THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED

CONTRACT NRA C.005-016-2015/1

CONTRACT TITLE: NEW PEDESTRIAN BRIDGE CROSSING ON NATIONAL ROUTE 2 SECTION 7 AROUND KM 25.6 NEAR GEORGE

PROJECT DOCUMENT

DATE: SEPTEMBER 2017
TENDER DOCUMENT
VOLUME 3
BOOK 2 OF 2

CHIEF EXECUTIVE OFFICER
SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED
48 TAMBOTIE AVENUE
VAL DE GRACE
PRETORIA, 0184

NAME OF TENDERER:
CONTRACT NRA C.005-016-2015/1

FOR

NEW PEDESTRIAN BRIDGE CROSSING ON NATIONAL ROUTE 2 SECTION 7 AROUND KM 25.6 NEAR GEORGE

PROJECT DOCUMENT

DATE: SEPTEMBER 2017
TENDER DOCUMENT
VOLUME 3
BOOK 2 OF 2

THIS DOCUMENT COMPILED BY: AURECON SOUTH AFRICA (PTY) LTD

AURECON CENTRE
CENTURY FALLS, CENTURY CITY
CAPE TOWN, SOUTH AFRICA
Tel: (021) 526 9400   Fax: (021) 526 9500   Email: hennie.niehaus@aurecongroup.com

UNDER THE DIRECTION OF THE REGIONAL MANAGER
THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED
1 HAVENGA STREET
OAKDALE
BELLVILLE
7530

Tel: (021) 957 4600   Email: lourense@nra.co.za
LIST OF CONTRACT DOCUMENTS

The following documents form part of this contract:

Volume 1: The Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer (1999), published by the Federation Internationale des Ingenieurs-Conseils (FIDIC) which the tenderer shall purchase himself. (See note 1 below).

Volume 2: The COLTO Standard Specifications for Road and Bridge Works for State Road Authorities (1998 edition), issued by the Committee of Land Transport Officials which the tenderer shall purchase himself. (See Note 2 below).

Volume 3: Books 1 and 2: The Project Document, containing the tender notice, Conditions of Tender, Tender Data, Returnable Schedules, general and particular conditions of contract, project specifications, Pricing Schedule, Form of offer and Site Information is issued by the Employer (see note 3 below). The Employer’s Form of Acceptance and any correspondence from the selected tenderer, performance security-demand guarantee and all addenda issued during the period of tender will also form part of this volume once a successful tenderer has been appointed.

The conditions of tender are the standard conditions of tender as contained in the South African Bureau of Standards, SANS 10845-3:2015, Construction procurement – Part 3: Standard conditions of tender, document, which the tenderer shall purchase himself.

Volume 4: The drawings.
Notes to tenderer:

1. Volume 1 is obtainable from CESA, P. O. Box 68482, Bryanston, 2021. Tel: (011) 463 2022 Fax: (011) 463 7383, e-mail: general@cesa.co.za.

2. Volume 2 is obtainable from SAICE, Private Bag X200, Halfway House, 1685. Tel: (011) 8055947/8, e-mail: civilinfo@saice.org.za or can be purchased from the Employer.

3. Volume 3 is issued at tender stage in electronic format on a CD and contains the following files:
   - The full Project Document in PDF format (excluding the standard conditions of tender)
   - The returnable forms in word format
   - The pricing data in excel format

   The standard conditions of tender (SANS 10845-3) is obtainable from the South African Bureau of Standards, Private Bag X191, Pretoria, 0001. Tel: (012) 428 7911 Fax: (012) 3441568, www.sabs.co.za.

   At contract stage Volume 3 will be a bound signed paper copy containing the following documents:
   - Returnable schedules relevant to the project
   - Agreements and Contract Data
   - Pricing Data
   - Scope of Work
   - Site Information

4. SUBMISSION OF TENDER – Of the contract documents, only the following elements of Volume 3 needs to be submitted in a neatly bound file and in the following order:
   - Form of Offer (paper copy)
   - All returnable schedules (paper copy)
   - Pricing Schedule (paper copy)
   - Completed pricing schedule (on CD)

   Information provided by a tenderer over and above the above elements of volume 3 shall be treated as information only and will only be bound into the document if the tenderer notes on Form A4: Schedule of Variations or deviations that the information has a bearing on the tender price.

5. For alternative offers the tenderer shall submit the following additional documentation, clearly marked as ALTERNATIVE, in a separate neatly bound file in the following order:
   - Form of Offer (paper copy) copy from CD and state “Alternative Form of Offer”
   - All returnable schedules (paper copies) applicable to alternative offer, as is appropriate
   - Alternative Pricing Schedule (paper copy)
   - Other relevant information.
<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOOK 1</td>
<td></td>
</tr>
<tr>
<td>PART T1: TENDERING PROCEDURES</td>
<td></td>
</tr>
<tr>
<td>PART T2: RETURNABLE SCHEDULES</td>
<td></td>
</tr>
<tr>
<td>PART C1: AGREEMENTS AND CONTRACT DATA</td>
<td></td>
</tr>
<tr>
<td>PART C2: PRICING DATA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOOK 2 (THIS BOOK)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PART C3: SCOPE OF WORKS</td>
<td>C-96</td>
</tr>
<tr>
<td>PART C4: SITE INFORMATION</td>
<td>C-267</td>
</tr>
<tr>
<td>PART C5: ANNEXURES</td>
<td>C-279</td>
</tr>
</tbody>
</table>
PART C3: SCOPE OF WORKS
TABLE OF CONTENTS

SECTION A: STANDARD AMENDMENTS ISSUED BY COLTO ........................................... C-98
SECTION B: PROJECT SPECIFICATION AMENDMENTS TO THE STANDARD
SPECIFICATIONS ........................................................................................................ C-99
SECTION C: ENVIRONMENTAL MANAGEMENT PLAN .............................................. C-213
SECTION C: ENVIRONMENTAL MANAGEMENT PLAN .............................................. C-214
SECTION D: SMALL CONTRACTOR DEVELOPMENT, TRAINING AND COMMUNITY
PARTICIPATION ......................................................................................................... C-234
SECTION E: REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND
REGULATIONS ........................................................................................................ C-247
SECTION A: STANDARD AMENDMENTS ISSUED BY COLTO

Notes to tenderer:

1. The Standard Specifications for Road and Bridge Works for State Road Authorities (1998 edition) prepared by the Committee of Land Transport Officials, (COLTO), as amended, shall apply to this contract. The amendments are those issued by COLTO and reproduced in Section A, together with additional amendments as set out in Section B.

2. Where reference is made to the General Conditions of Contract and sub-clauses thereof in the abovementioned Standard Specifications, they refer to the appropriate edition of the ‘General Conditions of Contract for Road and Bridge Works for State Road Authorities’ issued by COLTO (clause 1115 of the Standard Specifications refers).

3. The General Conditions of Contract applicable to this contract are the “Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer” (1999), published by the Federation Internationale des Ingenieurs-Conseils (FIDIC) and the necessary amendments to the Standard Specifications have been made and included in the Project Specifications contained in this document.

4. The terms “Schedule of Quantities”, (used throughout the Standard Specifications) and “Bill of Quantities”, (used in all other documents forming part of this contract), and “Pricing Schedule” are synonymous.

As at 31 August no amendments have been issued.
Notes to tenderer:

1. 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 alternatives or additional requirements applicable to this contract are contained in this part of the project specifications. It also contains some additional specifications required for this particular contract.

2. The number of each clause and each payment item in this part of the project specifications consists of the prefix B followed by a number corresponding to the number of the relevant clause or payment item in the standard specifications. The number of a new series, new clause or a new payment item which does not form part of a series, clause or a payment item in the standard specifications and which is included here, is also prefixed by B followed by a new number. The new numbers follow on the last clause or item number used in the relevant section of the standard specifications.

The tenderer shall note that the standard COLTO specification is based on the COLTO General Conditions of Contract. References to specific COLTO General Conditions of Contract clauses will need to be exchanged for the equivalent clause in the FIDIC Conditions of Contract as amended by the Particular Conditions of Contract to be found in Part C1 of this document. The Employer assumes no responsibility for the contractor’s interpretation of which are the correct relevant clauses.
# SECTION B: PROJECT SPECIFICATIONS

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>COLTO SERIES 1000: GENERAL</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECTION B1100: DEFINITIONS AND TERMS</td>
<td>C-102</td>
</tr>
<tr>
<td>SECTION B1200: GENERAL REQUIREMENTS AND PROVISIONS</td>
<td>C-105</td>
</tr>
<tr>
<td>SECTION B1300: CONTRACTOR'S ESTABLISHMENT ON SITE AND GENERAL OBLIGATIONS</td>
<td>C-117</td>
</tr>
<tr>
<td>SECTION B1400: HOUSING, OFFICES AND LABORATORIES FOR THE ENGINEER'S SITE PERSONNEL</td>
<td>C-121</td>
</tr>
<tr>
<td>SECTION B1500: ACCOMMODATION OF TRAFFIC</td>
<td>C-123</td>
</tr>
<tr>
<td>SECTION B1600: OVERHAUL</td>
<td>C-138</td>
</tr>
<tr>
<td>SECTION B1700: CLEARING AND GRUBBING</td>
<td>C-140</td>
</tr>
<tr>
<td>SECTION B1800: DAYWORKS</td>
<td>C-141</td>
</tr>
<tr>
<td>COLTO SERIES 2000: DRAINAGE</td>
<td>C-143</td>
</tr>
<tr>
<td>SECTION B2100: DRAINS</td>
<td>C-143</td>
</tr>
<tr>
<td>SECTION B2300: CONCRETE KERBING, CONCRETE CHANNELLING, CHUTES AND DOWNPIPES AND CONCRETE LINING FOR OPEN DRAINS</td>
<td>C-145</td>
</tr>
<tr>
<td>COLTO SERIES 3000: EARTHWORKS AND PAVEMENT LAYERS OF GRAVEL OR CRUSHED STONE</td>
<td>C-146</td>
</tr>
<tr>
<td>SECTION B3300: MASS EARTHWORKS</td>
<td>C-146</td>
</tr>
<tr>
<td>SECTION B3400: PAVEMENT LAYERS OF GRAVEL MATERIAL</td>
<td>C-149</td>
</tr>
<tr>
<td>SECTION B3600: CRUSHED-STONE BASE</td>
<td>C-152</td>
</tr>
<tr>
<td>COLTO SERIES 4000: ASPHALT PAVEMENTS AND SEALS</td>
<td>C-155</td>
</tr>
<tr>
<td>SECTION B4100: PRIME COAT</td>
<td>C-155</td>
</tr>
<tr>
<td>SECTION B4200: ASPHALT BASE AND SURFACING</td>
<td>C-157</td>
</tr>
<tr>
<td>COLTO SERIES 5000: ANCILLARY ROADWORKS</td>
<td>C-163</td>
</tr>
<tr>
<td>SECTION B5100: PITCHING, STONWORK AND PROTECTION AGAINST EROSION</td>
<td>C-163</td>
</tr>
<tr>
<td>SECTION B5400: GUARDRAILS</td>
<td>C-164</td>
</tr>
<tr>
<td>SECTION B5500: FENCING</td>
<td>C-166</td>
</tr>
<tr>
<td>SECTION B5600: ROAD SIGNS</td>
<td>C-167</td>
</tr>
<tr>
<td>SECTION B5700: ROAD MARKINGS</td>
<td>C-169</td>
</tr>
<tr>
<td>SECTION B5800: LANDSCAPING AND PLANTING PLANTS</td>
<td>C-175</td>
</tr>
<tr>
<td>COLTO SERIES 6000: STRUCTURES</td>
<td>C-179</td>
</tr>
<tr>
<td>SECTION B6100: FOUNDATIONS FOR STRUCTURES</td>
<td>C-179</td>
</tr>
<tr>
<td>SECTION B6200: FALSEWORK, FORMWORK AND CONCRETE FINISH</td>
<td>C-181</td>
</tr>
<tr>
<td>SECTION B6300: STEEL REINFORCEMENT FOR STRUCTURES</td>
<td>C-183</td>
</tr>
<tr>
<td>SECTION B6400: CONCRETE FOR STRUCTURES</td>
<td>C-184</td>
</tr>
<tr>
<td>SECTION B6500: PRESTRESSING OF STRUCTURES</td>
<td>C-195</td>
</tr>
<tr>
<td>SECTION B6600: NO-FINES CONCRETE, JOINTS, BEARINGS, PARAPETS AND DRAINAGE FOR STRUCTURES</td>
<td>C-196</td>
</tr>
<tr>
<td>COLTO SERIES 8000: SUNDRIES</td>
<td>C-200</td>
</tr>
<tr>
<td>SECTION B8100: TESTING MATERIALS AND WORKMANSHIP</td>
<td>C-200</td>
</tr>
</tbody>
</table>

C-100
COLTO SERIES 1000: GENERAL

SECTION B1100: DEFINITIONS AND TERMS

B1115 GENERAL CONDITIONS OF CONTRACT

Replace Clause 1115 with the following:

The General Conditions applicable to this Contract are the Conditions of Contract for Construction for Building and Engineering Works designed by the Employer, (1999) published by the Federation Internationale des Ingenieurs-Conseils (FIDIC).

Accordingly, all reference in the Standard Specifications to any other General Conditions of Contract (GCC) has to be amended. The Standard Specifications have been scrutinized and clauses which refer to another GCC identified. These are tabulated below together with the relevant equivalent clause in the FIDIC Conditions of Contract. The context of the reference to the GCC is also noted.

Whereas every effort has been made to include all of the affected clauses in the table, there may be some omissions. In every case, however, the FIDIC Conditions of Contract, as amended by the Particular Conditions of Contract in Part C1.2 of this Volume, shall apply and the contractor shall be responsible for interpretation of the equivalent clause.

CHANGES TO REFERENCES BY THE COLTO STANDARD SPECIFICATIONS TO THE COLTO GENERAL CONDITIONS OF CONTRACT AND FIDIC CONDITIONS OF CONTRACT

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause No</td>
<td>Page No</td>
<td>Clause No</td>
</tr>
<tr>
<td>1115</td>
<td>1100-2</td>
<td>1100-2</td>
</tr>
<tr>
<td>1204</td>
<td>1200-2</td>
<td>15</td>
</tr>
<tr>
<td>1204</td>
<td>1200-2</td>
<td></td>
</tr>
<tr>
<td>1206</td>
<td>1200-3</td>
<td>14</td>
</tr>
<tr>
<td>1209(a)</td>
<td>1200-4</td>
<td></td>
</tr>
<tr>
<td>1209(e)</td>
<td>1200-5</td>
<td>52(2)</td>
</tr>
<tr>
<td>1210</td>
<td>1200-5</td>
<td>54(1)</td>
</tr>
<tr>
<td>1212(1)</td>
<td>1200-7</td>
<td>49(2)</td>
</tr>
<tr>
<td>1215</td>
<td>1200-9</td>
<td>45(2)</td>
</tr>
<tr>
<td>1217</td>
<td>1200-10</td>
<td>35</td>
</tr>
<tr>
<td>1303(ii)</td>
<td>1300-1</td>
<td></td>
</tr>
<tr>
<td>1303(iii)</td>
<td>1300-1</td>
<td>49</td>
</tr>
<tr>
<td>1303(iii)</td>
<td>1300-2</td>
<td>49</td>
</tr>
<tr>
<td>1303(iii)</td>
<td>1300-1</td>
<td>53</td>
</tr>
<tr>
<td>1303(iii)</td>
<td>1300-2</td>
<td>53</td>
</tr>
<tr>
<td>1303</td>
<td>1300-2</td>
<td>12</td>
</tr>
<tr>
<td>1303</td>
<td>1300-2</td>
<td>45</td>
</tr>
<tr>
<td>1403(c)(ii)</td>
<td>1400-4</td>
<td>40(1)</td>
</tr>
<tr>
<td>1505</td>
<td>1500-3</td>
<td>40(1)</td>
</tr>
<tr>
<td>Item 15.08</td>
<td>1500-8</td>
<td>48</td>
</tr>
<tr>
<td>Item 15.09</td>
<td>1500-8</td>
<td>48</td>
</tr>
<tr>
<td>Item 15.11</td>
<td>1500-8</td>
<td>48</td>
</tr>
<tr>
<td>Note (2)</td>
<td>3100-4</td>
<td>40</td>
</tr>
<tr>
<td>3204(b)(iii)</td>
<td>3200-2</td>
<td>40</td>
</tr>
<tr>
<td>3303(b)</td>
<td>3300-2</td>
<td>2</td>
</tr>
<tr>
<td>Item 44.06</td>
<td>4400-3</td>
<td></td>
</tr>
<tr>
<td>Item 45.06</td>
<td>4500-3</td>
<td></td>
</tr>
<tr>
<td>5803(c)</td>
<td>5800-3</td>
<td>40</td>
</tr>
<tr>
<td>5805(d)</td>
<td>5800-4</td>
<td>40</td>
</tr>
<tr>
<td>Item 58.10</td>
<td>5800-10</td>
<td>48</td>
</tr>
<tr>
<td>8103(c)</td>
<td>8100-1</td>
<td>40</td>
</tr>
<tr>
<td>Item 81.02</td>
<td>8100-26</td>
<td></td>
</tr>
<tr>
<td>Item 81.03</td>
<td>8100-26</td>
<td>22</td>
</tr>
</tbody>
</table>
B1155 WORK IN RESTRICTED AREAS

Add the following:

“Any omission of payitems from the pricing schedule with regard to additional or extra over payment for work in restricted areas should be regarded as deliberate and any additional cost incurred shall be included in the bulk rates tendered. (Refer also to clause B1209(g))”

Add the following clauses:

B1156 OTHER DEFINITIONS

The COLTO Standard Specifications for Roads and Bridge Works for State Road Authorities (1998 edition) has been written for all contractors, employers and engineers. Similarly, the works and the site are not defined and the general nature of the entities and elements that collectively constitute construction under a contract are characterized by the use of lower case letters throughout.

These project specifications continue to use lowercase spellings in order to avoid the appearance of the capitalised and non-capitalised words to describe or prescribe the same elements of work required on this project. However, for the purposes of this contract the following definitions shall apply:

Contractor
The Contractor and the contractor is the same persona defined under clause 1.1.2.3 of the FIDIC Conditions of Contract, but who will only be formally identified by the completed Form of Acceptance C1.1.2 in this document and which will be bound into the final contract document.

Employer
The Employer and employer is the same persona and is defined in C1.2.2 Contract Data, and clause 1.1.2.2 of the FIDIC Conditions of Contract.

Engineer
The Engineer and engineer is the same persona and is defined in the C1.2.2 Contract Data, and clause 1.1.2.4 of the FIDIC Conditions of Contract.

Site
The site is defined in clause 1.1.6.7 of the FIDIC Conditions of Contract. It is bound by the limits of construction as shown in the drawings or the title of the project and extends to also include the following:

- Areas outside the construction zone areas where accommodation of traffic is placed.
- All borrowpits defined in the applications approved by the relevant Department of Minerals and Energy.
- All haul roads constructed by the contractor for purposes of access.
- Any non-adjacent sites specified in the contract documentation.
- The contractors and his subcontractors camp sites

Works
The works is described in Part C4 of this document and is as defined in clause 1.1.5.8 of the FIDIC Conditions of Contract and prescribed in Sections B, C, D & E of this Volume.

Prime cost
Is a specific type of Provisional Sum for which payment is made on the production of invoices showing the cost price of the implementation or installation of the service required. Services rendered in this manner carry a mark-up for which a rate is offered at tender stage to cover all the tenderer’s handling, supervision and liability costs and profit in providing the item or services.

Provisional Sum
Is a sum which is specified in the contract as a provisional sum, for the execution of any part of the works or the supply of plant, materials or services under sub-clause 13.5 (Provisional sums).
LANE OCCUPATION LEVY

Lane occupation is a charge levied by the Employer for use of its asset outside of times to which the contractor has committed himself through the original construction programme in terms of clause 8.3 of the FIDIC Conditions of Contract. The levy shall be applied each day, or part thereof, for the duration of the contractor’s unauthorised extended occupation of ramps or carriageway lanes to complete the required work. The levy shall be payable by the contractor in each and every month that it occurs, and shall be deducted from the amount due to the contractor on the relevant monthly payment certificates.

The same levy shall be applied whenever during the Defects Notification Period the contractor is required to undertake repairs to defective work.

The levy shall be applied at the rate stated in the appendix to tender and will be commensurate with the reduction in service levels imposed on road users by the contractor’s extended occupation.

SABS SPECIFICATIONS

Where reference is made in this specification or the standard specifications to SABS specifications, the latest published national standard shall be applicable. Use:


for the most up-to-date versions of the various standards.

AGGREGATE SIZE

Where reference is made in this specification or the standard specifications to aggregate size, nominal aggregate size or maximum aggregate size, the aggregate size as listed shall be replaced with the new corresponding aggregate size as indicated in the following table:

<table>
<thead>
<tr>
<th>Aggregate size</th>
<th>New aggregate size</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5</td>
<td>28</td>
</tr>
<tr>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>13.2</td>
<td>14</td>
</tr>
<tr>
<td>9.5</td>
<td>10</td>
</tr>
<tr>
<td>6.7</td>
<td>7</td>
</tr>
<tr>
<td>4.75</td>
<td>5</td>
</tr>
<tr>
<td>2.36</td>
<td>2</td>
</tr>
<tr>
<td>1.18</td>
<td>1</td>
</tr>
</tbody>
</table>

COMPACTION

In December 2017 the THM1 will cease to exist and be replaced by SANS 3001. In preparation for this change-over, SANRAL has already adopted the new test methods and all site Laboratories are required to perform testing according to the SANS 3001 test methods.

Therefore, the standard for compaction efforts should change from Modified AASHTO Density as per TMH1 Test Method to Maximum Dry Density (MDD) as per SANS 3001. Where reference is made to compaction or of Modified AASHTO Density in the tender documentation or the standard specifications or wherever there is conflict between the tender documentation and the standard specifications, the SANS 3001 specification and terminology shall govern.”
Add the following first paragraph:

“All reference to services in this clause shall also mean utility services as well as traffic monitoring devices such as Comprehensive Traffic Observation (CTO), Speed Measuring Device (SMD) and Weigh-in-Motion (WIM) stations.”

In the final paragraph, replace “clause 15” in the second line with “clause 8.3”

In the second paragraph, delete the word “utility” at the end of the second line.

In the final paragraph delete the second and third sentences starting with “Should” and replace with the following:

“Table B1202/1 lists all known services on the site. Those requiring removal, realignment or temporary replacement are indicated within the table with an asterisk. However, before any work can commence the contractor shall verify the actual position of each service and bring to the attention of the engineer any service that is not recorded. As the contractor is not authorised to remove or replace these facilities he shall:

i) Give preliminary notice, in writing to the relevant service provider, that the services on the site will require removal or protection prior to works being carried out in the vicinity of each station. The contractor shall advise the service provider of

a) The number of services, their locations and station ID numbers and
b) The proposed dates when work will commence in the vicinity of each service.

ii) In addition to the above preliminary notice, give the service provider 14 days written notice of the intention to commence work in the vicinity of each facility.

iii) Upon completion of the work in the vicinity of each facility, the contractor shall notify the service provider, in writing, that work is complete and the service may be reinstated.

Any delay resulting from the removal/replacement of a service shall not be the subject of a potential claim, unless the contractor can demonstrate that every effort has been made to timeously request and/or apply for the removal/replacement of the said service. In addition, the contractor shall be deemed to have employed the services of the service provider as a subcontractor for purposes of removing and/or replacing the relevant service.

TABLE B1202/1: LIST OF KNOWN SERVICES

<table>
<thead>
<tr>
<th>Chainage</th>
<th>Position</th>
<th>Service type</th>
<th>Identity number</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel to the route</td>
<td>LHS</td>
<td>Telkom/Communication</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

The CTO service provider is:
Mikros Traffic Monitoring (Pty) Ltd
P O Box 6956
HALFWAY HOUSE
1685
Tel: (012) 804 1710 or 086 111 5393
Fax: (012) 804 4716

Any cost of repairs, replacement and/or installation of the stations and equipment resulting from the contractor’s negligence or unauthorised action shall be to the contractor’s account.”

B1204 PROGRAMME OF WORK

a) General requirements
Add the following as a continuation of the first paragraph:

“In drawing up the programme the contractor shall make allowance for the following:

i) All special non-working days defined in the Contract Data.

ii) The expected delays defined in B1215: Extension of time resulting from inclement weather as a terminal float.

iii) The following embargo hours and days:

- Work, including erection and removal of traffic control facilities, may only take place in daylight during working hours Mondays to Fridays.

iv) The following restricted working conditions:

- The National Route 2 shall remain open to traffic, with at least one lane available in each direction, at all times, except with permission of the engineer. Such permission shall not unreasonably be withheld.

- No construction activities where road width is limited or traffic lanes are reduced, shall be allowed during:
  - the Christmas shut-down (between 10th December and 11th January inclusive)
  - the Easter long weekend (inclusive of the Thursday before, and the Tuesday after Easter Friday)

v) Meeting the requirements of the Environmental Management Plan (EMPI).

vi) The time needed for preparation and approval of the various mix designs specified in the relevant construction sections of the Scope of Works.

This initial programme shall realistically account for the forecast cashflow within the defined contract period, and as provided on Form D7: Schedule of Estimated Monthly Expenditure. An illustrative programme is shown opposite. The contractor shall not slavishly copy this programme, which is provided to illustrate that the required work can be realistically programmed within the contract period at the estimated cost. If an alternative contract period is offered, the contractor shall submit a separate programme with the alternative tender.”

b) Programme of work for rehabilitation work

In the first sentence of the second paragraph after “……in the project specifications,” insert the following:

“on the quantities contained in the Pricing Schedule (Part C2),”

Insert the following paragraphs:

c) Additional programme requirements

In addition to the requirements of clauses B1204(a) and B1204(b), and of clause 8.3 of the FIDIC Conditions of Contract, the programme of work shall include the following details:

(i) A work breakdown structure that identifies all major activities.

(ii) Scheduled start and end dates for each activity.

(iii) Linkages between activities that clearly identify sequence, floats and critical path.

(iv) Intended working hours and resource allocations (plant and labour).

(v) Production rates.

(vi) Monthly cashflow projections.

(vii) Key dates in respect of information required or due delivery.”

(viii) The contractor’s payment weekends
(ix) A risk assessment schedule with mitigating plans of issues that could prevent the due completion date being met.

Should the engineer require an electronic version of the programme for review purposes, the contractor shall supply the programme in a format compatible with the engineers software.

“d) Programme revisions

The programme will be reviewed at the monthly site meetings at which the contractor shall provide sufficient detail that will allow the comparison of completed work per activity against the current programme. The contractor shall indicate what resources and programme changes he intends to implement in order to remedy any activity that has fallen behind. The engineer may demand from the contractor a major revision of the programme. Such a revision shall be submitted for comment within 14 days of the demand.”

B1205 WORKMANSHIP AND QUALITY CONTROL

Insert the following heading after the title:

“a) General:

Insert the following as sub-clauses after the first paragraph:

b) Quality Systems

The contractor shall implement a quality assurance system that replicates an ISO 9002 and appoint a quality manager who shall ensure that members of the contractor’s staff comply with the requirements of the quality system. The quality system and the methods used to implement it shall be described in a quality plan produced by the contractor. The quality manager shall be resident on site full time.

The contractor shall submit the quality assurance system he proposes using to the engineer, for his approval, within two weeks of the site handover. The system shall record the lines and levels of responsibility and indicate the method by which testing procedures will be conducted. Once accepted by the engineer the contractor shall not deviate from it unless written notification of proposed changes have similarly been submitted and approved.

The system shall provide for a method statement for each construction activity for which a pay item is provided in the Pricing Schedule. Each method statement shall be submitted to the engineer for his approval two weeks prior to commencement of the activity. Where appropriate the contractor shall make use of the employer’s manuals in preparing his method statements. No construction activity shall commence before the engineer has approved the contractor’s quality assurance system.”
THE SETTING OUT OF WORK AND PROTECTION OF BEACONS

Replace “clause 14” in the first paragraph with “clause 4.7”

Add the following at the end of the fourth paragraph:

“Road markings, particularly the divergent/convergent lines of ramp interchanges and no overtaking barriers are also elements of the road that require proper setting out. The contractor shall prove to the engineer that critical reference points have been satisfactorily recorded for later reinstallation before any work commences that will obliterate the existing markings.”

Delete “and of clause 14 of the general conditions of contract” in the sixth paragraph.

Add the following paragraph:

“The contractor shall take care that property beacons, trigonometrical survey beacons or setting-out beacons are not displaced or destroyed without the consent of the engineer. Property beacons and trigonometrical survey beacons that have been displaced or destroyed shall be replaced by a registered land surveyor, who shall certify such replacement.

The cost of replacing all beacons displaced or destroyed during the course of the contract without the consent of the engineer shall be the contractor’s responsibility and included in the tender rates”.

NOTICES, SIGNS AND ADVERTISEMENTS

Delete the third paragraph and replace with the following:

“All signboards erected in accordance with the drawings shall be removed at the same time as the de-establishment of the contractor’s camp. Payment under subitem 13.01 for the final instalment of 15% of the tendered lump sum shall not be made unless all the advertisements, notices and temporary signs have been removed. A typical signboard layout is shown on drawing number 112471-IB-07 in Volume 4, Drawings”.

PAYMENT

b) Rates to be inclusive

Add the following to the first paragraph:

“VAT shall be excluded from the rates.”

Insert the following after “constructional plant” in lines 6 and 7 of the first paragraph:

“(distinguishing between operational costs and hire costs)”.

c) The meanings of certain phrases in payment clauses

Procuring and furnishing ... (material)

Add the following:

“Payment for procuring and furnishing material from commercial sources shall include all transport costs, irrespective of distance hauled”.

e) Materials on the site

Replace “clause 52” in the first line with “sub-clause 14.5”

Add the following sub-clauses:

“g) Work in confined areas”
Except where provided for in the specification and the Pricing Schedule no extra payment shall be made nor shall any claim for additional payment be considered for construction in confined areas. The omission of standard payitems from the schedule of quantities shall be taken to be deliberate and any additional costs incurred shall be included in the bulk rate.

h) Split quantities

Wherever in the Pricing Schedule allowance has been made to price items of work for which a product or material is uncertain and quantities split between pricing items, the Employer reserves the right to choose whichever is the most appropriate or combination thereof, regardless of any adverse effect on the Contractor’s costs and no claims for additional compensation shall be entertained.”

B1210 CERTIFICATE OF PRACTICAL COMPLETION OF THE WORKS

Amend the heading of this clause to read:

“TAKING-OVER CERTIFICATE”

Replace the 1st paragraph with the following:

“Notwithstanding that there might be natural or programmed sections of the works that will result in them being completed in their entirety before other sections, no consideration shall be given to the issuing of taking-over certificates for parts of the works. The use of any completed roadway or parts of the work, whether for unhindered use by the public or for accommodation of traffic while other parts are being constructed, shall not constitute use or occupation by the Employer.

The notice to the engineer, i.t.o clause 10.1 of the Conditions of Contract applying for a Taking-Over Certificate, shall include the contractor’s own list of what it considers to be the outstanding minor works that do not substantially affect the use of the Works. As justification that the issue of a Taking-Over Certificate is warranted the contractor shall take note that the following sections of the works are to be completed to the satisfaction of the engineer:”

Add the following to sub-clause (e) before the semicolon:

“(including road studs)”

Add the following paragraphs after item (h):

“In addition to the above itemised sections of the works and regardless of the degree of beneficial occupation by the Employer, the outstanding works contained in the lists produced by the contractor and the engineer shall be considered for taking-over only if the following criteria have been met:

(i) The estimated cost to complete the listed outstanding work is less than 2% of the tendered value of work plus the cost of any variation or extra work orders, but excluding CPA and VAT.

(ii) The written lists of outstanding items of work can be completed within 28 days of the lists having been issued.

(iii) Any information in the contractor’s possession, which is required by the engineer and has been requested in writing, has been supplied.

(iv) The Regional Manager of the Department of Mineral Resources (DMR) has issued written confirmation to the contractor that they are satisfied with the final shaping to all quarries, borrow pits, stockpile areas, and spoil sites used or intended to be used under this contract. In the event this written confirmation is not obtained from DMR, acceptance by the Environmental Assessment Practitioner (EAP) will be sufficient for the issuing of the Taking-Over Certificate.
If any of the listed criteria (i) through (iv) are not met at the date of the contractor’s notice of application, the engineer is to reject the application without providing any corresponding list of outstanding work. If an application is rejected, the contractor shall rectify what has been identified as deficient before submitting a new notice of application.”

**B1213 VARIATION FROM SPECIFIED NOMINAL RATES OF APPLICATION OR NOMINAL MIX PROPORTIONS**

*Amend the last line of the second paragraph to read as follows:*

“… materials, condition of the site and cement type (in order to comply with the durability requirements described in sub-clause B6404(h)).”

**B1214 CONTRACTOR’S ACTIVITIES IN RESPECT OF PROPERTY OUTSIDE THE ROAD RESERVE AND OF SERVICES MOVED, DAMAGED OR ALTERED**

*Add the following to the last paragraph of subclause (d):*

"These written statements shall be handed to the engineer before the final certificate will be issued. Failing to obtain these written statements from all landowners and authorities concerned, the Defects Notification Period will be extended including all conditions related to such an extension, until such time that all these statements are obtained.

The obtaining of any such written statements will not relieve the contractor of the execution of any of his obligations to the satisfaction of the landowner or authority concerned, and to the approval of the engineer.”

*Under sub-clause (e) replace the opening paragraph with:*

“Should the contractor use land not provided by the Employer for the purpose of his own establishment, engineer’s offices and laboratory, or storing of equipment or materials required for construction or disposal, it shall be subject to the following:”

*and add the following sub-sub-clauses:*

“(vi) That lease agreements are concluded with the owner or owners of such land for the full period that such areas are required. The leases shall provide for possible extensions to match the duration of the contract. The lease agreements shall also provide for the contract being terminated by contractor’s default or liquidation and the resulting possibility for them to be taken over by a succeeding contractor.

(vii) That copies of lease agreements shall be submitted to the engineer prior to signature by the signing parties, and copies lodged with the engineer after signing. Notwithstanding the engineer’s approval of the conditions of a lease the contractor shall be solely responsible for adhesion to the terms of the agreements.

(viii) Adherence to the principles of the environmental management plan and legal obligations"

*Add the following sub-clause:*

“f) Cleaning of public roads

Where material is spilled on public roads during the haul of material, the road shall be cleaned immediately.”

**B1215 EXTENSION OF TIME RESULTING FROM ABNORMAL RAINFALL**

*Change the existing heading of clause 1215 to read as follows: ‘EXTENSION OF TIME RESULTING FROM INCLEMENT WEATHER’ and replace this clause with the following:*

“Delays caused by inclement weather events may be considered as extension to the time for completion only if the engineer agrees that the event (and not the consequence of the event) occurred during the working hours of a working day (based on a twenty three (23) day working month) within the contract period and caused all progress on an item or items
of work on the critical path of the contractor’s approved programme (including revisions thereof) brought to a halt. Each day, or portion of a day so agreed will accrue as ‘n’ days of delay over the duration of the contract. The summary of accrued agreed ‘n’ delays shall be recorded at each site meeting.

In the case of the inclement weather event being rainfall, no limitation is placed on the quantity, severity or duration of the event as being the cause of delay except, if it is an exceptional climatic condition then it shall not be measured as a delay event under this clause, but shall be considered for delay under the general conditions of contract clause 8.4. Expressly excluded from the measurement of ‘n’ days are consequential delays, which are taken to mean delays to critical path activities attributable to the weather event but occurring after (i.e. outside of and distinctly separate from) the duration of the weather event itself.

The contractor shall make provision in his approved programme (including revisions thereof) of work for expected N working days caused by inclement weather. This provision shall be shown as a terminal float on the approved programmes. Any extension to the time for completion caused by inclement weather delays will only apply once the agreed cumulative ‘n’ delays exceed N = Σn days. On this contract N = 10

Table B1215/1 below is provided for demonstration purposes only. It shows the average number of days on which rainfall events of > 10 mm has occurred at 00126617 weather station. This station has been chosen because its records span 36 years and is considered sufficiently close to the site to be representative of what the contractor could expect during the contract. The full weather station record is included in Part C4: Site Information. The contractor may apply this record to any claim for weather delays that fall outside the prescripts of this clause and within the terms of the general conditions of contract Table B1215/1 also records the average ‘other’ inclement weather event days that the contractor could expect to encounter and cause delay. These have been derived from previous experience of wind and temperature influence on similar construction in the area of the site. ‘Other’ events could be extreme cold or heat, snow, wind or ice but are not limited to these.

From Table B1215/1 it will be noted that the sum of average rain and other delays measured over the contract duration is 14 days yet the contractor is instructed to allow N = 10 days in his approved programme (including revisions thereof). The reduction indicates the extent of the Employer’s share of the overall risk attaching to delays caused by inclement weather.

<table>
<thead>
<tr>
<th>TABLE B1215/1: AVERAGE DELAYS DUE TO INCLEMENT WEATHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Average rain days</td>
</tr>
<tr>
<td>Average other days</td>
</tr>
</tbody>
</table>

* The figures shown in brackets are the average days of rain expected in December/January but reduced to take account of the standard construction break over the Christmas/New Year period.

If approved extensions of time extend the completion date beyond the start of the Christmas shut-down as defined in the Appendix to Tender, the holiday period shall not be considered as working days. Any remaining extension of time shall be calculated from the first working day in January the following year.”

B1219 WATER

Add the following:

“Water for use on site other than municipal, shall be subject to the required permit from Department of Water Affairs (DWA). This shall include such extraction points as rivers, dams, streams, and boreholes.

Use Table B1219 below to determine the suitability of water for construction purposes.
TABLE B1219: WATER CLASSIFICATION FOR CONSTRUCTION: TESTING

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Pure water (AR)</th>
<th>Clean water (Rain)</th>
<th>Treated water (Municipal)</th>
<th>Silty (muddy) water with low salt content</th>
<th>Highly mineralised chloride sulphate water (brackish)</th>
<th>Waste brack, sewage, marsh, sea, etc. water</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH*</td>
<td>-</td>
<td>7.0</td>
<td>5.7 − 7.9</td>
<td>4.5 − 6.5</td>
<td>4.5 − 8.5</td>
<td>9.0</td>
<td>-</td>
<td>SABS M113 SM 11 - 1990</td>
</tr>
<tr>
<td>Dissolved solids*</td>
<td>ppm</td>
<td>0</td>
<td>1000</td>
<td>1500</td>
<td>3000</td>
<td>-</td>
<td>-</td>
<td>SABS 213 SM213 - 1990</td>
</tr>
<tr>
<td>Total hardness*</td>
<td>-</td>
<td>None</td>
<td>None</td>
<td>Temporarily</td>
<td>Temporarily</td>
<td>Permanent</td>
<td>-</td>
<td>SABS 215 SM 215 – 1971</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>mS/m</td>
<td>0</td>
<td>200</td>
<td>200</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>SABS 1057 SM 1057 – 1982</td>
</tr>
<tr>
<td>Sulphates (SO4)</td>
<td>ppm</td>
<td>0</td>
<td>200</td>
<td>300</td>
<td>500</td>
<td>1000</td>
<td>-</td>
<td>SABS 212 SM 212 – 1971</td>
</tr>
<tr>
<td>Chlorides (Cl)</td>
<td>ppm</td>
<td>0</td>
<td>500</td>
<td>1000</td>
<td>3000</td>
<td>5000</td>
<td>-</td>
<td>SABS 202 SM 202 – 1983</td>
</tr>
<tr>
<td>Alkali Carbonates</td>
<td>ppm</td>
<td>0</td>
<td>500</td>
<td>1000</td>
<td>1000</td>
<td>2000</td>
<td>-</td>
<td>SABS 241 – 1999</td>
</tr>
<tr>
<td></td>
<td>Sugar</td>
<td>-</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>SABS 833</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Quality of water required

- Untreated layer works
- Chemically treated layer works
- Concrete mass
- Concrete prestressed
- Slurry & emulsion
- Soil/gravel tests
- Chemical or control tests

- Investigate the effect on the quality of the material

A primary property. The quality of the water is that quality where all three of the primary properties are within the limits.

The tabulated single values are maximum value except in the case of the pH value for pure water, which must be 7.0

B1224 THE HANDING OVER OF THE ROAD RESERVE

Add the following paragraph:

“The road reserve within the defined limits of the contract falls within the limits of another contract that has already been let to a routine maintenance contractor who is obliged to conduct regular maintenance on the route on which this contract is sited. The contractor’s responsibility for maintenance shall be restricted to the surfaced road widths within the limits of this contract, including the surfaced road widths of interchange ramps and overpasses. Any potholes or other failures which occur in the road surface shall be repaired by the contractor within 24 hours after first being noted, the contractor shall recover his costs for the execution of maintenance works through the payment items provided under section 1500.”
The Routine Road Maintenance Contractor’s details are as follows:

Route Manager: Mr Johan Nel, (Qunu)
   Cell: 082 612 1980

Contractor: Mr Alec Bester, (MD Civils)
   Cell: 083 501 0028

The contractor shall take over the maintenance responsibility on the date of handover but may liaise with the routine maintenance contractor by arranging a transition period immediately after the hand-over of the site to allow sufficient time to muster his resources required for routine maintenance of the road. However, the transition period may not extend beyond the contractual starting time defined in sub-clause 8.1 of the FIDIC Conditions of Contract and C1.2.2 Contract Data."

B1229 SABS CEMENT SPECIFICATIONS

Delete this clause.

Add the following clauses:

"B1230 MATERIALS

(a) General

The contractor, when using materials that are required to comply with any standard specification, shall, if so ordered, furnish the engineer with certificates showing that the materials do comply with this specification.

Where so specified, materials shall bear the official mark of the appropriate authority. Samples ordered or specified shall be delivered to the engineer’s office on the site free of charge.

Where materials are specified under trade names tenders must be based on these materials. Alternative materials may be submitted as alternative tenders and the engineer may, after receipt of tenders, approve the use of equivalent materials. The tender must be clearly marked as an alternative tender, failing which the tender may be rejected.

Unless otherwise specified, all proprietary materials shall be used and placed in strict accordance with the relevant manufacturer’s current published instructions. Agrément certified products shall be used and placed in accordance with its Agrément certification criteria.

Unless anything to the contrary is specified, all manufactured articles or materials supplied by the contractor for the permanent works shall be unused.

Any materials excavated or present on the site or within the road reserve, or in borrow areas shall not become the property of the contractor, but will be at his disposal only in so far as they are approved for use on the contract, unless otherwise indicated in the project specification.

Existing structures on the site shall remain the property of the Employer and except as and to the extent required elsewhere in the contract, shall not be interfered with by the contractor in any way.

Materials to be included in the works shall not be damaged in any way and, should they be damaged on delivery or by the contractor during handling, transportation, storage, installation or testing they shall be replaced by the contractor at his own expense.

All places where materials are being manufactured or obtained for use in the works, and all the processes in their entirety connected therewith shall be open to inspection
by the engineer (or other persons authorised by the engineer) at all reasonable times, and the engineer shall be at liberty to suspend any portion of work which is not being executed in conformity with these specifications.

The contractor shall satisfy himself that any quarry selected for use provides the necessary mined material in accordance with the specification.

(b) **Banned materials**

No tar fluid products shall be used in the construction works.

**B1231 MIX DESIGNS**

Before commencing with certain construction activities, the contractor shall, except where specified otherwise in the relevant construction sections in the Scope of Works, apply the following procedures with regards to mix designs:
- Taking and submitting samples of the relevant materials.
- Undertake the required mix design(s) or allow the engineer to undertake them.
- Produce, where required, laboratory, production/plant and/or trial mix(es).
- Undertake the required adjustments to the mix design(s) and reproduce required laboratory, production/plant and/or trial mix(es).
- Complete trial section(s) where required.
- Await the engineer’s approval of the mix design(s) and trial section(s).

**B1232 MEASUREMENT AND PAYMENT**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B12.01 Protection, removal, realignment and replacement of services</td>
<td></td>
</tr>
<tr>
<td>(a) Unidentified services</td>
<td>PC Sum</td>
</tr>
<tr>
<td>(b) Handling cost and profit in respect of subitems B12.01 (a)</td>
<td>%</td>
</tr>
</tbody>
</table>

The prime cost item of B12.01(a) shall be paid in accordance with the provisions of sub-clause 13.5 of the FIDIC Conditions of Contract.

The tendered percentage for payitem B12.01(b) shall be a percentage of the amount actually spent under subitem B12.01(a) which shall include full compensation for handling cost and profit in connection with providing the specified service.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B12.02 Media releases and public relations</td>
<td></td>
</tr>
<tr>
<td>(a) Media releases and public relations.................................Prime Cost (PC Sum)</td>
<td></td>
</tr>
<tr>
<td>(b) Handling costs and profits in respect of subitem B12.02(a)..........Percentage (%)</td>
<td></td>
</tr>
</tbody>
</table>

The Prime Cost sum is provided to cover costs related to public notices as instructed by the Engineer.

The tendered percentage for subitem (b) shall include full compensation for the handling costs and profit of the contractor in connection with subitem (a)."

*Add the following clauses:*

**B1233 OWNERSHIP OF REDUNDANT ROAD SIDE FURNITURE AND OTHER MATERIALS**

Ownership of all redundant road side furniture and other materials will become the property of the contractor unless otherwise specified by the engineer.

**B1234 PENALTIES FOR OVERLOADING OF CONSTRUCTION VEHICLES**
The contractor shall ensure that trucks used to haul construction materials are not overloaded and the legal axle loads are not exceeded. Before any construction materials can be transported, the contractor must provide the engineer with the certified carrying capacity of each truck intended for the purpose of transporting the construction materials. The contractor shall provide the engineer with a weighbridge ticket before discharging/off-loading the materials.

Any truck that is overloaded shall not be allowed to discharge/off-load its load and shall return to the depot/batching plant for adjustment of the load. In addition a penalty shall be applied for the overload.

For the purposes of the calculation, the so called 5% grace shall not be used. The following example is provided:

Tare Weight of vehicle certified by a calibrated weighbridge = 6 tons
Maximum carrying capacity certified by a calibrated weighbridge = 8 tons
Gross vehicle mass = 14 tons
Actual Load (Weighbridge ticket) = 14.6 tons
Overload factor = 0.6 tons

Contractors rate tendered under applicable payment item = R350/unit

Penalty = 2 x R350/unit x 0.6 x distance hauled(km)
= R 420.00 x distance hauled (km)"

Penalty payments will be deducted from the front page of interim payment certificates."
b) Camps, constructional plant and testing facilities

*Insert the following after the first paragraph:*

In the event that SANRAL-owned land will be made available for the use of the contractor for his construction camps, offices, stores, workshops and/or testing facilities, the use of such land will not be treated as a lease but will form part of the contract. In this regard the contractor shall complete the prescribed agreement and comply with all the conditions thereof as if it is part of the contract. The Employer’s appointed service provider who administers and manages SANRAL owned land will facilitate the process and the contractor shall liaise and co-operate with the service provider in this regard. The availability of land will be indicated in Part C4: site information.

c) Legal and Contractual Requirements and responsibilities to the public

*Add the following:*

“Legislation imposes mutual obligations on the Employer and contractor in the performance of their duties to society and to the built and natural environment. To assist the contractor in understanding and assessing his obligations, and thus to make allowances for the cost of compliance with this legislation, the following additional specifications are included in the project specifications.

Section C of the Scope of Works contains the Environmental Management Plan (EMPI) for this project. Its provisions regulate the contractor’s construction methods to ensure responsible conduct and treatment of the environment relevant to the project. Payment subitem 13.01(f) makes allowance for the contractor to price for environmental compliance duties as well as the duties of the Designated/dedicated Environmental Officer (DEO) as prescribed in this section.

Section D of the Scope of Works contains provisions that regulate the contractor’s construction methods for compliance with Government’s initiatives towards black economic empowerment. It also contains information on criteria used in the procurement process. No separate payment mechanism has been made available for the contractor to allow for his compliance with relevant black economic empowerment legislation. The contractor shall include such costs in the existing payment items under section B1303: Payment. However, non-compliance with the provisions of this section may lead to the imposition of penalties.

Section E of the Scope of Works contains the specifications that regulate the contractor’s construction methods so far as to ensure health and safety of his employees and of the public. New payitem has been made available under this section to allow the contractor to make separate provision for the cost of health and safety measures during the construction process.”

*Add the following subclause:*

d) Monthly reporting

When submitting any information required and interim certificates for payment, the Contractor shall use the Employer’s standard forms and formats. No payment can be made before the Contractor is registered as a vendor on the Employer’s system.

The Contractor shall submit payment certificates for all work rendered in the Employer’s financial year within that specific year.

The Contractor shall submit and update on a monthly basis all the appendices to the site meeting minutes and a cash flow forecast for the works.
The Contractor shall complete monthly reports regarding training, empowerment, capacity building, small contractor development, labour and staff returns and any such aspects on the Employer's Integrated Transportation Information System (ITIS) or any other format as required by the Employer. This information shall also be reported on monthly for all sub-contractors employed.

ITIS is an integrated approach to the sharing and inter-relating of technical performance information for the Employer, and relies on the Contractor following procedures to populate the system with data. ITIS currently consist of the following platforms applicable to this contract:

- ITIS Web – Web enabled portal providing online access to various functions, workflows and reports.
- ITIS Desktop – Offline data capture tool enabling the capture of information offline, validation and then synchronisation of data with ITIS database.

The Employer then has several ITIS modules running on any of the above ITIS platforms which affect the Contractor, who will need to use some of these modules to provide the required information. The current module applicable to this contract is the Project Information Module – employment and training data.

The above information shall form part of supporting documentation required for making interim payments in terms of the General Conditions of Contract.

Allowance has been made for these requirements in the Pricing Schedule under pay item B13.01(f) Monthly Reporting. Failure to comply may result in payments being withheld.

---

**B1303 PAYMENT**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B13.01 The contractor's general obligations</td>
<td></td>
</tr>
</tbody>
</table>

*Add the following pay subitems:*

- Health and safety obligation ................................................................. month
- Environmental obligation ................................................................. month
- Monthly reporting cost ................................................................. month
- Security on site ................................................................. month
- Community engagement obligation.................................................... month

*Add the following sub-sub-clauses defining 'the contractor's general obligations':*

- Complying with the requirements and conditions of the additional specifications relating to the Government's Broad Based Black Economic Empowerment.

*Delete the third paragraph commencing “Should the final value of the work ..........”.*

*Replace “clause 49” in the 4th, 8th and 10th paragraphs with “sub-clauses 13.7 and 13.8”.*

*In the 11th paragraph, the following amendments apply:*

- Insert as a new 2nd sentence “Hire costs or minimum hourly charges per month for constructional plant shall be deemed to be a part of construction time”.
- Delete “received the letter of acceptance in terms of clause 12” and replace with “date of commencement in terms of clause 8.1”.

C-118
• In the last line, change “clause 45” to read “clause 8.4”.

Add the following at the end of the second last paragraph of the payment clause:

“... Such limitations to payments shall occur whenever the contractor falls behind by more than 1 month(s) on his initial approved programme, in which case the application of this payment item shall be the same as for 13.01(b) (i.e. the total price offered for 13.01(c) is treated as a lump sum). Normal application continues once the contractor’s progress has returned to within the time set for the limitation.”

Add the following paragraphs:

“Should the combined total tendered for subitems (a), (b), and (c) exceed 20% of the tender sum (excluding CPA, contingencies and VAT), the tenderer shall state his reasons in writing for tendering in this manner. The tenderer's attention is drawn to Form B1: Contractor's Establishment on Site, (bound in this Volume), to be completed by the tenderer. If the tenderer should require additional compensation for his obligations under section 1300 (over and above the total tendered for item B13.01) by including such additional compensation in the tendered rates and/or lump sum of items in the Pricing Schedule, these items and the value of such additional compensation shall also be indicated in writing in a letter attached to Form B1.

Payment of the rate per month for subitems B13.01(d), (e), (f) and (g) shall include full compensation for all the contractor’s obligations relevant to health and safety legislation, environmental compliance, monthly reporting and security on site (as per clause 4.8 and 4.22 of the FIDIC Conditions of Contract).

Payment of the rate per month for subitem B13.01(h) shall include full compensation for all the contractor’s obligations relevant to complying with SANRAL’s 14 point plan for community engagement on subcontracting and labor beneficiaries (an introduction to PLC’s in SANRAL projects is included in Annexure A in part C5). It is foreseen that after appointment of the contractor, a period of three (3) months will be required to establish the Public Liaison Committee (PLC) as foreseen in SANRAL’s 14 point plan. During this period the contractor will only be paid the sum tendered for this subitem. Establishment on site will only occur after the PLC is in operation, whereafter the subitems (a) to (g) shall become payable.

The tendered rates for subitems 13.01(d), (e), (f), (g) and (h) shall apply in the same manner as pay subitem B13.01(c) but shall not form part of the calculation of the restrictions imposed by Condition of Tender F.3.8(c) and Form to tender B1: Contractor’s Establishment on Site.

The rate tendered for subitem B13.01(f) shall include full compensation for registering on the Employer’s project information module, compiling and capturing, monthly for the full duration of the Contract, the required information regarding training, empowerment, capacity building, targeted enterprise development, labour and staff returns. It shall further include for all personnel and other costs, disbursements, overheads and profit.

A contractor who tenders zero for this payitem shall not be relieved of his statutory obligations. A nil rate tendered shall be deemed not as an omission but as deliberate notice that costs have been included in the tendered rates for individual items of work or in the other preliminary and general pay items.

All payitems for which the unit of measurement is “month” are deemed to be based on 23 working days per month and shall become applicable only for use in calculations of approved extensions of time in terms of the Conditions of Contract:

Add the following pay items:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>“B13.02”</td>
<td>Additional local subcontract costs</td>
</tr>
</tbody>
</table>
Measurement and payment shall be in accordance with the provisions of clause 13.5 of the Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer (1999) (FIDIC).

The provisional shall cover any additional costs approved by the Employer associated with local subcontracts. It shall not include any costs of the main contractor.

**B13.03 Tenders for local subcontractors**

(a) Pre-qualification process…………………………………………………………number (No)

(b) Tender process ………………………………………………………………………number (No)

Payment under subitem (a) shall be the number of pre-qualification processes which the main contractor carries out as agreed with the Employer. The tendered rate shall include full compensation for the preparation of the pre-qualification tender, advertising, assistance and guidance to the tenderers, and evaluation of the pre-qualification tenders.

Payment under subitem (b) shall be the number of tender processes which the main contractor carries out as agreed with the Employer. The tendered rate shall include full compensation for the compilation and issue of tender documents, invitation and advertising of tenders, training and provision of assistance to tenderers, evaluation of tenders, and the award of subcontracts.

**B13.04 Handling, coaching, guidance, mentoring and supervision of local subcontractor by main contractor………………………………..percentage (%)**

The tendered percentage is the percentage of the total amount actually paid by the main contractor to local subcontractors appointed in terms of this section. This percentage shall be paid to the main contractor in full compensation for the main contractor’s handling, overhead and management costs, profit and any other additional cost not directly related to the execution of the works, arising from coaching, guidance, mentoring and supervision of local subcontractors by full time site staff.”
SECTION B1400: HOUSING, OFFICES AND LABORATORIES FOR THE ENGINEER’S SITE PERSONNEL

B1402 OFFICES AND LABORATORIES

b) Offices

A complete telephone service capable of delivering electronic and facsimile data, together with...

Amend sub-clause (xvii) to read as follows:

“(xvii) A combination colour printer/copier/scanner/facsimile machine for A3 and A4 size documents.”

Add the following sub-clauses:

“(xviii) Plan holders which shall be able to accommodate 30 AO-sized drawings hanging vertically and of a robust construction to withstand continuous use over the duration of the contract.

(xix) An electric refrigerator of specified capacity.

(xx) Floodlights which are to be controlled by a photocell for security purposes at the offices and laboratory.

c) Laboratories

In the second paragraph, second line substitute “drawings” with “figures included in the project document”

B1404 SERVICES

b) Water electricity and gas

The power supply shall be regulated by a suitable voltage regulator in order to maintain a constant current and voltage level at all times to prevent damage to the office and laboratory equipment and related machinery during power surges. In the event of damage to the office and laboratory equipment and related machinery because of a faulty voltage regulator, the contractor shall be liable for payment of all repair or replacement costs of such damaged items.

An on-site motor-alternator shall supply electricity when power from a recognized power-supply authority is not available.

B1405 GENERAL

Add the following to paragraph (e):

“In addition, the offices and laboratories shall be supplied with approved burglar proofing and the whole site shall be guarded full time during the day and night, as well as over weekends and holidays. The site shall also be fenced with a 2.4m high security fence with a razor-cut wire being used as strands or with a brick wall. The cost of this protection shall be included in item B13.01."

