required by the Project Specification, the Contractor shall take measures to reduce disruption to recreational users of the area abutting the Site.

5.18 TEMPORARY SITE CLOSURE

If the Site is closed for a period exceeding 5 days, the Contractor's SHE Officer in consultation with the Engineer shall carry out the following checklist procedure and ensure that the following conditions pertain and report on compliance with this clause:

5.18.1 Fuels / flammables / hazardous materials stores

- Fuel stores are as low in volume as practicable.
- There are no leaks.
- The outlet is secure and locked.
- The bund is empty. • Fire extinguishers are serviced and accessible.
- The area is secure from accidental damage through vehicle collision and the like.
- Emergency and contact numbers are available and displayed.
- There is adequate ventilation in enclosed spaces.
- There are no stores or containers within the 1:50 year flood line.

5.18.2 Safety

- Site safety checks have been carried out in accordance with the Occupational Health and Safety Act (No. 85 of 1993) prior to site closure.
- An inspection schedule and log for use by security or contracts staff is developed.
- All trenches and manholes are secured.
- Applicable notice boards are in place and secured.
- Emergency and Management contact details are prominently displayed.
- Security personnel have been briefed and have the facilities to contact or be contacted by relevant management and emergency personnel.
- Night hazards such as reflectors, lighting, traffic signage etc have been checked.

• Fire hazards identified and the local authority notified of any potential threats e.g. large brush stockpiles, fuels etc.

• Pipe stockpiles are wedged / secured.

• Scaffolds are secure.

• Structures vulnerable to high winds secure.

5.18.3 Erosion

• Wind and dust mitigation measures such as straw, brush packs, irrigation etc are in place.

• Excavated and filled slopes and stockpiles are at a stable angle and capable of accommodating normal expected water flows.

• Re-vegetated areas have a watering schedule and the supply to such areas is secured.

• There are sufficient detention ponds or channels in place.

5.18.4 Water contamination and pollution

• Hazardous fuel stores are secure.

• Cement and materials stores are secure.

• Toilets are empty and secured.

• Refuse bins are empty and secured.

• Bunding is clean and treated with appropriate material that will absorb/ breakdown and where possible be designed to encapsulate minor hydrocarbon spillage.

• Drip trays are empty & secure.

5.19 PROTECTION OF ARCHAEOLOGICAL AND PALAEONTOLOGICAL SITES

If any possible palaeontological/archaeological material is found during excavations, including shell middens, Stone Age tools, fossil bones and other artefacts, graves and wrecked vessels, the Contractor shall stop work immediately and inform the Engineer. The Engineer will inform the South African Heritage Resources Agency (SAHRA) and arrange for a palaeontologist/archaeologist to inspect, and if necessary excavate, the material, subject to acquiring the requisite permits from SAHRA.

6 TOLERANCES

Refer to Contract document.

7 TESTING

Void

8 MEASUREMENT AND PAYMENT

8.1 BASIC PRINCIPLES

Except as noted below and in the Project Specification as Scheduled Items, no separate measurement and payment will be made to cover the costs of complying with the provisions of this Specification and such costs shall be deemed to be covered by the rates tendered for the items in the Schedule of Quantities completed by the Contractor when submitting his Tender.

8.2 SCHEDULED ITEMS

8.2.1 Protection of stock piles from blowing or washing away:

The spraying or covering of stockpiles, including the supply of the spray or cover material, as required, shall be measured as a lump sum.

8.2.2 Storage of fuel and oils:

The supply, construction, installation, transport, upkeep and removal of all facilities required for storage and management of fuel and oils will be measured as a lump sum.

8.2.3 Cement laden water management:

The supply, construction, installation, transport, upkeep and removal of all facilities required for the management of wastewater from concrete operations will be measured as a lump sum.

8.2.4 Contaminated water management:

The supply, construction, installation, transport, upkeep and removal of all facilities required for managing contaminated water will be measured as a lump sum.

8.2.5 Storm water management:

The supply, construction, installation, transport, upkeep and removal of all facilities required for managing storm water run-off from the site will be measured as a lump sum.

8.2.6 Bunding and management of run-off from workshop areas and supply of drip trays for stationary and "parked" plant:

The supply, construction, installation, transport, upkeep and removal of all facilities required for bunding and managing the run-off from workshop areas as well as all drip trays required will be measured as a lump sum.

8.2.7 Dust management:

The supply, application, transport, upkeep and removal of all materials required to ensure that dust is adequately controlled will be measured as a lump sum. 8.2.8 Fire Control: The supply, transport, upkeep and removal of all material required for fire control will be measured as a lump sum.

8.2.9 Provision of venue and staff attendance at the environmental awareness training course:

The provision of a venue and staff attendance at the environmental training course will be measured as a lump sum. The sum shall cover all costs incurred by the Contractor in providing

the venue and facilities as detailed in the Specifications and in ensuring the attendance of all relevant employees and sub-contractors and their employees, at the training.

8.2.10 Eating areas:

The supply, construction, installation, transport, upkeep and removal at the end of the construction of all eating areas structures shall be measured as a sum.

8.2.11 Ablutions:

The supply, maintenance, regular emptying and removal of toilets shall be measured as a sum.

8.2.12 Site demarcation: The supply, installation and removal at the end of the construction of all temporary fences shall be measured by length for each type of fence scheduled.

8.2.13 Construction personnel information posters:

The supply, installation and removal at the end of the construction of all construction information posters shall be measured by number of posters for each type of poster scheduled.

8.2.14 Solid waste (including hazardous waste) management:

The supply of bins and skips as well as transport of waste to appropriate waste disposal facilities shall be measured as a sum.

8.2.15 Spill kits

The supply, use and replenishment of spill kits, to be used at fuel storage areas and refuelling areas shall be measured as a sum.

8.2.16 Method Statements: Additional Work:

No separate measurement and payment will be made for the provision of Method Statements but, where the Engineer requires a change beyond the requirements of the Specification on the basis of his opinion that the proposal may result in, or carries a greater than warranted risk of damage to the environment, then any additional work required, provided it could not reasonably have been foreseen by an experienced Contractor, shall be valued in accordance with the Contract document. A stated sum is provided in the Schedule of Quantities to cover payment for such additional work.

8.2.17 Work "required by the Project Specification":

Where a clause in this Specification includes a requirement as "required by the Project Specification", measurement and payment for compliance with that requirement shall be in accordance with the relevant measurement and payment clause related to the Project Specification.