Add the following to paragraph (f):

“The offices and any living accommodation must be separated by at least 200m.”
B1406 MEASUREMENT AND PAYMENT

Item  
B14.03 Office and laboratory fittings, installations and equipment  

a) Items measured by number

Add the following subitems:

"(xix) Plan holder ................................................................. number (No)

(xx) Floodlights complete with poles and 500 Watt minimum globes ........................................ number (No)

(xxii) Uninterruptable power supply units ....................... number (No)

The tendered rate for subitem B14.03(a)(xx) shall include for the operation of the lights from sunset to sunrise for the full duration of the contract."

b) Prime cost items and items measured and paid for in a lump sum

Add the following subitems:

"(ix) Cell phones costs, including pro-rata rentals, for calls in connection with contract administration ......................................................... prime cost sum (PC) sum

(x) Handling costs and profit in respect of subitem 14.03(b)(ix) above ......................................................... percentage (%)

Payment of B14.03(b)(ix) shall include for the cost of all cellular telephone calls in connection with contract administration, as well as pro rata fixed costs.

The tendered percentage for payitem B14.03(b)(x) shall be a percentage of the amount actually spent under subitem B14.03(b)(ix) which shall include full compensation for the profit and handling costs incurred in managing provision of the cellular phones and monthly billings."

Item  
B14.10 Provision of photostat facilities  

Amend this payitem description to read “Provision of copying facilities” and in the payment prescription, amend “photocopier” to read “combination colour printer/copier/scanner/facsimile machine”.

Add the following payitem:

“Item  
B14.11 Provision of mobile outdoor weather station ....................... number (No)

The unit of measurement shall be the number of units supplied and operated.

The tendered rate shall include full compensation to procure, erect, operate and maintain, for the duration of the contract, a number of weather stations capable of measuring temperature, wind, chill, barometric pressure, UV levels, rainfall, wind direction and speed. The device should also have on-board storage capabilities for at least 7 (seven) days and it should include a USB PC connection with software, allowing data to be downloaded to a PC.”
SECTION B1500: ACCOMMODATION OF TRAFFIC

B1501 SCOPE

Add the following:

“It is a requirement of this specification that traffic is accommodated taking into account the provisions of the latest edition of the South African Road Traffic Signs Manual (SARTSM). The latest version for use in the accommodation of traffic is volume 2, chapter 13 of the June 1999 edition. Copies of this publication are available from Government Printers –Tel: (012) 334 4507/8/9 or (012) 334 4510 Fax: (012) 323 9574.

This section also covers the provision of additional information signs for motorists and the release of any notices to the media and public.”

B1502 GENERAL REQUIREMENTS

Insert the following:

“The whole of the site will be handed over to the contractor at the beginning of the contract. The sequence in which various parts of the site may be occupied by the contractor for the execution of the different items of work shall be subject to the requirements of the contract documents regarding, inter alia, working hours and the number, spacing and length of the work areas which may be occupied at any particular time.

The contractor shall programme his work taking due cognizance of restrictive conditions indicated in Clause B1204. The contractor's tendered rates shall include full compensation for all possible additional costs which may arise from the above and no claims for extra payment as a result of this *modus operandi* will be considered. The contractor shall in particular note that no additional compensation shall be made for work that could be considered as half-width construction.”

a) Safety

Replace the full stop at the end of the first paragraph and continue with the following:

“... flow of traffic, including the prohibition of his, and his subcontractor’s, construction plant from disregarding the stop/go accommodation of traffic control facilities. Failure to comply with this requirement shall be taken as a penalty event in terms of B1502(l).”

Add the following paragraphs:

“The contractor shall be responsible for maintaining the existing road surface both within the works area and the advance warning and termination areas in a safe and trafficable condition for the duration of the contract.

The contractor shall within 7 (seven) working days after receipt of a 3rd party claim acknowledge receipt to the claimant. The engineer shall be copied on all correspondence regarding 3rd party claims. The contractor shall at the monthly site meeting report on the status and outcome of the 3rd party claims.

The contractor shall be fully responsible for all the traffic accommodation on site, including for work undertaken by sub-contractors, e.g. at bridges etc.

Traffic shall be accommodated as indicated on the drawings unless an alternative tender incorporating an amended method of traffic accommodation has been accepted.

The contractor may amend the agreed traffic accommodation scheme but only with the approval of the engineer in consultation with the provincial and municipal traffic authorities.

During the non-working hours, or when construction is not taking place on a certain section of road all obstructions to the traffic shall be removed and all signs no longer
applicable to the situation shall be removed to an approved safe location or effectively covered.

No equipment or vehicles shall be stored or parked in the median or on the roadside during non-working hours except if protected or demarcated and only if approved by the engineer.

When requested by the engineer, the contractor shall provide lane closures for the purpose of road inspection. This must be done in advance of the actual programmed time for the work.”

f) Approval of temporary deviations

Add the following:

“If, after any temporary deviation has been constructed, any changes are considered necessary or desirable, the proposal shall be submitted to the engineer for his approval.”

i) Traffic Safety Officer

Add the following to the end of the second paragraph:

“The contractor shall submit a CV of the candidate to the engineer for approval before the candidate is appointed as the traffic safety officer.”

Insert the following as the opening phrase to sub-sub-clause (i):

“make himself available to discuss road safety and traffic accommodation matters whenever required by the engineer and shall be responsible…”

Delete sub-sub-clauses (ii) and (iii) and replace with the following:

“(ii) Record on neat and dimensioned sketches and submit to the engineer the position and sign reference number, where applicable, of each sign, barricade, delineator, cone, amber flicker light, guardrail and permanent or temporary painted road marking feature. The position of each shall be adequately referenced from the marker boards or other surveyed points on the site of the works.

These records shall also show the date and time at which the recorded traffic accommodation features are certified correct by the traffic safety officer, and shall be signed by the traffic safety officer before being submitted to the engineer.

The records shall similarly account for whatever changes are made in the field. Such changes shall record the position of flagmen and stop/go control men and their associated traffic accommodation equipment wherever they are used.

(iii) Personally inspect the position and condition of each traffic accommodation feature on the whole site of works twice per workshift, whether daytime or nightwork, and at least twice a day/night during non-working hours, to record all irregularities discovered and the remedial action taken, and to sign off as correct and submit to the engineer such record sheets by middle of the next working shift. The above inspections must at least take place before the commencement of peak traffic periods. The traffic safety officer shall keep a duplicate book for this specific purpose.

The traffic safety officer shall also submit with this report the daily labour returns of flagmen, stop/go, traffic signal control personnel employed and the traffic data recorded at each traffic control point.”

Add the following sub-sub-clauses:
“(ix) The traffic safety officer shall be equipped with a cellular telephone and shall have a traffic safety vehicle and sufficient labour at his disposal 24 hours a day, including all prescribed non-working days, and shall not be utilised for other duties. He shall be directly answerable to the contractor’s site agent. The traffic safety officer shall have his own vehicle to carry out inspections and at least one assistant to accompany him full time. Furthermore the traffic safety vehicle shall be a truck with a capacity of at least 3 tons and shall be equipped with a high visibility rear panel in accordance with the requirements of the SARTSM as well as a truck mounted impact attenuator complying with TL-2 criteria when tested in accordance with NCHRP 350 or N1 criteria when tested in accordance with EN 1317. (Certification of compliance must be on site at all times). The attenuator shall be used when the vehicle is utilized to close traffic lanes or when attending to stationary or broken down vehicles or accident scenes. The words TRAFFIC CONTROL shall be written on a warning sign in highly legible letters, not less than 150 mm high, and the sign shall be mounted on both the traffic safety officer’s vehicle and the traffic safety vehicle at least 1.5 m above ground level. The proposed sign and letter dimensions shall be submitted to the engineer for his approval.

The vehicles shall also be equipped with flashing amber LED lights or with flashing amber LED light bars of an approved design. The warning light shall be switched on at all times and the sign shall be displayed when the vehicle is used on site.

The traffic safety officer shall have a direct line of communication at all times with the police and traffic officers responsible for the area within limits of the contract.

(x) Ensure that all obstructions related to the contractor’s activities be removed at the end of each work shift where applicable as instructed by the engineer and that the roads are safe for the travelling public.

(xi) The traffic safety officer shall, in addition to the duties listed in paragraph 1502 (i), also be responsible to arrange for the removal of stationary or broken down vehicles off the roadway in conjunction with the routine maintenance contractor and/or traffic authorities and implementing actions requested by the traffic authorities with regard to the work to be carried out and be responsible for the erection and maintenance of all traffic signs necessary for the accommodation of traffic.

(xii) In the event of an accident the traffic officer shall record in a written report the details of the accident, record the position of all temporary road signs, barricades, delineators, flagmen and any other devices used for traffic accommodation. In addition the report shall include a neat dimensional sketch, photographs, identifiable permanent features, and any other relevant information.

(xiii) At least two separate traffic safety officers and teams shall be employed when construction is carried out during the day and night."

Add the following sub-clauses:

“j) **Crossing the median or carriageway centreline**

No vehicle or item of equipment shall be allowed to cross the median of a dual carriageway road or the centreline of a single carriageway unless the traffic accommodation and signage specifically allows for this and is approved by the engineer as safe.

k) **Site personnel**

The contractor shall ensure that all his personnel, excluding those who are permanently office bound, are equipped with reflective safety jackets and that these are worn at all times when working on or near to the travelled way. Any person found not wearing a reflective jacket under these circumstances shall be removed from the
site until such time as he is in possession of and wearing a reflective jacket. Reflective safety jackets shall be kept in good condition and any jackets that are, in the opinion of the engineer, ineffective shall be immediately replaced by the contractor.

l) Penalty events

Whenever the following events occur, the contractor shall be subjected to penalty conditions expressed in the Appendix to Tender.

(i) Non-compliance with accommodation of traffic specifications

Failure or refusal on the part of the contractor to take the necessary steps to ensure the safety and convenience of the travelling public, accommodation of traffic, plant and personnel in accordance with these specifications or as required by statutory authorities or ordered by the engineer, shall be sufficient cause for the engineer to apply penalties as follows:

A fixed penalty of R10 000,00 per occurrence shall be deducted for each and every occurrence of non-compliance with any of the requirements of section 1500 of the standard specifications and section B1500 of the project specifications.

In addition a time-related penalty of R1000,00 per hour over and above the fixed penalty shall be deducted for non-compliance to rectify any defects in the accommodation of traffic within the allowable time after the engineer has given an instruction to this effect. The engineer's instruction shall state the allowable time, which shall be the time in hours for reinstatement of the defects. Should the contractor fail to adhere to this instruction, the time-related penalty shall be applied from the time the instruction was given.

(ii) Late occupation of lanes, ramps and/or crossroads

The contractor shall be charged a lane occupation levy if he continues to occupy interchange ramps, crossroads and/or carriageway lanes beyond programmed completion dates. The levy shall be deducted from payments due on the relevant interim payment certificates at the rates provided in the Appendix to Tender and the pricing schedule."

m) Liaison with relevant Authorities

Where applicable, the contractor shall liaise on a daily basis with the Employer’s relevant i-traffic Management Centre (TMC), informing their operations manager about the expected works and lane closures for the next day, inclusive of all work shifts, in order for the operational manager to take into account the accommodation of traffic impacts in the TMC’s operations. The daily report shall be submitted to the TMC operations manager not later than 10h00.

For exceptional traffic accommodation impacts, such as lane closures in peak hours, short term contra flow conditions, lane closures over weekend peak periods etc., the TMC operational manager shall be informed seven days prior to the event.

The contractor shall inform the TMC about all traffic related incidents, as soon as he becomes aware of the incident.

Where required the contractor shall be responsible for acquiring the services of a municipal traffic officer and traffic vehicle (equipped with a blue light) to assist in the accommodation of traffic. The traffic officer and vehicle will be required when lanes are to be closed and/or where directed by the Engineer.

If the road under construction forms part of an abnormal load route the contractor shall liaise with the relevant provincial abnormal load office that issues permits to ensure that permits are not issued when construction restrictions do not allow passage of the abnormal load.
n) Other requirements

The following other requirements must be adhered to for the entire contract period:

i) 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 equipment and vehicles so as not to constitute a hazard on the road.

ii) The contractor’s tendered rates for the relevant items in the schedule of quantities shall include full compensation for all possible additional costs which may arise from the above and no claims for extra payment due to inconvenience as a result of the modus operandi will be considered.”

B1503 TEMPORARY TRAFFIC-CONTROL FACILITIES

Replace the first sentence of the first paragraph with the following:

“The contractor shall provide, erect and maintain the necessary traffic-control devices, road signs, channelisation devices, barricades, warning devices and road markings (hereinafter referred to as traffic-control devices) in accordance with these special provisions and as shown on the drawings and in the SARTSM and remove them when no longer required. It shall be incumbent upon the contractor to see to it that the abovementioned traffic-control devices are present where required at all times and are functioning properly.”

Replace the last sentence of the second paragraph with the following:

"Traffic-control facilities no longer required at the site of a deviation or a lane closure shall be moved for re-use. Traffic-control facilities lost or damaged by the contractor shall be replaced at his own cost. Where it can be proved that loss of or damage to such facilities is beyond the contractor's control and not the result of his actions or omissions, the engineer may order the facilities to be replaced and paid for at scheduled rates.”

Replace the third paragraph with the following:

“The type of construction, spacing and placement of traffic-control devices shall be in accordance with the SARTSM. The recommended arrangements of the traffic control devices illustrated and/or drawings issued by the engineer shall not be departed from without prior approval of the engineer. The arrangements expected to be most commonly used in the contract are given on the tender drawings.

The details shown for spacing and placement of traffic-control facilities may however, be revised at the discretion of the engineer where deemed necessary to accommodate local site geometry and traffic conditions.”

a) Traffic control devices

Add the following at the end of the last paragraph:

“At each signalised traffic control point, an all-weather shelter of at least three (3) square metres capable of accommodating two operators, with a clear window, a stable door, two chairs and a portable chemical toilet that shall be regularly maintained, shall be provided. Each control point shall have a 2 (two) phased signal system mounted on 3m high steel poles complete with all electrical wiring, a floodlight system of at least 2x400W metal halide floodlights mounted onto a 9m high pole to light up the traffic control point and lighting along the road where the traffic will queue. The provision shall include for a sufficient continuous power supply to operate each traffic control point. Included in the establishment and operation of the traffic control devices shall be a communication system that allows the operators to communicate with each other.

At each traffic control point, plastic moveable barriers, fitted with STOP signs to both sides, shall be provided to prevent vehicles from utilising the closed road lanes. These barriers shall be moved to open and close the relevant lanes for road users.
Records of opening and closing of closures and traffic counts shall be kept and submitted daily to the traffic safety officer.

b) **Road signs and barricades**

*Add the following:*

“The contractor shall be responsible for the protection and maintenance of all signs, and shall at his own cost replace any that have been damaged, lost, or stolen.

All temporary road signs required to remain in position for some time shall be pole mounted as shown on the drawings. All temporary road signs required to be moved more often shall be mounted on portable supports for the easy moving of signs to temporary positions. The only permitted method of ballasting the sign supports shall consist of durable sandbags filled with sand of adequate mass to prevent signs from being blown over by wind. The cost of the sandbags shall be included in the tendered rates for the various types of temporary road signs.

The covering of permanent road signs, if applicable, shall be by utilizing a suitable and durable covering that shall be pulled over the sign in the form of a hood and fastened to the signposts. Plastic bags or other materials and fastened by means of adhesive tape shall not be permitted. The cost of covering of permanent road signs shall be included in the tendered rates of items B15.01 and B15.10.”

c) **Channelisation devices and barricades**

*Add the following:*

“The use of drums as channelisation devices shall not be permitted. Drums may however be used to set up barriers as provided for in sub-clause 1503(d).

Delineators shall:

(i) comply with the manufacturing and reflective requirements of the SARTSM and the blades shall be reversible with dimensions as indicated on the drawings;

(ii) have smooth and round edges and be mounted on a post and base. All components shall be of durable plastic material;

(iii) have the lower edge of the reflective part of the delineator mounted not lower than 250mm above the road surface;

(iv) be capable of withstanding the movement of passing vehicles and gusting winds up to 60km/h in typical working conditions without falling over. To achieve this, the base shall be at least 0.18m² and ballasted by its own weight or with sandbags filled with sand;

(v) together with its mounting be designed such that it will collapse in a safe manner under traffic impact.

Traffic cones manufactured in a fluorescent red-orange or red plastic material may be used only at short term lane deviations during daylight. Cones shall not be used on their own, but shall be interspersed with delineators at a ratio not exceeding 3:1. Cones used on all deviations shall be 750mm high. Lane closures which continue into the night time shall be demarcated by delineators only.

On section of road where the centreline has been obliterated, delineators shall be provided on both road edges at minimum 200m spacing on straight sections and at least 3 (three) visible on all curves.”
d) Barriers

*Add the following:*

‘Barriers for preventing vehicles from leaving the permitted lanes shall be movable barriers with an approved safety shape design (e.g. New Jersey, F-shape or single slope). Temporary movable barriers shall be obtained from suppliers and placed between the existing road and the construction areas. They shall comply with the requirements of either of the following specifications:

(i) The European Specification EN 1317 with containment level H1, or


When applying these specifications the contractor must take cognisance of his liabilities relating to the installation of temporary works to provide protection to the permanent Works and safety to his personnel and select a barrier system appropriate to his chosen work methodology. Particularly pertinent is the working width rating of a barrier system; the displacement width of the system shall not exceed the available safe width to the nearest edge of the construction. All moveable barriers shall be installed in accordance with the manufacturer's instructions or generally accepted best practice and shall be submitted to the engineer for review and comment.

Even though the Employer has made available its own barrier system for the contractor to price no transfer of responsibility for use of that system shall pass to the Employer it being deemed that any price offered by the contractor constitutes his confirmation that this barrier system provides appropriate protection. When using the Employer’s concrete barriers the connecting system using metal plates and bolts (as shown in the drawings) provides a system compliant with the specifications of (i) above. The working width classifications of this system are W3 and W6 when impacted by a TB11 or TB42 vehicle respectively. This means that the unsafe working width behind this barrier system is 1000mm or 2100mm measured from the back of the barrier depending on the impact characteristics of each vehicle. If the contractor installs a different connecting system to that shown on the drawings it is entirely in the knowledge that the risk of protection lies entirely with the contractor.

Where instructed by the engineer, the terminal sections of moveable barriers may be a proprietary type or may be contractor designed to attenuate head-on impacts of at least NCHRP Test Level 1 (50 km/h, 2 000 kg) or EN1317 Containment Level H1 (80 km/h, 1 500 kg)."

e) Warning devices

*Add the following:*

“All construction vehicles and plant used on the works shall be equipped with flashing amber LED lights or with flashing amber LED light bars and warning boards as specified. All vehicles and plant before being allowed onto the site shall obtain a clearance permit from the engineer.

(i) Vehicle mounted flashing lights

Flashing lights shall be amber LED lights or amber LED light bar sof approved design and shall be mounted in such a way as to be highly visible from all directions. The lights on construction vehicles shall not be switched on while vehicles are being operated on unrestricted sections of a public road, but shall be switched on while construction vehicles are operating within the accommodation of traffic area, as the vehicles decelerate to enter a construction area, and as the vehicles accelerate to the general speed when entering the road from a construction area. Lights on plant shall operate continuously while the plant is working alongside sections of road open to public traffic within the work areas.
All LDVs and cars operating on site shall also be equipped with flashing amber lights which shall be placed so as to be highly visible from all directions and operated continuously while the vehicles are manoeuvring in or out of traffic or are travelling or parked alongside roads open to public traffic within the work areas.

Flashing lights and the "construction vehicle" signs on the contractor’s vehicles and plant shall not be paid for separately but shall be included in the rates covering the use of the vehicles.

The contractor shall apply and maintain lights together with temporary mounting brackets, to the approval of the engineer. Vehicles and plant that do not comply with these requirements shall be removed from the site.

(ii) Sign mounted flashing lights

Two amber flashing lights shall be vertically mounted on top of the traffic signs at each end of each traffic accommodation section as shown on the drawings. The lights shall be operated during the hours of darkness.

(iii) Flashing Illuminated Arrow Board

The arrow board shall be made up of light sources mounted on a backing board. A single shaft arrow will be required that can be used for both left and right directions. The light sources must be of LED type to improve visibility if used also during day time. The arrow board shall be used at lane drops as described B1502.

(iv) Mobile Variable Message Sign (VMS)

The VMS shall be mobile and located in a safe position to convey to the travelling public of traffic conditions ahead and/or inform a motorist of his actual travelling speed.

The mobile VMS system must be equipped with solar panels to provide an output of 400 Watt. It shall be stable for shocks up to 3G and wind speeds up to 120 km/h.

The sign face shall not be less than 3m wide by 1.5m high to provide a full matrix LED with at least 50 and 27 pixels for the width and height respectively. Each pixel shall have 4 LED’s and the pixel spacing shall not be less than 60mm. An LED mask for contrast and shading shall be provided. The sign shall be able to display 3 lines by 10 characters. The cone of vision is to be 30°.

The information displayed on each individual sign shall be controlled by a computer with internet connection operated by the contractor.

f) Road Markings

Add the following new paragraphs:

“Temporary road marking shall be reinstated before the road is opened to full width traffic. Temporary road marking shall consist of heavy pre-marking, and/or retro-reflective road marking paint, and/or temporary road studs, as directed by the engineer.

Temporary road studs shall be installed at double the spacing and shall be fixed to the road surface with the bitumen rubber crack sealant to allow for easy removal by application of gentle heat.

Temporary road marking lines for demarcation of temporary traffic lanes, on the final road surface shall not be allowed, except if approved by the engineer. Should temporary road marking lines be approved, it shall consist of one of the following as directed by the Engineer:
(i) Construction grade tape for temporary road marking which can be removed by applying gentle heat. The tape shall be foil backed, adhesive, reflective tape. The tape shall be capable of being easily removed from the road surface by the application of gentle heat.

(ii) Removable road marking paint.

Add the following sub-clauses:

“g) Other traffic control measures ordered by the engineer

The engineer may instruct the contractor to provide any other road sign, reflective tape, etc. not measured in standard payitems. Such road signs shall conform to the requirements of the SARTSM, or specification provided by the engineer. Similarly, in order to ensure that the travelling public is kept fully informed and warned on matters relating to the accommodation of traffic, construction sign posting and the effect of the construction on the free flow of traffic through the site, the engineer may arrange for advertising in the press and/or for other forms of publicity.

h) Flagmen

Flagmen shall be provided where shown on the drawings or required by the specification. During the daytime, at least two flagmen shall be provided at each traffic control point in addition to the STOP/GO sign operator, one flagman at the first speed reduction sign and a second roving flagman at least a 100m behind the last vehicle in the queue to indicate to the traffic to stop. At night time all flagmen shall be equipped with a suitably visible strobe, and a torch at each traffic control point as well as the traffic light operator. Where the shoulder of the road is closed to traffic, flagmen shall be provided at the leading ends of closures during daytime. These flagmen shall be provided at the first speed reduction sign to warn the traffic about the closure. No flagmen shall be on duty for a period of more than 10 hours per day.

Flagmen shall be adequately trained in the standard flagging techniques as described in the SARTSM (refer to figure 13.23 of detail 13.23.1) and be provided with conspicuous clothing such as safety jackets utilizing retro-reflective and/or fluorescent panels in red, yellow and/or white.

Flagmen shall have in their possession, at all times, certification that they have attended and passed an accredited course in flagging techniques before being allowed onto the construction site.

Flags shall be made from bright red or red-orange material and shall be square with a minimum side length of 600mm. The flag shall be attached to a staff at least 1.0m in length.

In terms of lateral clearance and safety, flagmen shall stand on the shoulder of the lane of traffic that is being controlled and under no circumstances shall flagmen be permitted to stand within the traffic lane. In order to obtain maximum visual impact for the travelling public, flagmen shall stand-alone.”

B1510 EXISTING ROADS USED AS DIVERSSIONS

Add the following:

"The contractor shall indemnify the employer against all proceedings, claims, actions, damages and costs which may arise from or be related to damage to vehicles or property or injury to persons as a result of loose stones or aggregates on the road surface or as a result of bituminous applications during the construction of the works.

The contractor shall arrange his activities so that construction traffic and equipment do not unnecessarily obstruct public traffic or force it to a complete standstill. The flow of public traffic shall always take precedence and the contractor shall not stop or delay public traffic to make way for construction traffic."
Insert the following paragraph after the heading:

“The contractor’s tendered rates for the relevant items in the schedule of quantities shall include full compensation for all possible additional costs which may arise from the above and no claims for extra payment due to inconvenience as a result of the modus operandi will be considered.”

Amend item 15.01 to read as follows:

“Item

B15.01 Accommodating traffic and maintaining temporary deviations:

(a) On the national route ............................................................... kilometre (km)
(b) On the ramps and cross roads of the Interchanges ....................... kilometre (km)

Replace the first paragraph with the following:

“The unit of measurement shall be the kilometre, measured along the centre lines of the road, the ramps from the noses and the cross roads where construction work is carried out. Accommodation of traffic shall be measured once only, that is no separate payments shall be made for lane and shoulder rehabilitation, slurry, reseal, asphalt overlay, side drains, etc. Only the net distance of the road shall be measured and overlapping distances during staged construction shall not be measured. A distinction shall be made between accommodation of traffic on the through road and accommodation of traffic on the ramps and cross roads of interchanges.

In the second paragraph, replace the comma after “deviations” at the start of the third line with a full stop and delete the remainder of this first sentence. Also delete the whole of the second sentence, which refers to compensation for the traffic safety officer.

In the third paragraph second sentence, insert a full stop after “use” and delete the remainder of the sentence.”

Item

B15.03 Temporary traffic control facilities

(a) Flagmen

Replace the 1st paragraph of the payment description to the following:

“The unit of measurement shall be a full day and night worked by flagmen. A man-day shall be deemed to comprise of a number of shifts within a twenty four hour period. Shifts of 12 hours and less shall be measured as half of a man-day.”

Amend sub-item (h) to read as follows:

(h) Delineators (TW 401 and TW402)
   (i) Single sided (size indicated) .................................................... number (No)
   (ii) Double sided (size indicated) ................................................... number (No)

Add the following at the end of the last paragraph of the payment description:

“However, allowance has been made in sub-item (h) Delineators for double the quantity of delineators required to execute the works. Payment under this item will be made up to the maximum quantity scheduled.”

Add the following sub-item:

(n) Extra over item 15.03 (e), (f) and (g) for using “diamond” grade retroflective material as:
   (i) Background ................................................................. square metre (m²)
(ii) Lettering, symbols, numbers, arrows, emblems
and borders .................................................. square metre (m²)

Add the following at the end of the last paragraph of the payment description:

“However, allowance has been made in sub-item (h) Delineators for double the quantity of delineators required to execute the works. Payment under this item will be made up to the

Item | Unit
--- | ---
B15.04 | Relocation of traffic control facilities:

Replace the first paragraph with the following:

“Except for the movement of barriers no payment for this item shall be made under this contract. All costs related to relocation of traffic control facilities shall be deemed to be included in the other pay items in this section.”

Add the following payitems:

“Item | Unit
--- | ---
B15.14 | Amber flashing lights mounted on signs ....................... number (No)

The unit of measurement shall be the number of sets provided.

The tendered rate shall include full compensation to provide, erect, operate and maintain a set of 2 (two) amber flashing lights per sign at each end of the traffic accommodation sections. It shall also include the provision of power to operate the lights, replacing bulbs as required and keeping the lenses clean and visible.

Item | Unit
--- | ---
B15.15 | Provision of traffic safety equipment for visitors

(a) Safety jackets .................................................. number (No)
(b) Hard hats .................................................. number (No)

The unit of measurement shall be the number of each item provided as specified, and approved by the engineer.

The tendered rates for the various safety items shall include full compensation for provision thereof and maintenance in good working order.

Item | Unit
--- | ---
B15.16 | Provision of traffic safety

(a) Traffic safety officer .................................................. month

The unit of measurement shall be the month (or part thereof) that the specified duties of the traffic safety officer are performed, irrespective of the number of traffic safety officers employed in any 24 hour day.

The tendered rate shall include full compensation for the cost of the traffic safety officer(s) to conduct the duties as specified in sub-clause B1502(i) and includes the provision of his own vehicle, fuel, vehicle maintenance and insurance and the cost of the cellular telephone and all other incidentals related to the performance of his duties.

(b) Traffic safety vehicle(s) .................................................. month

The unit of measurement shall be the month (or part thereof) that the safety vehicle is on site and in continuous use in the performance of traffic safety.
The rate tendered shall include the provision of the traffic safety vehicle, fuel, vehicle maintenance and insurance costs, drivers, labourers and all other incidentals related to the performance of the traffic safety duties.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B15.17</strong></td>
<td></td>
</tr>
<tr>
<td>Assistance by traffic officer</td>
<td></td>
</tr>
<tr>
<td>(a) Provision of traffic officer</td>
<td>Prime Cost (PC) Sum</td>
</tr>
<tr>
<td>(b) Handling costs and profit in respect of sub-item B15.18</td>
<td>Percentage (%)</td>
</tr>
</tbody>
</table>

The provisional sum provided to cover the cost of acquiring the assistance of a traffic officer and traffic vehicle (equipped with a blue light) to assist in closing of lanes or any other accommodation of traffic as ordered by the engineer in terms of the specifications shall be expended in accordance with the provisions of clause 45 of the FIDIC Conditions of Contract. The tendered percentage is a percentage of the actual amount spent under subitem B15.18, which shall include full compensation for the cost of acquiring the assistance of a traffic officer and traffic vehicle."

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B15.18</strong></td>
<td></td>
</tr>
<tr>
<td>Penalties</td>
<td></td>
</tr>
<tr>
<td>(a) Fixed penalty per occurrence</td>
<td>number (No)</td>
</tr>
<tr>
<td>(b) Time related penalty</td>
<td>hour (h)</td>
</tr>
</tbody>
</table>

In subitem B15.17(a) a fixed penalty of R10 000.00 per occurrence shall be deducted for each and every occurrence of non-compliance with any of the requirements of section 1500 of the standard specifications and section B1500 of the Project Specifications.

In addition in subitem B15.17(b), a time-related penalty of R1 000.00 per hour over and above the fixed penalty in subitem B15.17(a) shall be deducted for non-compliance to rectify any defects in the accommodation of traffic within reasonable time after the engineer has given an instruction to this effect. The Engineer's instruction shall state the time in hours for re-instatement of the defects. Should the Contractor fail to adhere to the instruction, the time-related penalty will be applied from the time the instruction was given.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B15.19</strong></td>
<td></td>
</tr>
<tr>
<td>Flashing Illuminated Arrow Board</td>
<td>number (No)</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the number of flashing arrow boards provided and completely erected.

The tendered rate shall include compensation for providing, erecting, maintaining, relocating and re-erecting the flashing illuminated arrow board around the boundaries of the site, including the power supply for functioning of the lights. The lights shall be of the new LED type lights and shall be available for the entire period of the contract.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B15.20</strong></td>
<td></td>
</tr>
<tr>
<td>Variable Message Signs mounted on trailers</td>
<td>number.month (No.month)</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the number of signs provided for the time in months that the Variable Message Sign (VMS) is operative on site.

The tendered rate shall include full compensation for the provision of the VMS mounted on the trailer, the operation and maintenance thereof including frequent day and night inspections, protection against and repairs due to vandalism.


**B15.21 Temporary Barriers**

(a) Contractor supplied:
   (i) Supply to site, initial placement and removal from site ................. metre (m)
   (ii) Dismantling and re-erecting barriers during the works ................. metre (m)

The unit of measurement shall be the metre of movable barrier.

The tendered rate for subitem (i) shall include full compensation to supply the barriers to the site, initial placement and erecting in position and removal off-site when no longer required.

The tendered rate for subitem (ii) shall include full compensation for dismantling and re-erecting the movable barriers and moving between locations on site where required, as and when approved by the Engineer.

(b) Employer supplied:
   (i) Transport to and from site ................................................ metre.kilometre (m.km)
   (ii) Initial placement and removal from site ..................................... metre (m)
   (iii) Dismantling and re-erecting barriers during the works ................. metre (m)

The unit of measurement for subitem (i) shall be the length of barriers in metres multiplied by the distance in kilometres, transported from a location indicated by the Employer to the site and back from the site to a location indicated by the Employer.

The tendered rate for subitem (i) shall include full compensation to load the barrier at the Employer’s location, transport to and off-loading at the site where the barrier is to be temporarily used as well as for all labour, plant and equipment and incidentals required.

The unit of measurement for subitems (ii) and (iii) shall be the metre of movable barrier.

The tendered rate for subitem (ii) shall include full compensation for initial placement and erecting in position of the barriers and removal off-site when no longer required.

The tendered rate for subitem (iii) shall include full compensation for dismantling and re-erecting the movable barriers and moving between locations on site where required, as and when approved by the Engineer.

*Add the following new sections:*

**“B1518 ACCOMMODATION OF TRAFFIC**

The contractor shall pay specific attention to the accommodation of pedestrian traffic along the newly constructed walkway where the safety of pedestrians could be compromised as a result of the works.

Where pedestrians have to cross the site, the contractor shall ensure that the pedestrians are safeguarded and shall be able to cross the site without being endangered. The pedestrians should not be able to enter areas where works are taking place.

Should a walkway be required, it shall have a clear opening of at least 1.2 m wide and 2.1 m high and shall be uniformly illuminated at all times. The surface of the walkway shall be free from obstructions and shall be clearly signposted to guide the pedestrians towards the walkway. If steps are required to reach the level of the walkway, these shall comply with the OHS act and have proper handrails. No ramps shall be steeper than 1 in 8.

Payment for compliance to this requirement shall be deemed to be included in the rates tendered for accommodation of traffic.”

a) Long term works in the median
The works shall be programmed that roadworks in the median and the outside shoulder does not take place simultaneously, if applicable. The following conditions must be adhered to:

i) The traffic shall be moved to the outside by changing of the lane markings to maintain the existing number of through lanes.

ii) The fast lane can be closed temporarily and the start shall be indicated with a flashing illuminated arrow board, also during daytime.

iii) A temporary barrier shall be placed between the construction area and traffic, inside the fast lane and next to the middle lane.

iv) The speed shall be reduced to 80 km/h.

v) Only one entrance to the construction area shall be provided.

vi) Construction vehicles will only be allowed to exit the construction area at the end of the closure in order to allow for acceleration in the fast lane.

vii) Should construction in the median during night hours be required, the contractor shall make use of alternate lighting and flashing illuminated arrow boards.

b) Short term diversion of a carriageway if applicable

This will typically be required during the placing of precast bridge beams and the erection of gantry structures. This will entail a slow lane drop on the one carriageway to be closed and a fast lane drop on the opposite carriageway. The following conditions must be adhered to:

i) A minimum of two lanes with 3,3m lane widths must be provided in both directions. This will require that certain widenings must be completed to provide a wide enough road surface.

ii) The speed shall be reduced to 60 km/h in both directions.

iii) Temporary barriers shall be used to separate the traffic.

iv) Double flashing illuminated arrow boards shall be placed at the lane drops.

v) This type of closure or diversion must be approved by the Engineer and may occur during Saturdays from 14:00 to sunset and Sundays from 08:00 to 15:00, or any other time approved by the Engineer. Consequently the penalty for late opening shall be applicable to this type of closure.

vi) The travelling public shall be informed by the information signs.

vii) The public shall also be informed through the media of the planned closure 7 days in advance of the closure or diversion.

c) Short term lane closure

Short term lane closures shall typically be required during the surfacing overlay of the existing national road, application of lane markings and road studs, parking of concrete trucks during the pour of the road concrete pavement, etc. The following conditions must be adhered to:

i) The approximate time periods for short term lane closures and construction of the works shall be as follows:

a) Day shifts: 08:30 – 15:30

The above-mentioned time period, especially the start of the lane closure, shall be determined at the start of each shift by the engineer and may vary
slightly from the times indicated. Different time periods shall be applicable for each of the carriageways, the individual ramps and cross roads.

ii) The day prior to a long weekend the full road width shall be re-opened not later than 14:00.

iii) A minimum of 2 lanes with 3,3m lane widths shall be provided at all times.

iv) Flashing illuminated arrow boards must be placed at the start of the closure.

v) Delineators shall be used to demarcate the construction area.

vi) Lane closure may only be done between the hours specified in this clause and the full road shall be opened at the end of the shift. Consequently the penalty for late opening of a lane to traffic shall be applicable to this type of closure.

vii) The maximum length of lane closure is 2,0 km.

viii) The maximum number of closures is one per direction of traffic flow.

ix) Information signs as detailed with variable dates and times of a lane closure shall be erected at positions as directed by the engineer. The travelling public shall be informed of the lane closure at least 7 days in advance by displaying the information on the sign.

d) **Permission must be given by the engineer**

i) The public must be informed through the radio the day preceding and the day of the closure.

ii) Information of the closure must be displayed on the Variable Message Signs 7 days in advance.

iii) Full closure will only be permitted during day time between peak hours.

iv) Closure must not occur on a Friday or the day preceding a long weekend.

v) The assistance of the traffic authorities shall be acquired.

vi) A possible procedure for halting the traffic is:
   - Close the slow lane to reduce the speed of the traffic.
   - For the remaining lanes, vehicles of the contractor with high visibility signs are to drive side by side in each lane and reduce speed until a stand still.

vii) The carriageway shall be opened only after declared safe by the contractor.
SECTION B1600: OVERHAUL

B1601 SCOPE

Insert in the second line between “excavation” and “or stockpile” the following:

“.... crushing and screening,”

B1602 DEFINITIONS

(a) Overhaul material

(iv) Insert “selected layers” before “subbase” in the first line.

Insert the following as a final paragraph

“Material procured from commercial sources shall not be regarded as overhaul material.”

b) Overhaul

Replace the sub-clause with:

“Regardless that the Standard Specification makes allowance for payment of restricted overhaul payment shall only be made for material hauled in excess of 1 kilometre. Overhaul shall be measured as the product of the volume of material hauled and the overhauled distance.

c) Haul distance

Add the following paragraph:

“Where material from one carriageway of a road is to be used on the opposite carriageway, the haul route shall be on the national route and crossing over at the nearest interchange or approved median crossing point. For this situation, the haul distance shall be measured from the position of obtaining the material, along the carriageway until centre point of the next interchange or approved median crossing point, and then back along the other carriageway. Only the distance on the national road will be measured and additional distances for travelling on the ramps, loops and cross roads will not be considered.

Return travel may have to be along other roads but will not be measured separately. Existing municipal streets can be used for haul of material.

d) Free-haul distance

Replace the last sentence with:

“This distance shall be 1 kilometre in the case of all overhaul materials and this specification shall be deemed to have replaced the ‘free-haul’ distance in all other sections of the standard specifications.”
Amend item 16.02 as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B16.02</td>
<td>Overhaul on material hauled in excess of 1 km</td>
</tr>
</tbody>
</table>

Delete the first paragraph of the first set of notes and replace it with the following:

“Only ordinary overhaul for haul in excess of 1.0 km will apply to all types of fill and layerwork materials. No restricted overhaul will be applicable on this contract.”
SECTION B1700: CLEARING AND GRUBBING

B1701 SCOPE

Add the following as a final paragraph:

“Clearing and grubbing for the construction of site offices shall not be measured separately and shall be deemed to be included in the rates tendered for item B13.01.”

B1702 DESCRIPTION OF WORK

(omitted)

B1704 MEASUREMENT AND PAYMENT

“Item  Unit
B17.01 Clearing and grubbing ................................................................. hectare (ha)

Add the following at the end of the payment clause:

“as well as temporarily stockpiling at approved spoilng or stockpiling areas or in the road reserve and later placing in approved areas after construction operations are complete. The tendered rate shall also include for the removal of stumps of all sizes of girths.”

Add the following to the measurement and payment paragraphs:

“Clearing and grubbing of the construction sites shall not be measured separately and shall be deemed to be included in the rates tendered for item B13.01”
SECTION B1800: DAYWORKS

B1801 SCOPE

This section covers the listing of daywork items in accordance with sub-clause 13.6 of the FIDIC Conditions of Contract, for the use in determining payment for work which cannot be quantified in specific units in the Pricing Schedule, or work ordered by the engineer during the construction period which was not foreseen at tender stage and for which no applicable rate exists in the Pricing Schedule.

B1802 ORDERING OF DAYWORK

No daywork shall be undertaken unless written authorisation has been obtained from the engineer.

B1803 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B18.01</td>
<td>Personnel</td>
</tr>
<tr>
<td>(a)</td>
<td>Unskilled labour</td>
</tr>
<tr>
<td>(b)</td>
<td>Semi-skilled labour</td>
</tr>
<tr>
<td>(c)</td>
<td>Skilled labour</td>
</tr>
<tr>
<td>(d)</td>
<td>Ganger</td>
</tr>
<tr>
<td>(e)</td>
<td>Foreman</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B18.02</td>
<td>Equipment</td>
</tr>
<tr>
<td>(a)</td>
<td>Specify</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B18.03</td>
<td>Materials</td>
</tr>
<tr>
<td>(a)</td>
<td>Procurement of materials</td>
</tr>
<tr>
<td>(b)</td>
<td>Contractor's handling costs, profit and all other charges in respect of sub-item B1803(a)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B18.04</td>
<td>Transport</td>
</tr>
<tr>
<td>(a)</td>
<td>LDV</td>
</tr>
<tr>
<td>(b)</td>
<td>Flatbed truck</td>
</tr>
</tbody>
</table>

The unit of measurement for items B18.01 and B18.02 shall be the hour for the item of equipment or personnel. Non-working hours for transport breakdown, lack of operator of any other reason shall not be measured. The time shall be taken from the time that the personnel and/or equipment depart until return.

Measurement shall only be for work instructed and directed by the engineer, where the engineer considers no other appropriate rate is applicable in the Pricing Schedule. Prior to the commencement of any work by the personnel described under item B18.01 the contractor must obtain written consent from the engineer regarding their classification in terms of "unskilled", semi-skilled" and "skilled" personnel.

The tendered rates for labour under B18.01 shall include full compensation to cover overhead charges and profit, leave pay, bonuses, subsistence, allowances, Employer's contributions, additional payment for overtime where applicable, insurances, housing, site supervision, use of small hand tools and appliances, non-mechanical plant and equipment and consumable stores, for all administrative, supervisory, operative and contingent costs, relating to the supply of personnel.
The tendered rates for plant for item B18.02 shall be an all-inclusive hire charge for the use of the vehicle and driver or plant/equipment and operator and shall apply only to vehicles, plant and equipment nominated in writing by the engineer, for all administrative, supervisory, operative and contingent cost, and profit relating to the running of the plant.

The unit of measurement for subitem B18.03(a) shall be the amounts actually paid for the procurement of materials to be purchased and shall be made in accordance with the provision of the FIDIC Conditions of Contract. Only the actual quantities of materials used, as verified by the engineer, shall be paid for.

The percentage tendered for subitem B18.03(b) shall be the percentage of the amounts actually paid for the procurement of materials as ordered under subitem B18.03(a) and shall be in full and final compensation in respect of the contractor's handling costs, profit and all other charges in connection with the procurement and supply of the materials to the point of usage.

The unit of measurement for item B18.04 shall be the kilometre distance that the vehicle travelled for transporting personnel and/or plant. All travelling shall be approved by the engineer.

The tendered rate for item B18.04 shall include full compensation for the cost of the vehicle including fuel, maintenance depreciation and running costs.

The above mentioned tendered rates shall be full compensation for the various items as specified and no further profit shall be paid.
Amend the first paragraph to read:

“This section covers all work both rehabilitative and new work in connection with the excavation and construction of open drains, subsoil drainage and banks and dykes at the locations and to the sizes, shapes, grades and dimensions as shown on the drawings or as directed by the engineers, and the test flushing of subsoil drains.”

Amend this sub-clause by adding the following to the end of the third paragraph:

“(category-heavy duty) or SABS 1601 (stiffness class 350)

The pipes to be used shall be either slotted u PVC pipes or perforated HDP pressure pipes, 100mm ID.”

Pipes must be stored in a shaded area without exposure to direct sunlight.

(ii) Natural permeable material

Add the following to the 3rd paragraph:

“The crushed stone shall be coarse (20mm nominal) and shall be washed clean of all fines”

(iii) Synthetic-fibre filter fabric

Under item (4) Selection, of this sub-clause, replace the 1st paragraph with the following:

“The filter-fabric used for subsoil drains shall be grade 1 and shall satisfy the criteria for this grade of geotextile as given in Table 2104/2.”

Add the following to table 2104/2:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration load (minimum), N</td>
<td>4000</td>
</tr>
<tr>
<td>Puncture resistance (maximum), mm</td>
<td>16</td>
</tr>
<tr>
<td>Water percolation (minimum), l/m²/s</td>
<td>20</td>
</tr>
</tbody>
</table>

Add the following item:

“(5) Testing

General:

The tests to be carried out on geo-textiles relate to the material and the method of manufacture and are mainly to ascertain that the correct grade of geo-textile is supplied, and that the material is equivalent in quality to that selected and specified for use in the works. The contractor will be required, on the request of the engineer, to submit a certificate by an approved laboratory to prove compliance with specified tests as stated in B8114 without additional cost to the employer.
b) Construction of subsoil drainage systems

Add the following sub-clause:

“(v) Proving of pipes in subsoil drainage systems

On completion of the pipe laying and prior to backfilling, all pipe joints shall be surveyed as proof of their installation to line and level. After backfilling the pipes shall be proved by pulling through a cylindrical cleaning brush followed by a wooden mandrill ± 400mm long and 5mm in diameter less than the bore of the pipe. Proving of pipes shall not be paid for separately and the cost thereof shall be deemed to be included in the rate tendered for laying the pipe.”

B2106 MANHOLES, OUTLET STRUCTURES AND CLEANING EYES

Insert the following paragraph after the last paragraph:

"The end of each subsoil outlet shall be marked with a 300mm x 300mm perspex plate fixed to the top portion of the fence line opposite each subsoil outlet structure in accordance with the details on the Drawings."

B2107 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B21.01 Excavation for open drains</td>
<td></td>
</tr>
</tbody>
</table>

Add the following to the penultimate paragraph:

“The tendered rate shall also include full compensation for trimming the open drains”

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B21.03 Excavation for subsoil drainage systems</td>
<td></td>
</tr>
</tbody>
</table>

Add the following subitem:

“(c) Extra-over item 21.03(a) for excavating through stabilised layers of existing pavement ........................................ cubic metre (m³)”

Add the following to the second paragraph:

“Excavation in stabilised pavement material shall be paid only in subitem (c) and shall not be paid as an extra over for hard material in subitem (b). For subitem (c), the tendered rate shall also include full compensation for backfill with soilcrete.”
SECTION B2300: CONCRETE KERBING, CONCRETE CHANNELLING, CHUTES AND DOWNPIPES AND CONCRETE LINING FOR OPEN DRAINS

B2301 SCOPE

Add the following to this clause:

“This section also covers the replacement of damaged concrete kerbing, channelling and lining.”

B2304 CONSTRUCTION

a) Excavation, and preparation of bedding.

(i) Kerbs and channels

In the first sentence of this sub-clause amend “approved bedding material at least 75mm thick” to read “15 MPa concrete at least 75mm thick”.

(ii) Concrete linings.

Add the following to the 3rd paragraph:

“This work will be paid for under item B23.17.”

Add the following to this Subsubclause:

“If necessary due to pavement layer thicknesses some of the layer on which the bedding material is to be placed will have to be removed in order to ensure that the minimum thickness of 75 mm bedding beneath the kerbs and channels can be placed. The Contractor must allow for the removal of this material in the rates for kerbing and channelling.”

b) Prefabricated concrete kerbing and channelling

Amend the end of the 2nd paragraph to read as follows:

“...road junctions, where the kerb units shall be 0.5 m in length for curve radii between 5.0 m and 20.0 m and 0.3 m in length for curve radii between 1.0 m and 5.0 m. For curves with a radius less than one metre the kerbs shall be cast in situ. Any associated prefabricated concrete channelling units shall also comply with the above requirements.”

g) Concrete-lined open drains

Add the following to the last paragraph:

“Alternatively the surface could be sprayed with invert bituminous emulsion as soon as possible after the excavations have been trimmed and compacted. The sprayed surfaces shall be maintained until the concrete lining is cast. The nominal rate of application of the emulsion shall be 0.5 litre/m² unless otherwise instructed by the engineer.”

Add the following sub-clause:

“l) Demolition of existing kerb and channel and concrete lined drains

Where shown on the drawings and/or indicated by the engineer, the existing kerb and channel and concrete lined drains shall be demolished to a specified maximum size, removed and transported to an approved spoil site as provided by the contractor...”
b) Fill

Add the following under item (iv):

“The maximum swell at 100% Maximum Dry Density shall not be more than 2%.”

B3303 CLASSIFICATION OF CUT AND BORROW EXCAVATION

Classification of cut and borrow excavation shall be revised as follows:

“a) Classes of excavation

(ii) Intermediate excavation

No distinction shall be made between soft and intermediate excavation, and all intermediate excavation shall be classified and measured as soft excavation.”

B3305 TREATING THE ROADBED

a) Removing unsuitable material

Replace “or” in the eight line of the third paragraph with “and”

d) In situ treatment of roadbed

Add the following after the second paragraph:

“Shales and mudstone shall be treated as directed by the engineer.”

B3306 CUT AND BORROW

e) The temporary stockpiling of materials

Replace the contents of this subclause with the following:

“The contractor shall plan his activities in such a manner so that materials excavated from borrow areas and cuttings can be directly transported to and placed at the designated points.

The temporary stockpiling of material will not be paid for separately unless instructed by the engineer, and full compensation will be deemed to have been included in the rates tendered for the various payment items for work for which the stockpiled material is to be used.”

g) General

Add the following after the first sentence of the second paragraph:

“The final cut surface in hard excavation shall not be more than 0.5 m below the specified slope face, measured at right angles to the strike and dip directions of the slope face.”
a) General

Add the following:

"Where existing embankments are to be widened, or where new embankments are to be constructed adjacent to existing embankments, the existing side slopes shall be benched as specified in subclause 3307(d) and in accordance with the details on the drawings.

In addition the material in the fill widening shall, unless otherwise instructed by the engineer, be compacted as follows:

(i) where the thickness exceeds 1.5 m, it shall be compacted to a minimum of 93% Maximum Dry Density to a depth of at least 1.5 m below the final road level; or

(ii) where the thickness is less than 1.5 m, the in situ roadbed and fill material shall be compacted to 93% Maximum Dry Density."

d) Benching

Replace the first sentence of the second paragraph with the following:

"The dimensions of benches as well as the extent to which existing fills have to be cut back to form benches shall be as indicated on the drawings or indicated by the engineer."

Add the following after the second paragraph:

"In order to obtain sufficient working width for road-building equipment when the existing road fill is widened, it may be necessary to form benches that extend beyond the normal road prism or to cut back into the existing road fill or both. The contractor shall submit his proposals in this regard to the engineer for approval before proceeding with such work. The contractor will be paid in accordance with the relevant payment items for work required to obtain a working width of up to 4 m. Additional work required to provide a working width in excess of 4 m shall be at the contractor's expense."

---

B3312 MEASUREMENT AND PAYMENT

Add the following items:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B33.20</td>
<td>Fill constructed with material obtained from commercial sources or sources provided by the contractor, including all haul</td>
</tr>
<tr>
<td>(a)</td>
<td>Gravel material in compacted layer thicknesses of 200 mm and less:</td>
</tr>
<tr>
<td>(i)</td>
<td>Compacted to 93% of Maximum Dry Density ........................................  cubic metre (m³)</td>
</tr>
</tbody>
</table>

The unit of measurement is the cubic metre of material measured in the compacted fill. The quantity measured shall be calculated by the method of average end areas from levelled cross-sections prepared from the ground line after clearing and grubbing and the removal of topsoil and the completion of any preparatory roadbed treatment which may have been ordered by the engineer, but prior to the construction of the fill, and the final specified or authorised fill cross-section superimposed at 20 m intervals along the centre line of the road. All measurement shall be neat and no payment will be made for that part of the fill placed in excess of the authorised cross-section shown on the drawings or instructed by the engineer, irrespective of the tolerances in workmanship allowed under the contract. Where the roadbed has subsided under the fills, the quantities shall be adjusted to make allowance for such
subsidence, as set out in the note at the beginning of clause 3312. Measurement of fill shall distinguish between the alternative methods of processing and compacting.

Where measurement by cross-sections is considered by the engineer to be impractical, the compacted volume of the material may be taken as equal to 70% of the loose volume of material in the hauling vehicles as an alternative method of measurement.

The tendered rates shall include full compensation for the costs of negotiations and payment of royalties, for procuring, furnishing and transporting the materials over an unlimited free-haul distance from the sources to the site, for placing, preparing, processing, shaping, watering, mixing and compacting the materials to the densities or in the manner specified, and for removing and disposing of all oversize material from the road after processing, including transport for the haul distance to approved dumping sites provided by the contractor.

Payment shall distinguish between the various methods of processing and compacting specified, as itemised above.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B33.21</td>
<td>Fill constructed with material from temporary (not designated) stockpiles or directly from existing pavement layers and existing road prisms, irrespective of material type, including all haul:</td>
</tr>
<tr>
<td>(a)</td>
<td>Gravel material in compacted layer thicknesses of 200 mm and less:</td>
</tr>
<tr>
<td>(i)</td>
<td>Compacted to 93% of Maximum Dry Density .................. cubic metre (m³)</td>
</tr>
</tbody>
</table>

The unit of measurement is the cubic metre of material measured in the compacted fill. The quantity measured shall be calculated by the method of average end areas from levelled cross-sections prepared from the ground line after clearing and grubbing and the removal of topsoil and the completion of any preparatory roadbed treatment which may have been ordered by the engineer, but prior to the construction of the fill, and the final specified or authorised fill cross-section superimposed at 20 m intervals along the centre line of the road. All measurement shall be neat and no payment will be made for that part of the fill placed in excess of the authorised cross-section shown on the drawings or instructed by the engineer, irrespective of the tolerances in workmanship allowed under the contract. Where the roadbed has subsided under the fills, the quantities shall be adjusted to make allowance for such subsidence, as set out in the note at the beginning of clause 3312. Measurement of fill shall distinguish between the alternative methods of processing and compacting.

The sources shall be points where existing pavement layers have been excavated or milled out or stockpiled and deemed to be acceptable for their use in the new fills elsewhere within the project boundaries. Fill and pavement layers from existing ramps or materials to be excavated or milled out from the existing pavements on sections that require repair or rehabilitation shall be included in this item.

Where measurement by cross-sections is considered by the engineer to be impractical, the compacted volume of the material may be taken as equal to 70% of the loose volume of material in the hauling vehicles as an alternative method of measurement.

The tendered rates shall include full compensation for the costs of procuring, furnishing and transporting the materials over an unlimited free-haul distance from the sources to the site, for placing, breaking down if required, preparing, processing, shaping, watering, mixing and compacting the materials to the densities or in the manner specified, and for removing and disposing of all oversize material from the road after processing, including transport for an unlimited haul distance to approved dumping sites provided by the contractor.
a) General

*Add the following after the second paragraph:*

“Distinction shall be made between crushed and natural G4, G5 and G6 materials. Where the crushing and/or screening of these materials has been specified, the combined grading shall conform to the grading limits specified for G4 class material in Table B3402/1.

The same shall apply for all materials obtained from commercial sources.”

*Replace the grading and grading modulus sections in Table 3402/1 with:*

<table>
<thead>
<tr>
<th>GRADING</th>
<th>Nominal aperture size of sieve (mm)</th>
<th>Percentage passing through sieve by mass</th>
<th>The percentage by mass passing the 2,00mm sieve shall not be less than 20% nor more than 70%</th>
<th>None specified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crunched material produced by multi-stage crushing and screening</td>
<td>Uncrushed material or material produced by single stage crushing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>None specified</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
<tr>
<td>50</td>
<td>100</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
<tr>
<td>37,5</td>
<td>100</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
<tr>
<td>28</td>
<td></td>
<td>None specified</td>
<td>2,6 ≥ GM ≥ 1,2</td>
<td>2,6 ≥ GM ≥ 1,2</td>
</tr>
<tr>
<td>20</td>
<td>61 – 91</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
<tr>
<td>14</td>
<td>48 – 82</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
<tr>
<td>5</td>
<td>31 – 66</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
<tr>
<td>2</td>
<td>20 – 50</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
<tr>
<td>0,425</td>
<td>10 – 30</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
<tr>
<td>0,075</td>
<td>5 – 15</td>
<td>None specified</td>
<td>2,4 ≥ GM ≥ 1,5</td>
<td>2,4 ≥ GM ≥ 1,5</td>
</tr>
</tbody>
</table>

**Note:**
Refer to standard COLTO table for COLTO grading if required
b) Compaction requirements

Amend the compaction requirements as follows:

“Selected layer: G7 material compacted to 95% MDD
In-situ: Roadbed preparation compacted to 93% MDD”

B3405 CONSTRUCTION TOLERANCES

(a) Level

Replace the table in the sub-sub-clause with the following:

<table>
<thead>
<tr>
<th></th>
<th>$H_{90}$</th>
<th>$H_{max}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected layers</td>
<td>25 mm</td>
<td>33 mm</td>
</tr>
<tr>
<td>Sub-base layers</td>
<td>15 mm</td>
<td>20 mm</td>
</tr>
<tr>
<td>Base layers</td>
<td>12 mm</td>
<td>15 mm</td>
</tr>
<tr>
<td>Shoulders</td>
<td></td>
<td>25 mm</td>
</tr>
</tbody>
</table>

Add the following:

“Level control for the various pavement layers shall be done at least at the following intervals in the longitudinal direction:

<table>
<thead>
<tr>
<th>Layer</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected layer, sub-base, shoulders and wearing course</td>
<td>20 m</td>
</tr>
<tr>
<td>Base</td>
<td>10 m</td>
</tr>
</tbody>
</table>

(b) Layer thicknesses

Replace the table in the sub-sub-clause with the following:

<table>
<thead>
<tr>
<th></th>
<th>$D_{90}$</th>
<th>$D_{max}$</th>
<th>$D_{ave}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected layers</td>
<td>25 mm</td>
<td>35 mm</td>
<td>8 mm</td>
</tr>
<tr>
<td>Sub-base layers</td>
<td>18 mm</td>
<td>24 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>Base layers</td>
<td>15 mm</td>
<td>22 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>Shoulders</td>
<td>30 mm</td>
<td>0 mm</td>
<td></td>
</tr>
</tbody>
</table>
B3406  QUALITY OF MATERIALS AND WORKMANSHIP

Replace the second paragraph with the following:

"Test results and measurements will be assessed in accordance with the provisions of Section 8200."

B3407  MEASUREMENT AND PAYMENT

Add the following payment items:

<table>
<thead>
<tr>
<th>&quot;Item&quot;</th>
<th>&quot;Unit&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>B34.14</td>
<td>Pavement layers constructed from gravel obtained from commercial sources or sources provided by the Contractor, including all haul:</td>
</tr>
<tr>
<td></td>
<td>(a) Gravel selected layer compacted to:</td>
</tr>
<tr>
<td></td>
<td>(i) 95% of Maximum Dry Density (150 mm G7 upper selected layer) ............... cubic metre (m³)</td>
</tr>
<tr>
<td></td>
<td>(ii) 95% of Maximum Dry Density (150 mm G5 subbase layer) ............... cubic metre (m³)</td>
</tr>
</tbody>
</table>

The tendered rates shall include full compensation for the costs of negotiations and payments of royalties, for procuring, furnishing, placing, spreading, mixing imported and in situ material if required, breaking down, shaping, watering, preparing and compacting the material, for hauling the material over an unlimited free-haul distance from the source to the point of use, for protecting and maintaining the layer and for conducting control tests, all as specified. The tendered rates shall include full compensation for blading all oversize material off the road into windrows, for loading and transporting the material for an unlimited free-haul distance to approved dumping sites provided by the Contractor, and for off-loading and spreading the material, all as specified.
a) Requirements for crushed aggregate

After the first sentence delete the remainder of the paragraph and replace with the following:

“The aggregate shall not contain more than 0.1% by mass of unwanted material such as wood, coal or similar organic material.

Aggregates containing mica, such as granite, gneiss, mica schist, pegmatite, sandstone shall not contain more than 2% by mass of free mica, especially muscovite, when assessed by visually separating the particles, or more than 4% by volume when assessed by means of microscopic slides. Aggregate containing easily detectable quantities (more than 1%) of olivine, serpentine and sulphide minerals such as pyrites and marcasite, must be considered with caution, and may warrant additional evaluation to the satisfaction of the engineer. Argillaceous rocks may only be used if specified in the project specifications, or with the engineer’s written approval.

Soft or weathered particles shall be controlled by the Durability Mill Index values specified in B3602(e) Durability.

Provision has been made in clause B8108(b)(iii), calculation, for the determination and calculation of the Apparent Density for aggregates with a total water absorption greater than 1.5%, when total water absorption is determined according to SANS 3001-AG20 (replacing TMH1 method B14) and SANS 3001-AG21 (replacing TMH1 method B15)."

c) Grading requirements

Replace entire clause with the following:

“The target grading, after compaction, shall be as near as possible to the mean of the specified grading envelope listed in table B3602/1 and shall be continuous with no marked gaps or excessive quantities of any particular size. The mean grading of each lot (minimum of 4 but preferably 6 test points per lot) shall conform to the approved target grading plus or minus the tolerances specified in table B3602/4. However, no target grading plus tolerance can be set outside the original grading envelope in table B3602/1."

Table 3602/1

In table 3602/1 delete “85% of bulk relative density” and replace with:

"88% of Apparent Relative Density".

Replace the grading section in Table 3602/1 with:
### TABLE B3602/4

<table>
<thead>
<tr>
<th>Sieve size (mm)</th>
<th>Permissible deviations by mean values (% by mass)</th>
<th>Permissible deviations by individual values (% by mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal maximum size (mm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>37.5</td>
<td>28</td>
</tr>
<tr>
<td>28</td>
<td>± 5</td>
<td>± 5</td>
</tr>
<tr>
<td>20</td>
<td>± 5</td>
<td>± 5</td>
</tr>
<tr>
<td>14</td>
<td>± 5</td>
<td>± 5</td>
</tr>
<tr>
<td>5</td>
<td>± 5</td>
<td>± 5</td>
</tr>
<tr>
<td>2</td>
<td>± 4</td>
<td>± 4</td>
</tr>
<tr>
<td>0.425</td>
<td>± 3</td>
<td>± 3</td>
</tr>
<tr>
<td>0.075</td>
<td>± 2</td>
<td>± 2</td>
</tr>
</tbody>
</table>

Note:
Refer to standard COLTO table for COLTO grading if required

Add the following sub-clause:

**e) Durability**

The durability property of aggregates derived from the basic crystalline group shall be assessed by means of the Ethylene Glycol Durability Index. When tested in accordance with the method prescribed in B 8105(g) the Durability Index shall not exceed four. In addition, the 10% FACT value obtained after soaking in ethylene glycol for four days shall not be less than 50% of that obtained on the unsoaked sample. Where any values are obtained that fall outside the above requirements, a detailed assessment of the quarry shall be undertaken together with a specialist mineralogical evaluation of both the coarse as well as fine fractions in order to assess the long-term durability properties of the material.

For Basic crystalline rocks, Arenaceous rocks, Argillaceous rocks and Diamictites the Durability Mill Index (DMI) shall be less than 125. For all other rock types the Durability Mill Index (DMI) shall not be more than 420, subject to the % passing the 0.425mm sieve not increasing by more than 8 percentage points during the Durability Mill test.”

### B3604 CONSTRUCTION

b) Compaction

*Replace that last sentence of the first paragraph with:*

“The density of the layer shall be tested at each third of the layer thickness.”
c) Surfacing preparation of the base

Replace the final paragraph in subsubclause 3604(c)(i) with:

“Slushing of the base, is compulsory and shall be carried out within 48 hours after completion of the compaction. Even if the specified density is achieved without slushing or before completion of the slushing process, the full slushing process must still be completed.”

Delete sub-sub-clause (ii) Multi-stage process (water or slurry rolling).

B3605 PROTECTION AND MAINTENANCE

Replace “moisture content of the layer” in the first paragraph with “moisture content of the upper 50mm of the layer.”

Add the following to the end of the second sentence:

“as determined according to SANS 3001-GR30 (replacing TMH 1 method A7).”

B3607 QUALITY AND WORKMANSHIP

Delete “or 8300” in the second paragraph.

B3608 MEASUREMENT AND PAYMENT

Delete the first paragraph and replace it with the following:

“Note: No additional or extra over payment shall be made for work in restricted or confined areas.”
b) Aggregate for blinding

Add the following sentence:

“Blinding of the primed surface with aggregate shall only be permitted to facilitate vehicular access to adjoining properties”

B4104 WEATHER AND OTHER LIMITATIONS

Replace paragraph (g) with the following:

“(g) When at any position within the layer the moisture content of a granular base layer is more than 50% of the optimum moisture content determined according to SANS 3001-GR30 (replacing TMH 1, Method A7). In the event of rain after priming, the base shall be allowed to dry out to meet the above moisture content requirement prior to surfacing.”

B4106 APPLICATION OF THE PRIME COAT

Replace paragraph (c) with the following:

“The type of prime and application rate best suited for the base shall be determined during construction. The Contractor shall provide about 20ℓ of each prime and apply it at different application rates with a brush on the base. Then engineer will then instruct the type of prime and application rate to be used. No payment shall be made for tests to determine the type of prime.

Unless directed otherwise by the engineer or indicated on the drawings, the edges of the primed surface shall be 150mm wider than the edges of the surfacing.”

Add the following sub-clause:

“(j) Application in areas treated by reworking and construction of a new base shall be primed using a mechanical distributor complying with sub-clause 4103(a). The edges of the previously constructed or existing surfacing shall be adequately protected by approved means to ensure that an overlap of prime not exceeding 50mm is sprayed onto the previously constructed or existing surfacing.”

B4108 TOLERANCES

Replace the first paragraph with the following:

“The actual spray rates measured at spraying temperature shall not deviate by more than 8.0% from that ordered by the engineer. The engineer may, at his discretion, conditionally accept application rates falling outside this tolerance at reduced payment in accordance with Table B4108/1.

<table>
<thead>
<tr>
<th>Deviation specified spray rate at spraying temperature. (%)</th>
<th>Payment reduction factor of tendered rate.</th>
</tr>
</thead>
<tbody>
<tr>
<td>±8.0</td>
<td>1.00</td>
</tr>
<tr>
<td>±9.0</td>
<td>0.97</td>
</tr>
<tr>
<td>±10.0</td>
<td>0.95</td>
</tr>
<tr>
<td>±11.0</td>
<td>0.90</td>
</tr>
<tr>
<td>±12.0</td>
<td>0.85</td>
</tr>
<tr>
<td>±13.0</td>
<td>0.80</td>
</tr>
</tbody>
</table>
Any deviation outside these limits shall not be paid for, however, the engineer shall have the right to instruct the contractor to make up any deficiency, or blind excessive prime without additional payment. Where so instructed, the material for blinding shall consist of approved, but shall consist of screened 5mm nominal single size aggregate. The use of crusher dust for blinding shall not be permitted. If under-spraying occurs, and it is accepted by the engineer, only the actual quantities applied shall be paid for.”

B4109 TESTING

Add the following:

“No payment will be made if this condition is not adhered to. The contractor shall provide, at his cost, representative samples of every batch of prime delivered onto site.”
B4202 MATERIALS

a) Bituminous binders
   (i) Conventional binders

   Add the following:

   “The binders to be used shall be as follows:
   (a) Continuously graded base: 50/70 penetration grade bitumen”.

b) Aggregates

   Add the following paragraph to the introductory description:

   “Asphalt mixes shall be manufactured using different individual single size coarse aggregates fractions and crushed fine aggregates blended to conform to the specified grading requirements. The use of natural sands shall only be permitted if approved by the engineer and shall be limited to a maximum of 5% for continuously graded mixes. All aggregate in excess of 5mm shall consist of individual nominal single sized aggregate. For stone mastic asphalt mixes all aggregate fractions in excess of 2mm shall consist of individual single size fractions. The Contractor shall note that commercial suppliers may not be able to supply all the required single size aggregates, in which instance arrangements will have to be made for additional on site screening. No additional payment shall be made for screening aggregate. The use of run of crusher type materials shall not be permitted.”

   (v) Absorption

   Add the following sentence:

   “In addition, the total binder absorption of the combined coarse and fine aggregate blend shall not exceed 0.5%”

   (viii) Grading

   Delete the second paragraph commencing with ”The target grading…” and add the following paragraphs “The grading limits for the combined aggregate grading for the asphalt base shall be as specified in table 4202/6: Continuously graded 28mm maximum.

   Add the following new sub-item:

   “(xi) Moisture content

   The moisture content of aggregates, sampled from the cold feed belt, shall not exceed the following limits at the time that it is introduced into the mix:
   - Coarse aggregate ................................................................. 2%
   - Fine aggregate................................................................. 4%”

c) Fillers

   Delete the second last sentence of the first paragraph and replace with:

   “With the exception of stone mastic asphalt, in no instance shall more than 2% by mass of active filler be used in the mixes.”

   Add the following after the last paragraph:

   “For tender purposes the active filler shall be hydrated lime”
h) General

Add the following after the second paragraph:

“Sufficient aggregate for a minimum of 3 days production shall be separately stockpiled and tested for conformance and uniformity prior to use. The test results shall be presented to the engineer”

B4203 COMPOSITION OF ASPHALT BASE AND SURFACING MIXTURES

In the first paragraph, third last line, after “or active filler content” add:

“or aggregate content”

Replace the fifth paragraph with the following:

“The design of the asphalt mixes shall be in accordance with “Interim Guidelines For The Design Of Hot-Mix Asphalt In South Africa (June 2001)”, and appropriate research results. The mix properties and requirements shall be as specified in the project specifications”

The relevant asphalt mixes for the base and surfacing layers shall comply with the requirements in table B4203/1.

Replace Table 4202/6 with:

| TABLE B4202/6: GRADING LIMITS FOR COMBINED AGGREGATE FOR ASPHALT BASE |
|-------------------------------------------------|------------------|------------------|------------------|------------------|
| Sieve size (mm)                                 | Percentage passing sieve by mass | Maximum nominal size (mm) |
| Continuous grade                                |                                 | 28 |
| 37,5                                            | 100                             | |
| 28                                              | 87 - 96                         | |
| 20                                              | 73 - 85                         | |
| 14                                              | 64 - 79                         | |
| 10                                              | 57 - 72                         | |
| 7                                               | 48 - 61                         | |
| 5                                               | 39 - 50                         | |
| 2                                               | 30 - 44                         | |
| 1                                               | 20 - 35                         | |
| 0,600                                           | 15 - 30                         | |
| 0,300                                           | 11 - 24                         | |
| 0,150                                           | 8 - 19                          | |
| 0,075                                           | 5 - 12                          | |
| Aggregate                                       | 94,5%                           | |
| Bitumen (grade according to project specifications) | 4,5%                           | |
| Active filler*                                  | 1,0%                            | |

* Active filler for tender purposes to be hydrated lime.

Notes:
1. For recycled asphalt the nominal mix ratios of recovered asphalt, new aggregate, new bituminous binders, and active mineral filler to be used for tender purposes, shall be as specified in Table B4202/16.
2. Refer to standard COLTO table for COLTO grading if required
Replace Table 4203/1 with:

**TABLE B4203/1: ASPHALT MIX REQUIREMENTS: BASE AND SURFACING**

<table>
<thead>
<tr>
<th>Property</th>
<th>Continuously graded surfacing mixes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marshall Stability (kn)</td>
<td>8 – 18</td>
</tr>
<tr>
<td>Marshall Flow (mm)</td>
<td>2 – 6</td>
</tr>
<tr>
<td>Stability /Flow (kN/mm)</td>
<td>&gt; 2,5</td>
</tr>
<tr>
<td>VMA (%)</td>
<td>&gt; 15</td>
</tr>
<tr>
<td>VFB (%)</td>
<td>65 – 75</td>
</tr>
<tr>
<td>Air voids (%)</td>
<td>4 – 6</td>
</tr>
<tr>
<td>Indirect tensile strength @ 25°C (kPa)</td>
<td>&gt; 1000</td>
</tr>
<tr>
<td>Dynamic Creep Modulus @ 40°C (MPa)</td>
<td>&gt; 20</td>
</tr>
<tr>
<td>Modified Lottmann @ 7% voids (TSR)</td>
<td>&gt; 0,8</td>
</tr>
<tr>
<td>Air permeability @ 7% voids (cm²)</td>
<td>&lt; 1 x 10⁻⁸</td>
</tr>
<tr>
<td>Binder film thickness (microns)</td>
<td>5,5 – 8,0</td>
</tr>
<tr>
<td>Filler bitumen ratio</td>
<td>1 – 1,5</td>
</tr>
<tr>
<td>Immersion index (%)</td>
<td>-</td>
</tr>
</tbody>
</table>

**B4204 PLANT AND EQUIPMENT**

(f) Vehicles

*Replace the second paragraph with the following:*

“For minimize temperature loss all vehicles used for transporting asphalt to the site shall be fitted with thermal asphalt covers (canvas covers not acceptable) irrespective of the prevailing climatic conditions or distance of transport.”

**B4205 GENERAL LIMITATIONS AND REQUIREMENTS AND THE STOCKPILING OF MIXED MATERIAL**

b) Moisture

*Amend the last paragraph as follows:*

*Insert “and/or primed base” after “surfacing” in the third line of the first sentence.*

*Replace the last sentence with “In such case the base shall be allowed to dry out to meet the above moisture content requirement prior to placing the surface layer.”*

c) Surface Requirements

(iii) Tack Coat

*Add the following paragraph:*

“Hand spraying shall only be permitted on areas approved by the engineer. The binder distributor shall be capable to apply the binder evenly over the full area. The equipment shall comply with clause 4103. Tack coat shall be applied to all transverse and longitudinal joints by hand utilizing a paint brush.”
b) Production of the mixture

(ii) Using drum-type mixer plants

Add the following:

“Pre-blending of aggregate fractions shall not be permitted and the contractor shall ensure that sufficient cold-feed bins are installed to accommodate each individual aggregate fraction, including the filler.”

c) Transporting the mixture

Delete the second sentence in this paragraph.

Add the following sub-clause:

“f) Approval of asphalt mixture

Before any asphalt is placed on the road, the engineer shall approve the mix design. The approval process shall be as follows:

The contractor shall prepare and submit a laboratory design mix with test results at four different bitumen contents. The design mix shall be submitted on the prescribed form D3 of TMH 10: “Instruction for the Completion of As-Built Materials Data Sheets” with all the necessary test results completed. In addition, the proposed asphalt mixture shall be subjected to gyratory testing. All the expenses in preparing and submitting the laboratory design mix shall be to the contractor’s cost.

Samples of all aggregate and bitumen shall be submitted with the laboratory design mix to enable the engineer to carry out check design testing as necessary. The above design and aggregate shall be submitted to the engineer at least six weeks before it is intended to commence with any asphalt production.

After approval is obtained for the laboratory design mix, a plant mix at varying binder contents of approximately 5 to 10 tons each shall be produced. The purpose of the plant mix is for the contractor to prove that the laboratory design mix can be produced successfully. The engineer shall conduct the necessary testing on the plant mix. The plant mix shall not be placed on the road. During the production of the plant mix, the engineer shall be afforded the opportunity to inspect the asphalt plant.

After the plant mix is approved, permission shall be given for laying a trial section at varying binder contents in accordance with the requirements of section 4211 of the specifications. The engineer may require that the mix be further assessed by means of CSIR Wheel Tracking or MMLS testing, the cost of which will be borne by the Employer. Mass production of asphalt shall only commence after approval of the trial section, which should be given within a maximum of ten days.

The engineer may instruct the contractor at any time to halt his paving process and to review the whole or part of the above process should a change of aggregate properties occur, the specified asphalt requirements not being met and/or a consistent asphalt mixture not be produced.”

B4208 JOINTS

Add the following to this clause:

“Where the difference in level between the new work and the existing road surface exceeds 25mm, joints shall be treated as follows:

Transverse steps at the end of a day’s work shall be tapered off at a slope of 1 vertical to 20 horizontal (1:20) to tie in with the existing surface. The tapered section shall be removed before surfacing is recommenced and a joint formed in accordance with clause 4208 of the specification.”
Longitudinal joints exposed to traffic shall be provided with a taper of compacted asphalt material over the full length of the exposed joint. The width of the taper shall be at least 5 times the difference in level between the old and new work.

All costs involved in the provision and removal of these temporary ramps shall be deemed to have been included in the rates tendered for the relevant asphalt payitem.

**B4211 LAYING OF TRIAL SECTION**

*Add the following to the end of the first paragraph:*

“As the purpose is not to calibrate any equipment, etc., the contractor shall calibrate the equipment and refine the mix design at his own cost.”

**(c) Gradings**

*Replace Table 4213/1 with:*

<table>
<thead>
<tr>
<th>Size of aggregate passing Sieve size (mm)</th>
<th>Permissible deviation from target grading (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>± 5</td>
</tr>
<tr>
<td>20</td>
<td>± 5</td>
</tr>
<tr>
<td>14</td>
<td>± 5</td>
</tr>
<tr>
<td>10</td>
<td>± 5</td>
</tr>
<tr>
<td>7</td>
<td>± 5</td>
</tr>
<tr>
<td>5</td>
<td>± 4</td>
</tr>
<tr>
<td>2</td>
<td>± 4</td>
</tr>
<tr>
<td>1</td>
<td>± 4</td>
</tr>
<tr>
<td>0.600</td>
<td>± 4</td>
</tr>
<tr>
<td>0.300</td>
<td>± 3</td>
</tr>
<tr>
<td>0.150</td>
<td>± 2</td>
</tr>
<tr>
<td>0.075</td>
<td>± 1*</td>
</tr>
</tbody>
</table>

*When statistical methods are applied the permissible deviation for the 0.075 fraction is ± 2%.*

**B4214 QUALITY OF MATERIAL AND WORKMANSHIP**

**(b) Coring of asphalt layers**

*Add the following:*

“A suitable coring machine shall be available on a daily basis when asphalt paving is taking place. Cores shall only be drilled, when the road temperature is 20°C or less. Core holes shall be filled with hot mix asphalt and compacted, all within 24 hours of the core being drilled. Coring shall be carried out within 48 hours after the paving has been completed and supplied to the engineer. The test results of cores shall be submitted to the engineer within 24 hours after coring.”

**(c) Routine inspection and tests**

*Add the following paragraphs:*

“The contractor shall keep accurate records of:

(i) The position where every truckload of asphalt is paved (chainage, lane, time and date).
(ii) The temperatures of the asphalt in the trucks both at the mixing plant and at the paving equipment immediately prior to discharging the load.
(iii) The truck and load number from which control samples are taken. All samples taken shall be appropriately numbered.
Test results and measurements will be assessed in accordance with the provisions of section 8200.

Add the following sub-clause:

d) Special tests

n-Heptane-Xylene Equivalent (Spot test) (AASHTO-T102)

If the engineer suspects that bitumen or asphalt has been overheated, he may order that the bitumen, or the bitumen recovered from the asphalt, be subjected to the Spot Test. Recovery of binder for use in the Spot Test shall be carried out according to an approved method.

Any bitumen having an n-Heptane-Xylene equivalent in excess of 36, or in excess of the manufacturer's test result on the dispatched stock, shall be considered to have been overheated and shall be deemed to be rejected unless proven otherwise.

---

**B4215 MEASUREMENT AND PAYMENT**

Amend the following payment item:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B42.08</td>
<td>100mm cores in asphalt paving</td>
</tr>
</tbody>
</table>

Amend the 1st sentence by adding the following after the word “drilled…”:

“irrespective of depth of core.”
COLTO SERIES 5000: ANCILLARY ROADWORKS

SECTION B5100: PITCHING, STONWORK AND PROTECTION AGAINST EROSION

B5102 MATERIALS

a) Stone

Replace the 2nd paragraph with the following:

“Unless suitable stone can be located on site, the stone for pitching shall come from commercial sources but, from whatever source, its use shall be subject to the prior approval of the engineer.”

c) Sand

(ii) Sand for bedding

Replace this sub-sub-clause with the following:

Sand for bedding used for paving blocks shall not contain any deleterious impurities and shall comply with the requirements given in table B5102/1.

<table>
<thead>
<tr>
<th>Sieve size (mm)</th>
<th>Percentage passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>95 – 100</td>
</tr>
<tr>
<td>2</td>
<td>73 – 86</td>
</tr>
<tr>
<td>1</td>
<td>43 – 78</td>
</tr>
<tr>
<td>0,600</td>
<td>25 – 60</td>
</tr>
<tr>
<td>0,300</td>
<td>10 – 30</td>
</tr>
<tr>
<td>0,150</td>
<td>5 – 15</td>
</tr>
<tr>
<td>0,075</td>
<td>5 – 10</td>
</tr>
</tbody>
</table>

Note:
Refer to standard COLTO table for COLTO grading if required

B5106 SEGMENTAL BLOCK PAVING

d) Edge beams

Add the following paragraph:

“Where concrete edge beams are constructed the relevant specifications under section 2300 shall apply.”

B5108 MEASUREMENT AND PAYMENT

B51.04 Concrete pitching and block paving:

Add the following sub-payment item:

“(f) Cast in situ concrete walkway slab (class of concrete and thickness of slab indicated) ................................................................. number (no)”

Add the following to the pay item description:

“The tendered rate for subitem (f) shall include full compensation for furnishing all materials, treating the prepared surface with an approved herbicide and ant poison, constructing the concrete walkway slab according to the casting sequence shown in the drawings, including normal formwork and expansion joints at maximum spacing of 10 m, providing a broomed top surface finish and for all other work necessary for completing the work as specified.”
SECTION B5400: GUARDRAILS

B5402 MATERIALS

a) Guardrails

At the end of the 1st sentence delete the full stop and add “or SANS 51317 and carry the SABS mark or a mark by any other SANAS approved certification body for the applicable SANS specification.”

b) Guardrail posts

(ii) Steel posts

Replace the paragraph with the following:

"Where offered or instructed to be used, steel posts shall be part of an approved guardrail system as tested and complying with SANS 51317, and galvanized in compliance with the requirements of SABS 763 for type A1 articles, shall be used.

Where guardrails are placed on concrete retaining walls or concrete structures, the steel posts shall be of the type and size shown on the drawings or described in the project specifications."

B5403 CONSTRUCTION

a) Erection

Replace the 7th paragraph with the following:

"Steel posts placed on concrete retaining walls or concrete structures shall be erected and fixed as shown on the drawings. For all other applications, steel posts shall be erected and fixed in compliance with the approved guardrail system as tested and approved in terms of SANS 51317."

B5405 REMOVING, RENOVATING AND RE-ERECTING GUARDRAILS

a) Removing the guardrails

In the 3rd line of the 1st paragraph, after “150mm layers,” delete the full stop and add “of suitable material (than less than G7 quality material).”

B5406 Measurement and Payment

Replace item 54.01 with the following:

"Item Unit

| B54.01 Guardrails on 3.81m spaced posts |
|-----------------|-----------------|
| (a) Complete galvanised system on: |
| i. Timber posts (2.34 m long) ........................................ metre (m) |
| (b) Extra over 54.01(a) for the following |
| (i) End treatments where single guardrail sections are used (including additional posts) ........................................ number (No) |

The unit of measurement for (a) and (b)(v) shall be the metre of guardrail as erected, (including length of end treatments and curved guardrails). The unit of measurement for (b)(i) to (b)(iv) shall be the number of end treatments of each type installed."
The tendered rates shall include full compensation for furnishing all materials and labour for erecting and galvanizing the guardrails, complete with posts, spacer blocks, bolts, nuts, washers and reinforcing plates, and excavating holes in all classes of material, concrete, backfilling and removing any surplus material. It shall also include full compensation for incidentals in respect of supplying and erecting curved guardrails, end treatments, and turned down sections.

Reflective plates and drilling and blasting will be paid for separately under items 54.06 and 54.12 respectively."

Delete items 54.03, 54.04 and 54.05 without replacement

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B54.07</td>
<td>Removing existing guardrails</td>
</tr>
</tbody>
</table>

Add the following:

"The tendered rate shall also include for the backfill of the holes with suitable G7 quality material."
SECTION B5500: FENCING

B5501 SCOPE

Add the following:

“This section also covers the repairing of existing fences that form part of the permanent work and/or routine maintenance”

B5514 MEASUREMENT AND PAYMENT

Add the following payitems:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B55.11 Supply and erect complete double post and rail timber fencing as per details on DRG PW – 112471_01 or to manufactures specifications.</td>
<td>m</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the meter of fencing erected.

The tendered rate shall include full compensation for procuring, furnishing and erecting all material as per details supplied on the drawings or the manufactures apecifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B55.12 Supply and erect new 1.8 m high “Clearvu” fence along entrance from/into township.</td>
<td>m</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the meter of fencing erected.

The tendered rate shall include full compensation for procuring, furnishing and erecting all material as per details supplied on the drawings or the manufactures apecifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B55.13 Create opening in existing fence for entrance from/into township.</td>
<td>No</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the number of openings created in the existing fence to allow access for pedestrians from/into the township.

The tendered rate shall include full compensation for all work, material and incidentals required to create an opening in the existing fence to allow for access into the township and to make good.”
SECTION B5600: ROAD SIGNS

B5601 SCOPE

Replace “South African Road Traffic Signs Manual” in the second paragraph with:

“SADC Road Traffic Signs Manual”

B5603 MANUFACTURING OF ROAD SIGN BOARDS AND SUPPORTS

a) Road signboards

Add the following:

“The contractor shall make every effort to ensure that signboards are correct in all respect and before dispatching the boards from the manufacturer's factory shall provide the engineer with a 100mm x 150mm colour photograph of each sign face for approval of the correctness of the legend. Such approval will not imply final acceptance of the board. If the contractor is in any doubt as to the correctness of the sign detail, the sign designer shall be contacted for verification.”

(ii) Steel profile road signboards

Add the following:

“Chromadek section shall be assembled in accordance with the details of Typical Drawings TD-R-RS-1100 and TD-R-RS-1100.

Where the letter or legends cross the horizontal joints of the sign panels, the letter shall be cut on the joint and both ends folded around the radius.

Retro-reflective material to adjoining Chromadek panels on a sign shall be practical visual match of the specified colour.”

B5604 ROAD SIGN FACES AND PAINTING

Add the following sub-clause:

“e) Application of retro-reflective material

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.”

B5605 STORAGE AND HANDLING

Add the following:

“The following shall not be allowed on the sign face:

• Drilling of holes, except for the fastening of overlays
• Application of any form of adhesive
• Cleaning with any chemicals that are not specifically approved by the manufacturer of the retro-reflective material.
• Covering the sign face with an impermeable material that does not allow free circulation of air.”

B5606 ERECTING ROAD SIGNS

c) Erection

Add the following:
“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 engineer.”

**B5608 DISMANTLING, STORING AND RE-ERECTING EXISTING ROAD SIGNS**

*Add the following:*

“Existing overhead and ground mounted road signs that are being replaced by new signs shall be dismantled and disposed of by the Contractor. Where possible the dismantling of the signs shall not be before the replacement sign is erected and displayed. Where dismantling of the sign is required before erection of the replacement sign, the dismantling shall not take place until immediately before work is to commence on the replacement, and the replacement shall be completed and the new sign displayed as soon as possible thereafter (within 72 hours).

Dismantling shall include sign panels and ground mounted sign supports.

Ground mounted sign supports shall be cut off just below ground level. Material excavated for removal of buried poles shall be replaced, and any depression made good using excess material from excavation for new signs.

Payitems are provided in the Pricing Schedule. Payment will differentiate between different types of sign panels.”
SECTION B5700: ROAD MARKINGS

B5701 SCOPE

Replace “South African Road Traffic Signs Manual” in the second paragraph with:

“SADC Road Traffic Signs Manual”

Replace the words “ordinary road marking paint” with “solvent borne road marking paint”.

Replace “BS 3262” with “EN 1436”.

Replace “Hot melt plastic road marking” with “thermoplastic road marking”.

B5702 MATERIALS

Insert the following before subclause (a) Paint:

“The selection of the appropriate road marking paint and materials for permanent road markings to ensure conformance with the requirements of this specification rests with the contractor. Such paint and material shall have technical characteristics (brightness, luminance, skid resistance, durability) equal to or greater than road marking paint and materials specified in subclauses 5702(a), (b) and B5702(c).

Where plastic road-marking material (hot-melt plastic (also known as thermoplastic) and two-component (also known as cold plastic)) is used, the contractor shall obtain an approved guarantee from the manufacturer that the paint complies with the specification. This shall be submitted to the Engineer on request.”

Replace sub-subclause B5702(a)(i) with the following:

“(i) Road marking paint

Road marking paint shall be Type 1 as specified in SANS 731-1. Only paint, manufactured in a SANS approved and accredited facility shall be accepted. The no-pick-up time of road-marking paint shall comply with the Class 1 requirement in accordance with SANS 731-1.

The paint shall be delivered at the site in sealed containers marked in accordance with SANS 731-1.

The viscosity of the paint shall be such that it can be applied without being thinned down.”

Replace sub-subclause B5702(a)(iii) with the following:

“(iii) Thermoplastic road marking material

Thermoplastic road marking material shall comply with the requirements of EN 1436, and EN 1423: 1998 for drop-on glass beads for road marking and anti-skid aggregates and mixtures thereof. Blending of thermoplastic road marking material and glass beads shall comply with EN 1424: 1998.

The binder shall be an elasticized synthetic resin and the material shall be reflectorized by mixing in 25% by mass Class A glass beads in accordance with EN 1424: 1998. An additional topping of glass beads shall be applied to the hot surface of the material for instant retro-reflectivity.

The white road marking material shall contain 6% by mass minimum titanium dioxide content and shall have a skid resistance of 45 S.R.T. – units or higher. SABS Method 1248: 1995 shall be used for determination of traffic wear index; indication of durability.

The following minimum lumination values are required for the completed product:
• 250 mcd/m².lux & 120 mcd/m².lux for white & yellow lines respectively, at 30 days after application.
• 200 mcd/m².lux & 100 mcd/m².lux for white & yellow lines respectively, at 6 months after application.

Determination of coefficient of retro-reflected luminance by means of portable retro-reflectometer shall be carried out using SANS 6261: 2008. Application of the permanent roadmarking will thus have to be performed within the first 6 months of the 12 month defects liability period to allow for the second measurement to fall within the contract dates. Should the application of the permanent road-marking fall outside the first half of the defects liability period for whatever reason, the settlement of the retention money will be delayed until the second measurement of luminance can be performed at the stipulated time and the required adjustment can be made to the tendered rate (if required).

Two-component cold plastic road marking material shall be used for symbols, arrows and letters (hand painted markings) unless otherwise instructed by the Engineer.

Add the following sub-subclause:

“(v) Cold plastic road marking material

Cold plastic road marking material shall be used for symbols, arrows and letters (hand painted markings) and shall consist of a solvent-free reactive acrylic resin, stuffing, beads and pigment to which a hardener shall be added. Application is carried out using a trowel. Material applied by paint brush shall not be used.

Cold plastic road marking material shall be reflectorized by mixing in 25% by mass (or 400g/m²) Class A glass beads in accordance with EN 1424: 1998. An additional topping of glass beads is applied to the wet surface of the material after application and will comply with EN 1423: 1997.”

b) Roadstuds

Replace the clause with the following:

Road studs for the areas of application shall be supplied and installed in accordance with the requirements set out in Table B5702/1 with reference to IS EN 1463.
Add the following sub-item:

**“c) Retro-reflective beads**

Retro-reflective glass beads shall be applied to the wet paint, thermoplastic and cold plastic.

The beads shall comply with Class A beads in accordance with EN 1424: 1998, with the following requirements or as approved by the Engineer:

- **colour**: crystal clear
- **roundness**: > 80%
- **size range of**: 14 – 200 US Mesh (75 – 1400 Microns)
- **refractive index**: > 1.5
- **specific gravity**: ± 2.5
- **granulometry**:

<table>
<thead>
<tr>
<th>CUMULATIVE RETAINED MASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIEVE</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1700</td>
</tr>
<tr>
<td>1400</td>
</tr>
<tr>
<td>1180</td>
</tr>
<tr>
<td>850</td>
</tr>
<tr>
<td>600</td>
</tr>
<tr>
<td>425</td>
</tr>
<tr>
<td>355</td>
</tr>
<tr>
<td>212</td>
</tr>
<tr>
<td>PAN</td>
</tr>
</tbody>
</table>

The beads shall be delivered to the site in sealed bags, marked with the name of the manufacturer, the batch number and an inspection seal of SANS, confirming that the beads form part of a lot tested by SANS and comply with the requirements of EN 1424: 1998. Alternatively, the Contractor shall at all times have a SANS certificate on the site, identifying the batches to which the inspection seals apply and certifying that they have been tested by SANS, and comply with the requirement of EN 1424: 1998."
B5704 MECHANICAL EQUIPMENT FOR PAINTING

Add the following sentence at the end of the first paragraph:

"The road-marking machine shall be fitted with a device to guide the operator to the centre of the line to be painted. This device shall be used at all times of operation."

B5705 SURFACE PREPARATION

Add the following at the end of the second paragraph:

“The onus is on the contractor to ensure that the surface on which the road markings are to be applied is sufficiently clean and dry to ensure that the quality of the road markings will not be adversely affected. The contractor is also responsible for protecting road studs from being painted over, and the subsequent cleaning thereof if such over-painting did occur.”

B5706 SETTING OUT THE ROAD MARKINGS

Insert the following before the first paragraph:

“Where road markings are to be replaced after any construction activity, it is essential that all existing road marking be accurately surveyed and referenced before commencement of such construction activities which will obliterate the existing road markings. The position of barrier lines shall be re-assessed on site by the engineer before the contractor commences with the road marking.”

B5707 APPLYING THE PAINT

Insert the following before the first paragraph:

“The Contractor’s establishment on site and general obligation shall be deemed to fully include the establishment of the road-marking team, irrespective of the number of times the road-marking team is required to be on site or is required to move within the site.

Provision is also made under item B57.07 for de-establishment and re-establishment in the contract or defects notification period if such action is required by delays not attributable to the contractor and/or ordered by the Engineer.”

Replace the sixth paragraph with the following:

“Solvent borne road marking paint shall be applied at a nominal rate of 0,42ℓ/m² or as directed by the Engineer. Thermoplastic road marking shall be applied at a nominal rate of 2,5 kg/m² to achieve a minimum thickness of 1,25mm to 1,5mm or as directed by the Engineer. The two-component road marking material shall be applied by hand by means of a trowel. The desired symbol or line shall be marked with a tape or a template on the road surface. Thereafter, apply the required volume of material and spread uniformly over the entire area. When dry/set, remove the tape or template. A spreading rate of 4,5kg/m² is estimated to achieve a 2,0mm material thickness.

In order to ensure proper coverage on all types of surfaces the Engineer may order an increase in the above nominal application rates. Payment for these variations in application rates shall be made under item 57.04.

A daily log-sheet, provided by the Employer, shall be completed and signed by the Contractor and the Engineer’s representative, recording the quantities of paint and glass beads used on that day and shall be available for inspection at all times. The completed and signed log-sheet for the period covered by a payment certificate shall be attached to the payment certificate.”

Replace the last paragraph with the following:

“Solvent-based road marking as specified by the Engineer shall be carried out within 14 days of opening the road full width to traffic after the completion of the surfacing.”
If in the opinion of the Engineer, conditions are unsafe, the centre-line shall be painted immediately after 2.0 km of continuous road has received a new asphalt layer, or 4.0 km of continuous road has received a new seal surfacing.

**B5708 APPLYING THE RETRO-REFLECTIVE BEADS**

*In the first paragraph, replace the nominal application rate of 0.8kg/litre with “400gm/m²”.*

*Replace the second paragraph with the following:*

“The thermoplastic road marking material and two-component road marking material shall contain insitu glass beads of minimum content of 25% in order to obtain night visibility (reflectivity). The contractor shall immediately apply additional glass beads at 400g/m² to obtain immediate reflectivity. The beads shall be sprayed onto the road marking layer by means of a pressure sprayer. Where letter, symbol, traverse line and island road marking is undertaken by hand, the glass beads may be applied by hand if approved by the Engineer. Prior to any hand application work, the contractor shall first request approval from the Engineer.”

*Add the following:*

“Beads shall be applied in accordance with EN 1424.”

**B5710 TOLERANCES**

*Add the following paragraphs to subclause (c) Alignment of markings:*

“When an unbroken line and a broken line are painted alongside each other, the beginning and the end of the unbroken line shall coincide with the beginning of one broken line and the end of another broken line. When existing lines are repainted, the new markings shall not deviate more than 100mm in the longitudinal direction nor 10 mm in the transverse direction from the existing marking.

The alignment of the road studs shall not deviate from the true alignment by more than 10mm and shall be positioned so that the reflective faces are within 5° of a right angle to the centre line of the road.”

*Add the following subclause:*

“e) Testing

(1) Plant

Before painting any permanent road markings, the Contractor shall satisfy himself and the Engineer, by painting test lines on a section of pavement other than the section required to be marked:

(i) that the painting machine is in good working order and properly adjusted;
(ii) that the operator is fully experienced; and
(iii) that the machine sprays at the specified rate of paint application.

The Contractor shall bear the cost of all materials and workmanship required for the above plant tests.

In addition, the Contractor shall conduct random paint thickness tests and dip/spread tests as required by the Engineer.”

**B5711 GENERAL**

*Insert the following into the last sentence of the last paragraph between “black paint” and “or chemical paint remover”:*

“, bituminous emulsion, slurry”
Add the following to the last paragraph:

“Where black paint is used, it shall be matt.”

Add the following clause:

“The Contractor shall provide temporary traffic control facilities in accordance with Section 1500 of the COLTO’s standard specifications for road and bridge works to ensure traffic safety where work is being executed.

Property and/or road signs damaged by the Contractor, his personnel, his agents or subcontractors shall be repaired or restored to their condition prior to the damage at his own cost.”

B5712 FAULTY WORKMANSHIP OR MATERIAL

Add the following paragraphs to this item:

"The Contractor shall rectify in an acceptable manner and at his own costs; all marking that do not comply with the specified requirements.

While work is in progress, tests shall be carried out on materials and/or the quality of work to ensure compliance with the specified requirements. The sampling methods are specified in SANS 731-1. The sampling methods described in TMH5 shall be followed where applicable.”

B5713 PROTECTION

Add the following paragraph

“Traffic cones shall not be smaller than 750mm in height and shall be placed on the road not further than 48m apart. Cones shall not be removed before the paint on the road has hardened to such an extent that it will not be damaged by traffic and the adhesive of the road studs has hardened to such an extent that the studs will not turn or become loose. All marks on the road caused by traffic driving over wet paint shall be removed by the Contractor at his own cost.”

B5714 MEASUREMENT AND PAYMENT

Amend the heading for payitem B57.03 as follows:

Amend payitem 57.05 by replacing the payitem heading with the following:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B57.05</td>
<td>Roadstuds (installation and maintenance) number (No)</td>
</tr>
</tbody>
</table>

Add the following after the first sentence of the second paragraph of payitem 57.05:

“No additional payment will be made should temporary or permanent road studs be replaced if lost or broken during the construction period or during the Defects Notification Period.”

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B57.06</td>
<td>Setting out and pre-marking the lines (excluding traffic island markings, lettering and symbols) kilometre (km)</td>
</tr>
</tbody>
</table>

Add the following:

“Referencing of existing barrier lines and other road marking lines prior to milling and other operations, shall be included in the tendered rate for setting out and pre-marking.”
SECTION B5800: LANDSCAPING AND PLANTING PLANTS

B5801 SCOPE AND DEFINITION

a) Delete this paragraph and replace with

“This section includes all areas affected by construction activities. It includes landscaping, grassing, rehabilitation, erosion protections and planting trees and shrubs.”

b) Definition

WEEDS

Delete the following:

“(as listed in bulletin 413 issued by the Department of Agriculture, Directorate of Agricultural Information)”

and replace it with:

“(as listed in the Conservation of Agricultural Resources Act)”

B5802 MATERIALS

c) Grass seeds

Add the following:

“The grass seed mixture shall be as follows:

i) Eragrotis tef 10kg/ha
ii) Hyparrhenia hirta 5 kg/ha
iii) Cynodon dactylon 20 kg/ha
iv) Panicum maximum 5 kg/ha
Total 40 kg/ha”

e) Grass sods

Delete “until they are placed” and add “once placed for planting”.

(i) Nursery-grown sods

Add the following:

“The sods shall be free of weeds, weed seeds, insects and fungal diseases.”

(ii) Veld sods

Add the following:

“The sods shall be free of weeds, weed seeds, insects and fungal diseases.”

g) Topsoil

Add the following at the end of the first paragraph:

“The contractor shall be responsible for the control of any germination of weed seeds within topsoil used on site.”

Add the following at the end of the second paragraph:

“Areas such as stockpiles, borrow pits and spoil sites shall be stripped of all topsoil before work may commence within the area. Should a larger site for any of the above
be required during construction, the contractor shall refer to the DEO for best practice methods on ensuring the preservation of the additional stripped topsoil.”

Add the following paragraph:

“The topsoil shall be kept free of all foreign material generated during construction. This shall include all stone and bituminous products. Topsoiling shall not be accepted should it contain any of the above material.”

**B5804 PREPARING THE AREAS FOR PLANTS**

b) Areas which do not require topsoil

Replace:

“50mm” with “20mm” and “150mm” with “20mm”

Add the following:

“In areas with large natural rock, i.e. not blasted or excavated rock, these rocks may be placed so as to look like a natural part of the landscape”

Add the following sub-clause:

“g) Removal of undesirable vegetation

During the course of the Contract the engineer may instruct the contractor to physically remove undesirable vegetation from within the road reserve. Such an operation will take place before the flowering stage of the undesirable vegetation upon written instruction from the engineer, but shall not relieve the contractor of his obligation towards weeding sodded, grassed areas as described under 5806(a) and any area directly affected by any construction activity. Should the contractor fail to respond to the written instruction from the engineer for the removal of the aforementioned undesirable vegetation before flowering, the contractor shall be held contractually responsible for any growth or seeding of said vegetation for a period of not less than twenty four (24) months in the affected area.”

**B5805 GRASSING**

a) Planting grass cuttings

2nd paragraph – remove “be covered with 30mm of approved soil”. Replace with:

“have the root system of the grass cuttings thoroughly planted within the topsoil layer to ensure good growth. No part of the grass root system shall be left protruding from the topsoil”.

Remove “and, when sufficiently dry, shall be rolled with a light agricultural roller”

b) Sodding

Add the following:

“Grass sods obtained from a commercial grass farm shall be used for the following:

- A 1m wide strip shall be placed next to the road edge where no gravel shoulder exists.

- A 0.5m wide strip shall be placed adjacent to all concrete-lined drains. Full sodding must be used for grass-lined drains. This sodding shall extend over the entire drainage channel, including the tops of the sides. The use of grass sods will commence from the point of acceptance of water, up to the safe discharge of water. No area shall be left without grass sods within the drainage channel should it provide a risk of erosion.”
- A minimum of a 1m wide strip shall be placed over the shoulder breakpoint for all fill slopes.

- Full sodding to be used for all slopes steeper than 1:2. Any slope that exceeds 3m in width shall be sodded, the type of which shall be determined by the slope."

f) **Sowing by hand**

*Delete the following:*

“If approved by the engineer,”

*Replace the second sentence with:*

“The top 20mm of prepared topsoil shall be raked away in sections, the seed shall then be spread uniformly within the prepared area. The top 20mm topsoil shall then be raked over the seedbed, ensuring an even thickness. This method is to be systematic, and where applicable, follow the contours of any slopes.”

*Add the following:*

“The thickness of the topsoil layer shall be as specified by the engineer. The preparation of the soil of the soil for areas to be grassed is to include scarifying just before sowing the grass seed. Should erosion of any kind (by animal, wind or rain) have occurred before the contractor applies the grass seed, the slope shall be re-instated, at the contractor’s cost, to its original, erosion free state before seeding.

The types and mixtures of seeds to be used shall be as specified in the project specifications. The contractor shall be solely responsible for establishing an acceptable grass cover, and any approval by the engineer of seed mixtures intended for use by the contractor shall not relieve him of his responsibility”.

**B5807** **TREES AND SHRUBS**

a) **Positions of trees and shrubs**

*Add the following:*

“(x) No median shall be planted with shrubs, should the median width be less than 10m wide.”

**B5808** **GENERAL**

*Add the following subitems:*

“f) **Weeding**

The contractor shall maintain all areas affected by construction activities free of all undesirable plant species. They shall be removed before the flowering stage of each species. Should the contractor fail to remove the alien plant species before flowering he shall be held responsible for alien plant removal within the affected area, for an additional period of one year, over and above the contractual one year defects liability period.

The method for the removal of undesirable plant species shall be either by hand, which shall include the removal of the complete root system, or by chemical means, through the use of a registered selective herbicide. A registered, licensed pest control operator, licensed for the industrial application of herbicides, shall only administer the application of the herbicide.

“g) **Establishment of vegetation within areas disturbed by construction activities**

The engineer shall assess any area within the construction boundaries that has been disturbed by construction activities, but which is not scheduled for formal revegetation within the contract. The assessment shall include whether re-vegetation
is required. These disturbed areas, none the less remain the contractor’s responsibility for the removal of alien vegetation (see 5807(e))."
a) Subsurface Data

Add the following:

“It is expressly understood that, while all subsurface information is given in good faith, the correctness of the information furnished is not guaranteed. Where the actual foundation conditions encountered are considerably at variance with conditions visualised and described in the Contract documents and those terms for which the rate or price provided for in the Contract is rendered unreasonable or inapplicable, such other rate or price consistent with the rates set out in the Contract shall be fixed as set out in Clause 13 of the FIDIC Conditions of Contract subject always to a founding depth variation not exceeding 2.5m in any foundation component (except piling depth) of the permanent structure not, by itself, being held to constitute cause for variation for the Contract rates or prices.”

B6104 ACCESS AND DRAINAGE

c) Drainage

Add the following:

“Where dewatering and keeping dry of excavations has not been billed separately as per item 61.03 “Access and Drainage”, it shall be deemed to be included in the rates tendered and paid for excavation and backfill.”

B6105 EXCAVATION

a) General

Add the following:

“Excavation required for diverting, channelling or widening streams within 5.0m of concrete structures shall be measured and paid for under item 61.02. Excavations beyond the 5.0m limit shall be measured and paid for under the appropriate items in Sections 2100 and 3300.”

c) Excavation

Add the following paragraphs:

“Where excavation is in soft material, the final 0.75m and in the case of hard material, the final 0.25m of material shall be removed using suitable hand tools such as pick and shovel or pneumatic tools.

During construction of the river bridges the Contractor will only be permitted to construct, subject to the approval of the Directorate of Water Affairs, low level causeways access the rivers that cause negligible backing up and cofferdams around the piers and abutments for the construction of the foundations using material excavated in the road prism consisting of natural alluvial deposits of sand boulders, etc. These obstructions must be removed at the end of the contract and the river and banks restored to their original condition.

g) The safety of excavations

Add the following paragraph:

“The design for shoring, signing of the drawings and inspection prior to construction of the permanent works of excavations to ensure it is safe shall be undertaken by the contractor’s competent person, who shall be a professional engineer with the
relevant experience. The contractor shall ensure that all temporary works undertaken shall comply with the relevant sections of the Occupational Health and Safety Act and the Construction Regulations”.

**B6106 FOUNDING**

*Add the following clause at the end of the last paragraph:*

“Where foundation slabs or pile caps are cast directly against the face of the excavations, the volume of concrete measured for payment shall be the total volume of concrete placed or the volume based on the plan dimensions detailed on the drawings plus a 100mm allowance for overbreak on each applicable side whichever is the lesser. No formwork to the footing shall be measured when the concrete is cast against the face of the excavations”.

**B6109 FOUNDATION FILL**

*In the 5th paragraph, 7th line delete “60” substitute “45”.*

*Add the following after the 6th paragraph:*

“Concrete blinding shall extend 100mm all round beyond the horizontal dimensions of all formed footings to facilitate placing of the formwork, unless otherwise directed by the engineer.

In the case of structures where excessive ground water is encountered, the blinding layer may extend over the full plan area of the base of the excavation and beyond the edge of the foundation where required. Payment shall be made for the quantity of concrete calculated as the product of the specified thickness of blinding layer and the actual area of blinding placed subject to a maximum distance of 500mm beyond the edge of the foundation.”

**B6115 MEASUREMENT AND PAYMENT**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B61.51</td>
<td>Lateral support to excavations</td>
</tr>
</tbody>
</table>

(a) In the median:

(i) 0 to 5m depth square metre (m²)

(ii) 5 to 10m depth square metre (m²)

The unit of measurement shall be the square metre of excavated face supported over the successive depth ranges, measured down from the existing road levels.

The tendered rate shall include full compensation for procuring and installing the lateral support system, as well as for removal, if required. It shall include for all materials, labour, plant, equipment and incidentals to provide support to the excavated faces for the duration of substructure construction.

The work will be paid for by way of a lump sum, 50% of which shall become payable when all equipment and material is on site and the first element of the lateral support system has been installed. The second instalment of 40% of the lump sum shall become payable after the excavation platform has been completed, and the final 10% of the lump sum shall be paid after the system has been removed from the site.

The cost of excavating the material shall not be included, but paid for under items B61.02 and B61.03(A)."
SE\$ION B6200:  FALSEWORK, FORMWORK AND CONCRETE FINISH

B6204  DESIGN

a) General

Add the following:

“The Contractor shall submit to the Engineer at least 4 weeks before the structure is scheduled for construction a detailed analysis showing the effect of the stresses that will be induced by the Contractor’s chosen method of construction. The cost of any additional prestressing, reinforcing steel, concrete, etc. required as a result of the Contractor’s chosen method of construction shall be to the Contractor’s account. No construction shall commence until the Engineer has given his written approval.”

b) Falsework

“Unless instructed otherwise by the Engineer, the Contractor shall submit his design criteria and detailed drawings of the staging to the formwork. The design, signing of the drawings and inspection of the falsework prior to construction of the permanent works shall be undertaken by the contractor’s competent person, who shall be a professional engineer with the relevant experience.”

B6205  CONSTRUCTION

b) Formwork

(i) General

Add the following:

“Formwork to faces of structures with a gradient equal to or greater than ten vertical to one horizontal shall be classified as vertical formwork.

Formwork to faces of structures with a gradient less than ten vertical to one horizontal, or equal to or greater than one vertical to ten horizontals, shall be classified as inclined formwork.

Formwork to faces of structures with a gradient of less than one vertical to ten horizontal shall be classified as horizontal formwork.”

(ii) Formwork to exposed surfaces

Add the following:

“The formwork at construction joints shall have moulding strips 25mm x 25mm neatly butted and set at the position of the construction joint”.

(vi) Permanent formwork

Add the following paragraph:

“Anchor ties shall be designed to resist full buoyancy forces and details of such shall be submitted to the engineer for approval. Void formers shall be held in position in order that no movement exceeding 1% of the deck thickness takes place during concreting.”

d) Class F3 surface finish

Replace the second paragraph with the following:

“The use of steel forms shall be permitted to form surfaces for which Class F3 surface finish has been specified, provided that only undamaged forms shall be used for such work and that the forms shall be subject to the approval of the engineer.”
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B62.04</td>
<td>Inclined Formwork to provide (class of finish indicated as F1, F2, F3 or board) surface finish to (description of member to which applicable)</td>
<td></td>
</tr>
</tbody>
</table>

*Delete the entire note at the end of this payitem.*

**B62.05 PERMANENT FORMWORK**

*Add the following to the second paragraph:*

“The tendered rates shall include for the installation of permanent drainage holes within the void formers at the low points of each void.”
SECTION B6300: STEEL REINFORCEMENT FOR STRUCTURES

B6306 PLACING AND FIXING

*Replace the second and third paragraphs with the following:*

“The concrete cover for all structural concrete shall be within the acceptance ranges shown in Table B6404/6. Prior to fixing the steel, samples of the proposed cover and spacer blocks shall be submitted to the engineer along with a written statement for in situ manufacture, if applicable, for approval.

Overlap of steel reinforcement bars shall be such that the cover to the lapped bars remains constant at the specified cover.”

B6307 COVER AND SUPPORT

*Amend the second paragraph as follows:*

*Replace the second sentence, commencing with:*

"Where no cover is indicated…shown in Table 6306/1" with the sentence “Where no cover is indicated, the contractor shall inform the engineer who shall after consultation with the design engineer indicate the required cover in writing and the as-built drawings shall indicate such cover”.

*Add the following to the end of the fifth paragraph:*

“Concrete cover and spacer blocks shall be made using the same cement and aggregate type as the main concrete with the same water/cement ratio so that differences in shrinkage, thermal movements and strain are minimised. Cover blocks shall be water cured by submersion for a minimum of 7 days and thereafter kept submerged in water until immediately before fixing onto reinforcing steel. Where concrete cover blocks, subsequent to fixing, have visually dried out they shall be remoistened by an appropriate method so that they are damp before the placing of concrete. Only semi-spherical concrete cover blocks shall be used. Where fixing wire is inserted into cover blocks, it shall be galvanised. Cover and spacer blocks manufactured from other materials e.g. plastic or wood, shall not be permitted. All cover blocks regardless of the type of material manufactured from, shall not be visible on exposed concrete surfaces.”

*Delete Table 6306/1 in its entirety.*

*Add the following paragraph:*

“Where the concrete cover specified has not been achieved after cover tests have been carried out in accordance with clause B8106(j), reduced payment as determined under clause B8212 shall be applied to all the relevant payitems under section 6300.”
B6401 SCOPE

Add the following paragraph:

“The contractor shall take and submit samples of materials and/or mixtures to the engineer who must approve mix designs before construction work can commence.”

B6402 MATERIALS

a) Cement

Replace the colon at the end of the first paragraph with a comma, and add the following:

“taking into account the adoption of the new SANS 50197-1:2000 code for cements: (refer to C&CI website www.cnci.org.za)”

Add the following paragraphs:

“The type of cement to be used in any concrete element shall take into account the environmental conditions and durability requirements at the location of the site of the works, and shall be as approved by the engineer.

With the exception of the standard SANS approved cement blends supplied by the primary cement producers, the blending of CEM1 and extenders shall not be permitted unless specifically approved by the engineer on the basis of an acceptable quality assurance procedure.

b) Aggregates

Delete the remainder of the sentence after “exceed” in sub-clause (i)(1) and replace with the following:

“150% of that of the reference norite aggregate or any of the other three reference aggregates”

Delete the remainder of the sentence after “exceed” in sub--clause (i)(2) and replace with the following:

“200% and of the coarse aggregate 175% of that of the reference norite aggregate or any of the other three reference aggregates”

Delete the remainder of the sentence after “exceed” in the first paragraph of sub-clause (i)(3) and replace with the following:

“235% of that of the reference norite aggregate or any of the other three reference aggregates”

Delete the entire last paragraph of sub-sub-sub-clause (i)(3) commencing with “The drying shrinkage of concrete...”

Add the following sub-sub-clause:

“(vi) The maximum chloride ion content of fine aggregate shall be 0,03% by mass of aggregate as specified by SANS 1083:2002. Where concrete is situated in a chloride environment the value shall be reduced from 0,03% to 0,01%.”

d) Water

Add the following:
“Water for concrete other than prestressed concrete, shall not contain chlorides, calculated as sodium chloride, in excess of three thousand parts per million (3000ppm) nor sulphates, calculated as sodium sulphate, in excess of two thousand parts per million (2000ppm).

Water for curing concrete shall not contain impurities in sufficient amount to cause discolouration of the concrete or produce etching of the surface.

No sea-water or water containing salts shall be used.

No water shall be added on site to ready mix concrete prior to placing to improve workability. All concrete delivered to site shall be checked for workability using the slump cone test and slump measured outside of the limit set from the design mix shall be rejected.”

e) Admixtures

Add the following sub-sub-clauses:

“(v) Admixtures, which have a retarding effect on the rate of hydration of the cement, may not be used when the concrete temperature is below 20°C.

(vi) A retarding admixture shall be used if the temperatures of concrete mixes using cements of strength class 42.5 or higher is between 20 to 30°C or where the ambient temperature is between 20 to 30°C.”

Add the following:

“Note: Only admixtures of the type that do not increase the water content of the mix will be considered by the Engineer. In addition, no admixtures shall be added on site to ready mix concrete prior to placing to improve workability.”

B6404 CONCRETE QUALITY

a) General

Insert the following paragraph after the second paragraph:

“When structural concrete prefixed ‘W’ is shown on the drawings, it shall, in addition to the strength requirement, comply with the durability requirements specified in sub-clause 6404(h), ‘W’ class concrete shall not apply to minor structural elements such as side drains and catchpits except in very severe environmental conditions of exposure. Requirements for concrete quality (including any durability requirements) for concrete pavements are found in Section 7100 of the specifications.”

b) Strength concrete

Replace the sixth paragraph with the following:

“Where concrete is designated by the prefix “W”, e.g. class W30/19, such designations shall denote concrete achieving the durability criteria specified in the relevant tables under sub-clause B6404(h).”

Add the following sub-clauses:

“h) Concrete durability

(i) General

Concrete designated by the prefix ‘W’ shall, in addition to the requirements of sub-clause 6404(b) comply with the durability parameters described below. Durability is influenced by the materials used in the concrete, their mix proportions, transporting, placing, compacting and, in particular, curing of the finished cover concrete (concrete layer between the outermost layer of steel reinforcement and the exposed outer surface of the concrete element). The
It is the engineer’s responsibility to approve the component materials and their mix properties, however it is the contractor’s responsibility to utilise acceptable component material and to achieve mix properties complying to the specifications. It is the contractor’s responsibility to design and blend materials to produce concrete of the specified quality.

(ii) Durability parameters

Water sorptivity: Sorptivity is sensitive to surface effects and may be used to assess the effectiveness of initial curing.

Oxygen permeability: Permeability is sensitive to changes in the coarse pore fraction and thus a means of assessing compaction of concrete. It is used to quantify the microstructure of the concrete and sensitive to macro-defects such as voids and cracking.

Chloride conductivity: Chloride conductivity provides a method of characterisation of concretes in the marine environment and is used to assess the chloride resistance of concrete.

Cover concrete: Cover concrete is the outer concrete layer that protects reinforcing steel. Concrete cover is a requirement for all concrete whether specified as durability concrete (Class “W”) or normal reinforced concrete.

Individual Cover Depth Measurement (CDM): Individual cover depth measurement determined by an electromagnetic cover meter, complying with BS 1881, Part 204.

Average Cover: The average of at least 30 individual CDM’s per m² determined on a clearly identified area.

Overall Cover: The mean average cover determined for the scanned area per structure.

Scan Area: Areas of approximately 1m², randomly distributed over the entire structure, representing at least 5% of total surface area for that structure.

Individual bar reading: A minimum of 3 linear CDM’s, spaced at 100mm intervals, representing a single bar of reinforcement.

Capped CDM: The value applied to all CDM’s in excess of the maximum allowed CDM, determined by the engineer (e.g. 40mm (specified cover) + 15mm (upper limit) = 55mm) or

Capped Value: A value in mm, assigned to a cover reading where the raw reading exceeds the specified cover, plus a value (mm) specified by the engineer.

Quick/Linear Scan: For evaluation of cover depth measurements taken perpendicular to closest rebar in a line covering required area to be scanned.

Image/Block/Grid Scan: Provides an overview of rebar layout. Measurements taken over a square meter clearly indicating position of first and second layer of rebar.
Notes:
1. Water sorptivity and Oxygen Permeability tests are required to assess carbonation resistance
2. Water sorptivity, permeability and chloride conductivity tests are required to assess chloride resistance

Concrete cover: Concrete cover is a dimensional indicator of cover concrete depth and it varies according to the requirements of the different environmental exposure classes.

When tested in accordance with the test protocols described in B8106 for each potential durability parameter, the concrete shall meet the limits listed in tables B6404/4.

(iii) Cement content

In order to meet the durability criteria, the proportions of cementitious binder used shall be determined to suit the fine and coarse aggregate and cement type used in order to achieve the durability limits specified in tables B6404/4 and B6404/6 under the Acceptance Category of “Concrete made, cured and tested in the laboratory.”

In order to avoid the possibility of Alkali Silica Reaction (ASR), the following shall be taken into account when designing the mixes:

1. Where the cementitious contents is less than 350 kg/m$^3$, the maximum equivalent sodium monoxide content (calculated as Na$_2$O) permitted shall be 0.60%, unless a test certificate from the CSIR (Built Environment) is provided stating that the long term testing has proved the aggregate to be non-reactive.
2. Where the cement content exceeds 350 kg/m$^3$, the maximum equivalent sodium monoxide content permitted shall be 2.1 kg/m$^3$ of concrete.
3. Where potentially reactive aggregate is used, the maximum cement content shall be 400 kg/m$^3$ and the equivalent sodium oxide (Na$_2$O) content permitted shall be 2.4 kg/m$^3$ of concrete.
4. The contractor shall prior to the use of cement provide test certificates from an approved laboratory confirming the equivalent sodium oxide (Na$_2$O) content of the batch of cement to be used.
5. Special literature should be consulted e.g. Fulton’s Concrete Technology.

(iv) Environmental Classes of Exposure

For this project, the environmental classes for carbonation and chloride exposure for the different structural elements are as shown below in Table B6404/3.

| TABLE B6404/3: ENVIRONMENTAL CLASSES OF EXPOSURE FOR ELEMENTS OF STRUCTURE |
|---------------------------------------------------------------|---|
| Element                        | Carbonation Environment (OPI) |
| Foundations                    | n/a                          |
| Substructures                  | XC4                          |
| Superstructures                | XC4                          |

(v) Acceptance ranges

<table>
<thead>
<tr>
<th>TABLE B6404/4: DURABILITY PARAMETERS ACCEPTANCE RANGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance Category</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
</tbody>
</table>
Concrete made, cured and tested in the laboratory using Trial Panels

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Description of Test</th>
<th>Specified Cover (mm)</th>
<th>Acceptance Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall cover</td>
<td>30 to 80</td>
<td>Specified cover + 15mm or where member depth is less than 300mm the limit accepted in writing by Design Engineer.</td>
</tr>
<tr>
<td>B8106(g)</td>
<td>Concrete cover to reinforce-ment (mm)</td>
<td>85% of specified cover – 5mm</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. A value has been given, but the value to be adopted shall be based on the results from design mixes.
2. Although no value has been given due to ongoing research, values above 12 are regarded as poor quality concrete.
3. For purposes of interpretation, substructure is deemed to be all supporting elements below the deck (superstructure), including buried lengths of columns, etc, but excluding foundation elements like bases and spread footings.

TABLE B6404/6: DURABILITY PARAMETERS ACCEPTANCE RANGES: COVER FOR ALL CONCRETE TYPES

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Description</th>
<th>Specified Cover (mm)</th>
<th>Acceptance Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall cover</td>
<td>30 to 80</td>
<td>Specified cover + 15mm or where member depth is less than 300mm the limit accepted in writing by Design Engineer.</td>
</tr>
<tr>
<td>B8106(g)</td>
<td>Concrete cover to reinforce-ment (mm)</td>
<td>85% of specified cover – 5mm</td>
<td></td>
</tr>
</tbody>
</table>

(v) Site Testing

To ensure that the concrete has been placed, compacted and cured correctly, a number of tests shall be carried out on the concrete by an approved laboratory.

(vi) Non-compliance with specified criteria

The Contractor should also note that there is specific provision made for curing of concrete under payment item B64.07 of the project specification. The amount priced under this item will be subject to reduced payments should the durability tests indicated under B8106(h) fail to meet the required targets. Similarly, failure to achieve the required durability test results will be sufficient cause to apply partial payment factors for all the payitems of the elements of the structure under sections 6300 and 6400 of the standard and project specifications or in some cases the removal of the rejected concrete.

Add the following sub-clauses:

(i) Mix design approval procedures

(i) General

The compressive strength achieved on ‘W’ class concrete shall generally exceed the characteristic strength class structurally required. The contractor shall note that the process of finalising ‘W’ class mix designs could take up to two months. In order to expedite the process, the contractor must submit samples of aggregate and cement to an approved laboratory within seven
days of the Commencement Date. Should ‘W’ class concrete be required before the mix design is finalised, the engineer will approve a preliminary mix design in consultation with the contractor.

(ii) Laboratory designs and site tests based on Trial Panels

Good mix design practice is essential and the following criteria shall be taken into consideration when pricing and determination of the mix design:

1. Selection of sands and aggregates to achieve a good grading is important if the desirable concrete density and durability have to be achieved.
2. The selection and use of the correct cement grade and type for the environmental conditions (and not based solely on costs) is fundamental.
3. Water: cement ratios are critical, dictating both the structural strength and the durability requirements.

Mix proportions for the concrete to be used on site need to be determined by an approved laboratory. Cylindrical specimens, 70 ± 2mm in diameter shall be made or cored from a trial panel during the laboratory trial mix for performance of tests B8106(g)(i), (ii) (if required).

Note that concrete cubes are not cored for durability testing during design trial mix stage or during the construction stage.

Testing for approval purposes shall be carried out by an accredited laboratory approved by the engineer, the costs of which are deemed to be included in the contractor’s rates for structural concrete. Concrete as designed shall satisfy the limits set out in Table B6404/4 under the heading “Concrete made, cured and tested in the laboratory, using Trial Panels”. It is therefore a requirement that the trial panels be cast on the site and the cores extracted and tested in the laboratory as part of the mix design approval process. Where the site is remote from the laboratory, the Trial Panels may be cast at the laboratory in accordance with the requirements of sub-clause B8106(g).

It will be necessary for the contractor to establish a target mean strength with a margin above the minimum requirement so that small fluctuations due to material changes or workmanship can be accommodated. In general, mean target strength = characteristic strength + 1.645xSn.

Once the mix is approved, the target mean compressive strength for quality control purposes for durability class concrete shall be the mean compressive strength obtained from the mix that satisfies the durability requirements.”

B6408 CONSTRUCTION JOINTS

a) General

Add the following:

“No construction joints other than those indicated on the drawings will be permitted without the written approval of the engineer. In all cases the proposed method of forming the joint shall be discussed and agreed with the engineer.”

B6409 CURING AND PROTECTION

Add the following to the end of sub-clause 6409(f):

“Where a curing compound is used, it shall consist of an approved water based low viscosity clear wax emulsion applied in accordance with the manufacturer’s instructions.”

Add the following paragraphs to the end of this sub-clause:
“Where curing by retention of formwork is used as the only method of curing the concrete, it must be left in place for the minimum period specified in Table 6206/1 but in no instance shall it be less than 7 days.

The materials used for formwork shall take into account properties such as thermal insulation and moisture absorption when assessing the suitability of the material, to the approval of the engineer.

If impermeable curing membranes are to be used as a curing method, they shall be installed at the same time as formwork is removed and no portion of a concrete surface may be left unprotected for a period in excess of 2 hours. If the surface is an unformed finish e.g. top of deck slab, then the surface must be protected immediately by appropriate methods approved by the engineer after it is finished, without damage to that surface, since it is vulnerable to plastic shrinkage cracking due to high rates of evaporation while the concrete is still in a plastic state. Plastic shrinkage and settlement shall not be permitted on any of the structural elements since it compromises the durability of the concrete. In order to prevent early settlement and shrinkage of the concrete, the concrete placed shall be re-vibrated after initial compaction while the concrete is still in a plastic state. Any remedial measures shall be as approved in writing by the engineer. On bridge decks, the top surface shall be cured using the method described in clause 6409(d) i.e. “Constantly spraying the entire area of exposed surfaces with water”.

For all concrete curing shall be excluded from the make-up of rates for measurement under items B64.01 and B64.02 and will paid for separately under payitem B64.07. Where the application of a curing compound is used, the type and nominal application rate thereof shall be as specified in the schedule of quantities or to the manufacturer’s nominal specified rates.”

B6410 ADVERSE WEATHER

Add the following sub-clause:

“d) Temperature and hydration of concrete

Site batched concrete: The temperature of concrete delivered to site shall be within the range 10°C to 30°C. Concrete which has a temperature outside of this range shall not be placed in the structure.

Ready mix concrete: In the case of ready mix concrete the temperature limits at point of delivery shall be as specified in SANS 878 2004 unless the engineer has specified other limits due to specific design requirements. If slump loss occurs at concrete temperatures of over 30°C and more than two hours after mixing, the concrete shall be rejected. Also if after addition of allowed water the concrete begins to stiffen again such as to place in doubt that full compaction and finishing can be achieved, the concrete shall be rejected.

Care must also be taken not to cast concrete onto hot steel shutters as this might induce cracking.

The rate of hydration of the cement in the concrete shall be such that the concrete can be placed and properly compacted within 2 hours after the addition of water to the mix ingredients. The initial set of the concrete shall not be unduly delayed due to inappropriateness of admixtures or cement type, which could promote bleeding.”

B6413 PRECAST CONCRETE

Add the following final paragraph:

"Precast concrete units shall comply with the requirements of the latest SANS 986:2006 specification.

Prior to the manufacture of any units the manufacturer shall submit his Quality Plan to be approved by the engineer. The quality plan must incorporate all requirements and frequency for durability index testing i.e. Sorptivity, Oxygen Permeability, Chloride Conductivity (if required) and Cover Testing. As part of the Quality Plan submitted for
approval, copies of calibration certificates of both gauges used for proof loads and cover meters used at the factory shall be supplied to the engineer. The originals of these certificates shall at all stages also be available for inspection at the factory premises. The manufacturer shall check each precast unit for cover compliance, and random checking of units shall not be permitted. The engineer's representative may visit the factory at any stage to ascertain adherence to the quality plan including test results from the durability index testing as well as to check covers before delivery to site. Any substandard cover shall result in the applicable structural element or part thereof being rejected. Should the manufacturer not be adhering to their Quality Plan the engineer may exercise the right to reject the use of products from the manufacturer concerned. The Employer shall also be informed in all such cases.

For durability requirements due to the reduced cover provided for precast culverts, all such durability testing shall be done in accordance with clause B6404(h).

**B6414 QUALITY OF MATERIALS AND WORKMANSHIP**

**a) Criteria for compliance with the requirements**

*Add the following paragraphs after the first paragraph:*

“The cores shall be taken from the Trial Panels cast using the design mixes made in the laboratory. Where the site is remote from the laboratory, the Trial Panels may be cast at the laboratory in accordance with the requirements of sub-clause B8106(g).

In the event that for ‘W’ classed concrete strength requirements the actual achieved average cube strengths of an element are less than 85% of the target mean strength needed to meet durability requirements or less than 100% of the target mean strength to meet strength requirements, it may result in the durability parameters not meeting the prescribed targets and the engineer will instruct the taking of cores from the test panel and structure for additional testing. The cost of these in situ tests shall be borne by the contractor.

The approved quality control criteria for process control testing for durability concrete shall be coring and testing of test panels. The frequency of manufacture and coring of test panels shall be as ordered by the engineer and indicated in Tables B8106/1 and B8106/2.

Tests B8106(g)(i), (ii) and (iii) (when required), shall be conducted on cores extracted from the test panels when the concrete reaches the age of at least 28 days. To allow for variability in the material potential, the type of chloride conductivity values shall be limited to 90% of the values indicated in table B6404/5. Test no. B8106(g)(iv) shall be conducted to confirm that the specified depth of concrete cover has been achieved. The frequency of these tests shall be as described under item B8106(g). The test results shall be accepted or rejected on the criteria set out in Table B6404/4 and B6404/5 based on the following categories:

(i) **Full acceptance**

Concrete shall be accepted unconditionally and full payment shall be made.

(ii) **Conditional acceptance**

Concrete may be accepted, based on the cube strength and durability index results with a warning that construction methods be examined to improve the durability criteria. A reduced payment shall be applied to all the relevant payitems of the specific element under B6300 where the cover requirements are not achieved and B6400 where the oxygen permeability and strength requirements are not achieved for the non-conforming element or concrete pour as set out in Tables B8212/1 and B8212/2. The decision to accept the substandard concrete at reduced payment shall rest solely with the Employer.

Should the test result(s) indicate conditional acceptance of the element tested, the Contractor shall have the option of carrying out additional tests (on 4 extracted cores) on that element of the structure, at his own expense to
confirm or disapprove the original test result(s). These cores shall be extracted within 56 days from the date of the element being cast.

Should the additional test confirm the original test result, then the original test result shall serve to determine payment in accordance with Tables B8212/1 and B8212/2.

Should the additional test show that the structure meets the targets, the penalty shall be halved."

(iii) **Rejection**

The concrete shall be removed and replaced with fresh concrete at the expense of the contractor, as directed by the engineer.

**B6416 MEASUREMENT AND PAYMENT**

*Add the following at the beginning of clause 6416:*

"Note that payitems B64.01, B64.02 and B64.07 below are only applicable to durability concrete prefixed ‘W’."

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
</table>
| **B64.01** Cast in situ concrete

*Amend the descriptions of subitems 64.01(a) and (b) to read as:*

"(a) Durability Concrete (Class W) ........................................ cubic metre (m³)

(i) Indicate part of structure and strength e.g. Piers (W30/19))
(ii) Etc for other parts of structure

(b) Normal Concrete .......................................................... cubic metre (m³)

(i) Indicate part of structure and strength e.g. Blinding (15/19)
(ii) Etc for other parts of structure

In the case of cast in situ concrete, delete “curing and protecting the concrete,” in the sixth line of the description of the tendered rate for item 64.01.

*Add the following after the second paragraph in the rate make-up:*

“The Contractor shall note that the strengths indicated above are to meet structural requirements only. In order for the durability criteria to be achieved, it may result in higher strengths being required. Target mean strengths to be achieved for durability purposes may therefore be higher than those shown above, as discussed under sub-clauses B6406(b) and B6404(h)(ii). All durability testing costs required for process control testing shall be included in the rate make-up for durability class concrete."

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
</table>
| **B64.02** Manufacturing precast concrete members
  (description of member with reference to drawing) ............ number (No)

*Replace the second paragraph of the description of the tendered rate with the following:*

The tendered rate for each precast member shall include full compensation for concrete work, formwork and safeguarding as required for manufacturing the member complete as shown in the drawings. Payment for curing, reinforcing steel and prestressing is provided elsewhere in the schedule of quantities.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B64.06</strong> Demolishing existing concrete</td>
<td></td>
</tr>
</tbody>
</table>
Amend the payment paragraph as follows:

“The tendered rate shall include full compensation for all labour, plant (including access and craneage) and equipment (including concrete cutters) required to demolish the existing concrete (irrespective of strength) and the disposal of the product of the demolishing to a borrow pit within a free-haul distance of 15km. The tendered rate shall also include full compensation for any necessary measures to ensure no debris falls into rivers or surfaces where damage is possible and for any debris that has fallen into rivers to be recovered.

Payment shall distinguish between plain and reinforced concrete. For the purposes of this item, reinforced concrete is defined as concrete containing at least 0.2% of steel reinforcement measured by volume.”

Add the following payment items at the end of clause B6416:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B64.07</td>
<td>Curing of concrete:</td>
</tr>
<tr>
<td>(a)</td>
<td>(Indicate structural element and surface to be cured) (Tenderer to specify method of curing)</td>
</tr>
<tr>
<td>(b)</td>
<td>Etc. for various elements (Tenderer to specify method of curing)</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the square metre of completed concrete element cured using an approved method as described in clause B6409 of these Project Specifications.

The tendered rates shall include full compensation for providing the curing agent and applying it to the fresh concrete surface by means of an approved pressure distributor (or other approved methods of application) in accordance with the manufacturer’s specified nominal rates of application. Wet fine mist spray curing is also permitted providing it is done for 7 days. Payment will also be made under this item if this is the preferred method to be used. Should no curing method be specified at time of tender then it will be assumed wet fine mist spray curing is to be done. Partial payment shall be applied in the event that the engineer allows conditional acceptance.

Add the following clause:

B6417 CONCRETE DURABILITY

a) General

All structural concrete prefixed ‘W’ shall conform to the durability requirements specified under sub-clause B6404(h) of the Project Specifications. Durability is influenced by the materials used in the concrete, their mix proportions, transporting, placing, compacting and, in particular, curing of the finished cover concrete (concrete layer between the outermost layer of steel reinforcement and the exposed outer surface of the concrete element). The tests required to prove durability performance of the placed concrete are given under sub-clause B8106. The numbers of panels and tests are shown in Tables 1 and 2 below and are the minimum requirement that the engineer considers necessary to achieve the desired quality of concrete.

It is the engineer’s responsibility to approve the component materials and their mix properties. However it is the contractor’s responsibility to design and blend them and in so doing produce concrete of the specified quality.

b) Concrete mix design

Good mix design practice is essential and the following criteria ought to be taken into consideration when pricing:
(i) Selection of sands and aggregates to achieve a good grading is important if the correct concrete density is to be achieved.

(ii) The use of the correct cement grade and type for the environmental conditions (and not based solely on costs) is fundamental.

(iii) Selection of the correct cement extenders and admixtures are also fundamental to appropriate mix designs.

(iv) Water: cement ratios are critical, dictating both the structural strength and the durability requirements.

Mix proportions for the concrete to be used on site need to be determined by an approved laboratory. Cylindrical specimens, 70 ± 2mm in diameter must be made or cored from a laboratory trial mix for performance of tests B8106(g)(i), (ii) and (iii) (if required).

It will be necessary for the contractor to establish a target mean strength with a margin above the minimum requirement so that small fluctuations due to material changes or workmanship can be accommodated.

c) Site testing

To ensure that the concrete has been placed, compacted and cured correctly, a number of tests shall be carried out on the trial and test panels as well as on the tops of decks and precast panels by an approved laboratory.

For this contract the following number of test / trial panels and testing are envisaged:

<table>
<thead>
<tr>
<th>TABLE 1: MINIMUM NUMBER OF TRIAL / TEST PANELS REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel Type</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Trial Panel</td>
</tr>
<tr>
<td>Test Panel</td>
</tr>
<tr>
<td>Substructures</td>
</tr>
<tr>
<td>Culverts</td>
</tr>
<tr>
<td>Retaining walls</td>
</tr>
<tr>
<td>Bases</td>
</tr>
<tr>
<td>Decks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 2: MINIMUM NUMBER OF CORE RESULTS REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Substructures</td>
</tr>
<tr>
<td>Culverts</td>
</tr>
<tr>
<td>Retaining walls</td>
</tr>
<tr>
<td>Bases</td>
</tr>
<tr>
<td>Decks</td>
</tr>
<tr>
<td>Precast element</td>
</tr>
</tbody>
</table>

d) Non-compliance with specified criteria

The contractor should also note that there is specific provision made for curing of concrete under payment item B64.07 of the project specification. The amounts priced under this item will be subject to reduced payments should the durability tests indicated under B8106(g) fail to meet the required targets. Similarly, failure to achieve the required durability test results will be sufficient cause to apply partial payment factors for all the payitems of the elements of the structure under section 6300 and 6400 of the standard and project specifications or in some cases the removal of the concrete rejected.
The contractor shall design the bursting reinforcement for his proposed prestressing system and submit drawings to the engineer for approval in accordance with clause 6507. The price for the steel and fixing shall be included in the rate tendered for stressing.

Vent pipes shall also be installed at all low points of the prestressing ducts to facilitate grouting.

Notwithstanding the concrete strength provisions above, permanent prestressing cables shall not be stressed within 7 days after completion of the last concrete pour unless the method and sequence of construction is based on a method of assessing the in situ concrete strength, such as match casting, which demonstrates that adequate strength has been attained. The proposed method shall be described in a method statement which shall be submitted to the engineer for approval at least 28 days before construction of that part of the Works commences. When determining concrete strengths at which stressing operations can safely commence, due regard shall be taken of the tensile strength in addition to compressive strength, to prevent undesirable cracking in tendon anchorage zones. In this regard, tests shall be carried out to determine the rate of gain of both tensile and compressive strengths before the above method statement is submitted to the engineer for approval.

The cross-sectional area of the tendon used in the calculations shall be the area of the minimum number of strands necessary to develop the jacking force.
SECTION B6600: NO-FINES CONCRETE, JOINTS, BEARINGS, PARAPETS AND DRAINAGE FOR STRUCTURES

B6603 JOINTS IN STRUCTURE

a) Materials

(i) General

Add the following after the last paragraph:

“It is a firm requirement that all contracts have full Agrément certification for bridge deck joints, with the target date for new applications for Agrément assessment one year from receipt and acceptance by Agrément South Africa of each application. Proof of original acceptance of application by Agrément is required in such a case.

(1) current Agrément assessments: 1 September 2010.

(2) new applications for Agrément assessment one year from receipt and acceptance by Agrément South Africa of each application. Proof of original acceptance of application by Agrément is required in such a case.”

(g) Installing the expansion joints

Delete the first paragraph and replace with the following:

“All deck expansion joints shall be installed by approved specialist subcontractors only. Installed deck expansion joints shall have the following guarantees:

Proprietary joints - 15 years
Asphalt plug type joints - 10 years
Concrete nosings (replacement) - 10 years
Joint sealant - 5 years

All deck expansion joints will only be considered for use on this contract if the manufacturer has obtained Agrément certification. New applications for Agrément assessment takes up to one year from receipt to acceptance by Agrément South Africa.”

B6604 BEARINGS FOR STRUCTURES

(e) Proprietary Bearings

(v) Construction

Delete the final three (3) paragraphs of subclause (e)(v)(7) and replace with the following:

“Applying two coats of epoxy MIO paint, with each coat a minimum of 75 micrometers of dry-film thickness and of a dark grey colour.

Applying a semi-gloss, acrylic polyurethane (2 pack) finish with a minimum of 50 micrometers of dry-film thickness and of light grey colour.

Surfaces in contact with concrete shall be sprayed with zinc, but not painted, so that it complies with the requirements of SABS 1391 part 1 for type Zn 150 surfacing.”

B6606 DRAINAGE FOR STRUCTURES

(c) Synthetic-fibre filter fabric
Replace the first sentence with “Synthetic-fibre filter fabric shall be grade 1 as specified below.”.

Delete the second paragraph and replace with the following:

"(i) Composition and manufacturing

The synthetic-fibre filter fabric, or geotextile, shall be manufactured from a synthetic polymer processed into a permeable, homogenous sheet. Geotextile of non-woven construction is preferred, and woven geotextiles will be considered only if published data can be provided which show the satisfactory long-term performance of these geotextiles in an environment similar to that in which they are to be used.

On account of the temperature and moisture susceptibility of polyamide, this synthetic product is not considered acceptable.

(ii) Classification

The geotextile is classified according to the mechanical properties thereof, viz. its penetration load, puncture resistance and the minimum water-percolation rate as measured in the permeability test. The table below gives values for the properties.

### Table B6606/1 Grade 1 Geotextile Properties

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>GRADE 1</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration Load (minimum), N</td>
<td>3800</td>
<td>3,5 of SABS 0221-1988</td>
</tr>
<tr>
<td>Puncture Resistance (maximum), mm</td>
<td>14</td>
<td>Clause 8114</td>
</tr>
<tr>
<td>Water percolation (minimum) m³/m²/s</td>
<td>20</td>
<td>3,7 of SABS 0221-1988</td>
</tr>
<tr>
<td>Mass per unit area (minimum), g/m²</td>
<td>320</td>
<td>3,4 of SABS 0221-1988</td>
</tr>
</tbody>
</table>

Notes:

- The standard atmosphere for testing and the preconditioning atmosphere for all geotextile tests (SABS tests and others) shall have a relative humidity falling within the rate of 0 to 80% and a temperature within the range of 15ºC to 35ºC.

- The resistance of a geotextile to puncture is the average diameter of the hole formed when a 45 cone with a mass of 1 kg is dropped through 500 mm onto the geotextile fixed in the holding device.

(iii) Durability

A geotextile is required to comply with the following specification:

- Resistance to chemical attack.

The geotextile shall withstand the level of aggressiveness of the soil and ground water given below without significant loss of its strength and hydraulic properties during its design life of 25 years:

Soil and ground water with a pH in the range 4 to 12 (pH to be determined by Method A20, TMH1, 1986)

Soil (as paste) and ground water containing salts with a conductance of up to 1.0 S/m (conductivity to be determined by Method A21T, TMH1, 1986)

- Resistance to ultra-violet light.

The geotextile shall maintain at least 80% of its original strength after direct exposure to sunlight of 1500 hours.

- Resistance to rot.
The geotextile shall be entirely rot-proof and shall not support the growth of algae.

### B6608 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B66.04</td>
<td>Installation of proprietary expansion joints</td>
</tr>
</tbody>
</table>

**Add the following to the end of the second paragraph:**

“The tendered rate for subitems (a) and (b) shall also include for water test required to prove the joint. The water shall be ponded and maintained to a minimum depth of 150mm above the top of the joint for a period of one hour each. Testing should follow the installation of the various sections of joints to take advantage of the existing traffic accommodation and each test shall cover the length of each joint installed (generally half width of bridge).”

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B66.05</td>
<td>Expansion Joints</td>
</tr>
</tbody>
</table>

**Add the following to the measurement clause of subitem (b):**

“The joint measured shall be the complete joint shown on the drawings including termination details and recesses at balustrades and cover plates and fixings.”

**Add the following to the end of the second paragraph:**

“The tendered rate for subitems (a) and (b) shall also include for water test required to prove the joint. The water shall be ponded and maintained to a minimum depth of 150mm above the top of the joint for a period of one hour each. Testing should follow the installation of the various sections of joints to take advantage of the existing traffic accommodation and each test shall cover the length of each joint installed (generally half width of bridge).”

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B66.06</td>
<td>Filled Joints</td>
</tr>
</tbody>
</table>

**Add the following to the end of the second paragraph:**

“The tendered rate for subitems (a) and (b) shall also include for water test required to prove the joint. The water shall be ponded and maintained to a minimum depth of 150mm above the top of the joint for a period of one hour each. Testing should follow the installation of the various sections of joints to take advantage of the existing traffic accommodation and each test shall cover the length of each joint installed (generally half width of bridge).”

**Add the following payment items:**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B66.28</td>
<td>Drainage strips</td>
</tr>
</tbody>
</table>

The unit of measurement shall be the linear metre of drainage strips laced behind the earth faces as shown on the drawing.

The tendered rate shall include full compensation for all material, labour, and equipment to supply and install the strips as shown.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B66.29</td>
<td>Perforated drainage pipes - M65 Netlon drainage pipe wrapped in Kaymat U34 or similar approved</td>
</tr>
</tbody>
</table>
The unit of measurement shall be the linear metre of perforated drainage pipes placed behind the earth faces as shown on the drawing.

The tendered rate shall include full compensation for all material, labour, and equipment to supply and install the perforated pipes as shown including the 300mm wide by 50mm thick mortar bed under the core.
COLTO SERIES 8000: SUNDRIES
SECTION B8100: TESTING MATERIALS AND WORKMANSHIP

B8102: TESTING METHODS

*Insert the following as a new first paragraph:*

“Where reference is made to TMH test methods in this specification or the standard specifications, it shall be replaced with the relevant current published SANS test method.”

B8103: THE COSTS OF TESTING

(a) Process Control

*Add the following paragraph:*

“THE EMPLOYER INTENDS TO MAKE USE OF A COMMERCIAL LABORATORY AND THEREFORE THERE WILL BE NO OPPORTUNITY FOR A COMBINED LABORATORY FACILITY. THE CONTRACTOR SHALL ALLOW FOR THEIR OWN PROCESS CONTROL.”

B8105 TESTING OF AGGREGATES

*Add the following sub-clause:*

“g) Determination of Ethylene Glycol Durability Index

The Ethylene Glycol Durability Index shall be determined as follows:

(i) **Apparatus**

Suitable pans or basins

Ethylene Glycol solution

Stirring rod

(ii) **Method**

Obtain three or more representative samples from the source to be evaluated.

If not already crushed, crush the material in order to obtain sufficient minus 19mm plus 13mm sized aggregate in order to totally cover the bottom of the basin or pan with a single layer of stone. Add sufficient ethylene glycol to each basin ensuring that every aggregate particle is completely submerged.

After soaking for 24 hours, gently stir the aggregate and allow to settle. Observe and record the response of the aggregate to the ethylene glycol according to the criteria listed in (iii) below. Continue the above cycle at intervals of 24 hours for a further 4 days, in each case recording the observed response. After 5 days allow the samples to remain submerged in the solution and observe and record the disintegration response after a total period of 15, 30 and 60 days have elapsed.

(iii) **Classification of response**

After each cycle, classify and record the response of the aggregate as follows:

**DISINTEGRATION CLASS**

Class 1: No obvious effects, or only very minor spalling of sand sized particles or very small flakes.

Class 2: Splitting of rock, accompanied by any other disintegrative effects.
Class 3: Fracturing (spheroidal and/or internal) without extensive spalling or distortion.

Class 4: Fracturing (spheroidal and/or internal) with extensive spalling or distortion.

Class 5: Complete disintegration.

TIME CLASS

The time factor in the above disintegrative process is classified according to the time taken for the most serious effect of the expansive stresses to occur i.e.

Class 4: 0 - 5 days
Class 3: 6 - 15 days
Class 2: 16 - 30 days
Class 1: 31 - 60 days
Class 0: Over 60 days

(iv) Determination of Glycol Durability Index

The Ethylene Durability Index is determined by adding the class number as assigned for the specific disintegrative response observed to the class number as assigned for the period for this response to occur. A durability index ranging from 1 (no response) to 9 (rapid and complete disintegration) is thus determined.

Amend the heading of B8106 to read as follows:

“B8106 TESTING THE CONCRETE AND COVER TO STEEL REINFORCEMENT”

Add the following sub-clauses under B8106:

“g) Trial panels for durability concrete (W class concrete)

As part of the durability class concrete mix design approval process, trial panels shall be constructed on the site (or at the laboratory) before construction of structural elements commences, to ensure that the contractor can successfully achieve the oxygen permeability and sorptivity targets set for the in situ concrete with method of construction to be adopted. Each trial panel shall be constructed using the same type of concrete mix, shuttering type, placing and curing methods (including application rates of curing compounds if applicable) as to be used on the final structural element to be constructed. The dimensions of such a trial panel shall be 0.40m wide, 0.60m high and 150mm thick. The panel shall be constructed vertically. It is suggested that 2 lifting hooks be cast into the panel to facilitate lifting, moving or disposal of panel. It most likely will be that one trial panel will be required for substructures (piers, abutments, retaining walls, etc.) if the same grade concrete is specified for all substructures and another for the decks due to type of casting and curing methods.

The test area for taking of cores (taken in horizontal direction) shall not be less than 100mm from all horizontal and vertical edges. The number of cores to be extracted and tested is described under B8106(i).

h) Test panels for durability concrete (W class concrete)

During casting of concrete on site, test panels shall be constructed on the site adjacent to where the concrete element is being placed. Each test panel shall be constructed with the same concrete, shutter type, compaction and curing methods being used in the element being cast (including same vibrator frequency and curing compound application rates), and be left to cure for 28 days adjacent to the concrete element. Thereafter it shall either be cored on site or transported to the laboratory for testing of the required durability parameters. The dimensions of the test panels
shall be 0.4m wide, 0.6m high and 150mm thick and be cast vertically to simulate vertical casts of the substructures and vertical faces of bridge decks. It is suggested that 2 lifting hooks be installed at both top ends of the test panel to assist with transport. For precast concrete, test panels will not be constructed, as cores will be drilled from the concrete elements at the Precast yard before being placed at its final location. For the horizontal faces of in situ bridge decks and culverts, test panels will also not be constructed. Instead cores will be extracted from the top surface of the decks.

The frequency of the testing and number of cores to be extracted is described under B8106(i).

The test area for the taking of cores (taken in a horizontal direction) shall not be less than 100mm all horizontal and vertical edges.

The costs for construction of the test panels shall be deemed to be included under rates for payitem 64.01.

i) Testing for concrete durability

Durability predictions for durability concrete prefixed ‘W’ will be based on the following tests that shall be carried out by an accredited laboratory approved by the Engineer:

(i) Oxygen permeability
(ii) Water sorptivity
(iii) Chloride conductivity (if specified)

Notes:
The test methods shall be as described below.

For test no’s (i) and (ii) (and (iii) when required), cores of 70 ± 2mm diameter shall be extracted from the test panels when the concrete reaches the age of at least 28 days and tested for the durability criteria set out in clause B6404(h) and used to determine the payment as per Table B8212/1. Test No. (iii) may only be required where specified (e.g. within a chloride environment along the coast or where chlorides are present in ground water).

A sample for the purposes of durability testing is as defined in Table B8106/1. The cores for durability testing shall be extracted from the test panels for process and acceptance control (at the frequency as shown in Table B8106/2). Durability testing shall only be required for concrete specified as durability concrete with the prefix “W”. The number of samples to be taken shall be as shown in Table B8106/2.

<table>
<thead>
<tr>
<th>TABLE B8106/1: NUMBER OF CORE RESULTS REQUIRED FOR A SINGLE SAMPLE FOR DURABILITY TESTING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Durability Parameter</strong></td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>a. Sorptivity</td>
</tr>
<tr>
<td>b. Oxygen Permeability</td>
</tr>
<tr>
<td>c. Chloride Conductivity</td>
</tr>
</tbody>
</table>

* Test undertaken only if specified and within a chloride environment.

<table>
<thead>
<tr>
<th>TABLE B8106/2: NUMBER OF TEST PANELS REQUIRED FOR DURABILITY TESTING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>In situ Bridge Decks</td>
</tr>
<tr>
<td>Bridge Piers/Abutments</td>
</tr>
<tr>
<td>Precast Elements</td>
</tr>
<tr>
<td>Bridge / Culvert Parapets</td>
</tr>
<tr>
<td>Culvert walls / wingwalls / slabs</td>
</tr>
<tr>
<td>Retaining walls</td>
</tr>
</tbody>
</table>
All bases 1 (per element/pour)$^2$

Notes:
1. Test panels required to be cast vertically. Additional cores required to be extracted from top of deck / major culvert slabs, i.e. in situ cores.
2. Note that where group of elements are cast on the same day, only one test panel will be required, but only if the same grade concrete is used.
3. Sample required to be taken from Precast element in casting yard. For edge beams, inner face to be cored.

For cores to be extracted from precast elements and top of bridge decks, the engineer will indicate the positions at which the cores will be extracted. Filling of the holes left by the drilling of the cores shall be the responsibility of the contractor and shall be carried out using an approved proprietary non-shrink repair mortar so as to restore structural integrity and durability of the structural element tested.

If the test results indicate that the durability requirement has not been achieved, then the structural element shall be cored and tested for the durability criteria. The engineer will indicate the positions at which the cores will be extracted. The costs for testing of the structure shall be borne by the contractor. Filling of the holes left by the drilling of the cores shall be the responsibility of the contractor and shall be carried out with material as described in the paragraph above.

Note that if testing has to be undertaken on sides of decks and walls, the cores shall be taken on the exposed faces of the concrete i.e. the sidewall face taking care not to cut the reinforcing bars. Where the cores do contain pieces of reinforcing steel, they shall not be used for the tests. The cores shall be extracted through the cover concrete from the Test Panels or constructed concrete element as applicable. The outer 5mm of the exposed surface of the core shall be cut off and then a slice (30 ± 2mm thick) shall then be cut and prepared for testing. The engineer will indicate the positions at which the cores will be extracted.

The methodology and latest revisions for the durability index tests are available at the University of Cape Town’s web address at [www.civil.uct.ac.za](http://www.civil.uct.ac.za). In addition, the results of all the durability testing shall be submitted at least once a month in the required format to the SANRAL regional materials representative as well as to Mr Andrew Mackellar - email: mackellara@nra.co.za.

j) Testing for concrete cover

Concrete cover testing shall be conducted using an approved calibrated electromagnetic cover meter, able to comply to requirements as defined in linear and block scans, and has the ability to save and calculate data measured.

The testing (non-destructive) shall be conducted to confirm that the specified depth of concrete cover has been achieved. The cover meter tests shall cover at least 1m$^2$ for every 20m$^2$ surface area of concrete placed. Readings shall be taken to identify individual bars, with at least 3 readings at 100mm spacing on every single bar within 1m$^2$. The average cover of the 1m$^2$ subjected to the test shall be used to determine the payment as per Table B8212/2 unless the Contractor chooses to carry out additional tests as detailed in the final paragraph of clause B6414(a). The cover meter must be calibrated whenever being used to test for cover on each project. Standard Calibration block must be used on each project, and where substantial testing is required, the calibration block shall be kept on site. Cover meters shall comply with the relevant modern standards (e.g. EN55011, 50082-1, 6100-6-1, 6100-6-2, 6100-6-3, 6100-6-4 and BS18881 Part 204).

Critical elements for cover surveys are parapets, deck edges including underside of cantilevers, lower portions of columns and abutments and walls. Soffits should be excluded from measurements. All parapets (F-shaped) including the parapet beam shall be fully tested for cover compliance. In addition, the entire area up to 1.5m high on piers, walls and abutments, including the rear of abutments and wingwalls, shall be fully tested before being backfilled. The engineer will identify other critical areas required to be surveyed. Should any of these areas shows deficiencies, the engineer may order additional cover tests on other areas at the contractors costs.
The procedure for testing for depth of reinforcement from concrete surface shall be in accordance with the manufacturer’s requirements for the relevant electromagnetic cover meter, but further requirements are set out in clause B8119. All cover meters shall be calibrated on site under the control of the engineer. The number of readings taken of the layer of rebar closest to the concrete surface to each 1m² to be tested shall be such that an accurate average cover can be determined for the tested area. For the purposes of calculating the average depth of cover bars that have covers 15mm or greater than what is specified shall be capped at specified cover plus 15mm in the calculations. For calculation of payment, specified cover to be reduced by 5mm (allowance for variation of equipment) before apply criteria as defined in Table B8212/2.

Example, where Specified cover = 40mm, test as 35mm, then apply limits, 85% * 35 = 30mm.

Quick Scan readings are to be taken perpendicular to the layer of rebar closest to the concrete surface for each scan area (+/- 30 per m²), so that an average cover to reinforcement can be determined for the tested area.

Readings are to be taken to identify individual bars within each 1m². At least three cover readings, at 150mm spacing, per an individual bar shall be shown in the test results but only overall cover measurement would be used for payment purposes. Reports generated by the equipment shall be used for determining payment. Where more than 10% of readings are below specified lower limit, the area shall be re-scanned, by Image, Block or Grid scan method, to verify the average cover. For calculation refer to specific worksheet (attached)

Cognizance to be taken of the effect to cover depth measured, where spliced bars are measured in same area as single bars. The size of rebar shall be corrected manually on the device by means of applying the following formula (approximately 1.41 x diameter of rebar as shown in design).

Where insufficient cover are established before placing of concrete, e.g. Starter bars from base not correct position, remedial action to be performed before continuing with next concreting – these actions to be clearly recorded and area identified.

B8108 DETERMINING THE TOTAL APPROXIMATE DRY BULK RELATIVE DENSITY AND THE APPARENT DENSITY

Add the following at the end of this clause:

“For materials where the total water absorption, when determined according to SANS 3001-AG20 (replacing TMH1 Method B14) and SANS 3001-AG21 (replacing TMH1 Method B15), is in excess of 1,5%, the Apparent Density shall be calculated in accordance to the following formula:

\[
\frac{(b-a)}{(d-a) + \{ (w - 1.0)/100 \times (b-a) \} - (c-b)}
\]

This formula shall be used as an alternative to note (5) regarding soaking period, when so instructed by the engineer.”

B8110 TESTS RELATING TO CHEMICAL STABILISATION

Add the following sub-clause:

“d) The Wet-Dry Durability Test for cement and/or lime-treated materials using the hand-brush method (SANRAL METHOD)

1. Scope
This method covers the procedure for determining the soil-cement losses obtained by repeated wetting, drying and hand brushing of hardened soil-cement specimens (see 5.4).

2. **Apparatus**

   2.1 A moisture curing room capable of maintaining a relative humidity of 95 to 100 percent and a temperature of 22 to 25°C, or suitable plastic bags capable of holding specimens and carriers in an air tight condition in a water bath as described in 2.2 below.

   2.2 A suitable water bath with thermostatic control capable of maintaining a temperature of 22 to 25°C.

   2.3 A balance to weigh up to 10 kg, accurate to 0.5 g.

   2.4 A drying oven capable of maintaining temperatures of 71 ± 3°C and 110 ± 5°C.

   2.5 A wire scratch brush made of 50 mm by 1.6 mm flat 26 gauge wire bristles assembled in 50 groups of 10 bristles and mounted to form five longitudinal rows and 10 transverse rows on a 200 by 65 mm wooden block.

3. **Method**

   3.1 *Preparation of specimens*

   Prepare specimens in accordance with the procedure described in the Appendix to method A19 in the TMH 1 with the following exceptions:

   - Use the material passing the 37.5 mm sieve and discard the material remaining on the sieve.

   - Use the apparatus and compaction method as described in SANS 3001-GR30 (replacing TMH 1 method A7) (100% Modified AASHTO at predetermined OMC).

   3.2 *Curing of specimens*

   Rapid cure the specimens (see 5.6). Alternatively, and where instructed by the engineer, the specimens may be cured for seven days at a relative humidity of 95% to 100% and a temperature of 22°C to 25°C in a suitable curing room or in plastic bags and a suitable water bath.

   3.3 *Wetting, drying and brushing*

   After curing, remove the specimens from the curing room or plastic bags, allow to cool and submerge them in water at room temperature for a period of five hours. Remove the specimens from the water and place them in an oven at 71°C for 42 hours.

   Remove the specimens from the oven. Give each specimen two firm strokes over the full surface area with the wire scratch brush. The brush must be held parallel to the long axis of the specimen or parallel to the ends as required to cover all areas of the specimen. Apply these strokes to the full height and width of each specimen with a firm stroke corresponding to approximately 13.5 kN force (see note 5.5).

   3.4 *Determination of soil-cement losses*

   After 12 cycles, dry the specimens to constant mass at 100°C and determine the oven dry mass of the specimens. The data collected will permit the calculation of the soil-cement losses of the specimens after the prescribed 12-cycle test.
4. Calculations

4.1 Calculate the soil-cement loss of the specimens as a percentage of the original oven-dry mass of the specimens as follows:

\[ L = \frac{W - N}{W} \times 100 \]

Where

- \( L \) = soil-cement loss (%)
- \( W \) = original calculated oven-dry mass (g) (calculated according to paragraph 3.5 in the Appendix to method A19 in the TMH 1).
- \( N \) = final oven-dry mass (g).

4.2 The percentage loss shall be calculated and reported to the nearest 0.1 percent. The results are normally required for stabilisation design purposes and should be reported graphically against relevant cement contents.

5. Notes

5.1 Mass determinations of the specimens before and after brushing are usually made at the end of each cycle during research or special investigations.

5.2 Care is required when assessing results obtained on very coarse graded materials as “plucking” out of the aggregate pieces during the brushing process could result in very high losses of material, which may however not be truly indicative of its potential erosion resistance.

5.3 If it not possible to run the cycle continuously because of Sundays or holidays, or for any other reason, the specimens should be held in the oven during the layover period.

5.4 The test was originally developed to determine wet-dry durability of cement-treated material. It can, however, be used with equal success on material tested with other chemical stabilizers, for example lime, or mixes of lime and milled blast furnace slag, or cement and milled blast furnace slag.

5.5 The pressure of the brushing stroke is determined as follows:

Clamp a specimen in a vertical position on the edge of a platform scale and zero the scale. Apply vertical brushing strokes to the specimen and note the force necessary to register approximately 1.36kg.

5.6 Rapid curing:

Seal each specimen airtight in a suitable container or plastic bag. Carefully place the briquettes on suitable holders or in pans and place in the oven at the relevant temperature and period given below:

<table>
<thead>
<tr>
<th>Stabilizing agent</th>
<th>Temp (°C)</th>
<th>Time (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>70 – 75</td>
<td>24 ±0.5</td>
</tr>
<tr>
<td>PBFC</td>
<td>70 - 75</td>
<td>24 ±0.5</td>
</tr>
<tr>
<td>Lime</td>
<td>60 ±2</td>
<td>45 ±1</td>
</tr>
<tr>
<td>Lime / FA</td>
<td>60 ±2</td>
<td>45 ±1</td>
</tr>
<tr>
<td>Lime / MBFS</td>
<td>60 ±2</td>
<td>45 ±1</td>
</tr>
</tbody>
</table>
Add the following new sub-clause:

c) Other Tests:

i. Thickness (mm):
The thickness of the material shall be specified by the contractor (or supplier). Thickness and compressibility tests shall be carried out in accordance with Code of Practice SABS 0221:1988. The Testing of Geo-textile, to check that the material supplied conforms to the thickness specified by the contractor.

ii. Mass per unit area (g/m²):
Testing shall be carried out in accordance with Code of Practice SABS 0221.

iii. Tensile strength (kN/m):
Testing shall be carried out in accordance with Code of Practice SABS 0221.

iv. Penetration load (kN):
Testing shall be carried out in accordance with Code of Practice SABS 0221.

v. Puncture resistance (mm):
Testing shall be done in accordance with test procedures laid down by CSIR, Pretoria.

vi. Permeability (l/s/m²):
Testing shall be carried out in accordance with Code of Practice SABS 0221.

Add the following clauses:

B8119 CONCRETE COVER TESTING PROCEDURE

1. Scope

This procedure covers all measurements to be done on concrete structures to establish conformance to specified concrete cover requirements.

2. Guidelines and Preparation
a. The contractor is to complete a cover survey request and forward it to the engineer.

b. The selected area for cover measurement is to be indicated on a sketch (see example attached).

c. The responsible person must identify the area to be scanned, take measurements on the required date and calculate the results in terms of project specification.

d. The cover meter is to be checked against a calibration box/block constructed with typical reinforcement of known parameters, on each day of use. Any deviations from actual measurement must be recorded on a Cover Survey Request.

e. Cognizance shall be taken of the effect to cover depth measured, where spliced bars are measured in the same area as single bars (typically, the rebar diameter is increased by a factor of 1.44).

f. The depth of cover shall be determined with equipment, complying with BS 1881, Part 204 and capable of identifying the location and depth of reinforcement on a scanned area. The results shall be recorded electronically by the equipment software.

g. Measurements are to be taken in accordance with cover meter manufacturer’s guidelines.

h. The person responsible for measurements must indicate the position, dimension, type and splicing of reinforcement on the sketch for each scanned area.

3. **Method of Measurement**

Two methods of measurement are proposed as follows:

a. **Quick/Linear Scan Method**

   (i) Readings are to be taken perpendicular to the layer of rebar closest to the concrete surface for each scan area (+/- 30 per m²), so that an average cover to reinforcement can be determined for the tested area.

   (ii) Readings are to be taken to identify individual bars within each 1m². At least three cover readings, at 150mm spacing, per individual bar shall be shown in the test results but only the overall cover measurement would be used for payment purposes. Reports generated by the equipment shall be used for determining payment. Further specified cover to be reduced by 5mm (allowance for variation of equipment), before applying criteria as defined in table B8212/2a.

   e.g. If specified cover is 40mm, the lower limit for full acceptance is:

   \[(40 \text{ mm}-5 \text{ mm}) \times 85\% = 30 \text{ mm}.\]

   (iii) Where more than 10% of readings are below specified lower limit, the area shall be re-scanned, by *Image, Block or Grid scan method*, to verify the average cover. Refer to item 3.2 below.
b. Image/Block/Grid Scan Method

(i) Readings are to be taken in both directions of a marked grid as per the equipment manufacturer’s recommendations.

(ii) This method shall be used to determine the average cover to reinforcement when more than 10% of the Quick/Linear Scan results do not meet the specified lower limit for overall cover.

(iii) For purposes of calculation of the averages for cover of a rebar layer, readings exceeding upper limit (cover + 15mm) to be capped on upper limit. Further specified cover to be reduced by 5mm (allowance for variation of equipment), before applying criteria as defined in Table B8212/2a.

e.g. If specified cover is 40mm, the lower limit for full acceptance is:

\[(40 \text{ mm} - 5 \text{ mm}) \times 85\% = 30 \text{ mm}.\]
An example of Image Scan information and presentation is shown in Figure B8119-2 below:

![Image Scan Output](image1)

**Figure B8119-2: Example of a Imagescan output**

If the equipment used is not able to provide the above presentation it has to be done manually by determining the grid of rebar, first and second layer closest to surface, and manually record readings in order to establish the depth of rebar, as shown in Figure B8119-3 below.

![Manual Recording](image2)

**Figure B8119-3: Manual recording of readings**
**SECTION B8200: QUALITY CONTROL**

**B8206 JUDGEMENT PLAN B**

Notes (Table 8206/3)

(1) Asphalt base or surfacing: Specification limits for-

(c) Voids

*Delete and replace the contents of this subitem with the following:*

\[
\begin{align*}
L_s &= \text{specified values} - 1.0\% \text{ points} \\
L_s' &= \text{specified values} + 1.0\% \text{ points}
\end{align*}
\]

*Add the following clause:*

"**B8212 DETERMINING BOTH REDUCED PAYMENTS FOR ‘W’ CLASS CONCRETE AND COVER METER TESTING**"

Payments for all durability concrete prefixed ‘W’ shall be based on the test results of the compressive strengths and of the durability parameters, i.e. oxygen permeability (from test panels) and for both durability and non-durability class concrete, cover meter testing as indicated in Tables B8212/1 and B8212/2 a and b.

General note:
The percentage payment shall be applied to a specific concrete member and shall apply to the relevant payitems of sections 6300 (based on concrete cover test) and 6400 (based on the worst results from the oxygen permeability and compressive strength tests.

**TABLE B8212/1: TABLE OF REDUCED PAYMENTS FOR OXYGEN PERMEABILITY INDEX - ‘W’ CLASS CONCRETE**

<table>
<thead>
<tr>
<th>Description of test</th>
<th>Oxygen permeability index (log scale)</th>
<th>Percentage (%) payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full acceptance</td>
<td>See Table B6404/4 for limit</td>
<td>100%</td>
</tr>
<tr>
<td>Conditional acceptance (with reduced payment)</td>
<td>See Table B6404/4 for limit</td>
<td>80%</td>
</tr>
<tr>
<td>Rejection</td>
<td>See Table B6404/4 for limit</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

**TABLE B8212/2: TABLE OF REDUCED PAYMENTS FOR CONCRETE COVER**

<table>
<thead>
<tr>
<th>Concrete cover (mm)</th>
<th>% of specified cover</th>
<th>Percentage (%) payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full acceptance</td>
<td>≥ 85% &lt;(100%+15mm)</td>
<td>100%</td>
</tr>
<tr>
<td>Conditional acceptance (with reduced payment)</td>
<td>&lt;85% ≥75%</td>
<td>85%</td>
</tr>
<tr>
<td>Conditional acceptance (with remedial measures as approved by the Engineer and reduced payment)</td>
<td>&lt;75% ≥65%</td>
<td>70%</td>
</tr>
<tr>
<td>Non-conforming (non-conformance raised with remedial measures as approved by the Engineer)</td>
<td>&lt;65%</td>
<td>Agreed by Engineer (Note: remedial measures at the contractor’s costs should restore full payment)</td>
</tr>
</tbody>
</table>

The following notes shall apply to Table B8212/2:

1. Specified cover to be reduced by 5mm (allowance for variation of equipment) before applying criteria as defined in Table B8212/2, e.g. where specified cover = 40mm, test as 35mm, apply limits, 85% * 35 ≫ 30mm.
2. For cantilevers, the cover shall in no instance be greater than 10mm of the specified cover for the top reinforcement.
3. Percentage payment for concrete cover shall be based on the average number of cover meter tests performed on a particular concrete element.

In addition, the engineer shall confirm to the Employer whether substandard cover at a reduced payment shall be acceptable by agreement with the contractor.”
SECTION C: ENVIRONMENTAL MANAGEMENT PLAN
# SECTION C: ENVIRONMENTAL MANAGEMENT PLAN

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>C1001</th>
<th>SCOPE</th>
<th>C-215</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1002</td>
<td>DEFINITIONS</td>
<td>C-215</td>
</tr>
<tr>
<td>C1003</td>
<td>LEGAL REQUIREMENTS</td>
<td>C-216</td>
</tr>
<tr>
<td>C1004</td>
<td>ADMINISTRATION OF ENVIRONMENTAL OBLIGATIONS</td>
<td>C-218</td>
</tr>
<tr>
<td>C1005</td>
<td>TRAINING</td>
<td>C-219</td>
</tr>
<tr>
<td>C1006</td>
<td>ACTIVITIES/ASPECTS CAUSING IMPACTS</td>
<td>C-220</td>
</tr>
<tr>
<td>C1007</td>
<td>ENVIRONMENTAL MANAGEMENT OF CONSTRUCTION ACTIVITIES</td>
<td>C-222</td>
</tr>
<tr>
<td>C1008</td>
<td>AREAS OF SPECIFIC IMPORTANCE</td>
<td>C-229</td>
</tr>
<tr>
<td>C1009</td>
<td>REHABILITATION</td>
<td>C-230</td>
</tr>
<tr>
<td>C1010</td>
<td>RECORD KEEPING</td>
<td>C-230</td>
</tr>
<tr>
<td>C1011</td>
<td>COMPLIANCE AND PENALTIES</td>
<td>C-230</td>
</tr>
</tbody>
</table>
The South African National Roads Agency SOC Limited (SANRAL) recognises environmental management as a key component of road infrastructure development and as part of its environmental policy has developed this Environmental Management Plan (EMPI) as a tool for continual improvement in environmental performance.

This EMPI prescribes the methods by which proper environmental controls are to be implemented by the Contractor. The duration over which the Contractor’s controls shall be in place cover the construction period of the project as well as the limited time after contract completion defined by the Conditions of Contract for Construction for Building and Engineering Works Designed by SANRAL (1999 edition) published by the Federation Internationale des Ingenieurs-Conseils (FIDIC) as the Defects Notification Period (maintenance period).

The provisions of this EMPI are binding on the Contractor during the life of the contract. They are to be read in conjunction with all the documents that comprise the suite of documents for this contract, particularly the conditions of any environmental authorisation and associated Environmental Management Programme (EMPr). In the event that any conflict occurs between the terms of the EMPI and the project specifications or environmental authorisation, the terms herein shall be subordinate.

The EMPI is a dynamic document subject to similar influences and changes as are brought by variations to the provisions of the project specification. Any changes to the EMPI and/or environmental authorisation cannot occur without being submitted to SANRAL who will manage the process of amending the EMPI.

The EMPI identifies the following:
- Relevant parties and their responsibilities;
- Construction activities that will impact on the environment;
- Specifications with which the Contractor shall comply in order to protect the environment from the identified impacts; and
- Actions that shall be taken in the event of non-compliance.

**DEFINITIONS**

- **Alien Vegetation**: undesirable plant growth which includes, but is not limited to all declared category 1 and 2 listed invader species as set out in the Conservation of Agricultural Resources Act (CARA), 1983 regulations. Other vegetation deemed to be alien are those plant species that show the potential to occupy in number, any area within the defined construction area and which are declared to be undesirable.

- **Construction Activity**: any action taken by the Contractor, his sub-contractors, suppliers or personnel during the construction process as defined in the contract documents.

- **Environment**: the surroundings within which the contract exists and comprises land, water, atmosphere, micro-organisms, plant and animal life (including humans) in any part or combination thereof as well as any physical, chemical, aesthetic or cultural inter-relationship among and between them.

- **Environmental Aspect**: any component of a contractor’s construction activity that is likely to interact with the environment.

- **Environmental authorisation**: a written statement from the National Department of Environmental Affairs, (DEA), with the general and specific conditions and the EMPr recording its approval of an application for a planned undertaking that triggers listed activities in the Environmental Impact Assessment (EIA) regulations of the National Environmental Management Act (NEMA).

- **Environmental Impact**: any change to the environment, whether desirable or undesirable, that will result from the effect of a construction activity. An impact may be the direct or indirect consequence of a construction activity.
Environmental Impact Assessment (EIA): a systematic process of identifying, assessing and reporting environmental impacts associated with an activity and includes basic assessment and scoping and environmental impact reporting.

Environmental Management Programme (EMPr): the embodiment of this EMPI to ensure that undue or reasonably avoidable adverse impacts of a development are prevented, and to ensure that positive impacts are enhanced. It thus addresses the how, when, who, where and what of integrating environmental mitigation and monitoring measures through identified projects.

Road Reserve: a corridor of land, defined by co-ordinates and/or proclamation, within which the road, including access intersections or interchanges, is situated. A road reserve may, or may not, be bounded by a fence.

Site; the site is defined in the FIDIC Conditions of Contract and in the scope of works. It is bound by the limits of construction as shown in the drawings or the title of the project and extends to also include the following:

- Areas outside the construction zones where accommodation of traffic is placed;
- All borrowpits defined in the applications approved by the relevant Department of Mineral Resources (DMR);
- All haul roads constructed by the Contractor for purposes of access;
- Any non-adjacent sites specified in the contract documentation;
- The Contractor’s and his subcontractors’ camp sites.

For the purposes of this EMPI, the site includes areas outside of, but adjacent to, the road reserve that may be affected by construction activities.

Spoil material: is material unsuitable for construction of the road pavement and for which no other useful purpose can be found in additional works on the project (e.g. for the provision of protection berms). Such material is considered as waste material that requires spoiling at convenient areas to be identified by the Engineer and/or Contractor within the Site. Spoil material does not require removal to a designated landfill site unless it contains identifiable hazardous contaminants.

C1003 LEGAL REQUIREMENTS

(a) General

Construction shall be according to the best industry practices, as identified in the project documents. This EMPI, which forms an integral part of the contract documents, informs the Contractor as to his duties in the fulfilment of the project objectives, with particular reference to the prevention and mitigation of environmental impacts caused by construction activities associated with the project. The Contractor should note that obligations imposed by the EMPI are legally binding in terms of this contract. In the event that any rights and obligations contained in this EMPI contradict those specified in the standard or project specifications then the latter shall prevail.

(b) Statutory and other applicable legislation

The Contractor is deemed to have made himself conversant with all legislation pertaining to the environment, including provincial and local government ordinances, which may be applicable to the contract.

Major environmental legislation, as amended from time to time, includes but is not limited to the following:

(i) Conservation of Agricultural Resources Act (Act No. 43 of 1983)

This act provides for control over the utilisation of the natural agricultural resources of South Africa in order to promote the conservation of soil, water sources and vegetation, as well as combating weeds and invader plants.

The Constitution states that everyone has the right to an environment that is not harmful to their health or well-being, and to have the environment protected through reasonable legislative and other measures to prevent pollution and ecological degradation; promote conservation and ensure ecologically sustainable development and use of natural resources.

(iii) **Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)**

This act makes provision for equitable access to, and sustainable development of, minerals and petroleum resources.

(iv) **National Environmental Management Act (NEMA), (Act No. 107 of 1998)**

This act supports the Bill of Rights within the Constitution and highlights principles of sustainable development including preservation of ecosystems and biological diversity and avoidance, minimisation and remediation of pollution and environmental degradation. It also sets the stage for the EIA Regulations.

(v) **National Environmental Management: Air Quality Act (Act No. 39 of 2004)**

This act provides reasonable measures for the prevention of pollution and ecological degradation; and provides for specific air quality measures; for national norms and standards regulating air quality monitoring, management and control by all spheres of government.

(vi) **National Environmental Management: Biodiversity Act (Act No. 10 of 2004)**

This act makes provisions to accomplish the objectives of the United Nations’ Convention on Biological Diversity. SANRAL may be required to apply for permits to conduct certain listed activities which, together with the listed threatened or protected species, may be identified by the Minister.

Section 73 (3) of this act empowers a competent authority to direct a person to take steps to remedy any harm to biodiversity resulting from the actions of that person or as a result of occurrence of listed invasive species occurring on land on which that person is the owner. Thus SANRAL may be directed to remedy harm caused by listed invasive species.

(vii) **National Environmental Management: Protected Areas Act (Act No. 57 of 2003)**

This act provides for the protection and conservation of ecologically viable areas representative of South Africa’s biological diversity, natural landscapes and seascapes.

(viii) **National Environmental Management: Waste Act (Act No. 59 of 2008)**

This act aims to regulate waste management practices through provision of national norms and standards, specific waste measures, licensing and control of waste activities, remediation of contaminated land as well as providing for compliance and law enforcement.

(ix) **National Forests Act (Act No. 84 of 1998)**

This act makes provision for promoting the sustainable management and development of forests, and for the protection of certain forests and trees for environmental, economic, educational, recreational, cultural, health and spiritual purposes.
(x) **National Heritage Resources Act (Act No. 25 of 1999)**

This act provides for an integrated and interactive system for identification, assessment and management of South Africa’s heritage resources, and empowers civil society to nurture and conserve their heritage resources.

(xi) **National Water Act (Act No. 36 of 1998)**

This act makes provision for the protection of surface water and groundwater and their sustainable management for the prevention and remediation of the effects of pollution, as well as for the management of emergency situations.

(xii) **The South African National Roads Agency Limited and National Roads Act (Act No. 7 of 1998)**

---

**C1004 ADMINISTRATION OF ENVIRONMENTAL OBLIGATIONS**

Copies of this EMPl shall be kept at the site office and must be distributed to all senior contract personnel who shall familiarise themselves with its contents.

Implementation of this EMPl requires the involvement of several stakeholders, each fulfilling a different but vital role as outlined herein, to ensure sound environmental management during the construction phase of a project.

(a) **SANRAL**

SANRAL and anyone acting on SANRAL’s behalf is accountable for the potential environmental impacts of any activities that are undertaken and is responsible for managing these impacts.

(b) **The Engineer**

The Engineer has been appointed by, and acts for, SANRAL as its on-site implementing agent and carries the responsibility to ensure that the Contractor undertakes its construction activities in such a way that SANRAL’s environmental responsibilities are not compromised.

The Engineer will, within seven days of receiving a contractor’s request for approval of a nominated Designated Environmental Officer (DEO), approve, reject or call for more information on the nomination. The Engineer will be responsible for issuing instructions to the DEO where environmental considerations call for action to be taken.

If in the opinion of the Engineer the DEO is not fulfilling his/her duties in terms of this EMPl, the Engineer may, after discussion and agreement with SANRAL, exercise his powers under FIDIC general conditions of contract and instruct replacement of the DEO in writing and with stated reasons.

(c) **The Contractor**

The Contractor is responsible for project delivery in accordance with the prescribed specifications, among which this EMPl shall be included.

The Contractor shall receive and implement any instruction issued by the Engineer relating to compliance with the EMPl including the removal of personnel or equipment.

Compliance with the provisions contained herein or any condition imposed by the environmental approvals shall become the responsibility of the Contractor through an approved Designated Environmental Officer (DEO). The Contractor shall nominate a person from among his site personnel to fulfil this function and submit to the Engineer for his approval the *curriculum vitae* of the proposed DEO. This request for approval shall be given, in writing, at least fourteen days before the commencement of any construction activity clearly setting out reasons for the nomination, and with sufficient detail to enable the Engineer to make a decision.
(d) **The Designated/Dedicated Environmental Officer (DEO)**

Once a nominated representative of the Contractor has been approved he/she shall become the DEO and shall be the responsible person for ensuring that the provisions of this EMP are complied with during the life of the contract. The DEO shall submit regular written reports to the Engineer, but not less frequently than once a month.

The DEO may undertake other construction duties unless the Appendix to Tender prescribes this position as ‘dedicated’ as opposed to the standard position being ‘designated’. However, the DEO’s environmental duties shall hold primacy over other contractual duties and the Engineer has the authority to instruct the Contractor to reduce the DEO’s other duties or to replace the DEO if, in the Engineer’s opinion, he/she is not fulfilling his/her duties in terms of the requirements of this EMP. Such instruction will be in writing clearly setting out the reasons why a replacement is required.

As a minimum the DEO shall have an accredited diploma qualification in environmental or natural sciences or equivalent and a minimum of 2 years’ experience in a similar role in construction or other environmental regulatory field.

In addition to the compliance duties relating to EMP the DEO shall also provide full cooperation whenever the Contractor is subjected to regular environmental audits.

(e) **Environmental Control Officer (ECO)**

The Environmental Control Officer (ECO) is an independent environmental specialist appointed by the Engineer to objectively and regularly monitor the Contractor’s compliance with the conditions of the authorisations issued for the project and the approved EMP (that is this EMP augmented with specifics of the project). These are external audits and the regularity is determined by the environmental authorisations.

### C1005 TRAINING

(a) **Qualifications**

The (DEO) shall have the minimum qualifications as prescribed above, and must be conversant with all legislation pertaining to the environment applicable to the contract. He/she must be appropriately trained in environmental management and possess the skills necessary to impart environmental management skills to all personnel involved in the contract.

The Contractor shall ensure that adequate environmental training takes place. All employees shall have been given an induction presentation on environmental awareness. Where possible, the presentation needs to be conducted in the language of the employees.

(b) **Content**

Apart from induction environmental training should, as a minimum, include the course content below and no induction or course should be given until the Engineer has been afforded the opportunity to appraise it and provide comment.

(i) The importance of conformance with all environmental policies and the consequences of departure from standard operating procedures;

(ii) Environmental impacts, actual or potential, caused by work activities, prevention measures to avoid them and mitigation measures when they occur;

(iii) Work force roles and responsibilities in achieving conformance with the environmental policy and procedures, including emergency preparedness and response requirements; and

(iv) The environmental benefits of improved personnel performance.
(c) Induction

In the case of permanent staff the Contractor shall provide evidence that such induction courses have been presented. In the case of new staff (including contract labour) the Contractor shall inform the Engineer when and how he intends concluding his environmental training obligations.

C1006 ACTIVITIES/ASPECTS CAUSING IMPACTS

Typical environmental aspects and impacts associated with road construction are listed in Table 1: Aspects and Impacts Associated with Road Construction. Actual impacts will differ from project to project and, therefore, so may the mitigation measures employed. The commonest aspects and impacts are addressed separately and typical avoidance and/or mitigation measures described. The list and descriptions are not by any means exhaustive and they shall be used for guideline purposes only.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste generation/storage</td>
<td>Water pollution; nuisance; visual impact</td>
</tr>
<tr>
<td>Water use and stormwater discharge</td>
<td>Change in flow regime and/or reduction in downstream availability; soil erosion: water pollution</td>
</tr>
<tr>
<td>Vehicle use and maintenance</td>
<td>Air pollution; noise</td>
</tr>
<tr>
<td>Chemical/fuel storage</td>
<td>Water/air/soil pollution; health impacts; accidents e.g. spills, fire</td>
</tr>
<tr>
<td>Site clearing; earthworks; layer-works; seal works</td>
<td>Change in landform; impact on heritage resources; noise; soil erosion; air pollution</td>
</tr>
<tr>
<td>River bridges; installing drainage structures</td>
<td>Water pollution; impact on river flows; noise</td>
</tr>
<tr>
<td>Land acquisition</td>
<td>Loss of land &amp;/or livelihood; change in landuse;</td>
</tr>
<tr>
<td>Acquisition of building material from borrow pits</td>
<td>Change in landform and use</td>
</tr>
</tbody>
</table>

(a) General approach

The role of the DEO cannot be underestimated and once approved he/she shall be on the site at all times, and before the Contractor begins each construction activity he/she shall give to the Engineer a written statement setting out the following:

(i) The type of construction activity about to be started.
(ii) Locality where the activity will take place.
(iii) Identification of the environmental aspects and impacts that might result from the activity.
(iv) The methodology of impact prevention for each activity or aspect.
(v) The methodology of impact containment for each activity or aspect.
(vi) Identification of the emergency/disaster potential for each activity (if any) and the reaction procedures necessary to mitigate impact severity.
(vii) Treatment and continued maintenance of impacted environment.

The Contractor shall programme his work in such a way that each cause and effect of a construction activity is also identified and the activity planned so as to prevent any impact from happening and shall demonstrate that he is capable of carrying out any repair and reinstatement of the damaged environment. These requirements shall be concurrent with the time constraints to produce method statements for each construction activity in compliance with the provisions of these project specifications.

The Contractor shall provide such information in advance of any or all construction activities provided that new submissions shall be given to the Engineer whenever there is a change or variation to the original.

The Engineer may provide comment on the methodology and procedures proposed by the DEO, but he shall not be responsible for the Contractor's chosen measures.
of impact mitigation and emergency/disaster management systems. However, the Contractor shall demonstrate at inception and at least once during the contract that the approved measures and procedures function properly.

(b) Spillages

Streams, rivers and dams shall be protected from direct or indirect spillage of pollutants such as refuse, garbage, cement, concrete, sewage, chemicals, fuels, oils, aggregate, tailings, wash water, organic materials and bituminous products. In the event of a spillage, the Contractor shall be liable to arrange for professional service providers to clear the affected area.

Responsibility for spill containment and treatment (whether hazardous or not) lies with the Contractor. The individual causing a spill, or who discovers a spill, must report the incident to his/her DEO or to the Engineer. The DEO will assess the situation in consultation with the Engineer and act as required. In all cases, the immediate response shall be to contain the spill. The exact treatment of polluted soil / water shall be determined by the Contractor in consultation with the DEO and the Engineer. Areas cleared of hazardous waste shall be re-vegetated according to the Engineer's instructions.

Should water downstream of the spill be polluted, and fauna and flora show signs of deterioration or death, specialist hydrological or ecological advice will be sought for appropriate treatment and remedial procedures to be followed. The requirement for such input shall be agreed with the Engineer. The costs of containment and rehabilitation shall be for the Contractor's account, including the costs of specialist input as well as the sampling and testing of the water quality upstream and downstream of the spill. Water quality sampling and testing, and further treatment shall continue until upstream and downstream results correspond with each other.

(c) Water use and control

The Contractor's use of water shall take into consideration that it is a scarce commodity, and shall be optimised. Authorisation shall be obtained from the Department of Water and Sanitation (DWS) before water is drawn from streams or new boreholes developed.

The Contractor shall also ensure that any stream deviations or diversions are undertaken in such a manner that the impact on the environment is minimised. Method statements shall be submitted to the Engineer for comment, detailing how the work will be undertaken, what risks are foreseen and what measures will be employed to minimise such risks. Notwithstanding any comments by the Engineer, no work on stream deviations or diversions shall be undertaken in accordance with the General Authorisation.

The quality, quantity and flow direction of any surface water runoff shall be established prior to disturbing any area for construction purposes. Cognisance shall be taken of these aspects and incorporated into the planning of all construction activities. Before a site is developed or expanded, it shall be established how this development or expansion will affect the drainage pattern. Recognised water users / receivers shall not be adversely affected by the expansion or re-development. No water source shall be polluted in any way due to proposed changes.

Streams, rivers, pans, wetlands, dams, and their catchments shall be protected from erosion and flooding by dredging, daylighting, removal of debris and vegetation, etc. These shall also be protected from direct or indirect spillage of pollutants such as refuse, garbage, cement, concrete, sewage, chemicals, fuels, oils, aggregate, tailings, wash water, organic materials and bituminous products.

The Contractor shall submit to the Engineer his proposals for prevention, containment and rehabilitation measures against environmental damage of the identified water and drainage systems that occur on the site. Consideration shall be given to the placement of sedimentation ponds or barriers where the soils are of a dispersive nature or where toxic fluids are used in the construction process. The
sedimentation ponds must be large enough to contain runoff so that they function properly under heavy rain conditions up to 1:5 year severity.

The Contractor shall submit to the Engineer the results of the baseline water quality test taken above and below the site of the proposed activity, and thereafter monthly testing results or at the frequency as may be specified by the Water Use Licence/General Authorisation, where applicable. No taking-over can be authorised until the water quality is shown to be at pre-construction levels or better.

(d) Vegetation management

The Contractor shall be responsible for the management of vegetation by protection of indigenous vegetation, especially identified protected species, and the prevention of alien vegetation germinating in areas disturbed by road construction activities within and outside the road reserve. This includes, for example, service roads, stockpile areas, stop/go facilities, windrows and wherever material generated for or from road construction has been stored temporarily. This responsibility shall continue for the duration of the defects notification period. The project specification may instruction the removal of CARA and/or NEMBA-listed category 1 and 2 alien species and planting of specified indigenous species.

(e) Dust control

Dust caused by construction activities shall be controlled by means such as water spray vehicles and applied at sufficient frequency so as not to cause nuisance to adjacent habitation or affect farming activities or natural vegetation. Vegetation cover should also be kept for as long as possible to reduce the area of exposed surfaces. Dust emissions from batching and screening plants shall be subject to the relevant legislation and shall be the subject of inspection by the relevant authorities.

(f) Noise control

The Contractor shall endeavour to keep noise generating activities to a minimum. Noises that could cause a major disturbance, for instance blasting and crushing activities, should only be carried out during the hours prescribed by the conditions of contract (i.e. normal hours). Should such noise generating activities have to occur at any time outside normal hours the people in the vicinity of the noise-generating activity shall be warned about the noise well in advance and the activities kept to a minimum. Relevant legislation shall also be taken into consideration, and any practical mitigation measures adopted. No noise generating activity outside of normal hours, regardless of its proximity to residences, can take place without application to the Engineer for approval. The application shall be accompanied by the noise containment measures proposed.

(g) Energy consumption

The Contractor shall take into consideration the impacts of high energy consumption, both from a cost and emissions point of view. Energy use shall be minimised, and where possible, alternative energy sources such as solar utilised.

Furthermore, the Contractor shall undertake a study of the consumption of carbon units his chosen method of construction produces in the execution of his programme. In conjunction with the Engineer who will provide complete cooperation in this study, a month by month output shall be compiled and efforts made to see how these outputs can be curtailed and reduced.

C1007 ENVIRONMENTAL MANAGEMENT OF CONSTRUCTION ACTIVITIES

The Contractor shall undertake “good housekeeping” practices during construction as stated in the COLTO Standard Specifications for Roads and Bridges and the FIDIC conditions of contract. This will help avoid disputes on responsibility and allow for the smooth running of the contract as a whole. Good housekeeping extends beyond the wise practice of construction methods that leaves production in a safe state from the ravages of weather to include the care for and preservation of the environment within which the site is situated.
The construction activities addressed below shall become part of the Contractor’s obligations regarding his programme of work and incorporated into the required method statements for workmanship and quality control.

a) Site establishment

i) Site Plan

The site refers to an area with defined limits on which the project is located. The Contractor shall establish his construction camps, offices, workshops, staff accommodation and testing facilities on the site in a manner that does not adversely affect the environment. However, before any site establishment can begin, the Contractor shall submit to the ECO for his comments and to the Engineer for his approval, plans of the exact location, extent and construction details of these facilities and the impact mitigation measures the Contractor proposes to put in place.

The plans shall detail the locality as well as the layout of the waste management facilities for litter, kitchen refuse, sewage and workshop-derived effluents. The site offices should not be sited in close proximity to steep areas, as this will increase soil erosion. Preferred locations would be flat areas along the route. If the route traverses water courses, streams and rivers, it is recommended that the offices, and in particular the ablution facilities, aggregate stockpiles, spoil areas and hazardous material stockpiles are located as far away as possible from any water course. No camp establishment, including satellite camps, can be placed within 150 metres of an identified wetland unless the Contractor has applied to DWS and received authorisation to do so. Regardless of the chosen site, the Contractor’s intended mitigation measures shall be indicated on the plan. The site plan shall have been submitted and approved before establishment commences. Detailed, electronic colour photographs shall be taken of the proposed site before any clearing may commence. These records are to be kept by the ECO and the Engineer for consultation during rehabilitation of the site in order that rehabilitation is, as a minimum, done to a standard similar to pre-construction activities.

ii) Vegetation

The Contractor has a responsibility to inform his staff of the need to be vigilant against any practice that will have a harmful effect on vegetation.

The natural vegetation encountered on the site is to be conserved and left as intact as possible. Vegetation planted at the site shall be indigenous and in accordance with instructions issued by the Engineer. Only trees and shrubs directly affected by the works, and such others as may be indicated by the Engineer in writing, may be felled or cleared. In wooded areas where natural vegetation has been cleared out of necessity, the same species of indigenous trees as were occurring shall be re-established. Protected trees may not be removed without a permit from the Department of Agriculture, Forestry and Fisheries.

Contravention of a notice of listed protected tree species under the National Forests Act, 1998 is regarded as a first category offence that may result in a fine or imprisonment for a period up to three years, or to both a fine and imprisonment. The DEO must be conversant with the latest gazette of declared protected trees.

Rehabilitation shall be undertaken using only indigenous tree, shrub and grass species. Special attention shall be given to any search and rescue operation identified during the environmental assessment process and any removal to an on site nursery for continuous nurturing and protection and later replanting.

Any proclaimed weed or alien species that propagates during the contract period shall be cleared by hand before seeding.
Fires shall only be allowed in facilities or equipment specially constructed for this purpose. The need for a firebreak shall be determined in consultation with the Engineer and the relevant authorities, and if required a firebreak shall be cleared and maintained around the perimeter of the camp and office sites.

iii) Water management

Water for human consumption shall be available at the site offices and at other convenient locations on site.

All effluent water from the camp/office sites shall be disposed of in a properly designed and constructed system, situated so as not to adversely affect water sources (streams, rivers, pans, dams etc.). Only domestic type wastewater shall be allowed to enter this system.

iv) Heating and cooking fuel

The Contractor shall provide adequate facilities for his staff so that they are not encouraged to supplement their comforts on site by accessing what can be taken from the natural surroundings. The Contractor shall ensure that energy sources are available at all times for construction and supervision personnel for heating and cooking purposes.

b) Sewage management

Particular reference in the site establishment plan shall be given to the treatment of sewage generated at the site offices, site laboratory and staff accommodation and at all localities on the site where there will be a concentration of labour. Sanitary arrangements should be to the satisfaction of the Engineer, the local authorities and legal requirements.

Safe and effective sewage treatment will require one of the following sewage handling methods: septic tanks and soak-aways, dry-composting toilets such as “enviro loos”, or the use of chemical toilets which are supplied and maintained by a specialist service provider. The type of sewage management will depend on the geology of the area selected, the duration of the contract and proximity (availability) of providers of chemical toilets. Should a soak-away system be used, it shall not be closer than 800 metres from any natural water course or water retention system. The waste material generated from these facilities shall be serviced on a regular basis. The positioning of the chemical toilets shall be done in consultation with the Engineer.

Toilets and latrines shall be easily accessible and shall be positioned within walking distance from wherever employees are employed on the works. Use of the veld for this purpose shall not, under any circumstances, be allowed.

Outside toilets shall be provided with locks and doors and shall be secured to prevent them from blowing over. The toilets shall also be placed outside areas susceptible to flooding. The Contractor shall arrange for regular emptying of toilets and shall be entirely responsible for enforcing their use and for maintaining such latrines in a clean, orderly and sanitary condition to the satisfaction of the Engineer.

c) Waste management

The Contractor’s intended methods for waste management shall be outlined and implemented at the outset of the contract, and shall be to the satisfaction of the Engineer. Opportunities for avoiding, reducing, reusing and recycling of materials should be identified upfront, as should constraints for their implementation. All personnel shall be instructed to dispose of all waste in the proper manner.

i) Solid waste

Solid waste shall be stored in an appointed area in covered, tip-proof metal drums or similar container for collection and disposal. Disposal of solid waste
shall be at a licensed landfill site or at a site approved by the relevant authority in the event that an existing operating landfill site is not within reasonable distance from the project area. No waste shall be burned or buried at or near the project area.

ii) Litter

No littering by construction workers shall be allowed and particular emphasis on litter control measures shall apply at stop/go facilities.

During the construction period, the various contractors’ facilities shall be maintained in a neat and tidy condition and the site shall be kept free of litter. At all places of work the Contractor shall provide litter collection facilities for later safe disposal at approved sites.

iii) Hazardous waste

Hazardous waste such as oils shall be disposed of at an approved landfill site. Special care shall be taken to avoid spillage of bitumen products such as binders or pre-coating fluid to avoid water-soluble phenols from entering the ground or contaminating surface water.

Under no circumstances shall the spoiling of bituminous products on the site, over embankments, in borrow pits or any burying, be allowed. Unused or rejected bituminous products shall be returned to the supplier’s production plant. Any spillage of bituminous products shall be attended to immediately and affected areas shall be promptly reinstated to the satisfaction of the Engineer.

iv) Construction and demolition waste

The opportunity for recycling and reuse of construction and demolition waste as fill for road embankments, land reclamation and drainage control must first be explored and take priority before the option of declaring these materials a ‘waste’.

The Contractor is encouraged to actively engage with authorities and landowners adjacent to the site and identify where such ‘waste’ materials can be usefully deployed to repair existing environmentally damaged areas such as erosion dongas.

d) Control at the workshop

The Contractor’s management and maintenance of his plant and machinery will be strictly monitored according to the criteria given below.

i) Hazardous Material Storage

Petrochemicals, oils and identified hazardous substances shall only be stored under controlled conditions. All hazardous materials such as bitumen binders shall be stored in a secured, appointed area that is suitably fenced, bunded and has restricted entry. Storage of bituminous products shall only take place using suitable containers to the approval of the ECO and the Engineer.

The Contractor shall provide proof to the Engineer that relevant authorisation to store such substances has been obtained from the relevant authority. In addition, hazard signs indicating the nature of the stored materials shall be displayed on the storage facility or containment structure. Before containment or storage facilities can be erected, the Contractor shall furnish the Engineer with details of the preventative measures he proposes to install in order to mitigate pollution of the surrounding environment from leaks or spillage. The preferred method shall be a concrete floor that is bunded. Any deviation from the method will require proof from the relevant authority that the alternative method proposed is acceptable to that authority. The proposals shall also
indicate the emergency procedures in the event of misuse or spillage that will negatively affect an individual or the environment.

ii) Fuel and gas storage

The Contractor shall take cognisance of the limits set by legislation for the storage of fuels and acquire the necessary authorisation for storage capacity beyond these. An adequate bund wall, 110% of volume, shall be provided for fuel and diesel areas to accommodate any leakage spillage or overflow of these substances. The area inside the bund wall shall be lined with an impervious lining to prevent infiltration of the fuel into the soil. Any leakage, spillage or overflow of fuel shall be attended to without delay.

Gas welding cylinders and LPG cylinders shall be stored chained in a secure, well-ventilated area exterior to any building wall.

iv) Oil and lubricant waste

Used oil, lubricants and cleaning materials from the maintenance of vehicles and machinery shall be collected in a holding tank and sent back to the supplier. Water and oil should be separated in an oil trap. Oils collected in this manner, shall be retained in a safe holding tank and removed from site by a specialist oil recycling company for disposal at approved waste disposal sites for toxic/hazardous materials. Oil collected by a mobile servicing unit shall be stored in the service unit’s sludge tank and discharged into the safe holding tank for collection by the specialist oil recycling company.

Drip trays shall be used to collect any lubricants or fuel spilled where any vehicle and machinery are repaired or refuelled. The lubricants and fuel collected shall be handled as specified above.

All used filter materials shall be stored in a secure bin for disposal off site. Any contaminated soil shall be removed and replaced. Soils contaminated by oils and lubricants shall be collected and disposed of at a facility designated by the local authority to accept contaminated materials.

e) Clearing the site

In all areas where the Contractor intends to, or is required to clear the natural vegetation and soil, either within the road reserve, or at designated or instructed areas outside the road reserve, a plan of action shall first be submitted to the Engineer for his approval. Working areas shall be clearly defined and demarcated on site to minimise the construction footprint. ‘No-go- areas’ and other sensitive areas shall also be clearly demarcated on site, and staff must be made aware of them.

The plan of action shall contain a photographic record and chainage/land reference of the areas to be disturbed. This shall be submitted to the Engineer for his records before any disturbance/stockpiling may occur. The record shall be comprehensive and clear, allowing for easy identification during inspections.

f) Soil management

i) Topsoil

Topsoil shall be removed from all areas where physical disturbance of the surface will occur and shall be stored and adequately protected. The contract will provide for the stripping and stockpiling of topsoil from the site for later reuse. Topsoil is considered to be the natural soil covering, including all the vegetation and organic matter. Depth may vary at each site. The areas to be cleared of topsoil shall include all storage areas. All topsoil stockpiles and windrows shall be maintained throughout the contract period in a weed-free condition. Weeds appearing on the stockpiled or windrowed topsoil shall be removed by hand. Soils contaminated by hazardous substances shall be disposed of at an approved waste disposal site. The topsoil stockpiles shall
be stored, shaped and sited in such a way that they do not interfere with the flow of water to cause damming or erosion, or itself be eroded by the action of water.

The Contractor shall ensure that no topsoil is lost due to erosion – either by wind or water. Areas to be top-soiled and grassed shall be done so systematically to allow for quick cover and reduction in the chance of heavy topsoil losses due to unusual weather patterns. The Contractor’s programme shall clearly show the proposed rate of progress of the application of topsoil and grassing. The Contractor shall be held responsible for the replacement, at his own cost, for any unnecessary loss of topsoil due to his failure to work according to the progress plan approved by the Engineer. The Contractor’s responsibility shall also extend to the clearing of drainage or water systems within and beyond the boundaries of the road reserve that may have been affected by such negligence.

ii) Subsoil

The subsoil is the layer of soil immediately beneath the topsoil. It shall be removed, to a depth instructed by the Engineer, and if not used for road building it shall be stored and maintained separately from the topsoil so that neither stockpile is contaminated by the other. This soil shall be used for rehabilitation purposes by first spreading it over the excavated slopes without interfering with or contaminating the stockpiled topsoil.

Whilst in stockpile it shall be maintained free from erosion and weed infestation in the same way as for topsoil stockpile maintenance.

g) Earthworks and layerworks

This section includes all construction activities that involve the mining of all materials, and their subsequent placement, stockpile, spoil, treatment or batching, for use in the permanent works, or temporary works in the case of deviations. Before any stripping prior to the commencement of construction, the Contractor shall have complied with the requirements of this EMPl. In addition, the Contractor shall take cognisance of the requirements set out below.

i) Quarries and borrow pits

The Contractor’s attention is drawn to the requirement of the Department of Mineral Resources, that before entry into any quarry or borrow pit, an Environmental Authorisation for the establishment, operation and closure of a quarry or borrow pit shall have been approved by the Department. It is the responsibility of the Contractor to ensure that he is in possession of the authorisation prior to entry into the quarry or borrow pit. The conditions imposed by the relevant authorisation are legally binding on the Contractor and may be more extensive and explicit than the requirements of this specification. In the event of any conflict occurring between the requirements of the specific authorisation and this EMPl, the former shall apply.

ii) Excavation, hauling and placement

The Contractor shall provide the ECO and the Engineer with detailed plans of his intended construction processes prior to starting any cut or fill or layer. The plans shall detail the measures by which the impacts of pollution (noise, dust, litter, fuel, oil and sewage), erosion, vegetation destruction and deformation of landscape will be prevented, contained and rehabilitated. Particular attention shall also be given to the impact that such activities will have on the adjacent built environment. The Contractor shall demonstrate his "good housekeeping", particularly with respect to closure at the end of every day so that the site is left in a safe condition.

iii) Spoil sites
The Contractor shall be responsible for the safe siting, operation, maintenance and closure of any spoil site he uses during the contract period, including the defects notification period. This shall include existing spoil sites that are being re-entered. Before spoil sites may be used proposals for their locality, intended method of operation, maintenance and rehabilitation shall be given to the ECO for his/her comments and to the Engineer for his approval. The location of these spoil sites shall have signed approval from the affected landowner before submission to the ECO and the Engineer. No spoil site shall be located within 500m of any watercourse. A photographic record shall be kept of all spoil sites for monitoring purposes. This includes before the site is used and after re-vegetation.

The use of approved spoil sites for the disposal of any waste shall be prohibited. Spoil sites will be shaped to fit the natural topography. Depending on availability these sites shall receive a minimum of 75mm topsoil and be grassed with the recommended seed mixture. Appropriate grassing measures to minimise soil erosion shall be undertaken by the Contractor. This may include both strip and full sodding. The Contractor may motivate to the Engineer for other acceptable stabilising methods. The Engineer may only approve a completed spoil site at the end of the defects notification period upon receipt from the Contractor of a landowner’s clearance notice.

iv) Stockpiles

The Contractor shall plan his activities so that materials excavated from borrow pits and cuttings, in so far as possible, can be transported direct to and placed at the point where it is to be used. However, should temporary stockpiling become necessary, the areas for the stockpiling of excavated and imported material shall be indicated and demarcated on the site plan submitted in writing to the Engineer for his approval. The Contractor’s proposed measures for prevention of environmental damage, containment and subsequent rehabilitation shall also be submitted.

The areas chosen shall have no naturally occurring indigenous trees and shrubs present that may be damaged during operations. Care shall be taken to preserve all vegetation in the immediate area of these temporary stockpiles. During the life of the stockpiles the Contractor shall at all times ensure that they are positioned and sloped to create the least visual impact, constructed and maintained so as to avoid erosion of the material and contamination of surrounding environment and kept free from all alien/undesirable vegetation.

After the stockpiled material has been removed, the site shall be re-instated to its original condition. No foreign material generated / deposited during construction shall remain on site. Areas affected by stockpiling shall be landscaped, topsoiled, grassed and maintained at the Contractor’s cost until clearance from the Engineer and the landowner is received.

Material milled from the existing road surface that is temporarily stockpiled in areas approved by the Engineer within the road reserve, shall be subject to the same condition as other stockpiled materials. Excess materials from windrows, in situ milling or any leftover material from road construction activities may not be swept off the road and left unless specifically instructed to do so in the contract documentation or under instruction from the Engineer.

The ECO shall comment on and the Engineer shall approve the areas for stockpiling and disposal of construction rubble before any operation commences and shall approve their closure only when they have been satisfactorily rehabilitated.

v) Blasting activities

Wherever blasting activity is required on the site (including quarries and/or borrow pits) the Contractor shall rigorously adhere to the relevant statutes and regulations that control the use of explosives.
h) On site plant

i) Crusher, screening plants and concrete batching plants

Crushing plants and concrete batching plants, whether sited inside or outside of defined quarry or borrow pit areas, shall be subject to the requirements of the applicable industrial legislation that governs gas and dust emissions into the atmosphere. Such sites will be the subject of regular inspections by the relative authorities during the life of the project. In addition, the selection, entry onto, operation, maintenance, closure and rehabilitation of such sites shall be the same as for those under section C1007(g)(i) of this EMP, with the exception that the Contractor shall provide additional measures to prevent, contain and rehabilitate against environmental damage from toxic/hazardous substances. In this regard the Contractor shall provide plans that take into account such additional measures as concrete floors, bunded storage facilities, linings to drainage channels and settlement dams. Ultimate approval of these measures shall be from the relevant authority, as shall approval of closure. The Engineer will assist the Contractor in his applications to the relevant authority.

Screening activities shall be undertaken so that dust and noise is minimised. This can be done by carefully choosing the site for the activity, and by using slightly damp material.

Effluent from concrete batch plants and crusher plants shall be reused where possible or treated in a suitable designated sedimentation dam to the legally required standards to prevent surface and groundwater pollution. The designs of such a facility should be submitted to the Engineer for approval.

ii) Asphalt Plant

Asphalt plants shall be subject to the applicable legislation that governs establishment and operation of batching plants. The Contractor shall be responsible to obtain the necessary permit from the relevant authority.

Operation of the plant shall conform to the same requirements as for a crushing plant or concrete batching plant under C1007(h)(i) above.

C1008 AREAS OF SPECIFIC IMPORTANCE

Any area, as determined and identified within the project documents as sensitive or of special interest within the site shall be treated according to the express instructions contained in these specifications or the specific environmental authorisation, as well as the approved EMP. The Contractor may offer alternative solutions to the Engineer in writing should he consider that construction will be affected in any way by the hindrance of the designated sensitive area or feature. However, the overriding principle is that such defined areas requiring protection should not be changed. Every effort to identify such areas within the site will have been made prior to the project going out to tender. The discovery of other sites with archaeological or historical interest that have not been identified shall receive ad hoc treatment.

a) Archaeological sites

If an artefact on site is uncovered, work in the immediate vicinity shall be stopped immediately. The Contractor shall take reasonable precautions to prevent any person from removing or damaging any such article and shall immediately upon discovery thereof inform the Engineer of such discovery. The South African Heritage Resource Agency (SAHRA) is to be contacted, and a SAHRA-registered archaeological consultant may undertake the necessary work involved in confirming the find and advising on how it should be preserved or removed. Work may only resume once clearance is given in writing by the archaeologist. (Read with FIDIC condition of contract clause 4.24)
If a grave or midden is uncovered on site then all work in the immediate vicinity of the graves/middens shall be stopped and the Engineer informed of the discovery. The South African Heritage Resource Agency and the South African Police Services (SAPS) should be contacted and in the case of graves, arrangements made for an undertaker to carry out exhumation and reburial. The undertaker will, together with SAHRA, be responsible for attempts to contact family of the deceased and for the place where the exhumed remains can be re-interred.

C1009 REHABILITATION

The Contractor shall be responsible for the re-establishment of grass within the road reserve boundaries for all areas disturbed during construction. This includes, for example, service roads, stockpile areas, stop/go facilities, windrows and wherever material generated for, or from, construction has to be stored temporarily, and designated or instructed areas outside the road reserve. It also includes the area where site offices were erected which may require rehabilitation at the end of the contract. All construction material, including concrete slabs and barbecue (braai) areas shall be removed from the site on completion of the contract unless written approval from the relevant landowner demonstrates it is to be left in place.

Responsibility for re-establishment of vegetation shall extend until expiry of the defects notification period. However, SANRAL reserves the right to continue holding retention monies (or not releasing guarantees in lieu of retention) depending upon the state of cover at the end of the defects notification period. Such extension may continue until closure of the relevant quarry or borrow pit has been secured.

Rehabilitation of affected areas should be undertaken as early as possible when the relevant activities are done in order to reduce further environmental damage. All re-vegetation should be undertaken using indigenous vegetation. The standard of rehabilitation should be to the satisfaction of the Engineer and the relevant authorities. The Department of Minerals Resources will only issue closure certificates for borrow pits and quarries when they are satisfied with the rehabilitation undertaken. It should also be noted that in some cases there is a requirement for a final environmental audit covering the extent of the project.

C1010 RECORD KEEPING

The Engineer and the DEO will continuously monitor the Contractor’s adherence to the approved impact prevention procedures and the DEO shall submit regular written reports to the ECO and to the Engineer at least once a month. The DEO will report the environmental compliance performance of the project at regular site meeting. The Engineer shall issue to the Contractor a notice of non-compliance whenever transgressions are observed. The DEO shall document the nature and magnitude of the non-compliance in a designated register, the action taken to discontinue the non-compliance, the action taken to mitigate its effects and the results of the actions. The non-compliance shall be documented and reported to the Engineer in the monthly report.

Copies of all authorisations shall be kept on site and made available for inspection by visiting officials from SANRAL, relevant authorities or internal/external auditors.

C1011 COMPLIANCE AND PENALTIES

The Contractor shall act immediately when a notice of non-compliance is received and correct whatever is the cause for the issuing of the notice. Complaints received regarding activities on the construction site pertaining to the environment shall be recorded in a dedicated register and the response noted with the date and action taken. This record shall be submitted with the monthly reports and an oral report given at the monthly site meetings.

Any non-compliance/omissions with the procedures in this EMP, environmental authorisations and the approved EMP constitute a breach of the Conditions of Contract. Regulatory financial penalties imposed on SANRAL shall be passed onto the defaulting parties.
<table>
<thead>
<tr>
<th>Section</th>
<th>Contents</th>
<th>Environmental Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Pollution Type</strong></td>
</tr>
<tr>
<td>1300</td>
<td>Camp Establishment</td>
<td>Waste treatment Hzaudous waste Water supply Spillage Storage</td>
</tr>
<tr>
<td>1400</td>
<td>Housing, Offices and laboratories</td>
<td>Waste treatment Hazardous waste Water supply Spillage Storage Noise/lights</td>
</tr>
<tr>
<td>1500</td>
<td>Accommodation of Traffic</td>
<td>Waste treatment Hazardous waste Water supply Spillage Storage Noise/lights Dust control</td>
</tr>
<tr>
<td>1600</td>
<td>Overhaul</td>
<td>Spillage Storage Noise/lights Dust control Exhaust fumes Washing waste</td>
</tr>
<tr>
<td>1700</td>
<td>Clearing and grubbing</td>
<td>Waste treatment Hazardous waste Water supply Noise /lights Dust control</td>
</tr>
<tr>
<td>2100 - 2400</td>
<td>Drainage</td>
<td>Waste treatment Hazardous waste Water supply Spillage Storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Deformation of Landscape</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selection of site Preserve indigenous vegetation Preserve topsoil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selection of site Preserve indigenous vegetation Demarcate sensitive areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selection of site Preserve indigenous vegetation Maintenance of windrows</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Soil erosion</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selection of site Preserve indigenous vegetation Preserve topsoil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selection of site Preserve indigenous vegetation Preserve topsoil</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Alien Vegetation</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preserve indigenous vegetation Preserve topsoil Management of weeds</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Sensitive Areas</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Site Camp</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Site Camp</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NONE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NONE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NONE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Site Camp</td>
</tr>
<tr>
<td>Section</td>
<td>Contents</td>
<td>Environmental Impacts</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>3100</td>
<td>Borrow pits</td>
<td></td>
</tr>
<tr>
<td>3200</td>
<td>Stockpiling</td>
<td></td>
</tr>
<tr>
<td>3300</td>
<td>Mass Earthworks</td>
<td></td>
</tr>
<tr>
<td>3400 - 3900</td>
<td>Pavement layers</td>
<td></td>
</tr>
<tr>
<td>4100</td>
<td>Asphalt works / sealing</td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Contents</td>
<td>Environmental Impacts</td>
</tr>
<tr>
<td>---------</td>
<td>------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>5000</td>
<td>Ancillary roadworks</td>
<td>Waste treatment Hazardous waste Water supply Spillage Storage</td>
</tr>
<tr>
<td>6000</td>
<td>Structures</td>
<td>Waste treatment Hazardous waste Water supply Spillage Storage</td>
</tr>
<tr>
<td>7000</td>
<td>Concrete pavements etc.</td>
<td>Waste treatment Hazardous waste Water supply Spillage Storage</td>
</tr>
</tbody>
</table>
SECTION D: SMALL CONTRACTOR DEVELOPMENT, TRAINING AND COMMUNITY PARTICIPATION
<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1001 SCOPE</td>
<td>C-236</td>
</tr>
<tr>
<td>D1002 DEFINITIONS AND APPLICABLE LEGISLATION</td>
<td>C-236</td>
</tr>
<tr>
<td>D1003 CONTRACT PARTICIPATION</td>
<td>C-237</td>
</tr>
<tr>
<td>D1004 COMMUNITY LIAISON</td>
<td>C-239</td>
</tr>
<tr>
<td>D1005 TRAINING</td>
<td>C-240</td>
</tr>
<tr>
<td>D1006 LABOUR ENHANCED CONSTRUCTION</td>
<td>C-244</td>
</tr>
<tr>
<td>D1007 MEASUREMENT AND PAYMENT</td>
<td>C-244</td>
</tr>
</tbody>
</table>
D1001 SCOPE

This section covers construction aspects relating to the processes by which the construction industry develops emerging and established small contractors, preferably from the Target Area. It also deals with labour enhanced construction by encouraging the engagement and training of labour recruited from local communities.

D1002 DEFINITIONS AND APPLICABLE LEGISLATION

(a) Definitions

Unless inconsistent with the context, in these specifications, the following terms, words or expressions shall have the meanings hereby assigned to them:

(i) Contract Participation

Contract Participation is a process by which the Employer implements Government’s objectives by setting targets relating to small contractor development and labour enhancement which the Contractor shall achieve as a minimum.

(ii) Contract Participation Goal (CPG)

Contract Participation Goal is the monetary value of the targets set by the Employer in the Contract Participation process.

(iii) Contract Participation Performance (CPP)

Contract Participation Performance is the measure of the Contractor’s progress in achieving the CPG.

(iv) Black People

Black people has the meaning assigned to it in section 1 of the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003).

(v) EME

EME is an exempted micro enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003).

(vi) Labour

Labour is the Contractor’s and Subcontractor’s personnel whose monthly earnings are derived from hours worked for a fixed hourly rate which is adjusted from time to time by legislation (as a statutory minimum) and the Contractor’s and Subcontractor’s employment policies. The personnel employed by suppliers are not defined as Labour.

(vii) Military Veteran

Military Veteran has the meaning assigned to it in section 1 of the Military Veterans Act, 2011 (Act No. 18 of 2011).

(viii) People with Disabilities

People with Disabilities has the meaning assigned to it in section 1 of the Employment Equity Act, 1998 (Act No. 55 of 1998).

(ix) QSE

QSE is a qualifying small business enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9(1) of
the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003).

(x) **Target Area**

Target Area is a defined area as indicated in the Appendix to Tender.

(xi) **Targeted Enterprise**

A Targeted Enterprise is an EME or QSE which:

a) is at least 51% owned by black people; and

b) the Contractor has no equity holding in; and

c) is registered in terms of the Company’s Act, 2008 (Act No. 71 of 2008)
or Close Corporation Act, 1984 (Act No. 69 of 1984); and

d) is registered on the National Treasury’s Central Supplier Database (CSD); and

e) is a sub-contractor who undertakes work within its registered CIDB category; or

f) is a supplier of Goods which satisfies (a) to (d).

(xii) **Target Groups**

A Target Group is a Designated Group as defined in the Preferential Procurement Regulations, 2017 or Youth.

(xiii) **Targeted Labour**

Targeted Labour is Labour recruited from the Target Area, who permanently reside in the Target Area or who are recognized as being residents of the Target Area on the basis of identification and association with and recognition by the residents of the Target Area.

(xiv) **Youth**

Youth has the meaning assigned to it in section 1 of the National Youth Development Agency Act, 2008 (Act No. 54 of 2008).

(b) **Applicable Legislation**

The following Acts, as amended from time to time, are predominant amongst those which apply to the construction industry and are listed here for reference purposes only:

(i) The Constitution of South Africa;

(ii) Public Finance Management Act No. 1 of 1999;

(iii) Preferential Procurement Policy Framework Act No. 5 of 2000;

(iv) Construction Industry Development Board Act No. 38 of 2000;

(v) Broad-Based Black Economic Empowerment Act No. 53 of 2003.

D1003 CONTRACT PARTICIPATION

(a) **Objective**

A major objective of Government is to extend economic opportunities and entrepreneurial capacity to all localities by the optimum utilisation of the resources existing in the vicinity of projects, the development of these resources in the execution of the project, and by maximising the amount of project funds retained within the project locality. To this end, the contractor shall preferably recruit Targeted Enterprises from the Target Area.

(b) **Contract Participation Targets**

Contract participation is the process by which the Employer implements Government’s objectives. The Employer sets targets for construction by specified
entities the rand value for which is based on the services and work undertaken by
the specified entities and measured as a percentage of the Final Contract Value
measured at the date of issue of the Taking-over Certificate. The Contractor is
obliged to commit to or exceed the targets stated in the Appendix to Tender. As far
as it is practical, the Contractor should consider utilising small contractor resources
from communities immediately adjacent to the contract before considering from
wider areas.

(c) Contract Participation Goal (CPG)

The CPG is the monetary value of the targets set by the Employer and will be
calculated as follows:

CPG = Final Contract Value × (% Targeted Labour + % Targeted Enterprise)

The Final Contract Value is the total value of the Contractor’s final certified work
measured at the date of issue of the Taking-Over Certificate. The Final Contract
Value include the value of scheduled work and extra work but exclude any Contract
Price Adjustment and adjustments for reduced payments, Rise and Fall, Retention
Money, penalties and VAT.

(d) Contract Participation Performance (CPP)

The CPP is the monetary value of the Contractor’s actual progress towards
achievement of the CPG calculated as follows:

CPP = total value (excluding VAT) of Targeted Labour contribution + total value
of Targeted Enterprise contribution by subcontractors (excluding VAT) + 50% of the
value of Targeted Enterprise contribution by suppliers of Goods (excluding VAT).

The Contractor’s participation performance will be measured monthly in order to
monitor the extent to which he is striving to reach the CPG. The basis of monitoring
shall be the levels of the individual contributions for Targeted Labour, Targeted
Enterprises and Target Groups. Monthly returns, in the format provided by the
Employer, are required from the Contractor and shall be submitted with each interim
payment certificate.

To assist in the measurement of the CPP the Contractor shall include in his contract
programme details of how he will achieve the CPG. The detail shall be provided not
later than 1 (one) month after the engineer has accepted the original construction
programme and updated with every subsequent revision.

As an incentive to encourage the Contractor to exceed the CPG, a bonus is offered,
measured as follows:

The bonus = 0.05 × (CPP – CPG) up to a maximum of R 50 000.00.

Any bonus due (or portion thereof) shall be calculated on the Final Contract Value.
No bonus shall apply if either the Targeted Labour, Targeted Enterprises and/or any
individual sub-targets for Target Groups are not reached.

Conversely, failure to reach the CPG or any individual Target Group targets shall
render the Contractor liable for a penalty as prescribed in clause 8.7 of the FIDIC
Conditions of Contract. Penalties shall be calculated as follows:

Penalty = 0.5 × ([TL + TGL] + [TE + TGE])

Where:
TL = Monetary value of the shortfall on the Targeted Labour target
TGL = Cumulative amount of the monetary value of the shortfall on each
individual Target Group for Labour target
TE = Monetary value of the shortfall on the Targeted Enterprises target
TGE = Cumulative amount of the monetary value of the shortfall on each individual
Target Group for Targeted Enterprise target
Where shortfall means the amount by which the monetary value of the actual achievement reached for the specific target is less than the monetary value of the target.

Where the monetary value of the actual achievement for Targeted Labour is the total value (excluding VAT) of Targeted Labour contribution, and the monetary value of the actual achievement for Targeted Enterprise is the total value of Targeted Enterprise contribution by sub-contractors (excluding VAT) and 50% of the value of Targeted Enterprise contribution by suppliers of Goods (excluding VAT).

It shall be monitored on a monthly basis and the penalty will be applied on the final contract value.

(e) Accredited Registration

CPP for Targeted Enterprises shall only be accepted if the respective Targeted Enterprises comply fully with the definition of a Targeted Enterprise, and documentary evidence to support the claim lodged with the engineer before the work or service may be considered as having been performed by a Targeted Enterprise. The responsibility for producing evidence of the respective registration documentation shall rest with the Contractor.

The Contractor shall assume responsibility for the compilation and maintenance of comprehensive records detailing each Targeted Enterprise progress during construction, starting from the award of a subcontract to a Targeted Enterprise until the successful completion of the subcontract or termination of the subcontract. The Contractor may engage a small contractor who is not yet registered as a Targeted Enterprise and it then becomes a responsibility of the Contractor to assist with the registration process. If not successfully registered within the contract period, work completed by that small contractor shall not count towards CPP.

D1004 COMMUNITY LIAISON

(a) Purpose

The purpose of community liaison is to ensure good working relations between the Contractor and communities through which the contract passes. It is a requirement of this contract to create a project liaison committee (PLC) before commencement of any construction activities, to create a platform for project liaison, works execution, sub-contracting and employment facilitation. The contractor would be required to be represented on and play an active role in the duties of the PLC.

(b) Structure and composition

A public liaison committee (PLC) shall be established as a communication structure that interacts with all parties involved with the contract. The composition of the PLC comprises representation by the Employer, the Contractor, the engineer and formal structures within the communities. The Contractor is required to make use of established community communication channels and appoint from among his site personnel a responsible person, (community relations officer (CRO)), to participate in the PLC business. Should the locality and size of the contract warrant the need for a project liaison officer (PLO) such appointment will be made by the engineer as part of the engineer’s staff. The selection of the CRO and PLO shall be done under the auspices of the PLC.

(c) Use of the PLC

The Contractor is required to utilise the community liaison process in order to facilitate harmonious relationships on the contract. Some of the suggested elements of construction activity that should be discussed by the PLC are,
(i) Targeted Enterprises with whom the Contractor is already contractually committed prior to the commencement of the contract,
(ii) Assist the contractor with the recruitment of Targeted Labour,
(iii) Assistance with general community/project liaison,
(iv) The need for training.

(d) Use of the PLO

The purpose of the PLO is to facilitate liaison between the community, community structures, local authorities, the contractor and the engineer. The engineer and contractor shall, at the start of the contract, agree on the duties of the PLO which may include the following:

(a) communicating the labour requirements with regards to numbers and skills to the community;
(ii) determining, in consultation with the contractor, the needs of the labour for training;
(iii) identifying possible labour disputes and to assist in their resolution;
(iv) informing labour of their conditions of temporary employment and to inform labourers as soon as possible when their period of employment will be terminated;
(v) attending disciplinary proceedings to ensure that hearings are fair and reasonable;
(vi) attending meetings in which the community and/or labour is present or is required to be represented;

In terms of the Conditions of Contract, all labour recruitment, employment and associated risks shall remain the sole responsibility of the contractor.

D1005 TRAINING

(a) Purpose of training

The Employer has no service agreement or memorandum of understanding with any education and training quality assurance body and, therefore, does not function as the employer as defined under any three-party-agreement between the learner, the training provider and the employer. But the Employer desires similar outcomes to such agreements; specifically to train Targeted Enterprises and Targeted Labour and equip them with residual skills that can be used to gain meaningful future employment and qualifications that permit continued access to further learning and qualifications within a defined programme.

The Employer will facilitate training and in this capacity demands continuous involvement in the necessary decision making and quality control process of the anticipated training within a skills program which identifies multiple but connected and full learnerships.

The training shall be at both a theoretical and practical level and in accordance with the various laws and regulations contained in the South African Qualification Authority (SAQA) statutes.

Wherever in this section reference is made to the selection and training of learners, any person, employed by any national, provincial or local authority, being it full time or part time, is expressly excluded from being considered for this training.

The complete training programme shall be approved by the engineer before training can commence.

(b) Skills analysis

Before any training programmes can be approved the contractor shall complete a skills audit of his own employees and those of his subcontractors to determine existing qualifications and education received. The outcome of the analysis shall be used to create a training programme that will benefit both the employee and the construction industry at large.
A separate skills analysis shall be conducted for the Targeted Enterprises with the specific purpose of identifying programmes that will develop and improve the ability of the owners of those enterprises to better manage their companies.

The skills analyses and subsequent training programmes must be provided by a suitably qualified training practitioner (the training manager) whose services the contractor shall procure.

(c) The training provider

The training manager shall be the training provider in terms of his obligations and commitment to undertake the training required. In the event that the training manager does not himself have the requisite training qualifications he may include as part of his management team a person who does. Such person may be an institution/organisation, company, collaborative partnership or consultancy in which case, whoever is approved from that entity shall be dedicated to provide all training once the programme has been approved by the engineer.

The training provider must be accredited and have in its employ Practitioners and/or Assessors registered with the Construction Education Training Authority (CETA) and who must have the necessary certified proof. Accreditation and registration proof shall be current, valid and list the NQF levels and unit standards for which he/she is accredited.

The training and competency levels required of the training provider are given in the table below:

<table>
<thead>
<tr>
<th>Designation</th>
<th>Title &amp; Unit Standard No</th>
<th>NQF Level</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practitioner</td>
<td>Train the trainer; No 7384</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Assessor</td>
<td>Conduct outcome base assessment; No 115753</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Moderator</td>
<td>Conduct moderation of outcome based assessment; No 115759</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

In addition to the above qualifications, and in keeping with current CETA practical experience requirements for registration as a trainer, NQF level 4 training courses shall only be provided by a practitioner/assessor with NQF Level 5 (one level up) credentials. For this project the Employer requires the further qualification that assessors/moderators means persons who have been employed for at least 5 years as a site agent managing construction processes in the specific fields of roads maintenance, roads new construction, roads rehabilitation, structures, etc.

It may be appropriate and effective to have different calibre/experienced personnel for each of the fundamental, core and elective training and assessment elements. In other words because the elective unit standards are more vocationally orientated and require specialist input, it is not expected that a single trainer/assessor will have all the necessary skills. In such cases, the training provider shall acquire an appropriate Practitioner/Assessor to perform elective training duties. Such appointments shall be approved by the Employer.

(d) Training

(i) Skills programme

Recognised Prior Learning of each employee shall be investigated, and taken into account and incorporated into each skills programme along with the additional competencies identified as being capable of providing a full learnership outcome.

It is recognised that the programme may consist of several unit standards but totalling insufficient credits for a full learnership qualification. Nevertheless,
the competencies and credits achieved in a skills program should contribute
to a full learnership by a later acquisition of the outstanding Unit Standards
required for the full learnership.

The skills programme must also be geared in such a way that a selected
number of applicable and urgently required unit standards will equip a learner
with the minimum skills to become economically involved in the execution of
the works as soon as possible.

Studying for any learnership requires minimum literacy and numeracy
competencies as defined by SAQA. The actual literacy and numeracy levels
inform the training provider on how to conduct the selection process. Learners
with grade 12 literacy, numeracy and computer skills will, in most cases,
comply with the minimum learning necessities. However, a baseline
assessment (for example by conducting mini RPL enquiries and tests) may
be required to ensure that the competency levels still exist. Some fill-in skills
programme of fundamental unit standards may be needed.

Learners identified as having already acquired some tertiary training,
particularly in the field of civil engineering, may be better suited to a more
specialised learner programme. In other words the skills programme must
reflect a degree of flexibility to cater for the different levels of competencies
the selected learners will have and a single programme suitable for all learners
should not be considered.

All training shall take place within normal working hours, or as agreed with the
trainees.

(ii) Targeted learnerships

The essential SAQA learnership criteria that must be applied by the training
provider are given below for the sake of providing sufficient detail for the
contractor to understand the Employer’s requirements:

- minimum credits for qualification;
- fundamental unit standards and credit values;
- core unit standards and credit values;
- elective units standards and credit values;
- assumption that NQF level 3 language, computer and mathematical
  competencies exist;
- RPL processes;
- exit level outcomes;

Notwithstanding the appearance of the above criteria in the contract
document, they are not exhaustive and the training provider must apply the
systems and processes provided by the relevant SAQA and other related
legislation pertinent to training. The training provider shall constantly consult
the SAQA website (www.saqa.org.za) page to ensure that the most current
unit standard is used. In the event of any conflict, the legislated requirements
shall apply.

Before qualifying, the learners will be expected to demonstrate competence
in a practical situation that integrates the assessment of all specific outcomes,
for all unit standards in the learnership programme.

When considering learnerships and skills programmes the training provider
shall distinguish between levels of learning required. NQF level 5 training is
not anticipated but may be applicable for some members of existing small
contractors’ staff. The main training focuses on NQF levels 4 and 3. The former
level is for the qualification title National Certificate: Supervision of
Construction Processes, and is the prerequisite qualification for NQF level 5,
The NQF level 3 qualification title is National Certificate: Construction
Roadworks.
It may be necessary to include additional core unit standards (e.g. “tendering” as an additional unit standard for NQF level 4) in order to achieve project development objectives and identification of any additional unit standards shall be discussed with the engineer and cannot be implemented without prior approval.

(iii) Learning material

Learning material is required for each unit standard. This learning material is like prescribed books for other qualifications. It is a requirement for all the learners to receive a copy, to learn the contents, and also to serve as a reference source after qualification.

The SAQA unit standards define the content of the learning material. The learning material must not only comply with the SAQA and CETA guidelines but must, and most importantly, be technically and practically aligned to road construction or road maintenance. Any input from a subject matter expert required to ensure the appropriateness of a particular unit standard subject is to be included in the training provider’s costs.

The requirements to be addressed in learning material as outlined by the SAQA unit standard are, amongst others, the following:

- The purpose of the unit standard;
- Each of the specific outcomes (normally 4 per unit standard);
- Each of the assessment criteria (normally 4 per specific outcome);
- The range as is defined for each specific outcome;
- The critical cross-field outcomes for the unit standard;
- The unit standard essential embedded knowledge.

(iv) Student experiential training

The Employer may provide students to the contractor to provide experiential training. The contractor is required to provide experiential training to the university or university of technology undergraduate students in accordance with the academic institution requirements.

The contractor shall also provide the students with all the tools (including appropriate information technology hardware and software) and space necessary to carry out engineering work as if they were the contractor’s own permanent staff.

Reporting on training progress of each student shall be compiled according to the formats and intervals set by the relevant academic institution.

(e) Training facilities

The Contractor shall be responsible for the provision of everything necessary for the delivery of the various training workshops and modules including:

(i) A suitable venue with sufficient furniture, lighting and power
(ii) All necessary stationery consumables and study material
(iii) Transport for attendants

Before commencing with any structured training the Contractor shall submit his intended programme to the engineer for approval of its subject content and proposed trainers, and the Contractor shall, if so instructed by the engineer, alter or amend the programme and/or course content.

(f) Generic skills training

Generic skills shall be taught where the need for these has been identified as being necessary.

In this regard the contractor shall make representation to the engineer, who shall approve candidates that should attend such courses as thought appropriate. Those selected shall receive formal generic skills training in a programmed and progressive
manner. The PLC and/or the engineer may also identify a need for generic skills training.

Typical training programmes could comprise some or all of the following modules:
(i) Basic hygiene and HIV/AIDS awareness
(ii) Road safety
(iii) Basic management of the environment
(iv) Tourism awareness and opportunities
(v) Managing personal finance

(g) Keeping of records

The training provider shall keep comprehensive records of the training given to each trainee and ensure that trainees’ successful completion of successive unit standards are entered onto the national database. With successful completion of generic skills courses each trainee shall be issued with a certificate indicating the course contents as proof of attendance and completion. The contractor shall keep a register of certificates issued in this regard. Whenever required, the contractor shall provide copies of such records to the engineer.

D1006 LABOUR ENHANCED CONSTRUCTION

The Contractor’s attention is drawn to the fact that it is an objective of the contract to maximise the labour content of certain operations or portions thereof. In this regard, where the specified work allows for a choice between mechanical or labour-enhanced means, the former should generally be kept to the practical minimum.

Before commencing with any labour enhanced operations the Contractor shall discuss his intentions with the engineer, and shall submit to the engineer on a monthly basis, daily labour returns indicating the numbers of temporary personnel employed on the works and the activities on which they were engaged.

D1007 MEASUREMENT AND PAYMENT

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10.01</td>
<td>Community participation</td>
</tr>
<tr>
<td>(a)</td>
<td>Cost of community participation and PLC support</td>
</tr>
<tr>
<td>(b)</td>
<td>Handling cost and profit in respect of sub-item D10.01(a)</td>
</tr>
</tbody>
</table>

The provisional sum shall be used to cover the direct costs incurred by attending members of the PLC that the contractor establishes. The rate of compensation shall be at a fair rate agreed by the engineer. In accordance with clause 13.5 of the FIDIC Conditions of Contract, the tendered percentage for sub-item D10.01(b) shall include full compensation for all handling costs and profit of the contractor in connection with sub-item D10.01(a).

The assistance provided by the contractor to the PLC in the form of in-task training, arranging service providers, appointment and services of a community relations officer shall not be paid from the provisional sum. The contractor’s costs to render such assistance shall be deemed to have been included in his rate offered for pay sub-item B13.01(c), Contractor’s Establishment on Site and General Obligations: Time Related Obligations.
**Item**

**D10.02 Training**

(a) Generic skills ........................................ prime cost (PC) sum
   (i) Training Costs ........................................ prime cost (PC) sum
   (ii) Handling cost and profit in respect of subitem
       D10.02(a)(i) ........................................ percentage (%)

(b) NQF level 3 training ..........................................................
    (i) Training Costs ........................................ prime cost (PC) sum
    (ii) Handling cost and profit in respect of subitem
       D10.02(b)(i) ........................................ percentage (%)

(c) NQF level 4 training ..........................................................
    (i) Training Costs ........................................ prime cost (PC) sum
    (ii) Handling cost and profit in respect of subitem
       D10.02(c)(i) ........................................ percentage (%)

(d) Student experiential training ..........................................
    (i) Student stipend ....................................... prime cost (PC) sum
    (ii) Provision of experiential training .................. person month

(e) Other costs during training ........................................... provisional sum

(f) Training venue ............................................................ lump sum

The prime cost sum under sub-items D10.02(a)(i), D10.02(b)(i) and D10.02(c)(i) shall be paid in accordance with the provision of sub-clause 13.5 of the FIDIC Conditions of Contract. The prime cost sums shall include all charges for provision and delivery of the service by accredited trainers including the cost of undertaking the required skills audits and analyses and creation of the individual training programmes.

The rates tendered under sub-items D10.02(a)(ii), D10.02(b)(ii) and D10.02(c)(ii) shall be deemed to cover all costs required to organise accredited trainers to provide training and shall include the contractor’s handling cost, profit, record keeping, reporting and all other costs in connection therewith.

The prime cost sum under sub-item D10.02(d)(i) shall be paid in accordance with the provision of sub-clause 13.5 of the FIDIC Conditions of Contract. The prime cost sum shall cover the monthly stipend as prescribed by the Employer to be paid to students.

The unit of measurement for sub-item D10.02(d)(ii) shall be the person-month, with pro-rata payments made for partial months for training provided based on a 23 working day month.

The rate tendered under sub-item D10.02(d)(ii) shall include full compensation for the Contractor to provide training to the students provided by the Employer inclusive of all costs to communicate with the Employer and any other body or organisation in respect of work assigned to the students. The rate tendered shall include telephone calls and charges, stationery and information technology hardware, software, connection or licence costs and lost production, profits and all other incidentals as well as all administrative and overhead costs.

The provisional sum under pay item D10.02(e) shall be paid in accordance with the provision of sub-clause 13.5 of the FIDIC Conditions of Contract. The provisional sum shall include wages of trainees during the duration of the courses, provision of meals, transport and all other incidentals required by the trainees and approved by the engineer. No mark-up is payable to the contractor under this item.

The unit of measurement for pay item D10.02(f), shall be the lump sum. The sum tendered shall include full compensation for the provision of the training venue, for all necessary lighting, power, furniture, stationery, consumables and study material and all other costs necessary to maintain the venue for the duration of the contract. Payment of the lump sum shall be made in two instalments as follows:

The first instalment, 75% of the lump sum, shall be paid after the contractor has met all his obligations regarding the provision of the training venue as specified.
The second and final instalment, 25% of the lump sum, shall be paid after the provision of all the accredited training as specified in the document.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>D10.03 Bonus</td>
<td>............................................................... provisional (Prov) sum</td>
</tr>
</tbody>
</table>

The provisional sum shall cover any CPP bonus due as specified in clause D1003. The provisional sum shall be expended in accordance with clause 13.5 of the FIDIC Conditions of Contract.

**Note:**
No separate payment shall be made for any costs incurred by the Contractor, whether direct or indirect, for his efforts in accomplishing the specified requirements, and which are not recoverable from the pay-items allowed. Such costs shall be deemed to have been included in the rate offered under pay sub-item 13.01(c), Contractor's Establishment on Site and General Obligations: Time Related Obligations.

No payment, nor pro rata payment, shall be made for trainees that, once selected, do not attend or only partially complete structured training courses. The contractor’s own staff may attend the courses provided. However, such attendants from the contractor’s staff shall not be considered for measurement and payment purposes unless they also qualify as Targeted Labour.
SECTION E: REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS

Note to tenderer:
Wherever reference is made in this section of the Scope of Works to contractor this is the equivalent of the principal contractor in the Occupational Health and Safety Act and Regulations. Similarly, reference to subcontractors is equivalent to other contractors.
### SECTION E: REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS

#### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1001</td>
<td>SCOPE</td>
<td>C-249</td>
</tr>
<tr>
<td>E1002</td>
<td>GENERAL OCCUPATIONAL HEALTH AND SAFETY PROVISIONS</td>
<td>C-249</td>
</tr>
<tr>
<td>E1003</td>
<td>OPERATIONAL CONTROL</td>
<td>C-254</td>
</tr>
<tr>
<td>E1004</td>
<td>PROJECT/SITE SPECIFIC REQUIREMENTS</td>
<td>C-256</td>
</tr>
</tbody>
</table>
This part of the specification has the objective to assist the contractor entering into contracts with the Employer that they comply with the Occupational Health and Safety (OH&S) Act, No. 85 of 1993, as well as all applicable Regulations. Compliance with this document does not absolve the contractor from complying with minimum legal requirements and the contractor remains responsible for the health and safety of his employees and those of his Mandataries. The contractor shall therefore include this part of the specification to any contract that he may have with subcontractors and/or suppliers.

This section covers the development of a health and safety specification that addresses all aspects of occupational health and safety as affected by this contract. It provides the requirements that the contractor shall comply with in order to reduce the risks associated with this contract, which may lead to incidents causing injury and/or ill health. In this matter the spirit and intention of Regulation 5(1)(l) of the Construction Regulations, 2014 regarding negotiations between the parties, related to the contents and approval of the Health and Safety Plan, must be complied with.

E1002 GENERAL OCCUPATIONAL HEALTH AND SAFETY PROVISIONS

(a) Hazard Identification and Risk Assessment (Construction Regulation 9)

(i) Risk Assessments

Clause E1004 contains a generic list of risk assessment headings that have been identified by the Employer as possibly applicable to this contract. It is, by no means, exhaustive and is offered as assistance to the contractor.

(ii) Development of Risk Assessments

The contractor shall, before the commencement of any construction work or work associated with the aforesaid construction work and during such work, conduct a risk assessment by a competent person and the risk assessment so produced shall form part of the OH&S plan and be implemented and maintained as contemplated in Construction Regulation 9(1). Competence is a factor of training, knowledge, experience and/or appropriate qualifications. Where proof of competence is required by the Regulation, a concise CV must be attached to the appointment letter.

The risk assessment shall include, as far as is reasonably practicable, at least:

- the identification of the risks and hazards to which persons may be exposed;
- the analysis and evaluation of the risks and hazards identified, inclusive of a residual risk rating methodology. The method to be used is not prescribed;
- a documented plan of safe work procedures, to mitigate, reduce or control those residual risks that have been identified as unacceptably high, by means of the rating system;
- a monitoring plan;
- a review plan, inclusive of dates to be adhered to; and
- ergonomic related risks are to be analysed, evaluated and addressed as part of the process.

Based on the risk assessments, the contractor shall develop a set of site-specific OH&S rules that shall be applied to regulate the OH&S aspects of the construction. The risk assessments, together with the site-specific OH&S rules shall be submitted to the Employer before construction on site commences. Despite the more advanced (or site specific) risk assessments listed below in clause E1004: PROJECT/SITE SPECIFIC REQUIREMENTS, the Employer would have conducted a baseline risk assessment before work commences and made the same available to the contractor. This does not mean that all possible Risk Assessments must be attended to before work commences, but
that all relevant Risk Assessments receive the necessary attention as the contract progresses, and this is the responsibility of the contractor.

All variations to the scope of work shall similarly be subjected to a risk assessment process.

(iii) Review of Risk Assessment

The contractor shall review the hazard identification, risk assessments and standard working procedures at each production planning and progress report meeting as the contract work develops and progresses and each time changes are made to the designs, plans and construction methods and processes. The contractor shall provide the Employer, subcontractors and all other concerned parties with copies of any changes, alterations or amendments as contemplated above.

(b) Legal Requirements

The contractor shall, as a minimum, comply with:

- The Occupational Health and Safety Act and Regulations (Act 85 of 1993), an up-to-date copy of which shall be available on site at all times.
- The Compensation for Occupational Injuries and Diseases Act (Act 130 of 1993), an up-to-date copy of which shall be available on site at all times.
- Where work is being carried out on a “mine”, the contractor shall comply with the Mines Health and Safety Act and Regulations (Act 29 of 1960) and any other OH&S requirements that the mine may specify. An up-to-date copy of the Mines Health and Safety Act and Regulations shall be available on site at all times.

(c) Structure and Responsibilities

(i) Overall Supervision and Responsibility for OH&S

It is a requirement that the contractor, when he appoints subcontractors in terms of Construction Regulations 7(1)(c), 7(1)(d), 7(1)(f) and 7(3) includes in his agreement with such subcontractors the following:

- OH&S Act (85 of 1993), Section 37(2) agreement: “Agreement with Mandatary”
- OH&S Act (85 of 1993), Section 16(2) appointee/s as detailed in his/her/their respective appointment forms. (Where applicable)

(ii) Further (Specific) Supervision Responsibilities for OH&S

The contractor shall appoint designated competent employees and/or other competent persons as required by the Act and Regulations. Below is a generic list of identified appointments and may be used to select the appropriate appointments for this contract. The contractor shall note that it is a generic list only and is intended for use as a guideline.

<table>
<thead>
<tr>
<th>Appointment</th>
<th>Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction manager (Contractor’s Representative), Assistant Construction Manager, Construction Supervisor, Assistant Construction Supervisor</td>
<td>(Construction Regulation 8(1), 8(2), 8(7) and 8(8)</td>
</tr>
<tr>
<td>Construction Vehicles and Mobile Plant/Machinery Supervisor</td>
<td>(Construction Regulation 23)</td>
</tr>
<tr>
<td>Demolition Supervisor</td>
<td>(Construction Regulation 14)</td>
</tr>
<tr>
<td>Drivers and Operators of Construction Vehicles or Plant</td>
<td>(Construction Regulation 23)</td>
</tr>
<tr>
<td>Electrical Installation and machinery on construction sites</td>
<td>(Construction Regulation 24)</td>
</tr>
<tr>
<td>Emergency/Security/Fire Coordinator</td>
<td>(Construction Regulation 29)</td>
</tr>
</tbody>
</table>
Excavation Supervisor (Construction Regulation 13)
Explosive actuated fastening device (Construction Regulation 21)
Fall Protection Supervisor (Construction Regulation 10)
First Aider (General Safety Regulation 3)
Fire Equipment Inspector (Construction Regulation 29)
Temporary Works designer and Temporary Works Supervisor (Construction Regulation 12)
Hazardous Chemical Substances Supervisor (HCS Regulations)
Incident Investigator (General Admin Regulation 29)
Ladder Inspector (General Safety Regulation 13A)
Crane (Construction Regulation 22)
Materials Hoist Inspector (Construction Regulation 19)
OH&S Committee (OH&S Act Section 19)
Construction OH&S Officer (Construction Regulation 8(5) & 8(6))
OH&S Representatives (OH&S Act Section 17)
Person Responsible for Machinery (General Machinery Regulation 2)
Scaffolding Supervisor (Construction Regulation 16)
Stacking & Storage Supervisor (Construction Regulation 28)
Structures Supervisor (Construction Regulation 11)
Suspended Platform Supervisor (Construction Regulation 17)
Tunnelling Supervisor (Construction Regulation 15)
Bulk Mixing Plants (Construction Regulation 20)
Working on/next to Water Supervisor (Construction Regulation 26)
Welding Supervisor (General Safety Regulation 9)

It is a requirement that a part-time Construction health and safety officer is appointed as per Construction Regulation 8(5) and that the Construction health and safety officer complies with the requirements of Construction Regulation 8(6).

In addition the Employer requires that a Traffic Safety Officer be appointed. The above appointments shall be in writing and the responsibilities clearly stated together with the period for which the appointment is made. This information shall be communicated and agreed with the appointees. Notice of appointments shall be submitted to the Employer. All changes shall also be communicated to the Employer.

The contractor shall, furthermore, provide the Employer with an organogram of all subcontractors that he/she has appointed or intends to appoint and keep this list updated and prominently displayed on site.

(iii) Designation of OH&S Representatives (Section 17 of the OH&S Act)

Where the contractor employs more than 20 persons (including the employees of subcontractors) he has to appoint one OH&S representative for every 50 employees or part thereof. This is a minimum (legal) requirement. The contractor may at his own discretion appoint more OH&S Representatives according to site specific requirements. General Administrative Regulation 6 requires that the appointment or election and subsequent designation of the OH&S representatives be conducted in consultation with employee representatives or employees. (Section 17 of the Act and General Administrative Regulation 6 & 7). OH&S representatives shall be designated in writing and the designation shall include the area of responsibility of the person and term of the designation. OH&S representatives must be experienced, permanently employed by the contractor or his subcontractors, trained and able to move freely within their designated area of responsibility.
(iv) Duties and Functions of the OH&S Representatives (Section 18 of the OH&S Act)

The contractor shall ensure that the designated OH&S representatives conduct continuous monitoring and regular inspections of their respective areas of responsibility, focusing on unsafe acts and unsafe conditions and report thereon to the contractor. OH&S representatives shall participate in accident or incident investigations. OH&S representatives shall attend all OH&S committee meetings.

(v) Appointment of OH&S Committee (Sections 19 and 20 of the OH&S Act)

The contractor shall establish an OH&S committee, which shall meet at least once a month.

(d) Administrative Controls and the Occupational Health & Safety File

(i) The OH&S File (Construction Regulation 7(1)(b))

As required by Construction Regulation 7(1), the contractor and subcontractors shall each keep an OH&S file on site. The following list is neither exhaustive nor prescriptive but recommended as a guide for the contents of the OH&S file:

- Notification of construction work (Construction Regulation 4) where applicable
- Latest copy of OH&S Act (General Administrative Regulation 4)
- Proof of registration and good standing with COID Insurer (Construction Regulation 5(1)(j))
- OH&S plan agreed with the Employer including the underpinning risk assessment/s and method statements (Construction regulation 7(1))
- Copies of OH&S committee and other relevant minutes
- Designs/drawings (Construction Regulation 7(1)(e))
- A list of subcontractors including copies of the agreements between the parties and the type of work being done by each subcontractor (Construction Regulation 7(1)(f))
- Appointment/designation forms as per sub-sub-clause E1002(a)(i) and (ii).
- Registers as follows:
  - Accident/Incident register (Annexure 1 of the General Administrative Regulations)
  - OH&S representatives’ inspection register
  - Asbestos demolition and stripping register
  - Bulk mixing plant inspections
  - Construction vehicles and mobile plant inspections by controller
  - Daily inspection of vehicles, plant and other equipment by the operator/driver/user
  - Demolition inspection register
  - Designer’s inspection of structures record
  - Electrical installations, -equipment and -appliances (including portable electrical tools)
  - Excavations inspection
  - Explosive actuated fastening device inspection, maintenance, issue and returns register (incl. cartridges and nails)
  - Fall protection inspection register
  - First aid box contents
  - Fire equipment inspection and maintenance
  - Temporary works inspections
  - Hazardous chemical substances record
  - Ladder inspections
  - Lifting equipment register
  - Materials hoist inspection register
  - Machinery safety inspection register (incl. machine guards, lock-outs etc.)
  - Scaffolding inspections
- Stacking and storage inspection
- Inspection of structures
- Inspection of suspended platforms
- Inspection of tunnelling operations
- Inspection of vessels under pressure
- Welding equipment inspections
- Inspection of work conducted on or near water
- Welfare facilities as provided

(e) Notification of Construction Work (Construction Regulation 3)

The contractor shall, where the contract meets the requirements laid down in Construction Regulation 4 prior to commencement notify the Department of Labour of the intention to carry out construction work and use the form (Annexure 2 in the Construction Regulations) for the purpose. A copy shall be kept on the OH&S file and a copy shall be forwarded to the Employer for record keeping purposes.

(f) Training and Competence

The training required by the Act and Regulations shall be included in the contractor’s OH&S plan. The contractor shall be responsible for ensuring that all relevant training is undertaken. Only accredited training providers shall be used for the regulatory OH&S training. The contractor shall ensure that his and his subcontractors’ personnel appointed are competent and that all training required for doing the work safely and without risk to health, has been completed before work commences. The contractor shall ensure that follow-up and refresher training is conducted as the contract work progresses and the work situation changes. This does not absolve any subcontractors from their responsibilities as Employers. Records of all training must be kept on the OH&S file for auditing purposes.

(g) Consultations, Communication and Liaison

OH&S liaison between the Employer, the contractor, the subcontractors, the designer and other concerned parties will be through the OH&S committee as contemplated in sub-sub-clause E1002(c)(v). In addition to the above, communication may be directly to the Employer or his appointed agent, verbally or in writing, as and when the need arises.

Consultation with the workforce on OH&S matters will be through their construction managers and supervisors, OH&S representatives and the OH&S committee. The contractor shall be responsible for the dissemination of all relevant OH&S information to the subcontractors e.g. design changes agreed with the Employer and the designer, instructions by the Employer and/or his/her agent, exchange of information between subcontractors, the reporting of hazardous/dangerous conditions/situations etc. The contractors’ most senior manager on site shall be required to attend all OH&S meetings.

(h) Checking, Reporting and Corrective Actions

(i) Monthly Audit by Employer (Construction Regulation 5(1)(o)

The Employer will conduct monthly health and safety and document verification audits in compliance with Construction Regulation 5(1)(o) in order to ensure that the contractor has implemented and is maintaining the agreed and approved OH&S plan.

(ii) Other Audits and Inspections by the Employer

The Employer reserves the right to conduct other ad hoc audits and inspections as deemed necessary. This will include site safety walks.
(iii) **Contractor’s Audits and Inspections**

The contractor must conduct his own regular internal audits to verify compliance with his own OH&S management system, as well as with this specification. The contractor shall furthermore ensure that each subcontractor’s health & safety plan is being implemented by conducting periodic audits at intervals mutually agreed between the contractor and subcontractors, but at least once per month.

(iv) **Inspections by OH&S Representatives and other Appointees**

OH&S representatives shall conduct weekly inspections of their areas of responsibility and report thereon to their foreman or supervisor whilst other appointees shall conduct inspections and report thereon as specified in their appointments e.g. vehicle, plant and machinery drivers, operators and users must conduct daily inspections before start-up.

(v) **Recording and Review of Inspection Results**

All the results of the abovementioned inspections shall be in writing, reviewed at OH&S committee meetings, endorsed by the chairman of the meeting and placed on the OH&S File.

(i) **Accidents and Incident Investigation (General Administrative Regulation 9)**

The contractor and his subcontractors shall coordinate their investigation of all accidents/incidents where employees and non-employees were injured to the extent that he/she/they had to be referred for medical treatment by a doctor, hospital or clinic. The results of the investigation shall be entered into an accident/incident register listed in sub-sub-clause E1002(d)(i).

The affected subcontractor shall be responsible for the investigation of all minor and non-injury incidents as described in Section 24(1)(b) & (c) of the Act and keeping a record of the results of such investigations including the steps taken to prevent similar accidents in future.

(j) **Reporting**

The contractor shall provide the Employer with copies of all statutory reports required in terms of the Act within 7 days of the incident occurring. In addition, the contractor shall update monthly the Disabling Injury Frequency Ratio (DIFR) and display this information on a signboard at the site office.

(k) **Medical certificate of fitness (Construction Regulation 7 (1) (g) and 7 (8)**

The Contractor as well as subcontractor (where appointed) shall ensure that all their employees have a valid certificate of fitness, specific to the construction work to be performed and issued by an occupational health practitioner, in the form of Annexure 3 to Government Gazette No. 37305 of 7 February 2014.

**E1003 OPERATIONAL CONTROL**

(a) **Operational Procedures**

Each construction activity shall be assessed by the contractor so as to identify operational procedures that will mitigate against the occurrence of an incident during the execution of each activity. This specification requires the contractor:
- to be conversant with all relevant Regulations;
- to comply with their provisions;
- to include them in his OH&S plan where relevant.

(b) **Emergency Procedures**
Simultaneous with the identification of operational procedures (per sub-clause E1003(a) above), the contractor shall similarly identify and formulate emergency procedures in the event an incident does occur. The emergency procedures thus identified shall also be included in the contractor’s OH&S plan, and communicated as part of induction training. It is the responsibility of the first aid worker, together with the construction supervisor, to make an assessment regarding the severity of injuries and which actions are appropriate. For example: transfer to a medical facility by ambulance or helicopter.

(c) Personal & Other Protective Equipment (Sections 8/15/23 of the OH&S Act)

The contractor shall identify the hazards in the workplace and deal with them. He must either remove them or, where impracticable, take steps to protect workers and make it possible for them to work safely and without risk to health under the hazardous conditions.

Personal protective equipment (PPE) should, however, be the last resort and there should always first be an attempt to apply engineering and other solutions to mitigating hazardous situations before the issuing of PPE is considered.

Where it is not possible to create an absolutely safe and healthy workplace the contractor shall inform employees regarding this and issue, free of charge, suitable equipment to protect them from any hazards being present and that allows them to work safely and without risk to health in the hazardous environment.

It is a further requirement that the contractor maintain the said equipment, that he instructs and trains the employees in the use of the equipment and ensures that the prescribed equipment is used by the employee/s.

Employees do not have the right to refuse to use/wear the equipment prescribed by the Employer and, if it is impossible for an employee to use or wear prescribed protective equipment through health or any other reason, the employee cannot be allowed to continue working under the hazardous condition/s for which the equipment was prescribed but an alternative solution has to be found that may include relocating or discharging the employee.

The contractor shall include in his OH&S plan the PPE he intends issuing to his employees for use during construction and the sanctions he intends to apply in cases of non-conformance by his employees. Conformance to the wearing of PPE shall be discussed at the weekly inspection meetings.

(d) Other Regulations

Wherever in the Construction Regulations or this specification there is reference to other regulations (e.g. Construction Regulation 24: Electrical Installations and Machinery on Construction Sites) the contractor shall be conversant with and shall comply with these regulations.

(e) Public Health & Safety (Section 9 of the OH&S Act)

The contractor shall, as far as is reasonably practicable, be responsible for ensuring that non-employees affected by the construction work are made aware of the dangers likely to arise from said construction work as well as the precautionary measures to be observed to avoid or minimise those dangers.

This includes:
- Non-employees entering the site for whatever reason
- The surrounding community
- Passers by to the site
E1004 PROJECT/SITE SPECIFIC REQUIREMENTS

For the project specific Health and Safety specifications, including the baseline risk assessment, please refer to the document “Project Health and Safety Specification” included in Annexure B (Part C5).
<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1001</td>
<td>TECHNICAL SPECIFICATION</td>
<td>C-258</td>
</tr>
<tr>
<td>F1002</td>
<td>AURECON STANDARD SPECIFICATIONS</td>
<td>C-265</td>
</tr>
<tr>
<td>F1003</td>
<td>AURECON TYPICAL DRAWINGS</td>
<td>C-266</td>
</tr>
</tbody>
</table>
F1001 TECHNICAL SPECIFICATION

This part of the specification summarises the street lighting component of the construction activities and specification.

Contents

F1001.1 GENERAL .................................................................................................................... C-259
F1001.2 ELECTRICAL OPERATING PARAMETERS .................................................................. C-260
F1001.3 PHYSICAL AND CLIMATIC CONDITIONS ................................................................. C-260
F1001.4 FUNCTIONAL SYSTEM DESCRIPTION ....................................................................... C-260
F1001.5 SPECIFICATIONS ....................................................................................................... C-261
F1001.1 GENERAL

(a) Compliance with Specification

(i) Standard Aurecon Specifications (refer to Section F1002)

PS-001 Introduction to Standard Engineering Specifications
PS-002 Engineering Specification for Inspection, Testing and Commissioning
PS-003 Engineering Specification for Medium and Low Voltage Cable Systems
PS-004 Engineering Specification for Trenching and Excavations
EL-07 Earthing of Industrial MV & LV Electrical Installations
PS-601 Engineering Specification for Street and Area Lighting

(ii) Technical Datasheets (refer to PART T2: RETURNABLE SCHEDULES, FORMS G2)

a) PS-003 LV Cable Systems Datasheet
b) EL-07 Earthing Datasheet
c) PS-004 Trenching and Excavations Datasheet
d) PS-601 Street and Area Lighting Datasheet

(iii) Drawings (refer to Book 4.)

All drawings as listed in Book 4.

(iv) Order or Precedence of Documentation

With regards to the street lighting works, in case of any contradiction between the technical specifications, technical datasheets and drawings, the order of precedence shall be:

- Particular Specification (This Section)
- Technical Datasheets
- Drawings
- Standard Aurecon Specifications

(v) General

Only 100% new equipment and/or material may be offered.

As far as possible, all new products shall be of the same manufacturer as similar existing products at the Works.

All material shall comply with the relevant part of these specifications. In case of there being no specification for a particular item, the tenderer must inform the Engineer thereof. The Engineer will resolve the matter in writing before tender closure.

The equipment and installation supplied under this contract shall be guaranteed for a minimum period of twelve months. This defects notification period will commence on issue of the Taking-over certificate and shall be terminated by issue of a Performance certificate. The tender price shall include for this period.

(b) Scope of Works

The two flood lights are to be installed under this contract are located on the N2 roadway in the George Municipality vicinity as per drawing 112471-E-SL-02.

The flood lights will be installed at the ends of the Thembalethu pedestrian overpass on the N2 roadway. This part of the tender shall include the design, supply, delivery, installation, testing and commissioning of:

- Mid-hinge lighting masts, luminaires and electric control gear
- Structurally engineered concrete plinth for wind and load factors of the mid-hinge mast
- Low voltage street light cable. The cable shall be routed and terminated from the existing Streetlight SL6/10 to connect to the newly installed flood lights.
- Bare Copper Earth Wire (BCEW) installed in parallel with all low voltage cables
- All labelling and danger signage

The works shall include liaison with the Western Cape Provincial office and George Municipality, including any and all wayleaves, permits and connection of works to the supply point. The works includes testing & commissioning and making right of all works for service. Including all documentation for factory acceptance test (FAT) and site acceptance test (SAT)
A complete Operational and Maintenance Manual is to be submitted. The manual shall include all FAT & SAT reports, manufacturing drawings, As Built drawings, technical datasheets and defects list at time of taking over.

The contractor shall ensure that all requirements are met for the successful integration of the works to ensure that the street lighting installation is fully functional to the approval of the Employer, the Provincial office and the Engineer.

**F1001.2 ELECTRICAL OPERATING PARAMETERS**

The operating conditions of the electrical network to which the complete electrical installation shall connect, is specified in the table below.

Table F1: Electrical System Operating Parameters

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>System Voltage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Nominal</td>
<td>V</td>
<td>400</td>
</tr>
<tr>
<td>1.2</td>
<td>Maximum</td>
<td>V</td>
<td>415</td>
</tr>
<tr>
<td>2</td>
<td>System Fault Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>3 Phase</td>
<td>kA</td>
<td>2.8</td>
</tr>
<tr>
<td>2.2</td>
<td>Single Phase</td>
<td>kA</td>
<td>Unknown</td>
</tr>
<tr>
<td>3</td>
<td>Frequency</td>
<td>Hz</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>Phase Rotation (Standard / Non-Standard)</td>
<td></td>
<td>RWB positive phase sequence</td>
</tr>
<tr>
<td>5</td>
<td>Earthing Method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Direct or Indirect</td>
<td></td>
<td>Direct</td>
</tr>
</tbody>
</table>

**F1001.3 PHYSICAL AND CLIMATIC SITE CONDITIONS**

Refer to section PART C4: SITE INFORMATION below.

**F1001.4 FUNCTIONAL SYSTEM DESCRIPTION**

**(a) General**

The flood lighting installation will form part of the Thembalethu Pedestrian Overpass on the N2 roadway. The objective of the client is to ensure that the Pedestrian Overpass is well lit for use and security of pedestrians in the area, and the lighting requirements confirm with SANS.

**(b) Description and Co-ordination of works**

All works shall be completed as described below:

- Construct plinths for mid-hinge mast and create safe space for installation and lowering of the mast. Allow sufficient time for plinths to cure for 28 days.
- Erect mid-hinge mast with luminaire and internal wiring
- Obtain all notices and permits from the George Municipality Electricity Department to disconnect the streetlights at the pole mounted street light control box fed from the existing ground mounted Bontebok Street 200 kVA transformer.
- Trench and install 16 mm 4 core copper cable and 10 mm stranded copper conductor from existing streetlight SL6/10 to new floodlight SL6/11. Terminate at both ends and backfill the excavations and restore soil conditions to its natural state.
• Install 16 mm 4 core copper cable and 10 mm stranded copper conductor in ducts across the pedestrian overpass and terminate from SL6/11 to Sl6/12.
• Label all equipment before commissioning.
• Commission the installation and issue Certificate of Compliance (CoC).

The description and co-ordination of works shall follow the requirements of the development and co-ordination between the main Civil Contractor and the relevant Western Cape Provincial office.

The tenderer shall price as if the works is continuous and follows a standard construction process without disruptions.

Upon his appointment, the contractor shall draw up a detailed schedule of works for the project.

F1001.5 SPECIFICATIONS

(a) Drawings

A complete drawing list and drawings relevant to the streetlight works forms part of Book 4.

(b) Interface with other parties and Battery Limits

Various interfaces with other parties are required to ensure a seamless integration of the Works:

(i) Civil Works

The Main civil contractor will be constructing all civil related works. The Main civil contractor will also be installing all the required ducting for the electrical works. The marking and labelling requirements of the electrical ducts is however included in the works of the street lighting tenderer.

(ii) Client

The successful tenderer will be responsible to liaise with the client (Western Cape Provincial Office) and George Municipality Electrical Department through the Main Civil Contractor, in order to successfully disconnect and connect to the existing LV network. The Works, will be handed over to the client, through the Main Civil Contractor, after the works have been completed. Close co-ordination with the client’s Clerk of Works and other representatives from the client, through the Main Civil Contractor, shall be required to ensure a seamless integration of the works.

(iii) Engineer

The successful tenderer shall closely liaise with the Site Engineer and obtain his approval as per the requirements of this contract.
(c) Preliminary and General

All Preliminaries and General required for this tender shall comply with Preliminary and General Specifications, as provided to the Main Civil Contractor.

(d) Introduction to Standard Engineering Specifications

All quality guidelines for this project shall comply with Engineering Standard PS-001: Introduction to Standard Engineering Specifications.

All equipment must have suitable labelling and signage as approved by the client.

(e) Inspection, Testing and Commissioning of Electrical Equipment and Installations


It remains the responsibility of the tenderer to do the required pre-tests before an inspection, FAT, SAT or commissioning.

If an inspection, FAT, SAT or commissioning fails the tenderer shall remedy all failures at his own cost and retest the hardware. If the retest requires witnessing by the Engineer and client the tenderer shall carry all costs associated with this testing.

(f) Operational and Maintenance Manuals

Operational and Maintenance manuals must be compiled and submitted to the Engineer for approval.

A pro forma index for the manuals is listed below to guide the contractor. The manuals are divided into three volumes namely,

- Volume 1 for regular use,
- Volume 2 to be used once a year and
- Volume 3 for reference

(g) Flood lighting

The supply, delivery, installation, testing, commissioning and handover of the flood lighting systems (mast and luminaire) that are required for this tender shall comply with:

- Engineering Standard PS-601 Street and Area Lighting
- PS-601 Street and Area Lighting Datasheet

(i) Mid-hinge Masts

The new mid-hinge masts will be Hot Dip Galvanized Steel Poles.

- Mast Installation
  The installed masts under this contract shall be installed so that the access openings are accessible. The orientation shall be the same on all poles.

- Pole Base Compartment Equipment
  Circuit breakers shall be fixed to the backboard and shall be Din Rail mounted. Breakers shall be fitted with shrouds to prevent accidental contact with live terminals. They shall be positioned to facilitate access to the operating toggle. The contractor shall install and terminate a 4-Core cable within each streetlight pole, from the circuit breaker, at the bottom of the pole, to the luminaire, as shown in drawing 112471-E-SL-05.

- Anti-Theft Measures

C-262
The fixing screws shall be high security countersunk types with Allen socket heads. The sockets shall have a hardened pin in the centre of the socket, which requires an Allen key with a matching hole in the end of the key to enable it to be inserted into the socket and release the screw. The access cover shall be strapped closed with stainless steel “Bandit” strapping. Two Bandit straps, covering the fixing screws, shall be used over each access cover.

Where the design of the access cover precludes the implementation of these measures Bandit straps shall still be fitted but may be installed between the access cover screws i.e. above the lower screw and below the upper screw making it more difficult to force the strap beyond the edge of the cover.

(ii) **Luminaires**

All luminaires to be installed shall be BEKA LED flood MAXI luminaires or similar with the same distribution of light and at least equal performance. The Engineer’s prior approval shall be obtained for the use of any proposed substitute luminaires.

(h) **Low Voltage Cable Systems**

The supply, delivery, installation, testing, commissioning and handover of the Low Voltage cable systems that are required for this tender shall comply with:

- Engineering Standard PS-003 Engineering Specification for Medium and Low Voltage Cable Systems
- PS-003 LV Cable Systems Datasheet

The streetlight supply feeder cable routes from the existing Streetlight shall be as indicated in the drawing 112471-E-SL-02 in Book 4. These cables shall be installed in a trench as per drawing 112471-E-SL-04 in Book 4. These shall be 4-core, 600/1000V Cu/PVC/SWA cables.

The streetlight service connection cables shall be 3 x 1-core PVC insulated Cu cables running from the circuit breaker at the base of the pole to luminaire.

(i) **Earthing**

The supply, delivery, installation, testing, commissioning and handover of the earthing system that are required for this tender shall comply with:

- Engineering Standard EL-07 Earthing of Industrial MV & LV Electrical Installations
- EL-07 Earthing Datasheet

Bare Copper Earth Wire (BCEW) shall be installed in parallel with the streetlight supply feeder cables, back to the earth bar of the streetlight LV kiosk. All BCEW to be terminated onto the earth stud located inside the lighting poles.

(j) **Trenching and Excavation**

The streetlights supply cables shall be installed in trenches 0.8m x 0.4m (depth x width) for the whole length of the streetlight pole installation. The details of the LV cable trenches required, as shown in 112471-E-SL-04 in Book 4, are given and shall comply with:

- PS-004 Engineering Specification for Trenching and Excavations
- PS-003 LV Cable Systems Datasheet

The Tenderer shall be responsible for all trenching and excavation works in the project area. The measurement of the trenches is detailed in the Bill of Quantities (BOQ). The Tenderer must provide a rate to excavate the trench to the required dimension as set out in the Bill of Quantities. Rates per soft ground (pickable ground), Jackhammer and hard rock (blasting) must be submitted.

The Tenderer shall ensure that all required trenching and excavations are timeously completed to prevent delays to the construction program. As per local authority requirements, the contractor shall liaise with the responsible person, through the Main Contractor, for approvals and permits and also ensure that that roadways and surrounding areas are made good after completion of works.

The Tenderer shall ensure that all required trenching, excavations and backfilling associated with road crossings, including final layer compaction, are completed and comply with the PS-004 Engineering Specification.
(k) Labelling

All newly installed equipment under this contract shall comply with the labelling requirements indicated in:

- Engineering Standard PS-003 Engineering Specification for Medium and Low Voltage Cable Systems
- Engineering Standard PS-601 Street and Area Lighting

In addition, the following specification shall be adhered to with regards to the streetlight pole numbering:

- Poles shall be numbered and labelled using reflective, self-adhesive foil stickers, designed for outdoor use. The stickers shall be placed at a height of 3500 above ground level, facing approaching traffic, in a position allowing the number to be easily read from a passing vehicle. Lettering shall be black on a yellow background and a minimum of 50 mm high.
- The numbering shall match the existing system, or otherwise shall be based on the following logic. Each supply point is numbered. Appropriate labels, if not already present, shall be fitted to the supply kiosks or panels. Poles shall be numbered sequentially starting from the poles closest to each point of supply and moving towards the last pole on each circuit.

(l) Design and Manufacturing Drawings

The contractor is to provide design and manufacturing drawings for the concrete plinth and flood lighting masts, inclusive of luminaires. All drawings shall be approved in principle by the Engineer before manufacturing.

The final installation by means of as built drawings will be signed by the Contractor's appointed ECSA registered structural engineer who has sufficient experience with such works.
F1002 AURECON STANDARD SPECIFICATIONS

The following additional specifications (attached separately) are included in addition to the Particular Specification in Section F1001:

a) PS-001 – Introduction to Standard Engineering Specifications
b) PS-002 – Engineering Specification for Inspection, Testing and Commissioning
c) PS-003 – Engineering Specification for Medium and Low Voltage Cable Systems
d) PS-004 – Engineering Specification for Trenching and Excavations
e) S-EE-0020 – Earthing of Industrial MV & LV Electrical Installations
f) PS-601-Engineering Specification for Street and Area Lighting
ENGINEERING STANDARD PS-001

INTRODUCTION TO STANDARD ENGINEERING SPECIFICATIONS

aurecon
# TABLE OF CONTENTS

1. INTRODUCTION .................................................................................................................. 5
2. STANDARDS .......................................................................................................................... 6
   2.1 Associated Documentation .............................................................................................. 6
   2.2 Regulations, Specifications and Standards ....................................................................... 6
3. DRAWINGS AND DOCUMENTATION .................................................................................... 12
   3.1 General ............................................................................................................................ 12
   3.2 Drawings .......................................................................................................................... 12
   3.3 Operation and Maintenance Manuals ............................................................................. 12
4. PERFORMANCE WARRANTY ................................................................................................. 14
5. SIGNAGE, NOTICES AND LABELLING .............................................................................. 15
   5.1 Danger Notices and Phase Identification Disks ............................................................... 15
   5.2 Marking and Labelling .................................................................................................... 15
   5.3 Labelling of Cables ......................................................................................................... 16
   5.4 Paint Colours .................................................................................................................. 16
6. CLEARANCES OF OUTDOOR BUSBARS, CONNECTIONS AND OVERHEAD LINES 17
   6.1 Minimum Clearances of Outdoor Busbars and Connections ......................................... 17
   6.2 Earth Conductor Sizes .................................................................................................... 17
# Amendment History

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Amendment Section / Chapter / Page</th>
<th>Version</th>
<th>Checked By: Name And Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011-11-21</td>
<td>First Issue</td>
<td>Ver 0</td>
<td>A Zwiegers</td>
</tr>
</tbody>
</table>
| 2     | 2012-08-06 | a)All SABS changed to SANS  
b) Introduction changed to reflect reference to standard technical specification  
c) Table 6.4 updated to reflect SANS 780 Table 2 | Ver1    | K Adu-Asomaning/A Zwiegers   |
CD containing manuals added to operations and maintenance manuals  
Numbering changes: 6.4 renumbered 7.  
Table 6.4 renumbered 7.1.  
Tables 7.2 added to insulations levels for transformer | Ver2    | K Adu-Asomaning/A Zwiegers   |
### Distribution Page

<table>
<thead>
<tr>
<th>Copy No</th>
<th>Name</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. INTRODUCTION

The specifications in this document form the basis of the quality guidelines for this project and serve to set the standards to which individual components as well as the complete installation must adhere. If any deviations from or additions to these specifications should occur, it is detailed in the relevant standard technical specification. In all cases the latest available update of the specifications mentioned, applies to this contract. All material supplied must be new and undamaged and SANS mark-bearing material shall have preference.
2. **STANDARDS**

2.1 **Associated Documentation**

2.1.1 This Specification identifies the Employer’s standard modifications and requirements which shall be applied to the statutory and recognised standards. The detailed specification of the project or site specific requirements will be found in the Particular Specification and its accompanying Technical Data Sheets, which shall be read in conjunction with this Specification and any other applicable Standard Specification documents.

The decreasing order of precedence of these requirements shall be as follows:

(a) Statutory requirements
(b) Employer’s requirements
(c) Project Technical Specifications:
   1. Drawings
   2. Technical Datasheets
   3. Aurecon Standard Engineering Specifications
(d) National and international standards

2.1.2 Any items not specifically detailed in this Specification, which are necessary to provide a safe and fully operational working system, shall be deemed to be included.

2.1.3 The Contractor shall operate an auditable quality assurance procedure covering the design, construction, inspection and testing of the installation.

2.2 **Regulations, Specifications and Standards**

The complete installation shall comply with all the latest editions (current at the time of Tender) of all relevant documents listed in the tables below, including:

(a) Construction Regulations 2003 issued in terms of Section 43 of the Act;
(b) Local Fire Regulations; and
(c) Regulations of the Local Supply Authority.

2.2.1 National Statutory Regulations

<table>
<thead>
<tr>
<th>ACT No. / Year issued</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Electricity Act</td>
</tr>
<tr>
<td>85/1993</td>
<td>Occupational Health and Safety Act</td>
</tr>
<tr>
<td>29/1996</td>
<td>Mines Health and Safety Act</td>
</tr>
<tr>
<td>50/1991</td>
<td>Minerals Act</td>
</tr>
<tr>
<td>73/1989</td>
<td>Environmental and Conservation Act</td>
</tr>
<tr>
<td>31/1963</td>
<td>Fencing Act</td>
</tr>
<tr>
<td>122/1984</td>
<td>Forest Act</td>
</tr>
<tr>
<td>63/1970</td>
<td>Mountain Catchment Areas Act</td>
</tr>
</tbody>
</table>

2.2.2 Guidelines and Recommended and Standard Codes of Practices

<table>
<thead>
<tr>
<th>No. / Year Issued</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAIC/1990</td>
<td>SA Steel Construction Handbook</td>
</tr>
<tr>
<td>NWP 3109</td>
<td>Standard Drawing Practice</td>
</tr>
</tbody>
</table>
### 2.2.3 SANS/SANS/NRS/BS/ANSI/IEC and Other Specifications

<table>
<thead>
<tr>
<th>SANS/SANS</th>
<th>Other Spec</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELECTRICAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SANS 1418, Part 1 tot 3</td>
<td>Aerial Bundled Conductor</td>
<td></td>
</tr>
<tr>
<td>DTS 0105 (NRS 018)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRS 051</td>
<td>ABC – Suspension and Strain fittings</td>
<td></td>
</tr>
<tr>
<td>SANS 135</td>
<td>Bolts and Nuts</td>
<td></td>
</tr>
<tr>
<td>SANS 178</td>
<td>Bolts, Eye</td>
<td></td>
</tr>
<tr>
<td>SANS 1195</td>
<td>Busbars</td>
<td></td>
</tr>
<tr>
<td>SANS 1632</td>
<td>BS 6290</td>
<td>Batteries</td>
</tr>
<tr>
<td>SANS 1652</td>
<td>Battery Charger</td>
<td></td>
</tr>
<tr>
<td>BSS 3858</td>
<td>Binding/Identification Sleeves for Cables and Wires</td>
<td></td>
</tr>
<tr>
<td>SANS 1268 : 1979 NRS 016 : 1991</td>
<td>CNE</td>
<td></td>
</tr>
<tr>
<td>SANS 0198 : 1988</td>
<td>Cables, installation of electric</td>
<td></td>
</tr>
<tr>
<td>NRS 012 : 1991 SANS 1507</td>
<td>Cables, low voltage - Solid Dielectric Insulation (PVC) 300/500 to 1900/3300V</td>
<td></td>
</tr>
<tr>
<td>SANS 150 - 1970</td>
<td>Cables – PVC Insulated and Flexible Cords</td>
<td></td>
</tr>
<tr>
<td>NRS 013 : 1991</td>
<td>Cables, medium voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cables – Cross-Linked Polyethylene (XLPE) 3.8/6.6 to 19/33kV</td>
<td></td>
</tr>
<tr>
<td>SANS 97/91</td>
<td>Cables – PILC 3.3/3.3 to 19/33kV</td>
<td></td>
</tr>
<tr>
<td>SANS 1507-6</td>
<td>Cable (house service split concentric) – Airdac</td>
<td></td>
</tr>
<tr>
<td>SANS 1507-6</td>
<td>Cable (House service concentric) - Airdac</td>
<td></td>
</tr>
<tr>
<td>SANS 1213 SANS/IEC 60529</td>
<td>Cable Glands</td>
<td></td>
</tr>
<tr>
<td>NRS 028</td>
<td>Cable lugs and ferrules</td>
<td></td>
</tr>
<tr>
<td>NRS 075</td>
<td>Cable lugs and ferrules – Mechanical Torque shear connectors</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>SANS 808</td>
<td>Cable Ties</td>
<td></td>
</tr>
<tr>
<td>DTS 0086 (NRS 020)</td>
<td>Clamps (strain for split concentric)</td>
<td></td>
</tr>
<tr>
<td>DTS 0086 (NRS 020)</td>
<td>Clamps (suspension for split concentric)</td>
<td></td>
</tr>
<tr>
<td>SANS 178</td>
<td>Clamps Strain</td>
<td></td>
</tr>
<tr>
<td>SANS 178</td>
<td>Clevis Tongue Adaptor (twisted)</td>
<td></td>
</tr>
<tr>
<td>SANS 10142</td>
<td>Clips for Wiring</td>
<td></td>
</tr>
<tr>
<td>SANS 1091</td>
<td>Colours - Standard</td>
<td></td>
</tr>
<tr>
<td>BS 3288 Part 1 (Tests)</td>
<td>Compression Fittings</td>
<td></td>
</tr>
<tr>
<td>SANS 470</td>
<td>DTS 0106 Concrete Poles</td>
<td></td>
</tr>
<tr>
<td>SANS 182</td>
<td>Conductor ACSR/AAC and AAAC</td>
<td></td>
</tr>
<tr>
<td>DTS 0087 (NRS 021)</td>
<td>Conductor, Covered</td>
<td></td>
</tr>
<tr>
<td>SANS 182</td>
<td>Conduit Saddles</td>
<td></td>
</tr>
<tr>
<td>NRS 028</td>
<td>Conduit</td>
<td></td>
</tr>
<tr>
<td>EDF 6737/HN 33 E60 (Main cable 350 mm² to 70 mm² take off 6 mm² to 35 mm²)</td>
<td>Connectors, insulation piercing</td>
<td></td>
</tr>
<tr>
<td>BS 3288 (Tests)</td>
<td>Connectors, mid-span/full tension</td>
<td></td>
</tr>
<tr>
<td>SANS 0162</td>
<td>Connectors, mid-span/no tension</td>
<td></td>
</tr>
<tr>
<td>SANS 1200 H/HA</td>
<td>Connectors</td>
<td></td>
</tr>
<tr>
<td>SANS 1092</td>
<td>Contactors</td>
<td></td>
</tr>
<tr>
<td>SANS 0162</td>
<td>Cross Arm Braces</td>
<td></td>
</tr>
<tr>
<td>SANS 1200 H/HA</td>
<td>Cross Arms</td>
<td></td>
</tr>
<tr>
<td>SANS 1063</td>
<td>D Fuses</td>
<td></td>
</tr>
<tr>
<td>IEC 60529</td>
<td>Degrees of Protection of Enclosures for LV SG en Control</td>
<td></td>
</tr>
<tr>
<td>SANS 0199</td>
<td>Earthing rods, couplers &amp; clamps</td>
<td></td>
</tr>
<tr>
<td>SANS 1063</td>
<td>Earthing rods, couplers &amp; clamps</td>
<td></td>
</tr>
<tr>
<td>SANS 1524-1</td>
<td>Earthing rods, couplers &amp; clamps</td>
<td></td>
</tr>
<tr>
<td>NRS 009-1</td>
<td>Electricity Dispenser</td>
<td></td>
</tr>
<tr>
<td>BSS 152</td>
<td>Electric Power Switchgear and Associated Apparatus</td>
<td></td>
</tr>
<tr>
<td>SANS 1222</td>
<td>Enclosures for electrical equipment classified by IP code</td>
<td></td>
</tr>
<tr>
<td>NRS 008</td>
<td>Enclosures to Cable terminations in Air: For rated AC voltages of up to 7.2kV and up to 36kV</td>
<td></td>
</tr>
<tr>
<td>BSS 1767</td>
<td>Grommets</td>
<td></td>
</tr>
<tr>
<td>SANS 8528</td>
<td>Generators – Diesel Alternators Sets</td>
<td></td>
</tr>
<tr>
<td>SANS 0198/1988</td>
<td>Installation of electric cables</td>
<td></td>
</tr>
<tr>
<td>SANS 177</td>
<td>Insulators for Overhead Lines above 1000V</td>
<td></td>
</tr>
<tr>
<td>SANS 950</td>
<td>Impulse Tests for Power Cables</td>
<td></td>
</tr>
<tr>
<td>NRS 068</td>
<td>Indicator – Earth Fault</td>
<td></td>
</tr>
<tr>
<td>NRS072</td>
<td>Indicator – Overhead line fault path indicator</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>BSS 158</td>
<td>Marking and Arrangement for Switchgear Busbars Main and Auxiliary Wiring</td>
<td></td>
</tr>
<tr>
<td>SANS 156</td>
<td>Moulded Case Circuit Breakers</td>
<td></td>
</tr>
<tr>
<td>SANS 1029</td>
<td>Miniature Substations</td>
<td></td>
</tr>
<tr>
<td>SANS 1091</td>
<td>National Colour Standards for Paint</td>
<td></td>
</tr>
<tr>
<td>SANS 0200</td>
<td>Neutral earthing in medium voltage industrial power systems</td>
<td></td>
</tr>
<tr>
<td>SANS 555</td>
<td>Oil – Mineral for Transformers, Switchgear</td>
<td></td>
</tr>
<tr>
<td>BSCP 1014</td>
<td>Protection of Electrical Power Equipment against Climatic Conditions</td>
<td></td>
</tr>
<tr>
<td>SANS 1619</td>
<td>Ready Boards</td>
<td></td>
</tr>
<tr>
<td>NRS 036</td>
<td>Re-closers – Pole Mounted</td>
<td></td>
</tr>
<tr>
<td>DTS 0104 (NRS 032)</td>
<td>Service box</td>
<td></td>
</tr>
<tr>
<td>SANS 0162</td>
<td>BS 16 Stay Assemblies</td>
<td></td>
</tr>
<tr>
<td>SANS 0162</td>
<td>BS 16 Stay Attachment Brackets</td>
<td></td>
</tr>
<tr>
<td>SANS 0162</td>
<td>BS 16 Stay Insulators</td>
<td></td>
</tr>
<tr>
<td>SANS 182, Part 5</td>
<td>BS 16 Stay Wires</td>
<td></td>
</tr>
<tr>
<td>SANS 1507</td>
<td>Suffix Wiring</td>
<td></td>
</tr>
<tr>
<td>SANS IEC 99-4</td>
<td>NWS 1108 BS 2914 Surge Diverters</td>
<td></td>
</tr>
<tr>
<td>SANS 171</td>
<td>Surge Arresters – Low Voltage</td>
<td></td>
</tr>
<tr>
<td>SANS 1186 / 1978</td>
<td>Surge Arresters – Medium Voltage</td>
<td></td>
</tr>
<tr>
<td>NRS 039</td>
<td>Symbolic Safety Signs</td>
<td></td>
</tr>
<tr>
<td>NRS 036</td>
<td>Switchgear: Metal Clad – 1 to 24kV AC RMS</td>
<td></td>
</tr>
<tr>
<td>SANS 1874</td>
<td>NRS 006 BS 5227 Switchgear: Metal Enclosed Ring Main Units – 1kV AC to 24kV AC RMS</td>
<td></td>
</tr>
<tr>
<td>SANS 60439</td>
<td>Switchgear and Control Gear Assemblies – Low Voltage – Requirements for Type testing</td>
<td></td>
</tr>
<tr>
<td>SANS 60947</td>
<td>Switchgear and Control – Low Voltage Part 1 General Rules</td>
<td></td>
</tr>
<tr>
<td>SANS 60947</td>
<td>Switchgear and Control – Low Voltage Part 2 Circuit Breakers</td>
<td></td>
</tr>
<tr>
<td>SANS 60947</td>
<td>Switchgear and Control – Low Voltage Part 3 Switches/Isolators/Switch Isolators and Combination switches</td>
<td></td>
</tr>
<tr>
<td>SANS IEC 947-4-1</td>
<td>Switchgear &amp; Control Gear – Low Voltage</td>
<td></td>
</tr>
<tr>
<td>NRS 035-1</td>
<td>Switchgear – Drop-out Fuse link, Solid Links, Pole mounted – up to 33kV</td>
<td></td>
</tr>
<tr>
<td>NRS 036</td>
<td>Switchgear: Sectionalisers and Reclosers – Pole Mounted</td>
<td></td>
</tr>
<tr>
<td>NRS 046</td>
<td>Switchgear: Load-break Disconnectors, Pole mounted, to 36kV</td>
<td></td>
</tr>
<tr>
<td>BS 464</td>
<td>Thimbles</td>
<td></td>
</tr>
<tr>
<td>SANS 780</td>
<td>Transformers, Self-protected</td>
<td></td>
</tr>
<tr>
<td>NRS 054, BS 171 IEC 60076; NWS 1532</td>
<td>Transformer - Power</td>
<td></td>
</tr>
<tr>
<td>SANS 780</td>
<td>Transformer - Distribution (2 MVA Max)</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td><strong>Aurecon Standard PS-001</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRS 02</td>
<td>Transformers – Current: 3,6kV to 420kV</td>
<td></td>
</tr>
<tr>
<td>IEC 44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEC 185</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NRS 030</strong></td>
<td>Transformers - Voltage</td>
<td></td>
</tr>
<tr>
<td>IEC 44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEC 185</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NWS 1827</td>
<td>Transmission line hardware</td>
<td></td>
</tr>
<tr>
<td><strong>SANS 60-2</strong></td>
<td>Test Techniques for High Voltage – Measuring Systems</td>
<td></td>
</tr>
<tr>
<td><strong>SANS 135</strong></td>
<td>Washers</td>
<td></td>
</tr>
<tr>
<td><strong>SANS 182</strong></td>
<td>Wire, PVC Covered</td>
<td></td>
</tr>
<tr>
<td>BS 462</td>
<td>Wire Rope Grips</td>
<td></td>
</tr>
<tr>
<td><strong>SANS 753</strong></td>
<td>Wire, Stranded Copper, bare</td>
<td></td>
</tr>
<tr>
<td><strong>SANS 754</strong></td>
<td>Wood Poles – Pine</td>
<td></td>
</tr>
<tr>
<td><strong>SANS 754</strong></td>
<td>Wood Poles – Gum</td>
<td></td>
</tr>
<tr>
<td><strong>SANS 754</strong></td>
<td>Zinc coatings, hot dipped galvanized</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 60871-1</strong></td>
<td>Shunt Capacitors</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 664</strong></td>
<td>Insulation Coordination - LV Networks</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 71</strong></td>
<td>Insulation Coordination – above 1kV</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 273</strong></td>
<td>Dimensions of Post Insulators</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 168</strong></td>
<td>Tests on Insulators</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 815</strong></td>
<td>Guide for selection of insulators for polluted conditions</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 62271-200 (Prev 60298 &amp; 60694)</strong></td>
<td>Construction of medium voltage switchgear and control gear assemblies</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 62271-100</strong></td>
<td>Construction of medium voltage circuit breakers</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 62271-102</strong></td>
<td>High voltage alternating current disconnectors and earthing switches</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 60076-6</strong></td>
<td>Iron Core Reactors</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 60549</strong></td>
<td>High Voltage fuses for external protection of power capacitors</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 60420</strong></td>
<td>High Voltage Contactors</td>
<td></td>
</tr>
<tr>
<td><strong>SANS / IEC 694</strong></td>
<td>Common Clauses for HV switchgear &amp; control gear standards</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 44-4</strong></td>
<td>Tests – Partial Discharge - Measurement</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 270</strong></td>
<td>Test – HV Testing methods, measurements of partial discharge</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 60-1,2 &amp; 3</strong></td>
<td>Tests – HV – Test Techniques</td>
<td></td>
</tr>
<tr>
<td><strong>IEC 70</strong></td>
<td>Capacitors</td>
<td></td>
</tr>
</tbody>
</table>

**CIVILS AND OTHER**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>863</td>
<td>Comprehensive Strength of Concrete</td>
</tr>
<tr>
<td>862</td>
<td>Slump of Fresh Mixed Concrete</td>
</tr>
<tr>
<td>044/1963</td>
<td>Welding and Welding Symbols</td>
</tr>
<tr>
<td>0162/1993</td>
<td>The structural use of steel</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>0100/1992</td>
<td>The structural use of concrete</td>
</tr>
<tr>
<td>0400/1987</td>
<td>Standard specification for the application of National Building Regulations</td>
</tr>
<tr>
<td>0144/1987</td>
<td>Detail of steel reinforcement for concrete</td>
</tr>
<tr>
<td>1200</td>
<td>The standard specification for civil engineering and construction</td>
</tr>
<tr>
<td>1024/1974</td>
<td>Welded mesh for concrete reinforcing</td>
</tr>
<tr>
<td>1186/1978</td>
<td>Symbolic safety sign</td>
</tr>
<tr>
<td>920/1985</td>
<td>Steel bars for concrete reinforcement</td>
</tr>
<tr>
<td>986/1970</td>
<td>Pre-cast reinforced concrete culverts</td>
</tr>
<tr>
<td>831/1971</td>
<td>Portland Cement 15</td>
</tr>
<tr>
<td>471/971</td>
<td>Portland Cement</td>
</tr>
<tr>
<td>626/1971</td>
<td>Portland blast furnace cement</td>
</tr>
<tr>
<td>677/1986</td>
<td>Non-pressure concrete pipes</td>
</tr>
<tr>
<td>675/1993</td>
<td>Zinc coated fence wiring</td>
</tr>
<tr>
<td>SANS ISO 1461/1999</td>
<td>Hot dip (galvanised) zinc coatings</td>
</tr>
<tr>
<td>10240/1997</td>
<td>Hot dip (galvanised) zinc coatings</td>
</tr>
<tr>
<td>558/1973</td>
<td>Cast iron surface boxes and manhole and inspection covers &amp; frames</td>
</tr>
<tr>
<td>82/1976</td>
<td>Bending dimensions for bars for reinforced concrete</td>
</tr>
<tr>
<td>1083/1976</td>
<td>Aggregates from natural sources</td>
</tr>
</tbody>
</table>
3. DRAWINGS AND DOCUMENTATION

3.1 General

All drawings, information and documentation shall be in English and each item shall be identified with the Employer’s name and project / scheme / contract reference title and numbers, the Engineer’s name and reference numbers and the Manufacturer’s works / contract / order references.

3.2 Drawings

The drawings forming part of the Works are listed in the Drawing List as per the Main Index, Section I.1.

3.2.1 Record Drawings

(a) It is a requirement of this contract that detailed “as-built” drawings of the Works must be provided by the Contractor after completion thereof, on which all details regarding the final installation are clearly indicated. Three sets of drawings, printed to their original size shall be provided by the Contractor. Drawings larger than A3, shall be printed with reduced scaling, but without omitting any information from the printed area, to A3 size.

(b) All drawings and schematics shall have been generated by a computer aided design (CAD) package (handwritten documents will not be accepted). The drawings and schematics shall be (where applicable) to scale and must be formatted and styled in accordance to the client and/or Engineer’s requirements (with regards to title blocks, text heights, drawing names, etc.). A compact disc containing these files, in both CAD and printable document (pdf) format, as well as any and all available electronic versions of relevant data sheets etc. must also be handed over to the Engineer.

(c) All “as-built” drawings and schematics must be submitted not later than two (2) weeks after the work has been completed.

(d) These drawings need to be approved by the Engineer prior to completion of the Works.

3.2.2 Manufacturing Drawings

The contractor shall submit manufacturing drawings for comments and approval as soon as possible. These manufacturing drawings shall at least include the following:

(a) General layout drawings of the different equipment to be installed under this contract;

(b) The internal construction of the different equipment to be installed under this contract;

(c) Complete wiring diagrams of the equipment to be installed under this contract;

(d) A detailed parts list containing all components of the different equipment that will be installed under this contract. This parts list shall contain detail such as serial numbers, supplier detail, etc.

Manufacturing drawings for approval shall be provided on A3 paper copies. No manufacturing shall proceed without the approval of the drawings.

3.3 Operation and Maintenance Manuals

(a) The contractor will submit operating and maintenance manuals in triplicate format. These manuals should contain all the relevant literature, drawings, schedules of installed equipment, procedures, write-ups, type and routine test certificates, etc. which are applicable on the installed equipment and material.

(b) These manuals should be properly indexed and shall be in A4 format.

(c) The manuals shall be properly labelled with the contract details and a complete description of the works.

(d) A sample manual will be submitted to the engineer for approval before the final copies will be compiled.
(e) The manuals will be bind in durable format with suitable plastic covering for protection.

(f) No First Taking-over Certificate will be issued before all the manuals have not yet been received.

(g) In each manual a CD of the complete manuals including as built drawings will be included in suitable pockets.
4. PERFORMANCE WARRANTY

The Contractor/Supplier shall guarantee the performance of the equipment to meet the duties and the technical requirements included in this specification and associated specification and requirements of which this specification forms part of. A minimum guarantee period of 12 months is required.

Failure to meet the performance and other requirements herein (and associated specifications and requirements it forms part of) shall deemed to be a defect and the Defects Liability Clause in the General Conditions of Contract will apply.
5. **SIGNAGE, NOTICES AND LABELLING**

5.1 **Danger Notices and Phase Identification Disks**

Approved danger notices shall be mounted at all structures fitted with transformers, remote mechanically operated switchgear, distribution boards, capacitors, reactors, open cables or other live apparatus, and at other positions as may be decided by the Engineer. They should be written in the appropriate official languages of the Region. The internationally approved electrical warning sign (black lighting beam on a yellow background) shall also be clearly visible on the notice. Notices shall be mounted on the wooden poles, at a height of three meters above ground level and on steel structures and fences at a clearly visible height. Writing must be easily discernible letters.

All transformers, drop-out fuses, gang-operated links, terminal and T-off structures and busbars must be equipped with phase identification disks on the high voltage side. These must be red, white and blue, corresponding to the phases and be fixed around the connecting studs of the transformer bushings or around the conductor where it terminates on the units in question.

5.2 **Marking and Labelling**

All equipment shall be labelled according to the table below. Trefolite shall be used for all indoor labels and Aluminium shall be used for all outdoor applications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Device</th>
<th>Language of Inscription</th>
<th>Colours</th>
<th>Plate Dimensions (mm)</th>
<th>Letter Height (mm)</th>
<th>Stroke width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Outdoor Labels</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Circuit/Busbar Phase identification</td>
<td>English</td>
<td>Black on orange</td>
<td>200 high</td>
<td>150</td>
<td>15</td>
</tr>
<tr>
<td>1.2</td>
<td>Yard gear, items</td>
<td>English</td>
<td>Red/Yellow/Blue</td>
<td>100 dia</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1.3</td>
<td>Kiosks, junction boxes</td>
<td>English</td>
<td>White on black</td>
<td>As required</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>1.4</td>
<td>Indoor Labels</td>
<td>English</td>
<td>Black on white</td>
<td>As required</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>2.1</td>
<td>GIS</td>
<td>English</td>
<td>Black on orange</td>
<td>As required</td>
<td>As required</td>
<td>As required</td>
</tr>
<tr>
<td>2.2</td>
<td>Equipment labels</td>
<td>English</td>
<td>Black on orange</td>
<td>As required</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>2.3</td>
<td>Panel labels</td>
<td>English</td>
<td>Black on white</td>
<td>As required</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>2.4</td>
<td>Panel equipment labels</td>
<td>English</td>
<td>Black on white</td>
<td>As required</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Danger, Caution</td>
<td>English and Afrikaans</td>
<td>Red on white</td>
<td>As required</td>
<td>25</td>
<td>3</td>
</tr>
</tbody>
</table>
5.3 Labelling of Cables

Labelling of cables should be in English and be unambiguous, durable and legible. Labels should be attached directly to the cable to which they refer. Labels must be attached to cables using appropriate corrosion resistant, mechanical fixings.

The cable should be labelled on both ends indicating where it is running from and where it is going to. The fixing of the cables shall not affect the IP rating of the cable.

5.4 Paint Colours

Colours to be used for equipment shall be in accordance SANS 1091. Standard available colours and the typical equipment, to which they will be applied, are listed in the table below.

All paintwork shall have a “Texture” finish and not a “Mat” or “Glossy” finish, unless specified otherwise elsewhere in the documentation.

<table>
<thead>
<tr>
<th>Colour No.</th>
<th>Colour Name</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>A11</td>
<td>Signal Red</td>
<td>Incomer panels and Emergency feeder panels</td>
</tr>
<tr>
<td>C12</td>
<td>Avocado Green</td>
<td>Outdoor Kiosks, Miniature Substations and Transformers</td>
</tr>
<tr>
<td>F11</td>
<td>Strong Blue</td>
<td>Bus-section Coupler</td>
</tr>
<tr>
<td>G12</td>
<td>Dark Admiralty Grey</td>
<td>3.3, 11 and 22kV Switchgear</td>
</tr>
<tr>
<td>G29</td>
<td>Light Grey</td>
<td>3.3kV Switchgear for Power Factor Correction</td>
</tr>
<tr>
<td>G35</td>
<td>Navy Light Grey</td>
<td>Steel Structures</td>
</tr>
<tr>
<td>C37</td>
<td>Light Stone</td>
<td>Miniature Substations, Transformers, MV Switchgear, Kiosks etc.</td>
</tr>
<tr>
<td>F06</td>
<td>Dark Violet</td>
<td>UPS Supply</td>
</tr>
<tr>
<td>B26</td>
<td>Light Orange</td>
<td>LV DB’s and MCC’s</td>
</tr>
</tbody>
</table>
6. CLEARANCES OF OUTDOOR BUSBARS, CONNECTIONS AND OVERHEAD LINES

6.1 Minimum Clearances of Outdoor Busbars and Connections

Minimum clearances of outdoor busbars and connections are summarised in the table below. In the case of the minimum clearance not complying with the requirements in the table below, insulation for the full operating voltage will be done with heat shrinkable insulation material suitable for outdoor application.

Table 6.1 Clearance distances in the table below are expressed in meters

<table>
<thead>
<tr>
<th>Rated System Voltage kV</th>
<th>5</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>72</th>
<th>100</th>
<th>123</th>
<th>145</th>
<th>245</th>
<th>300</th>
<th>362</th>
<th>420</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum clearance</td>
<td>0.20</td>
<td>0.30</td>
<td>0.38</td>
<td>0.70</td>
<td>1.00</td>
<td>1.15</td>
<td>1.30</td>
<td>2.00</td>
<td>2.40</td>
<td>2.80</td>
<td>3.36</td>
<td></td>
</tr>
<tr>
<td>between live metal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and earth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum clearance</td>
<td>0.25</td>
<td>0.34</td>
<td>0.43</td>
<td>0.82</td>
<td>1.16</td>
<td>1.22</td>
<td>1.50</td>
<td>2.30</td>
<td>2.80</td>
<td>3.40</td>
<td>3.90</td>
<td></td>
</tr>
<tr>
<td>between live metal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of different phases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum safety</td>
<td>2.60</td>
<td>2.80</td>
<td>2.90</td>
<td>3.00</td>
<td>3.50</td>
<td>3.60</td>
<td>3.80</td>
<td>4.50</td>
<td>4.80</td>
<td>5.30</td>
<td>5.50</td>
<td></td>
</tr>
<tr>
<td>clearance between</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>live metal and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>positions to which</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>access is permissible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with other equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>alive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum clearance</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from ground level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to base of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>insulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2 Earth Conductor Sizes

Table 6.2 Minimum sizes of Copper earth conductors (in mm2) are summarized in the table below

<table>
<thead>
<tr>
<th>RATED SHORT CIRCUIT CURRENT (kA)</th>
<th>8.0</th>
<th>10.0</th>
<th>12.5</th>
<th>16.0</th>
<th>20</th>
<th>25</th>
<th>31.5</th>
<th>40.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum cross section area for a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>conductor required to carry full</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fault current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 s rating mm²</td>
<td>61</td>
<td>76</td>
<td>95</td>
<td>122</td>
<td>153</td>
<td>191</td>
<td>241</td>
<td>306</td>
</tr>
<tr>
<td>1 s rating mm²</td>
<td>35</td>
<td>44</td>
<td>55</td>
<td>71</td>
<td>88</td>
<td>110</td>
<td>139</td>
<td>176</td>
</tr>
<tr>
<td>Minimum cross sectional area for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a conductor in a mesh system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 s rating mm²</td>
<td>40</td>
<td>51</td>
<td>63</td>
<td>81</td>
<td>102</td>
<td>127</td>
<td>160</td>
<td>204</td>
</tr>
<tr>
<td>1 s rating mm²</td>
<td>23</td>
<td>29</td>
<td>36</td>
<td>47</td>
<td>58</td>
<td>73</td>
<td>92</td>
<td>117</td>
</tr>
</tbody>
</table>
6.3 Overhead Line Clearances

Safety clearances of overhead lines are listed in the table below and will at all times be adhered to.

Table 6.3 Clearance (at maximum sag or swing as applicable)

<table>
<thead>
<tr>
<th></th>
<th>Ground Outside Towns (m)</th>
<th>Ground Inside Towns (m)</th>
<th>Above Railways and Main Roads (m)</th>
<th>Above Township Roads (m)</th>
<th>Along Roads Parallel with entry/exit (m)</th>
<th>Across Communal Land (m)</th>
<th>Across Private Property (m)</th>
<th>Telkom Insulated (m)</th>
<th>Buildings and structures (m)</th>
<th>Other Power lines (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV 24 kV</td>
<td>5.2</td>
<td>5.5</td>
<td>6.4</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>0.9</td>
<td>3.0</td>
<td>0.9</td>
</tr>
<tr>
<td>12 kV</td>
<td>5.1</td>
<td>5.5</td>
<td>6.3</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>0.9</td>
<td>3.0</td>
<td>0.8</td>
</tr>
<tr>
<td>7.2 kV</td>
<td>5.0</td>
<td>5.5</td>
<td>6.2</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>0.9</td>
<td>3.0</td>
<td>0.7</td>
</tr>
<tr>
<td>LV bare</td>
<td>4.9</td>
<td>5.5</td>
<td>6.1</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>0.6</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>420 V/230</td>
<td>-</td>
<td>3.3</td>
<td>5.1</td>
<td>4.7</td>
<td>3.5</td>
<td>3.3</td>
<td>3.3</td>
<td>0.2</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>V</td>
<td>-</td>
<td>3.0</td>
<td>5.1</td>
<td>4.7</td>
<td>3.0</td>
<td>2.5</td>
<td>2.5</td>
<td>0.2</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Insulated</td>
<td>-</td>
<td>3.0</td>
<td>5.1</td>
<td>4.7</td>
<td>3.0</td>
<td>2.5</td>
<td>2.5</td>
<td>0.2</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>ABC 420 V</td>
<td>-</td>
<td>3.0</td>
<td>5.1</td>
<td>4.7</td>
<td>3.0</td>
<td>2.5</td>
<td>2.5</td>
<td>0.2</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>V/230 V</td>
<td>-</td>
<td>3.0</td>
<td>5.1</td>
<td>4.7</td>
<td>3.0</td>
<td>2.5</td>
<td>2.5</td>
<td>0.2</td>
<td>3.0</td>
<td>0.6</td>
</tr>
</tbody>
</table>

An LV or Telkom pole position at MV midspan is considered to be a separate structure, hence 3 m clearance required.

NOTES

1. Column 2 is the minimum clearance of conductor to ground outside built-up areas.
2. Column 3 is the minimum clearance of conductor to ground inside built-up areas.
3. Column 4 is the minimum clearance to railway lines and proclaimed roads.
4. Column 5 is the minimum clearance to unproclaim roads used by vehicles such as delivery vans and buses.
5. Column 6 is the minimum clearance to ground where lines run parallel to any road used by vehicles and vehicle entries/ exits to the road cross underneath the line.
6. Column 7 is the minimum clearance to ground in areas used by the community such as tracks or walkways.
7. Column 8 is the minimum clearance to ground in an area owned by one owner.
8. Column 9 is the minimum clearance to Telkom cable supported on the same structures.
9. Column 10 is the minimum clearance to buildings and structures not forming part of the network, including a LV/Telkom pole installed midspan underneath a MV line.
10. Column 11 is the minimum clearance to other power lines excluding the conditions listed in column 9.
7. STANDARD INSULATION LEVELS FOR WINDINGS AND CONNECTED PARTS

All Transformers shall comply with the standard insulation levels as is summarised in the table 7.1 below.

Table 7.1 - Standard insulation levels for windings and connected parts (SANS 780:2009)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highest r.m.s voltage ( U_n ) for equipment kV</td>
<td>Nominal System r.m.s Voltage ( U_m )</td>
<td>Lightning impulse test voltage, peak kV</td>
<td>Power-frequency test r.m.s voltage kV</td>
<td>Insulation level</td>
</tr>
<tr>
<td></td>
<td>List 2(^a)</td>
<td>List 3(^b)</td>
<td>Separate source voltage withstand</td>
<td>Induced voltage withstand</td>
<td></td>
</tr>
<tr>
<td>≤1,0</td>
<td>25</td>
<td>30</td>
<td>2,5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,6</td>
<td>40</td>
<td>60</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7,2</td>
<td>60</td>
<td>75</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>75</td>
<td>95</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>125</td>
<td>150</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>170</td>
<td>200</td>
<td>70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) List 2 values apply to transformers designed for non-exposed installations (such as those connected to cable networks)

\(^b\) List 3 values to apply to transformers designed for exposed installations

Transformers shall comply with the standard insulation levels and Creepage distances as summarised in table 7.2 below.
Table 7.2 – Transformer Minimum Insulation, Fault and Creepage Distances

[Table 4 – Minimum insulation, fault and Creepage levels for power transformers (Extract from Eskom NWS Specification) ]

<table>
<thead>
<tr>
<th>System highest voltage $U_m$ (kVrms)</th>
<th>System nominal voltage $U_n$ (kVrms)</th>
<th>System fault level (kA)</th>
<th>Lightning impulse voltage withstand level at sea level (BIL) (kV peak)</th>
<th>60 s power frequency voltage withstand level at sea level (60s 50Hz)</th>
<th>60s 50Hz (kVrms)</th>
<th>BIL (kV peak)</th>
<th>60s 50Hz (kVrms)</th>
<th>BIL (kV peak)</th>
<th>Creepage (31mm/kV)</th>
<th>Tap changer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Terminal</td>
<td>Neutral Terminal</td>
<td>Separate source</td>
<td>Induced</td>
<td>BIL (kV peak)</td>
<td>60s 50Hz</td>
<td>BIL</td>
<td>60s 50Hz</td>
<td>BIL</td>
<td>Creepage (kV)</td>
<td>Tap changer</td>
</tr>
<tr>
<td>3.6</td>
<td>3.3</td>
<td>20</td>
<td>45</td>
<td>45</td>
<td>16</td>
<td>6.6</td>
<td>200</td>
<td>70</td>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td>7.2</td>
<td>6.6</td>
<td>25</td>
<td>75</td>
<td>75</td>
<td>22</td>
<td>13.2</td>
<td>200</td>
<td>70</td>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td>12.0</td>
<td>11</td>
<td>25</td>
<td>95</td>
<td>95</td>
<td>28</td>
<td>22</td>
<td>200</td>
<td>70</td>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td>17.5</td>
<td>16</td>
<td>20</td>
<td>110</td>
<td>110</td>
<td>38</td>
<td>32</td>
<td>200</td>
<td>70</td>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td>24</td>
<td>22</td>
<td>20</td>
<td>150</td>
<td>150</td>
<td>50</td>
<td>44</td>
<td>200</td>
<td>70</td>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td>36</td>
<td>33</td>
<td>20</td>
<td>200</td>
<td>200</td>
<td>70</td>
<td>66</td>
<td>250</td>
<td>95</td>
<td>250</td>
<td>95</td>
</tr>
<tr>
<td>48</td>
<td>44</td>
<td>20</td>
<td>250</td>
<td>200x</td>
<td>70x</td>
<td>95</td>
<td>350</td>
<td>140</td>
<td>250</td>
<td>95</td>
</tr>
<tr>
<td>72</td>
<td>66</td>
<td>20</td>
<td>350</td>
<td>250x</td>
<td>95x</td>
<td>140</td>
<td>380</td>
<td>150</td>
<td>350</td>
<td>140</td>
</tr>
<tr>
<td>100</td>
<td>88</td>
<td>25</td>
<td>380</td>
<td>250x</td>
<td>95x</td>
<td>150</td>
<td>550</td>
<td>230</td>
<td>350</td>
<td>140</td>
</tr>
<tr>
<td>145</td>
<td>132</td>
<td>40</td>
<td>550</td>
<td>250x</td>
<td>95x</td>
<td>230</td>
<td>650</td>
<td>275</td>
<td>350</td>
<td>140</td>
</tr>
<tr>
<td>145</td>
<td>132</td>
<td>40</td>
<td>550</td>
<td>110+</td>
<td>38+</td>
<td>230</td>
<td>650</td>
<td>275</td>
<td>350</td>
<td>140</td>
</tr>
</tbody>
</table>

Non uniform insulation + Fully graded insulation  
- Partially graded insulation (see 4.9.6 Insulation tests, fault and creepage levels)

NOTE 1 Phase-to-phase values specified in this table for all transformer windings shall be designed to withstand the appropriate test voltages, and shall be tested as specified in 5.2 Test by the Manufacturer.  
NOTE 2 145kV values specified in the last table are for Auto Transformers only.
ENGINEERING STANDARD PS-002

ENGINEERING SPECIFICATION

FOR

INSPECTION, TESTING AND COMMISSIONING OF MEDIUM VOLTAGE
ELECTRICAL EQUIPMENT AND INSTALLATIONS

© Copyright – Aurecon South Africa (Pty) Ltd
# TABLE OF CONTENTS

1. SCOPE ........................................................................................................................................ 4
   1.1 APPLICATION ...................................................................................................................... 4
   1.2 GENERAL ............................................................................................................................ 4
2. STANDARDS ................................................................................................................................ 5
   2.1 Regulations, Specifications and Standards ............................................................................. 5
3. SPECIFICATION .......................................................................................................................... 6
   3.1 GENERAL ............................................................................................................................ 6
   3.2 DISCONNECTORS AND EARTHING SWITCHES ................................................................. 6
   3.3 POST INSULATORS ............................................................................................................... 7
   3.4 BUSBAR CONDUCTORS ....................................................................................................... 7
   3.5 CURRENT CARRYING CONNECTORS .................................................................................. 7
   3.6 INDICATING AND RECORDING INSTRUMENTS AND METERS ........................................... 7
   3.7 MOTORS ................................................................................................................................ 8
   3.8 MOTOR CONTROL EQUIPMENT ............................................................................................. 8
   3.9 MATERIAL ............................................................................................................................. 8
   3.10 GALVANISING ...................................................................................................................... 8
   3.11 POWER TRANSFORMERS (Oil Filled) ............................................................................... 8
   3.12 VOLTAGE CONTROL EQUIPMENT .................................................................................... 10
   3.13 CABLE BOXES AND DISCONNECTING CHAMBERS .......................................................... 10
   3.14 BUSHINGS .......................................................................................................................... 10
   3.15 TANK AND ONAN COOLERS ............................................................................................. 10
   3.16 COOLING PLANT WITH FORCED OIL CIRCULATION ....................................................... 11
   3.17 PUMPS, MOTORS, PIPEWORK, OIL SAMPLING DEVICES AND VALVES ................. 12
   3.18 OIL ........................................................................................................................................ 12
   3.19 GAS AND OIL ACTUATED RELAYS .................................................................................... 12
   3.20 SECONDARY WIRING ......................................................................................................... 13
   3.21 WELDING ............................................................................................................................ 13
   3.22 CURRENT TRANSFORMERS .............................................................................................. 14
   3.23 SURGE ARRESTERS ............................................................................................................ 14
   3.24 TRANSFORMERS (oil insulated) – Minimum tests On SITE ............................................. 14
   3.25 EARTHING AND AUXILIARY TRANSFORMERS ............................................................... 15
   3.26 POWER TRANSFORMERS – (DRY TYPE) ........................................................................ 15
   3.27 MEDIUM VOLTAGE CABLES .............................................................................................. 16
   3.28 MEDIUM VOLTAGE SWITCHGEAR ...................................................................................... 17
Approval Page

<table>
<thead>
<tr>
<th>Compiled by:</th>
<th>ACJ Lombard</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checked by:</td>
<td>J Hattingh</td>
<td>2011-11-25</td>
</tr>
<tr>
<td>Approved by:</td>
<td>A Zwiegers</td>
<td>2011-11-29</td>
</tr>
</tbody>
</table>

Amendment History

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Amendment Section / Chapter / Page</th>
<th>Version</th>
<th>Checked By: Name And Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011-11-29</td>
<td>First Issue</td>
<td>Ver 0</td>
<td>A Zwiegers</td>
</tr>
<tr>
<td>2</td>
<td>2012-08-06</td>
<td>a) All SABS changed to SANS</td>
<td>Ver 1</td>
<td>K Adu-Asomaning/A Zwiegers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) All Type, Routine and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Special test as per IEC have</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>been added to section 3.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2012-10-09</td>
<td>Test and commissioning of</td>
<td>Ver 2</td>
<td>K Adu-Asomaning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Substation Automation added</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2013-06-27</td>
<td>Overhead Line Installations</td>
<td>Ver 3</td>
<td>F Sattar/A Zwiegers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>added</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Distribution Page

<table>
<thead>
<tr>
<th>Copy No</th>
<th>Name</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. SCOPE

1.1 APPLICATION

This document specifies the standard requirements for various inspections and tests of electrical equipment and installations in order to ensure that all electrical equipment and installations comply with the necessary standards.

1.2 GENERAL

The following definitions are used in this Specification:

1.2.1 The term “Employer” shall mean the person named as employer in the Appendix to tender and the legal successors in title to this person.

1.2.2 The term “Contractor” shall mean the person(s) named as contractor in the letter of Tender accepted by the employer.

1.2.3 The term “Engineer” shall mean the person appointed by the Employer as the Engineer for the purposes of the contract.
### 2. STANDARDS

#### 2.1 REGULATIONS, SPECIFICATIONS AND STANDARDS

The works shall be done in accordance with the latest editions (current at the time of Tender) of all relevant National and International Standards, including but not limited to:

<table>
<thead>
<tr>
<th>Specification No.</th>
<th>Specification Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS 159</td>
<td>Specification, Busbars and busbar connections.</td>
</tr>
<tr>
<td>BS 171</td>
<td>Power transformers, Specification for insulation levels and dielectric tests.</td>
</tr>
<tr>
<td>BS 2914</td>
<td>Specification for surge diverters for alternating current power circuits.</td>
</tr>
<tr>
<td>BS 3288</td>
<td>Insulator and conductor fittings for overhead power lines.</td>
</tr>
<tr>
<td>BS 3938</td>
<td>Specification for current transformers.</td>
</tr>
<tr>
<td>BS 4579</td>
<td>Performance of mechanical and compression joints in electric cable and wire connectors.</td>
</tr>
<tr>
<td>IEC 137</td>
<td>Bushings for Alternating Voltages Above 1000 V</td>
</tr>
<tr>
<td>IEC 168</td>
<td>Test on Insulators</td>
</tr>
<tr>
<td>IEC 207</td>
<td>Aluminium stranded conductors.</td>
</tr>
<tr>
<td>IEC 208</td>
<td>Aluminium alloy stranded conductors (aluminium-magnesium-silicon type).</td>
</tr>
<tr>
<td>IEC 214/IEC 60214</td>
<td>Tap-changers.</td>
</tr>
<tr>
<td>IEC 296/IEC 60296</td>
<td>Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear.</td>
</tr>
<tr>
<td>IEC 34-1</td>
<td>Rotating electrical machines: Rating and performance</td>
</tr>
<tr>
<td>IEC 56</td>
<td>Rating and testing requirements for high-voltage ac circuit-breakers</td>
</tr>
<tr>
<td>IEC 60</td>
<td>High-voltage test techniques</td>
</tr>
<tr>
<td>IEC 60076</td>
<td>Power transformers</td>
</tr>
<tr>
<td>NEMA 107</td>
<td>Methods of Measurement of Radio Influence Voltage (RVI) of High Voltage Apparatus</td>
</tr>
<tr>
<td>SANS 763</td>
<td>Hot-dip (galvanized) zinc coatings (other than on continuously zinc coated sheet and wire)</td>
</tr>
<tr>
<td>SANS 935</td>
<td>Hot-dip (galvanized) zinc coatings on steel wire</td>
</tr>
<tr>
<td>SANS 10142-2</td>
<td>The wiring of premises Part 2: Medium-voltage installations above 1 kV a.c. not exceeding 22 kV a.c. and up to and including 3 000 kW installed capacity</td>
</tr>
<tr>
<td>SANS 10198-13</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 13: Testing, commissioning and fault location</td>
</tr>
</tbody>
</table>
3. SPECIFICATION

3.1 GENERAL

The plant and equipment are subject to inspection and test by the Engineer during the course and on completion of manufacture and erection to ensure compliance with this Specification and to provide the necessary operating data.

Not less than twenty-one days of notice of all tests shall be given to the Engineer in order that he may be present if he so desires. As many tests as possible shall be arranged together in accordance with a programme to be agreed with the Engineer.

The Contractor or his Sub-Contractor shall supply to the Engineer, as soon as practicable after works tests, site tests and commissioning have been witnessed, six copies of the records, results and calculations of all electrical tests shall be provided.

The subsequent sections of this Specification list specific, works and site tests which the Engineer requires, but this shall not preclude the Engineer's right to call for further tests if he considers these necessary.

After the plant has passed the site tests required under this Contract, and the plant become available for commercial operation, certain additional tests may be carried out in order to investigate the response and recovery of the system during events such as the switching of various items of plant, system faults and load rejection.

3.2 DISCONNECTORS AND EARTHING SWITCHES

Each type of disconnector and earthing switch being provided shall be subjected to the type and routine tests specified in IEC 129, and shall comply fully with the following supplementary type and routine tests:

3.2.1 TYPE TESTS

(a) Insulation Co-ordination

In order to demonstrate the insulation co-ordination of the disconnector the critical flashover levels to earth and across the open gap shall be determined. The "up and down" method described by IEC 60 shall be used for these tests.

(b) Short Circuit Current Carrying Capability

Disconnectors, earth switches and maintenance earthing devices shall have a rated short time current carrying capacity in accordance with the respective Technical Datasheets. The incoming and outgoing connections to the disconnector shall simulate as closely possible those of the particular installation for which it is being supplied.

(c) Mechanical Endurance Test

The test shall be made in accordance with the requirements of IEC 129 but the number of operations shall be increased to 2 000 in the case of the disconnector and 1 000 in the case of the earth switches. Operations of all auxiliary switches shall be checked.

(d) Radio influence Voltage Tests

A complete single phase of each disconnecting device shall be assembled as in service and subject to radio influence voltage tests in accordance with NEMA 107. The noise level shall not exceed that specified in the Technical Datasheets.

(e) Auxiliary Switch - Type Test

Switches shall withstand the current stated in the Technical Datasheets. The current shall be applied five times to each switch and the mechanism operated ten times between each application. The contact resistance measured after the test series shall not exceed the resistance measured at the commencement of the tests.
3.2.2 ROUTINE TESTS

Routine tests shall be carried out in accordance with IEC 29 with the exception that, where required by the Engineer, the specified tests shall be made on each disconnector and operating mechanism being provided.

When the disconnector is not completely assembled in the manufacturer’s works, the operational test specified shall be made on each mechanism being provided, the disconnector loading being simulated in a manner to the approval of the Engineer.

3.3 POST INSULATORS

Type, sample and routine tests shall be made on post type insulators in accordance with the requirements, IEC 168 as appropriate.

Each type of post insulator shall all be subjected to radio influence voltage tests in accordance with NEMA 107. The post insulators shall be assembled as in service for the tests.

3.4 BUSBAR CONDUCTORS

The tests shall be in accordance with IEC 207 and 208 and BS 125 or BS 159.

3.5 CURRENT CARRYING CONNECTORS

3.5.1 TYPE TESTS

(a) General

Where type tests have been carried out on connectors similar in design but not identical in all respects to those to be supplied on the contract, existing test results on the connectors may be submitted for consideration in lieu of testing the actual contract clamp designs.

(b) Mechanical

Connectors shall be tested in accordance with the requirements for non-tension joints of BS 3288, Part 1.

(c) Electrical

Resistance measurement, short circuit and electrical load cycling tests shall generally be in accordance with BS 4579 and BS 3288.

The number of heating and cooling cycles to be performed shall be as specified in BS 3288.

Tests shall also be performed to prove compliance with corona and radio interference requirements.

3.5.2 SAMPLE TESTS

Tests shall be in accordance with the requirements for non-tension joints of BS 3288 Part 1.

3.6 INDICATING AND RECORDING INSTRUMENTS AND METERS

3.6.1 ROUTINE TESTS

(a) All instruments and meters shall satisfactorily comply with the tests specified in the appropriate BS or IEC Specifications.

(b) Each instrument shall be calibrated, with its associated instrument transformer, to the specified accuracy.

(c) Insulation tests

The windings and electrical connections of each instrument and meter shall be subjected for one minute to an alternating test pressure of 2,000 Vrms, 50 Hz, to the case or any other metal which is not intended to be insulated from the case when the instrument or meter is in use.
3.7 MOTORS
Performance tests shall be in accordance with IEC 34-1.

3.8 MOTOR CONTROL EQUIPMENT
Type and routine tests shall be carried out in accordance with IEC 158.

3.9 MATERIAL
Samples selected by the Engineer from metals used in the Contract Works shall be tested to prove compliance with the Specification including the guarantees stated.

3.10 GALVANISING
All galvanized material shall be subject to visual examination. Samples shall be subjected to tests in accordance with the following procedure:

3.10.1 WIRES
The sampling and testing procedures laid down in SANS 935.

3.10.2 MATERIAL OTHER THAN WIRES
Two test samples shall be taken for each batch of similar items, the size of which shall not exceed 100 items. Should either sample fail to pass any of the undermentioned tests, four samples of the actual material shall be taken from each batch. Should any of these further samples fail the batch shall be rejected.

The test samples shall be of a thickness equal to that of the articles galvanized and shall be loosely attached to the articles during galvanizing. The testing procedures specified in SANS 763 shall be extended to cover the thickness of galvanizing specified:

(a) Test for uniformity of Zinc Coating - In accordance with SANS 763.
(b) Test for weight of Zinc Coating - Acid strip test in accordance with SANS 763

3.11 POWER TRANSFORMERS (OIL FILLED)
Routine, type and special tests shall be carried out in accordance with IEC 60076. The tapping connection to be used for the impulse tests shall be the one on which the highest voltage stresses occur. Verification of the correct choice of tapping shall be provided. Impulse tests shall be applied by direct application to each line terminal in turn except where, by agreement with the Engineer, the transferred surge method of test may be adopted for tests on lower voltage windings. The following additional tests shall be made.

3.11.1 ROUTINE TESTS
For all routine tests to be conducted refer to section 3.26.2 of this document.

(a) The impedance voltage test shall also be carried out on the maximum and minimum tapping positions.

(b) Magnetic circuit insulation (where appropriate):
   i. A power frequency voltage of 2 kV for 1 minute applied as follows:
      Core bolts to core, to yoke clamps and to core leg side plates.
      Core to yoke clamps and to core leg side plates.
   ii. Immediately prior to despatch, 2 kV for 1 minute applied between core and earth.
      A megger may be used for this test.

(c) No load current at:
   i. 90 % rated voltage
   ii. 100 % rated voltage
   iii. 110 % rated voltage
iv. The maximum voltage equivalent to the value quoted in the Technical Datasheets.

(d) Noise level: The level of noise shall be measured to NEMA Standards TRI or other approved national standards.

(e) Vibration: Vibration measurements shall be taken and the level recorded shall be subject to approval. This test shall be carried out unless it can be shown to the satisfaction of the Engineer that the level of vibration in the transformer and its auxiliaries is harmless.

(f) Partial discharge (pd): The details of the pd test shall be as far as possible based on IEC 270 subject to the agreement of the Engineer except where otherwise stated. Transformers with a nominal value of 132 kV and below need not be subjected to partial discharge tests unless otherwise advised by the Engineer. In the following specification, wherever possible, reference will be made to the relevant parts of IEC 270. Those aspects of the test not covered by IEC 270 will be specified herein.

Test conditions: The test shall be made under controlled ambient pd conditions; if possible in a large shielded enclosure, using corona free terminals and connections, a filtered power supply and a calibrated test circuit.

The arrangement of the transformer, the supply leads and earth, etc. shall simulate installed conditions as clearly as possible, except where this may interfere with the achievement of a low ambient pd level.

Test procedure: The pd measurements shall be associated with the induced over potential test. The test voltage shall be applied across the whole winding.

The pd measurements shall be made on each phase in turn and where possible on at least two terminals of the winding under test.

With increasing voltage observe the pd of the transformer, remain at 1.2 x nominal voltage for half-an-hour or longer if necessary to examine, measure and record the pd. As the indeed voltage is increased, record pd inception voltage (*1) and the pd level. With reducing voltage record the pd extinction voltage (*1) and the pd level. When 1.2 x nominal voltage is reached it shall be maintained for half-an-hour or longer if necessary to examine measure and record the pd.

If possible it would be preferable to record continuously the pd level throughout the tests. (1*)

It is required that the transformer is shown to have an internal pd extinction voltage which is greater than 1.2 x nominal voltage, i.e. that the transformer is discharge free (*2) at 1.2 x nominal voltage.

Reasons for any changes in the recorded pd before and after the application of the full induced over-voltage shall be explained.

Test circuit: The test circuit shall be one of those described in IEC 270 Section 4.2 and Appendix 1.

Method of measurement: The method of measurement and instrumentation shall be according to IEC 270 Section 4.3 and 4.3.1.

This is the preferred method, any other method will be subject to the Engineers agreement.

Calibration: The instruments and the test circuits shall be calibrated according to IEC 270 Section 5.1, 5.2, 5.2.1, 5.3 and 5.3.1; any other method will be subject to the Engineers agreement.

3.11.2 TYPE TESTS

For all type test to be conducted refer to section 3.26.1 of this document.

(a) Capacitance: The capacitance between windings and between each winding and earth shall be measured.

(b) Switching surge: Each high voltage terminal of 330 kV and above shall be switching surge tested, with one reduced voltage wave (50 - 70 %), and three full voltage waves, of negative polarity, between line terminal and ground.
The switching surge wave form shall have the following characteristics:

A crest value as specified in the Technical Datasheets.

The wave front time (time to crest) shall be 100 microseconds ± 20 % and the wave tail shall be a minimum of 1 000 microseconds and shall exceed 90 % of its crest value for at least 200 microseconds.

(c) Transferred surge: Where recurrent surge oscillograph tests are required by the Technical Datasheets, the transformer shall be designed so that with the test voltage, applied to the other windings, the maximum surge that can be transferred to the unloaded winding(s) does not exceed its specified insulation level. Compliance with this requirement may be achieved by the use of external equipment connected to the unloaded winding and shall be proved by recurrent surge oscillograph measurements.

The test shall be repeated with the unloaded winding(s) connected to earth via a circuit simulating a connected machine and the transferred surge shall not be greater than 50 % of the winding BIL.

(*1) See IEC 270, Section 3.5, 55.1, 3.4.1 and 6.4.2.

(*2) “Discharge free“ means: not greater than the background pd level. See IEC 270, Section 5.4.3.

During the temperature rise test the accuracy of oil and/or winding temperature indicating devices shall be determined.

Where an impulse test is required it shall follow the power frequency tests.

Where impulse, partial discharge, switching and transferred surge and temperature rise tests have previously been carried out on equipment similar in all essential respects to that included in this contract, the Engineer may waive one or all these tests on production of complete test records which they consider satisfactory, and the Purchaser will be credited with the amount stated in the Bill of Quantities.

3.12 VOLTAGE CONTROL EQUIPMENT

Routine and type tests shall be carried out in accordance with IEC 214.

3.13 CABLE BOXES AND DISCONNECTING CHAMBERS

Oil tightness - All cable boxes and disconnecting chambers shall be tested with oil, having a viscosity not greater than that of IEC 296 insulating oil when at a temperature of 15°C, at a pressure of 70 kN/m² for 12 hours, during this time no leakage shall occur nor shall there be any permanent set when the pressure is released.

3.14 BUSHINGS

Routine, type, sample and special tests shall be carried out in accordance with IEC 137. The following special test shall be made:

(a) Short time current

Each type of bushing being provided shall be subject to a short time current test of 3 seconds at the fault rating specified in the Technical Datasheets, the test procedure being in accordance with that of IEC 56.

3.15 TANK AND ONAN COOLERS

3.15.1 ROUTINE TESTS

(a) Oil leakage - All tanks and oil filled compartments including all forms of radiator, but excluding separate coolers using forced oil circulation, (see Section 3.16 below) shall be tested, before painting, for oil tightness by being completely filled with oil of a viscosity not greater than that of IEC 296 insulating oil at a temperature of 15°C and subjected to a pressure equal to the normal pressure plus 35 kN/m². This pressure shall be
maintained for a period of not less than 24 hours, during which time no leakage shall occur.

(b) The tapchanger barrier shall be subjected to normal oil pressure head for 24 hours, during which time there shall be no leakage from the panel or bushings.

(c) Detachable radiators may be tested as separate units.

3.15.2 TYPE TEST

(a) Vacuum

i. One transformer tank, tap changing compartment, radiator and cooler of each size shall be subjected when empty of oil to that vacuum test level specified in the Technical Datasheets. There shall be no permanent deflection of the stiffeners, nor shall the permanent deflection of the panels exceed the value specified in the following table:

<table>
<thead>
<tr>
<th>Major dimension of panel between stiffeners (meters vertical or horizontal)</th>
<th>Maximum permanent deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up 10 1,5 m</td>
<td>3 mm</td>
</tr>
<tr>
<td>1,5 m - 3 m</td>
<td>8 mm</td>
</tr>
<tr>
<td>Above 3 m</td>
<td>13 mm</td>
</tr>
</tbody>
</table>

ii. A further test at a vacuum equivalent to 3 m bar absolute pressure for a period of 8 hours shall be made for the purpose of checking the mechanical withstand capability of the tank; during this test no damage or fractures shall occur. This test is only applicable to units to 200 kV and above and may be combined with other tests or made during the processing of the unit.

(b) Pressure

One transformer tank of each size shall be subject to a pressure corresponding to the normal pressure plus 35 kN/m² for 12 hours. There shall be no permanent deflection of the stiffeners exceed the value specified in the above table. This test may be combined with a routine oil leakage test.

The tapchanger barrier shall be shown to withstand an over pressure test of normal pressure plus 35 kN/m² for 12 hours.

(c) Pressure relief device

When required by the Engineer one pressure relief device of each size shall be subjected to increasing oil pressure and shall operate before reaching normal pressure plus 35 kN/m².

The operating pressure shall be recorded on the test certificate.

3.16 COOLING PLANT WITH FORCED OIL CIRCULATION

3.16.1 ROUTINE TEST

(a) Air/oil coolers - All coolers using forced oil circulation shall be filled with oil of a viscosity no greater than that of IEC 296 insulating oil at a temperature of 15°C and subjected to a pressure equal to twice the maximum working pressure at the inlet to the cooler under service conditions which shall be maintained for a period of not less than 24 hours; during this time no leakage shall occur.

(b) Water/oil coolers - The oil and water compartments of all water cooled oil coolers shall be tested separately to withstand a hydraulic pressure of 350 kN/m² for 15 minutes after which the pressure shall be reduced to twice the maximum working pressure at the inlet to the cooler under service conditions and shall be maintained for a period of not less than 24 hours during which time no leakage shall occur.

3.16.2 TYPE TESTS
One force oil cooler of each type shall be subjected, when empty of oil, to that vacuum test level specified in the Technical Datasheets. There shall be no permanent deformation or distortion of any part of the cooler.

3.17 PUMPS, MOTORS, PIPEWORK, OIL SAMPLING DEVICES AND VALVES

3.17.1 ROUTINE TEST

(a) Oil filled equipment - The bodies of all oil pumps complete with submerged motors, if any, and the oil pipework, oil sampling devices and valves shall withstand a hydraulic pressure of 140 kN/m² for 15 minutes.

(b) Water filled equipment - Water pumps, water pipework and valves shall withstand a hydraulic pressure of 700 kN/m for 15 minutes after which the pressure shall be reduced to twice the maximum working pressure, at the inlet to the cooler under service conditions and shall be maintained for a period of not less than 24 hours during which time no leakage shall occur.

(c) Control gear - All control gear shall be subjected to the tests specified in the appropriate IEC.

(d) Motors - Each machine shall be subjected to the following tests where applicable:
   i. Measurement of winding resistance (cold).
   ii. No load test at rated voltage for determination of fixed losses.
   iii. An overvoltage test at 1.5 times rated voltage applied with the machine running at no load, for a period of 3 minutes, to test interturn insulation.
   iv. High voltage in accordance with IEC 3401.

3.17.2 TYPE TESTS

(a) Motors - Performance tests shall be in accordance with IEC 34-1 however, certificates of type tests in accordance with IEC will be accepted.

(b) Except for non-return valves, all valves and oil sampling devices which are subject in service or during maintenance to oil pressure shall withstand, when empty of oil, absolute pressure not exceeding 350 m bars. In the case of valves this test is to be applied to the body only. This type test shall subsequently be followed by a repeat oil leakage test.

3.18 OIL

Samples of oil from each consignment shall be tested in accordance with IEC 296 before despatch.

Subject to the agreement of the Engineer a test certificate, confirming that the oil from which the consignment was drawn has been tested in accordance with IEC 296, may be accepted. Before commissioning any transformer, the electric strength of its oil shall be check-tested and the results approved by the Engineer.

3.19 GAS AND OIL ACTUATED RELAYS

3.19.1 ROUTINE TESTS

The following tests shall be made on relays when completely assembled. Where oil is referred to it shall have a viscosity not greater than that of IEC 296 insulating oil at 15°C.

(a) Oil leakage - The relay, when filled with oil shall be subjected to an internal pressure of 140 kN/mm² for 15 minutes. No leakage shall occur either from the casing or into normally oil free spaces, such as floats, within the casing.

(b) Gas collection:
   i. With the relay mounted as in service and at a rising angle of 5 degrees (tank to conservator) and full of oil, gas shall be introduced into the relay until the gas collection contacts close. The oil level contacts shall not close when gas is
3.20 SECONDARY WIRING

All secondary wiring, including panel wiring and control circuits and all apparatus connected thereto shall be subjected to the following test:

3.20.1 ROUTINE TESTS

(a) Voltage - 2 kV applied for one minute except where this requirements is modified by a SANS, IEC or BS, to which item the appropriate test shall be applied.

(b) Insulation resistance - By megger of not less than 500 volts.

3.21 WELDING

3.21.1 WELDERS QUALIFICATION TESTS

All welders engaged on fabrication either in the manufacturer's works or on site and on any weld repairs subsequently found necessary shall, before undertaking welding, satisfactorily complete procedure and qualification tests in the presence of the Engineer.

The minimum requirements for the testing of welders engaged on structural steel would be as follows:

(a) Butt welds (manual)

Test plates to be of average thickness of those called for the Contract. Two tests are required:

- Horizontal/vertical; and
- Vertical.

From each test weld are to be prepared one forward and one reverse bend test and one macro specimen. The bend tests are to be taken through 180 degrees over a former of diameter equal to three times the thickness of the plate.

(b) Fillet welds

escaping freely from the relay on the conservator side. These contacts shall, however, close when the pipework is empty of oil.

ii. The empty relays shall be tilted, as if mounted in pipework rising from tank to conservator, at an increasing angle until the gas collection contacts open. The angle of tilt shall then be reduced and the gas collection contacts shall close before the angle is reduced to less than 13 degrees to the horizontal.

iii. With the relay mounted at a falling angle of 16 degrees to the horizontal and full of oil, the gas collection contacts shall be open.

(c) Oil surge - with the relay mounted as in service and full oil at approximately 15 °C, the surge contacts shall close within the steady oil flow limits specified in the Technical Datasheets. This operation shall not be adversely affected when the gas collection contacts have already closed and gas is escaping freely.

(d) Voltage - with the relay empty of oil, a voltage of 2 kV shall be applied in turn between each of the electrical circuits and the casing for one minute, the remaining circuits being connected to the casing.

(e) Operation - with the transformer assembled with its cooling plant as in service, tests shall be made to demonstrate that the relay does not operate whilst the oil pump motors are being started or stopped.

3.19.2 SAMPLE TESTS

All discretion of the Engineers, the following tests shall be made:

Variation of performance with mounting angle with the mounting conditions as in service, the mounting angle shall be varied within the rising angle limits 1° and 9° and tests repeated in the manner prescribed for the routine tests.

© Copyright – Aurecon South Africa (Pty) Ltd

November 2011
The size of fillet weld must be an average of those called for on the Contract. Two tests are required:

- Horizontal/vertical; and
- Vertical.

From each test weld, nick break and macro specimens are to be prepared.

(c) Butt welds (machine welding)

On full penetration butt welds, the first two seams welded are to be witnessed with 'run on' and 'run off' plates attached. From these plates are to be prepared a forward bend, a reverse bend and a macro. The bend requirements are as for the manual test.

On partial penetration butt welds the first two seams are to be witnessed and macro specimens are to be prepared from the 'run on' and 'run off' plates in addition to the ends of the actual weld. The extent of penetration is to comply with the approved drawing.

### 3.22 CURRENT TRANSFORMERS

The following tests shall be conducted on the current transformers in accordance with the requirements of BS 3938 as follows:

(a) Prior to assembly in turrets and neutral cases:
- Inter-turn insulation tests - Clause 2.4.4 Polarity
- test for lead marking - Clause 2.4.1 Accuracy
- and parameter tests - Clause 4

(b) After assembly in turrets and neutral cases: Insulation tests - Clause 2.4.3
- Polarity test - Clause 2.4.1

The turret installation shall be checked for mechanical soundness of installation, freedom from interference with bushings and oil tightness of terminal box.

### 3.23 SURGE ARRESTERS

(a) Tests on Surge Arresters: Routine, Manufacturer's control and standard acceptance tests in accordance with the latest revision of IEC Publication 99-1 shall be conducted on each arrester assembly.

(b) Tests on Surge Counters: The rated minimum operating current stated in the Technical Datasheets shall be passed through the surge counter ten times and operation shall be registered on each occasion. The surge counter shall correctly register and withstand the current waves as specified in BS 2914 Clause 14(c) at twice the rated arrester current. The peak voltage across the counter during this test shall not exceed the value stated in the Technical Datasheets.

### 3.24 TRANSFORMERS (OIL INSULATED) – MINIMUM TESTS ON SITE

The site tests, full details of which are to be submitted by the Contractor after the Contract has been placed, shall include those tests described in outline below.

3.24.1 Transformers:

(a) Insulation resistance of core and windings;

(b) Dielectric strength of oil samples;

(c) Ratio and no-load current at low voltage (e.g. 400V) on all tappings;

(d) Vector relation check;

(e) Calibration check of temperature instruments, including secondary current injection and providing contact settings;
(f) Air injection tests of gas/oil-actuated relays;
(g) Setting check of oil-level, oil-flow and water-flow;
(h) Complete functional tests of cooling equipment and tap change equipment, including manual/automatic sequences, indications, alarms and interlocks, measurement of motor current, adoption of suitable motor protection settings and proof of protection operation for stalled or single phasing conditions;
(i) Operation tests of ‘freeze-drier’ type breathers;
(j) Insulation resistance of all secondary circuits;
(k) Final checks before energising:

Venting, position and locking of valves, earthing of star-point(s) and of tank, state of breathers and of pressure-relief devices, oil levels, absence of oil leakage, operation of kiosk heaters, tap-change counter readings, resetting of maximum temperature indicators, final proving of alarms and trips.

(l) Tests when energised:

On-load tap-changer operation throughout range (subject no exceeding 1.1 pu volts on any windings); and
Maintenance of 1.1 pu volts on untapped windings for 15 minutes (but not exceeding this value on tapped winding).

(m) Test on load:

Temperature instrument readings; and
Measurements of WTI CT secondary current.

3.25 EARTHING AND AUXILIARY TRANSFORMERS

The following tests shall be conducted in accordance with the requirements of BS 171 as detailed in Schedule F A.1, as follows:

Routine tests: (a), (b), (e), (f), (g), (j), (l) and BS 171 Clause 38
Type Tests: (q)
Short Circuit Tests: The test shall be conducted at a current equal to the 10 second rated current prior to carrying out test (j)

3.26 POWER TRANSFORMERS – (DRY TYPE)

Routine, type and special tests shall be carried out in accordance with IEC 60076. The tapping connection to be used for the impulse tests shall be the one on which the highest voltage stresses occur. Verification of the correct choice of tapping shall be provided. Impulse tests shall be applied by direct application to each line terminal in turn except where, by agreement with the Engineer, the transferred surge method of test may be adopted for tests on lower voltage windings

3.26.1 Type Test

(a) Temperature-rise Test (IEC 60076-2)
(b) Dielectric Type Test (IEC 60076-3)

Lightning Impulse Test

Full Impulse Voltage Withstand Test

Full and chopped Impulse Voltage withstand Test

(c) Determination of Sound Level (IEC 60076-10) for each method of cooling for which a guaranteed sound level is specified

(d) Measurement of power taken by the fan and liquid pump motors

(e) Measurement of No Load Loss and Current at 90% and 110% of Rated Voltage
3.26.2 Routine Test
(a) Measurement of winding resistance (11.2)
(b) Measurement of voltage ratio and check of phase displacement (11.3)
(c) Measurement of short-circuit impedance and load loss (11.4)
(d) Measurement of no-load loss and current (11.5)
(e) Dielectric routine test (IEC 60076-3)
(f) Test on on-load tap-changers, where appropriate (11.7)
(g) Leak testing with pressure for liquid-immersed transformers (tightness test) (11.8)
(h) Tightness tests and pressure tests for tanks for gas-filled transformers (refer to 60076-15)
(i) Check for the ratio and polarity of built-in current transformers
(j) Check of core and frame insulation for liquid immersed transformers with core or frame insulation (11.2)

3.26.3 Special Test
(a) Dielectric Special Test (IEC 60076-3)
(b) Winding Hot-Spot Temperature Rise Measurement
(c) Determination of capacitances windings-to-earth and between windings
(d) Measurement of dissipation factor tag of the insulation system capacitance
(e) Determination of transient voltage transfer characteristics (Annex B of IEC 60076-3:2000)
(f) Measurement of zero sequence impedance(s) on three phase transformers (11.6)
(g) Short Circuit withstand test (IEC 60076-5)
(h) Measurement of d.c insulation resistance each winding to earth and between windings
(i) Vacuum deflection test on liquid immersed transformers (11.9)
(j) Pressure deflection test on liquid immersed transformers (11.10)
(k) Vacuum tightness test on site on liquid immersed transformers (1.11)
(l) Measurement of frequency response (Frequency Response Analysis or FRA). The test procedure shall be agreed between manufacturer and purchaser.
(m) Check of external coating (ISO 2178 and ISO 2409 or as specialized)
(n) Measurement of dissolved gasses in dielectric liquid
(o) Mechanical test or assessment of tank for suitability for transport (to customer specification)
(p) Determination of weight with transformer arranged for transport. For transformer up to 1.6MVA by measurement. For larger transformers by measurement or calculation as agreed between manufacturer and purchaser.

3.27 MEDIUM VOLTAGE CABLES
During construction of the Medium Voltage cable system continuous visual inspections shall be performed by the Clerk of Works in order to verify:

That all parts of the electrical installation is correctly selected and installed; and
That no part of the installation is visibly damaged or otherwise defective.

The complete Medium Voltage system shall be tested in accordance with SANS 10142-2.

All newly installed Medium Voltage cables shall be subjected to the following tests before it is energised:

- XLPE cables shall be subjected to an a.c. over-voltage test, in accordance with SANS 10198-13. Only VLF (0.1 Hz) test voltages will be allowed;
- All newly installed Medium Voltage paper-insulated test, in accordance with SANS 97 and SANS 10198-13; and
- A cable sheath test in accordance with SANS 10198-13.

### 3.28 MEDIUM VOLTAGE SWITCHGEAR

#### 3.28.1 Factory Inspection and Tests

The engineer reserves the right to visit and enter the manufacturer's works during the design and manufacturing stages for the purposes of interim and final inspections and for progress information acquisition. Where the contractor makes use of third parties for the manufacturing and/or procurement of equipment, the contractor shall ensure that this requirement is agreed with the third party.

The engineer reserves the right to be present at all or any tests (or, at the engineer’s discretion repeats of such tests) conducted on the equipment.

Two calendar weeks’ notice of pending tests shall be given to the engineer in writing. Three copies of all test records are to be submitted to the Engineer for approval. Factory tests shall be required at the following holding points:

(a) Completion of steel work, but before it is sent for painting
(b) On the commencement or early stages of wiring of the panels
(c) A functional Factory Acceptance Test shall be conducted once the switchgear is completed. It is given that the switchgear manufacturer shall completely test the board for operation before the FAT is called. All the test sheets and FAT check lists shall be supplied to the engineer before the FAT.

#### 3.28.2 Tests at site – Commissioning

The test and commissioning will be in accordance of SANS 10142-2

(a) Cold Commissioning

After the plant and auxiliary equipment have been erected and connected up on site, the Contractor shall carry out to the satisfaction of the Engineer such tests as may be required to prove compliance with the Specification, independently of any tests carried out at the manufacturer's works.

Not less than 12 weeks before any section of the plant is required to enter commercial service, the Contractor shall submit for the approval of the Engineer his detailed site test proposals for that section of the plant, together with details of the test equipment and methods that he proposes to use. Subject to approval of the tests, these will be written by the Engineer into an overall programme of tests, which will be issued to all directly concern prior to the starting date for the tests.

The Engineer shall have the right to witness all tests, and the results must be available to him as the tests proceed. He may recommend waiving of some tests, or may add further test if considered necessary to prove compliance with the Specification.

Clear records of all tests necessary before the plant can be regarded as ready to be first connected to the Purchaser's system shall be maintained by the Contractor and submitted to the Engineer in duplicate (one copy being for the Purchaser). Both the Purchaser and the Engineer require this information before the plant will be accepted for initial energising.

(b) Hot Commissioning
Initial energising and all subsequent 'live' tests will be directed by the Engineer, and carried out jointly by the Purchaser, Contractor and Engineer. They will be subject to the Purchaser's standard safety procedures, and all operational switching will be carried out by the Purchaser according to a detailed programme which the Engineer will prepare and which will be agreed in advance between all three parties.

During these 'live' tests the Contractor shall remain responsible for the performance of his plant.

A record of the results of the tests in this category will be made available to the Contractor by the Engineer.

The Contractor shall submit to the Engineer for approval a list of recommended settings for all protection and other types of automatic equipment, not less than thirteen weeks before such equipment is required in commercial service. Where the settings involve discrimination with settings of an existing network or plant supplied under a separate contract, the relevant information will be supplied to the Contractor.

(c) Fault level report and Relay Protection settings

A fault level report will be supplied to the Switchgear supplier in order to apply the correct over current and earth fault settings to the relay. All other settings should be applied by the switchgear manufacturer based on the type of relays supplied and the nature of the duty of the switchgear.

(d) Relay programming

The Switchgear supplier shall provide the following services:

- Programing each relay before FAT
- Settings file - hard and soft copies thereof
- Logic file - hard and soft copy thereof
- SCADA soft file and suitable hard copy of the manual and design of the system in order to be able to maintain the system after going into service.

(e) Substation Automation

The Substation Automation systems supplier shall provide the following services:

- Programing the complete automation system before commissioning
- Settings file - hard and soft copies thereof
- Logic file - hard and soft copy thereof
- Complete substation automation system soft file and suitable hard copy of the manual and design of the system in order to be able to maintain the system after going into service.

3.29 OVERHEAD LINE INSTALLATIONS

The following minimums tests are required:

(a) Phase to earth insulation test of all phase conductors, metal parts on structures and equipment.

(b) Phasing to ensure ring networks are in phase.

(c) Continuity of ground or earthing conductors.

(d) Proof of earthing integrity at all points.

(e) Earth resistance tests.

(f) Phase rotation (if required)

(g) Continuity of phase conductors

(h) Clearances
ENGINEERING STANDARD PS-003

ENGINEERING SPECIFICATION FOR MEDIUM AND LOW VOLTAGE CABLE SYSTEMS

aurecon
# TABLE OF CONTENTS

1. SCOPE ........................................................................................................................................... 4
   1.1 Application ................................................................................................................................. 4
2. General ............................................................................................................................................... 4
   2.2 Electrical System Characteristics ............................................................................................... 4
   2.3 Installation Performance Requirements ...................................................................................... 4
3. STANDARDS ...................................................................................................................................... 4
   3.1 Regulations, Specifications and Standards ................................................................................. 4
4. TECHNICAL SPECIFICATION ....................................................................................................... 6
   4.1 General ........................................................................................................................................ 6
   4.2 Cable Selection .............................................................................................................................. 6
   4.3 Cable Installation ......................................................................................................................... 7
   4.4 Joints and Terminations ............................................................................................................... 11
   4.5 Glands ........................................................................................................................................ 11
   4.6 Earthing ..................................................................................................................................... 12
   4.7 Marking and Labelling ................................................................................................................ 12
5. TESTING AND COMMISSIONING ............................................................................................... 13
   5.1 General ....................................................................................................................................... 13
Approval Page

<table>
<thead>
<tr>
<th>Compiled by:</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACJ Lombard</td>
<td></td>
<td>2011-09-28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Checked by:</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>J Hattingh</td>
<td></td>
<td>2011-10-24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Approved by:</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Zwiegers</td>
<td></td>
<td>2011-10-28</td>
</tr>
</tbody>
</table>

Amendment History

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Amendment Section / Chapter / Page</th>
<th>Version</th>
<th>Checked By: Name And Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011-10-28</td>
<td>First Issue</td>
<td>Ver 0</td>
<td>A Zwiegers</td>
</tr>
<tr>
<td>2</td>
<td>2012-04-11</td>
<td>Second Issue</td>
<td>Ver 1</td>
<td>A Zwiegers</td>
</tr>
<tr>
<td>3</td>
<td>2012-04-11</td>
<td>Third Issue</td>
<td>Ver 2</td>
<td>A Zwiegers</td>
</tr>
</tbody>
</table>

Distribution Page

<table>
<thead>
<tr>
<th>Copy No</th>
<th>Name</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. SCOPE

1.1 Application
This document specifies the standard requirements for the supply, delivery to site, site installation, site testing, commissioning and handover of Medium and Low Voltage cable systems.

2. GENERAL

The following definitions are used in this Specification:

2.1.1 The term “Employer” shall mean the person named as employer in the Appendix to tender and the legal successors in title to this person.

2.1.2 The term “Contractor” shall mean the person(s) named as contractor in the letter of Tender accepted by the employer.

2.1.3 The term “Engineer” shall mean the person appointed by the Employer as the Engineer for the purposes of the contract.

2.2 Electrical System Characteristics
The operating conditions of the electrical system for which the cable(s) are required, are stipulated in the Particular Specification.

2.3 Installation Performance Requirements
2.3.1 The installation shall be suitable for its intended duty with respect to the operating conditions of the electrical system and the electrical load requirements.

2.3.2 The installation shall be suitable for the environmental conditions, particularly with respect to corrosion resistance and ingress protection.

3. STANDARDS

3.1 Regulations, Specifications and Standards
The works shall be done in accordance with the latest editions (current at the time of Tender) of all relevant National and International Standards, including but not limited to:

<table>
<thead>
<tr>
<th>Specification No.</th>
<th>Specification Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRS 028</td>
<td>Cable Lugs and Ferrules for copper and aluminium conductors: Preferred requirements for applications in the Electricity Supply Industry</td>
</tr>
<tr>
<td>NRS 075</td>
<td>Mechanical torque shear connectors for medium voltage applications</td>
</tr>
<tr>
<td>SANS 97</td>
<td>Electric cables - Impregnated paper-insulated metal-sheathed cables for rated voltages 3,3/3,3 kV to 19/33 kV (excluding pressure assisted cables)</td>
</tr>
<tr>
<td>SANS 876</td>
<td>Cable terminations and live conductors within air-filled enclosures (insulation co-ordination) for rated a.c. voltages from 7.2 kV up to and including 36 kV</td>
</tr>
<tr>
<td>SANS 950</td>
<td>Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations</td>
</tr>
<tr>
<td>SANS 1019</td>
<td>Standard voltages, currents and insulation levels for electricity supply</td>
</tr>
<tr>
<td>SANS 1213</td>
<td>Mechanical cable glands</td>
</tr>
<tr>
<td>SANS 1339</td>
<td>Electric cables - Cross-linked polyethylene (XLPE) insulated cables for rated voltages 3,8/6,6 kV to 19/33 kV</td>
</tr>
<tr>
<td>SANS 1507</td>
<td>Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SANS 1803-1</td>
<td>Lugs and ferrules for insulated electric cables Part 1: Copper conductors</td>
</tr>
<tr>
<td>SANS 6281-4</td>
<td>Test methods for impregnated paper-insulated electric cables Part 3: Tests on finished cable</td>
</tr>
<tr>
<td>SANS 10142-1</td>
<td>Wiring of Premises Part 1: Low Voltage Installations</td>
</tr>
<tr>
<td>SANS 10142-2</td>
<td>The wiring of premises Part 2: Medium-voltage installations above 1 kV a.c. not exceeding 22 kV a.c. and up to and including 3 000 kW installed capacity</td>
</tr>
<tr>
<td>SANS 10198-1</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 1: Definitions and statutory requirements</td>
</tr>
<tr>
<td>SANS 10198-2</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 2: Selection of cable type and methods of installation</td>
</tr>
<tr>
<td>SANS 10198-3</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 3: Earthing systems General provisions</td>
</tr>
<tr>
<td>SANS 10198-4</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 4: Current ratings</td>
</tr>
<tr>
<td>SANS 10198-5</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 5: Determination of thermal and electrical resistivity of soil</td>
</tr>
<tr>
<td>SANS 10198-6</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 6: Transportation and storage</td>
</tr>
<tr>
<td>SANS 10198-7</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 7: Safety precautions</td>
</tr>
<tr>
<td>SANS 10198-8</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 8: Cable laying and installation</td>
</tr>
<tr>
<td>SANS 10198-9</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 9: Jointing and termination of extruded solid dielectric-insulated cables up to 3,3 kV</td>
</tr>
<tr>
<td>SANS 10198-10</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 10: Jointing and termination of paper-insulated cables</td>
</tr>
<tr>
<td>SANS 10198-11</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 11: Jointing and termination of screened polymeric-insulated cables</td>
</tr>
<tr>
<td>SANS 10198-12</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 12: Installation of earthing system</td>
</tr>
<tr>
<td>SANS 10198-13</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 13: Testing, commissioning and fault location</td>
</tr>
<tr>
<td>SANS 61238</td>
<td>Compression and mechanical connectors for power cables for rated voltages up to 30 kV(Um = 36 kV)</td>
</tr>
<tr>
<td>Engineering Standard PS-004</td>
<td>Engineering Specification for Trenching and Excavations</td>
</tr>
</tbody>
</table>
4. **TECHNICAL SPECIFICATION**

4.1 **General**

(a) Cables shall be delivered within 12 months from being manufactured and shall be delivered to site on cable drums or coiled with protective wrappings;

(b) Cables shall be delivered, stored and handled in accordance with the manufacturer’s instructions. Where the performance of the cable is likely to be adversely affected by the ingress of moisture, it shall be adequately sealed at either ends; and

(c) The end protruding from the drum shall be protected against mechanical damage.

4.2 **Cable Selection**

4.2.1 **Medium Voltage Cables**

The type of cable(s) to be used for the electrical installation shall be as specified in the Particular Specification. The conductor shall either be copper or aluminium as specified in the Particular Specification. All Medium Voltage cables that are used for an electrical installation shall comply with the requirements of the respective standards as follow:

(a) SANS 97 for Paper-Insulated Lead Covered (PILC) cables; and

(b) SANS 1339 for Cross-linked Polyethylene (XLPE) cables.

4.2.2 **Low Voltage Cables**

Unless otherwise specified, all LV cables shall have copper conductors to SANS 1411-1. Cores of cross sectional area greater than 1,5mm² shall be stranded or flexible. Where neutral conductors are to be provided, they shall be of the same cross sectional area as the associated phase conductor.

All LV cables used in an electrical installation shall be as specified in the Particular Specification and shall comply with either of the following:

(a) PILC/PVC and PILC/SWA/PVC

- Paper insulated lead covered cables shall not be used in low voltage installations. However, if specified, these cables shall comply with SANS 97; and

- Multicore cables shall have single (steel) wire armouring.

(b) PVC/AWA/PVC and PVC/SWA/PVC

- Cables shall comply with SANS 1507-3 and be rated at 600/1000V;

- Single core cables shall have aluminium wire armouring; and

- Multicore cables comprising five conductors and above shall have each core individually coloured, or, where not available, be coloured white with phase identification in black numerals.

(c) XLPE/AWA/PVC and XLPE/SWA/PVC

- Cables shall comply with SANS 1507-4 and be rated at 600/1000V; and

- Single core cables shall have aluminium wire armouring.

(d) PVC/PVC

- Cables shall comply with SANS 1507-3 and be rated at 600/1000V.

(e) XLPE/PVC

- Cables shall comply with SANS 1507-4, and be rated at 600/1000V.

(f) Single Core PVC

- Cables shall comply with SANS 1507-2 and be rated at 600/1000V; and
- The insulation shall be phase coloured, and, where used in single phase systems, line cables shall be red, neutral cables black and earth cables yellow and green.

(g) Flat Twin and Earth PVC
- Copper conductors shall comply with SANS 1411-1, PVC insulated to SANS 1411-2, laid up with a bare copper earth continuity conductor between them, with PVC bedding to SANS 1411-2; and
- Cables shall be rated at 300/500V.

(h) Fire Resistant Cables
- Cables requiring protection against the effects of fire shall be of fire-resistant construction (note here that “fire-rated” cables are not the same as “fire-resistant” cables);
- Fire-resistant cables shall thus comply with SANS IEC 60331-21 and / or BS EN 50200; and
- Except where prior approval in this regard has been granted by the Engineer, increasing the resistance to fire of normal (i.e. non-fire resistant) cables though the application of a coat of fire-resistant compound will not be accepted.

4.3 Cable Installation

4.3.1 General
(a) The installation of any cable shall comply with the requirements of SANS 10142-1, SANS 10142-2, SANS 10198-2 and SANS 10198-8. Any site specific situation that is not covered in these standards shall be discussed with and approved by the Engineer.
(b) Where two or more cables are installed along each other, they will run in straight lines and not cross over each other, except where transposing of cables is required to reduce capacitive or inductive effects.
(c) Cables and their support systems shall not be fixed to protective barriers, guards or directly to guard-rails.
(d) Cables shall be installed strictly according to the manufacturer’s requirements pertaining to:
   - Maximum tensile or compressive stresses (e.g. due to pinching or squashing);
   - Minimum bending radius;
   - Temperature or installation; and
   - Operating environment.

4.3.2 Cable Route
The cable trench shall be excavated along the routes indicated on the relevant drawings and shall, as far as possible, follow features of the site such as roadways and building lines.

The trench shall be absolutely straight and shall comply with all requirements. The Engineer shall determine the length of the trench to be excavated, which shall not exceed 400 m, before the cable is installed and the trench backfilled.

If any obstacle or interference is encountered which may require alterations to the trench or cable routes, such alterations shall be approve by the Engineer.

4.3.3 Cable Trenches
All activities associated with trenching and excavations, as well as the installation of sleeves shall comply with Engineering Standard PS-004: Engineering Specification for Trenching and Excavations.

4.3.4 Cable Trays and Ladders
4.3.4.1 General

(a) Cable trays and ladders shall be selected and installed strictly in accordance with their manufacturer’s guidelines, with a safety factor of 1.5 after taking into account maximum permissible loading and all external factors (not limited to wind, snow and thermal expansion). Upon demand to do so, the Contractor must furnish all data and calculations he used to derive the type and spans of the systems to the Engineer.

(b) Notwithstanding above, the deflection of a cable tray and/or a cable ladder due to installed cable weights shall be, in accordance with IEC 61537, limited to 1/100th of the span.

(c) Except where it is to be installed in locations with corrosive atmospheres, cable trays and ladders shall be manufactured of galvanized and/or epoxy-powder coated steel. In locations with corrosive atmospheres, cable trays and ladders shall be manufactured from stainless steel (316 Marine Grade) or aluminium.

(d) All clamps, clips, hinges screws, bolts, nuts and support fittings used for fastening cable trays or cables shall be of the same material as the cable tray and/or ladder itself.

(e) Cable ladders and/or trays shall be selected and installed such that spare capacity (weight as well as height and width) of 20% will be available for the addition of future services (the cable tray and/or ladder to still exhibit a 1.5 safety factor after services were added).

4.3.4.2 Cable Trays

(a) All cable trays shall be of the heavy duty, increased upstand (“siderail”), type.

(b) Metal cable trays shall be manufactured from base-perforated (in excess of 30% of the surface area, in accordance with SANS 10142-1, in other words, class D according to Table 4 of IEC 61537) rolled steel. Metal trays manufactured to the following standards shall be used:

<table>
<thead>
<tr>
<th>Width</th>
<th>Minimum Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 150 mm wide</td>
<td>1.2 mm minimum thickness with 12 mm minimum upstand</td>
</tr>
<tr>
<td>150 mm to 450 mm</td>
<td>1.2 mm minimum thickness with 19 mm minimum upstand</td>
</tr>
<tr>
<td>Above 450 mm (Heavy duty)</td>
<td>2.5 mm minimum thickness with 76 mm upstand</td>
</tr>
</tbody>
</table>

(c) The edges of cable trays are to be turned up on both sides to improve rigidity (return flange cable tray), and, where necessary, the sides of trays shall be reinforced with galvanised steel angles, minimum 25 x 25 x 3 mm, with 25 x 3 mm cross-braces at 600 mm centres.

(d) Cable trays shall be hot-dip galvanised only after the perforation and bending processes have been completed.

4.3.4.3 Cable Ladders

(a) Metal cable ladders shall have side rails with 2 mm minimum thickness. Cross rungs shall be spaced at maximum intervals of 300 mm (measured between the centres of rungs). Where cables of 10mm² or smaller are installed on cable ladders, the spacing of cross rungs shall be reduced to 125mm.

(b) Where cables will sag excessively across rungs, rung spacing shall be adjusted.

(c) Cable ladders consisting of slotted metal rails which accommodate plastic or metal cable binding bands may be used in vertical cable runs against walls, etc.

4.3.4.4 Installation

(a) Installation of cable ladders and/or trays shall be strictly according to manufacturer’s specifications.

(b) The spacing between tiers of horizontally stacked trays and/or ladders shall be 300 mm minimum. Furthermore, they shall be installed such that a minimum separation of
300mm exists between ceilings and the top of a tray or ladder (where the latter is installed horizontally) and 50mm between the nearest sides of trays or ladders and the finished surfaces of walls, floors and ceilings for other configurations.

(c) Fixing materials shall be compatible with cable tray and/or ladder materials, and offer resistance to corrosion.

(d) Cuts in trays shall not pass through perforations, except where practically impossible to implement.

(e) Cable trays and ladders shall be mounted with a minimum air gap of 25 mm between the underside of the tray and the mounting surface.

(f) Cable tray and ladder connections shall be suited to and of the same manufacture and dimensions as the linear sections that they connect.

(g) The radius of all bends shall be 1 m minimum. The inside dimensions of horizontal angles or connections shall be large enough to ensure that the allowable bending radius of cables is not exceeded.

4.3.5 Laying of Cables

Where cables are installed in trenches, they shall, after the completion of the trench, be laid with the minimum of delay so that the trench can be backfilled.

No cable shall be laid and installed without both of its ends sealed; hence each cable shall be properly inspected for sealed ends and possible damages prior to and after installation. Any damaged end caps shall be removed and replaced. Subsequently, each end of a cable shall be properly sealed if it is not yet installed. All cable ends shall remain properly sealed until such time when they are terminated.

Care shall be taken where cables are drawn into ducts, in order to ensure that they are not damaged by the ends of a duct. Once cables are drawn into the ducts, the ends of the ducts shall again be properly sealed.

At instances where two or more cables will run in the same trench, only one cable shall be installed at a time. The Contractor shall take precautions that the cables which are already installed are not damaged. Medium Voltage cables shall be laid in such a manner that the beginning of a drum shall be laid from the end of the previous drum to ensure that the lay of the cores remain the same.

Cables shall be laid such that they overlap at joints by at least 1 m, but not more than 1.5 m. Sufficient lengths of cable shall be left at the beginning and end of the cable routes to allow for the termination of the cables. Where necessary the Engineer shall decide on what length of cable is to be left.

Cables running parallel to each other shall be positioned as follow in the same trench:

- Low Voltage (0 – 1,000V_{RMS}) service cables shall all be buried 600 mm below finished ground level. The horizontal spacing between these parallel cables shall be equal to one cable diameter of the larger cable.
- Low Voltage (0 – 1,000V_{RMS}) feeder cables shall all be buried 750 mm below finished ground level. The horizontal spacing between these parallel cables shall be equal to one cable diameter of the larger cable.
- Medium Voltage (1,000 – 44,000V_{RMS}) cables shall all be buried 1,000 mm below finished ground level. The horizontal spacing between these parallel cables shall at least be 200 mm.

Cables that will cross other services shall be positioned as follows:

<table>
<thead>
<tr>
<th>Service</th>
<th>Vertical Spacing (mm)</th>
<th>Horizontal Spacing (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPO Cables</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Water pipes</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Sewer pipes</td>
<td>300</td>
<td>800</td>
</tr>
<tr>
<td>Storm water pipes</td>
<td>300</td>
<td>600</td>
</tr>
</tbody>
</table>

Note:
The above figures need not to apply to the short lengths of cables near the equipment to which the cables are connected.

Where a cable will cross over other services, the cable shall not be installed at a depth less than 600 mm below ground level, and if this is not possible the cable shall be installed underneath the other service. The depth of the cable shall be maintained for one metre on either side of the crossing. If it is not possible to cross over or underneath a service as per the above prescribed manner, the matter shall be referred to the Engineer for a decision.

The following applies to cables laid in cable trays/ladders:

(a) Cables shall be supported to avoid damage during installation, prior to dressing and fixing;

(b) Depending on the overall diameter, single cables and groups shall be secured according to the following:

<table>
<thead>
<tr>
<th>Overall Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nylon UV Protected Cable Ties</td>
</tr>
<tr>
<td>&lt; 35 mm</td>
</tr>
<tr>
<td>Propriety cable clamps</td>
</tr>
<tr>
<td>&gt; 35 mm</td>
</tr>
<tr>
<td>Stainless Steel Strapping (Every 4th tie)</td>
</tr>
<tr>
<td>All</td>
</tr>
</tbody>
</table>

(c) In outdoor applications, where the installation maybe subject to ultra-violet light, PVC covered aluminium tape shall be used instead of nylon cable ties.

(d) Where cables exit ladders, trays or mesh, the latter shall be formed or covered with PVC to ensure a smooth surface.

The Contractor shall keep accurate records of each length of cable laid. The following information shall be recorded:

- Cable drum number;
- Size of cable;
- Laid from where to where;
- Length of cable; and
- Date when the cable is laid.

The contractor shall be held liable for the repair of the cable due to the faulty manufacturing thereof, should this information not be recorded directly after the cable has been laid.

4.3.6 Protective Concrete Slabs

Concrete protective slabs shall be installed on bedding, approximately 100mm above MV cables, and shall be approximately 300mm wide and 50mm thick. The slabs shall be constructed of 20MPa concrete. Each slab shall be reinforced with two longitudinal and three transverses Y (reinforcing) mild steel rods having a diameter of 8mm.

Where cables cross other services such as water pipes and sewage pipes or where the chance exists that the cable may be damaged as a result of excavation by others, the cable shall be protected by means of reinforced concrete slabs. The slabs shall protect the cable for a distance of 500mm on either side of the crossing.

Contractors may quote for the supply of good second hand cement slabs (small cracks permitted) and for the laying of them as per the Bill of Quantities.

4.3.7 Electrical Warning Tape

All electrical cables shall be covered with a continuous brightly coloured electrical warning tape. The tape shall have an 800 gauge thickness. It shall be ensured that the warning tape covers all cables that are installed in a trench. Where two tapes need to be laid side-by-side, they will overlap by at least 10 mm.

The warning tape shall be installed 300 mm below finished ground level.
4.4 Joints and Terminations

Termination of cables shall be by lugs jointed to the cable by an exothermic welding process, by crimping or by compression joints complying with SANS 61238.

Where holes are drilled in copper tape for connection to items of plant, the effective cross sectional area of the connection shall be maintained.

Surfaces of all equipment to which protective conductors are connected shall be clean, and free from paint and other non-conducting material. Surface preparation shall be removed at the point of contact, with the exception of galvanised or similar metallic preparations. Any surface preparations removed, shall be made good upon completion of the connection to preserve the life and purpose of both the surface and the protective conductor.

All Medium Voltage joints and terminations shall be done according to SANS 10198-10 and SANS 10198-11. All accessories required for these shall be installed according to the manufacturer’s instructions and SANS 10198-10 and SANS 10198-11. Any Medium Voltage jointer shall be trained and qualified according to SANS 10198-10 and SANS 10198-11, with the necessary proofing documents submitted to the Engineer.

The Engineer shall be informed in advance of when jointing is to take place to enable him to inspect the joint.

The jointer shall, before he commences with the jointing, ensure that:

(a) He has sufficient and suitable material to properly and efficiently complete the joint;
(b) The joint chamber is dry and clean;
(c) The walls and sides of the joint chamber is firm and free of loose ground, stones, gravel etc. which could fall into the chamber;
(d) The necessary barriers are made to keep water out of the joint chamber;
(e) The necessary cover is provided over the joint chamber to keep unexpected rain out of the chamber and that enough light and ventilation is provided under the cover;
(f) He has the necessary material to seal off the joint or termination when he has to discontinue jointing or terminating the cable due to unexpected storms or flooding of the chamber which makes it impossible to continue jointing or terminating the cable, irrespective of how far the work has commenced;
(g) He has the necessary ground sheets to line the floor of the joint chamber;
(h) The cable and other materials are dry, undamaged and in all respects suitable for jointing or terminating; and
(i) His equipment and tools are at all times dry, clean and absolutely free of ground.

No jointing or terminating shall commence in rainy weather without the prior approval of the Engineer. When the jointer commences with a joint he shall complete the joint before he leaves the site.

The Contractor is responsible to ensure that all the requirements are carried out by his jointer.

The standard phase agreement shall be observed when connecting up cables in the end boxes. The Contractor shall ensure that the prescribed phase arrangement is at all times maintained on the external terminals of the boxes.

A moisture test shall be carried out in accordance with SANS 6281-4, on the outermost and innermost papers on each core of a PILC cable, prior to the making of any joints or terminations. If the results show that moisture is present in the paper, the cable shall be cut to where it is dry. If the complete cable is wet, it shall be removed and replaced.

4.5 Glands

All metallic cable glands shall comply with SANS 1213 and PVC glands shall comply with SANS 950. Glands installed shall be suitable for the type and size of cable being installed and the intended operating environment. Where cables could be subjected to a wet or
damped environment, water tight seals shall be fitted on inner/outer sheaths. All cable
glands shall be fitted with an overall neoprene sealing sleeve.

Gland plates shall be a minimum of 2.0mm thick and shall maintain the IP rating of the
enclosure.

Where a cable is glanded through a painted or otherwise coated metallic surface, provision
shall be made to ensure earth continuity between the gland and the enclosure.

Where single core power cables enter an enclosure, the glanding arrangement shall prevent
circulating currents.

Glands shall be rigidly supported to ensure cable entry at 90˚ to the enclosure.

4.6 Earthing

All MV cables shall be earthed to a BCEW strap that has a minimum size of 95mm². All three
core cables shall be bonded to earth by means of the braided earth straps that are provided
with termination kits.

Single core cables shall be earthed as follows:

- At the source end – Armouring and metallic sheath of the cable bonded to
earth by means of the braided earth strap that is provided with the termination
kit; and
- At the non-source end – The metallic sheath of the cable bonded to earth and
the armouring bonded to earth via a sheath voltage limiter (SVL) in order to
prevent circulating currents.

4.7 Marking and Labelling

4.7.1 Low Voltage Cables

(a) Conductors and/or cables shall be identified at both ends by a cable marker,
consisting of plastic sleeves with pre-printed, legible and indelible alpha/numeric
element inserts. The plastic sleeves shall fully encircle the conductor and/or cable and
the marker shall be suitable for use in its intended environment (for instance, UV
resistant where installed in sunlight, etc.). Reference character sizes shall not be less
than 3mm high.

(b) The colours of conductor PVC insulation shall comply with SANS 10142-
par. 6.3.3. The colours of conductors for sub-circuits shall as far as possible correspond with the
colour of the supply phase. Except in the case of multi-way switching, the colour of a
conductor may not change at any point along its run, starting from its point of origin at
a circuit breaker inside the switchgear assembly. In other words, where loop wiring is
employed, the colour of conductor insulation shall be the same throughout the circuit.

4.7.2 Medium Voltage Cables

4.7.2.1 All Medium Voltage cables shall be properly labelled at both of its ends with stainless steel
labelling plates. These labelling plates shall contain the following information:

(a) Where the cable is running to;
(b) Voltage of the cable;
(c) Type of cable;
(d) Conductor material of the cable; and
(e) Size of the cable.

4.7.2.2 Each joint kit is provided with a labelling system that indicates the manufacturer and part
number of the joint kit. The date of installation of the joint kit shall also be indicated on this
label.

4.7.2.3 Pyramid concrete markers shall be installed for the indication of Medium Voltage cable
positions and cable joints. These markers shall be placed directly above the cable as follows:

(a) At each change of direction in the cable run;
(b) At each joint; and
(c) Along straight cable runs with intervals not greater than 100m.

4.7.2.4 Cable route markers shall be marked with “HT Cable” for any cable having a voltage higher than 1,000V. An arrow on the cable route marker shall indicate the cable route.

4.7.2.5 Cable joint markers that are installed above Medium Voltage joints shall be marked as “HT Joint”.

5. TESTING AND COMMISSIONING

5.1 General

ENGINEERING STANDARD PS-004

ENGINEERING SPECIFICATION FOR TRENCHING AND EXCAVATIONS

aurecon
TABLE OF CONTENTS

1. SCOPE ........................................................................................................................................... 3
   1.1 Application .......................................................................................................................... 3
   1.2 General .................................................................................................................................. 3

2. STANDARDS .................................................................................................................................. 4
   2.1 Regulations, Specifications and Standards .......................................................................... 4

3. TECHNICAL SPECIFICATION .................................................................................................. 4
   3.1 General .................................................................................................................................. 4
   3.2 Trenching .............................................................................................................................. 5
   3.3 Bedding of Cables ............................................................................................................... 5
   3.4 Telecommunication Requirements ...................................................................................... 5
   3.5 Cable Sleeves ....................................................................................................................... 6
   3.6 Backfilling ............................................................................................................................ 6
   3.7 Joint Chambers ..................................................................................................................... 7
   3.8 Draw Pits .............................................................................................................................. 7
   3.9 Protection .............................................................................................................................. 7
   3.10 Holding Points ..................................................................................................................... 7

4. STANDARD DRAWINGS ............................................................................................................. 7
1. SCOPE

1.1 Application

This document specifies the standard requirements for all activities associated with trenching and excavations required for the installation of electrical systems.

1.2 General

The following definitions are used in this Specification:

1.2.1 The term “Employer” shall mean the person named as employer in the Appendix to tender and the legal successors in title to this person.
1.2.2 The term “Contractor” shall mean the person(s) named as contractor in the letter of Tender accepted by the employer.

1.2.3 The term “Engineer” shall mean the person appointed by the Employer as the Engineer for the purposes of the contract.

2. STANDARDS

2.1 Regulations, Specifications and Standards

The works shall be done in accordance with the latest editions (current at the time of Tender) of all relevant National and International Standards, including but not limited to:

<table>
<thead>
<tr>
<th>Specification No.</th>
<th>Specification Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SANS 10198-5</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 5: Determination of thermal and electrical resistivity of soil</td>
</tr>
<tr>
<td>SANS 10198-8</td>
<td>The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 8: Cable laying and installation</td>
</tr>
<tr>
<td>SANS 1200 Part DB</td>
<td>Standardized specification for civil engineering construction: Earthworks (pipe trenches)</td>
</tr>
<tr>
<td>SANS 1200 Part LC</td>
<td>Standardized specification for civil engineering construction: Cable ducts</td>
</tr>
</tbody>
</table>

3. TECHNICAL SPECIFICATION

3.1 General

All activities associated with excavations and trenching shall generally be carried out in accordance with SANS 10198-8 and SANS 1200 Part DB and SANS 1200 Part LC. Furthermore all activities shall be carried out to the satisfaction of the Engineer.

The following shall also be adhered to:

(a) Prior to commencement of trenching, all “existing services” shown on the service drawings must be exposed by means of hand digging. This shall be done by labourers suitably skilled for this work.

(b) Particular care must be exercised during all activities associated with excavations and labourers shall be fully alerted especially where “live” electric cables are to be exposed.

(c) Any damage to existing services shall be reported to the Clerk of Works without delay.

(d) Particular care must be exercised not to damage other services when excavating in close proximity. Repairs to “known” existing services shall be for the Contractors account and shall be repaired with new materials and in accordance with acceptable and correct repair procedures, as approved by the Engineer.

(e) Where other services must be removed by the Contractor, prior written consent of the Engineer is required. Care shall be taken not to damage the removed services. Any damage shall be reported to the Clerk of Works.

(f) Other services shall be replaced by a competent authority or Contractor.

(g) Survey beacons or pegs may not be removed, altered or replaced by the Contractor. Where this is unavoidable the Engineer/Clerk of Works shall be advised in writing and appropriate action shall be taken at his instruction.

(h) Beacons or pegs that are lost, removed or altered shall be replaced at the main Contractor’s expense.
Where surplus material has to be disposed of, the Contractor shall remove it from site and dispose of it in a location of his choosing in accordance with statutory environmental regulations.

3.2 Trenching

Unless otherwise detailed on the drawings, the following minimum depths are required to the centre lines of cables or services:

- Telecommunication cables: 600 mm
- Low voltage (0 – 1,000V<sub>RMS</sub>) service cables: 600 mm
- Low voltage (0 – 1,000V<sub>RMS</sub>) feeder cables: 750 mm
- Medium voltage cables (1,000 – 44,000V<sub>RMS</sub>): 1,000 mm

The width of trenches shall be in accordance with the Bill of Quantities. If the contractor chooses to excavate wider than specified, he may do so at his own cost.

Should the Contractor, during the excavation operations, come across obstacles (or other interferences, e.g. soil drenched with hydrocarbon-based solvents such as spilt oil, which could adversely affect cable insulation), he shall report the matter to the Engineer, who shall then advise an appropriate course of action.

The bottom of the trench shall be level and shall follow the contours of the final ground level. Where the excavation is in excess of the required depth, the excavation shall be backfilled and compacted with suitable material to the required depth.

The Contractor shall trim the trenches and clean up the bottom of the trenches after he has completed the required excavation.

No excavated material shall be left closer than 300 mm from the side of the excavation.

The Contractor shall maintain the excavation in a good condition, free of water, mud, loose ground, rocks, stones, gravel and other strange material until the cables are installed.

3.3 Bedding of Cables

Bedding and selected fill material shall consist of graded sandy soil that has a thermal resistivity of 1.2 Km/W. The Engineer shall make the final decision of whether bedding is required or not.

Normal bedding requirements for electric cables will be as follows:

<table>
<thead>
<tr>
<th>Cable and Ground Conditions</th>
<th>Under (mm)</th>
<th>Over (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV and LV cables in earth</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MV cables in other conditions (Gravel / Hard Rock)</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>LV kiosk feeder cables in other conditions (Gravel / Hard Rock)</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>LV service connection cables in other conditions (Gravel / Hard Rock)</td>
<td>150</td>
<td>100</td>
</tr>
</tbody>
</table>

**Note:**
Trenches shall be excavated such that the installation depths in Section 3.2 are maintained when bedding as per the above requirements need to be laid.

If the soil for the bedding has to be sifted, a sieve with holes not larger than 6 mm shall be used.

3.4 Telecommunication Requirements

(a) Special conditions as required by the telecommunication authorities must be studied carefully and fully complied with.

(b) Suitable protection as per SANS 10198-8 shall be provided where the clearance between telecommunication cables and underground electric power cables is less than 600 mm even if the latter is installed in a duct (Road crossings excluded).
(c) At road crossings where cables come together to enter pipe sleeves, concrete slabs shall be installed above electrical cables, such that they are adequately protected.

3.5 Cable Sleeves

(a) All sleeves used for road crossings shall be straight and undamaged. They shall be laid straight across a road at a depth of approximately 800 mm from the top of the duct to the finished surface of the road.

(b) All sleeves shall protrude approximately 1,000 mm beyond the kerb line. Adequate precautions must be taken to ensure the correct compaction of ground layers with a maximum thickness of 150 mm, to avoid undermining of the road or kerb.

(c) One extra sleeve shall be installed at each road crossing for possible future use.

(d) Sleeves for MV cables shall be laid in a straight line with the proposed trench approximately 1 m from the property line.

(e) LV cable sleeves will be adjacent to the MV cable ducts but towards the splay of the road.

(f) In certain positions, at least one pipe sleeve may be for use by the telecommunication authorities and the drawings must be checked before cables are drawn in.

(g) All sleeves must be cleared by pulling through a loose fitting mandrel prior to the installation of cables.

(h) After pipe sleeves have been installed by the contractor and before any backfilling may commence, a No. 10 gauge galvanised draw wire shall be left in the sleeve, prior to the ends of the sleeves being sealed by means of plastic plugs.

(i) MV and LV cables shall not be drawn into the same sleeve. Cables shall be drawn into the ducts as follows:

<table>
<thead>
<tr>
<th>Cable</th>
<th>Maximum Amount of Cables per Sleeve and Sleeve Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV Cables</td>
<td>1 Cable in a 160 mm sleeve</td>
</tr>
<tr>
<td>LV Feeder Cables (larger than 185mm²)</td>
<td>1 Cable in a 160 mm sleeve</td>
</tr>
<tr>
<td>LV Feeder Cables (smaller than 185mm²)</td>
<td>1 Cable in a 110 mm sleeve</td>
</tr>
<tr>
<td>Service Cables (16mm² or smaller)</td>
<td>4 Cables in a 110 mm sleeve</td>
</tr>
<tr>
<td>Streetlight Cables (16mm² or smaller)</td>
<td>4 Cables in a 110 mm sleeve</td>
</tr>
</tbody>
</table>

3.6 Backfilling

(a) All loose stones or any other materials likely to cause damage to cables shall be removed from trenches, before backfilling commences. Similarly, as per the requirements in SANS 1200 Part DB, any remains in the backfill material that is likely to cause damage to cables, shall be removed prior to backfilling. Care should be taken that all backfilling material consists of a graded soil and sand mix that has a thermal resistivity of 1.2 K.m/W.

(b) Backfilling of trenches in road reserves shall be in layers not exceeding 150 mm and the use of a suitable compacting device is essential in order to achieve an approximate 93 % MOD AASHTO density.

(c) Backfilling across properties shall be in layers of 300 mm with the use of correct facilities. Careful removal and prompt replacement of plants, shrubs, grass, etc. including care of subject matter until growth is re-established, is essential and must be allowed for in rates quoted. After completion of the work the route of the trench shall be neatly finished off and cleared. All stones bigger than 25 mm, as well as all loose organic material and rubble, shall be removed.

(d) Prior to handover and final payment, all cable trenches shall be checked and any subsidence shall be repaired.
(e) Where trenches are across or in a permanent walkway, pavement or gravel road, etc. it shall be reinstated such that the final topping is similar to the surrounding material.

3.7 Joint Chambers

Joint Chambers shall comply with the requirements of SANS 10198-8. Special precautions must be taken at joints to ensure correct and secure support below cables and joints as well as for the subsequent backfilling.

3.8 Draw Pits

(a) Where draw pits are to be constructed and where part of the draw pit will be visible above ground, the masonry units to draw pits shall be FBS (face brick standard). All other draw pit builds shall utilize solid concrete units.

(b) Draw pit covers shall be of cast iron manufacture.

3.9 Protection

(a) The Contractor shall take all necessary precautions to prevent trenching from being a hazard to the public.

(b) The contractor shall safeguard all structures, roads, railways, other services, properties, etc., from any risk of subsidence and damage.

(c) Trenches in front of occupied properties shall be closed by nightfall as far as possible or else suitable safe access must be provided for residents and vehicles. The trenches will be covered against accidental access.

3.10 Holding Points

No construction activities will commence until the site is officially handed over to the Contractor by the Project Manager or his representative.

No construction activities will commence prior to the submission of a detailed construction program and special tool calibration certificates, etc. by the contractor.

The employer’s Clerk of Works will have the prerogative to execute a proper inspection on the condition of all construction tools, equipment and vehicles prior to the commencement of any construction activities.

Construction activities will only commence when the Clerk of Works gives a written instruction to the Contractor that:

(a) All connections and joints have been inspected and that earth backfill may commence;

(b) The excavation, earth tail connections to holding down bolts, reinforcement and shuttering have been checked and that concrete foundations may be casted.

(c) A supplier checklist has been submitted and that the erection of isolators and breakers on the support structures may commence.

(d) Backfilling of cable trenches may commence as per the holding points indicated Figure 1.

The contractor will be held responsible for any construction errors, defects, claims, etc. for continuing with the construction activities at the “hold point” stages without the written instructions from the Employers’ Clerk of Works.

4. STANDARD DRAWINGS

A schematic, indicating detail discussed in Chapter 3, is presented in Figure 1. Unless otherwise stated, all MV and LV cable trenches will comply with these minimum requirements.
Notes:

**INSTRUCTION/HOLDING POINTS:**

1  **FULL TRENCH DEPTH**
2  **LOWER BEDDING**
3  **UPPER BEDDING**
4  **DANGER TAPE**
5  **TOP FINAL COMPACTION**

**BACKFILLING:**

1  **BEDDING - GRADED SANDY SOIL WITHISTIVITY OF 1.2 K.m/W**
2  **SIFTED OR SELECTED GROUND WITH MAXIMUM PARTICLE SIZE OF 25mm**
3  **NORMAL BACKFILLING WITH EXCAVATED MATERIAL WITH A MAXIMUM PARTICLE SIZE OF 25mm**

**Bedding:**

- **NORMAL BACKFILLING**
- **SIFTED OR SELECTED GROUND**
- **BEDDING**

**Legend**

- **LOW VOLTAGE SERVICE CONNECTION CABLES**
- **LOW VOLTAGE FEEDER CABLES**
- **MEDIUM VOLTAGE CABLES**
- **ELECTRICAL WARNING TAPE**
- **CONCRETE SLABS**

**Figure 1:** Standard Cable Trench details.
## Contents

1. **SCOPE** 1
   1.1 Application 1
   1.2 General Requirements 1

2. **STANDARDS** 2
   2.1 Associated Documentation 2
   2.2 Statutory Requirements 2
   2.3 Reference Standards 2

3. **EARTHING OF TRANSFORMER AND GENERATOR NEUTRALS** 3
   3.1 Distribution Transformers 3
   3.2 Standby Generators 3

4. **EARTH ELECTRODES** 4
   4.1 General 4
   4.2 Earth Grids 4
   4.3 Ring and Foundation Earth Electrodes 4
   4.4 Array of Rods 5
   4.5 Trench Electrodes (Cable-route Earth Electrodes) 5
   4.6 Earth Termination Systems for Lightning Protection 5
   4.7 Earth Mats 5
   4.8 Earth Rods 5

5. **EARTHING BARS AND CONDUCTORS** 7
   5.1 Earthing Bars 7
   5.2 Earthing-, Parallel Earthing-, and Earth Continuity Conductors 7

6. **EARTHING OF MV AND LV EQUIPMENT AND ELECTRICAL YARD FENCES** 9
   6.1 MV Switchgear 9
   6.2 Distribution Transformers 9
   6.3 Miniature Substations (Mini-subs) 12
   6.4 Motors 14
   6.5 PFC Capacitor Banks and Harmonic Filters 14
   6.6 MV and LV Cables 14
   6.7 MV Surge Arresters 15
   6.8 Equipment Yard Fences 16
   6.9 LV Electrical Equipment 17

7. **EQUIPOTENTIAL BONDING** 18
   7.1 Main Equipotential Bonding 18
   7.2 Supplementary Equipotential Bonding 18
   7.3 Bonding of Wireways 18

8. **NECR AND NER** 19
   8.1 Neutral Electromagnetic Coupler/Resistor Combinations 19
   8.2 Neutral Earthing Resistors 19

9. **TESTING** 20
9.1 Soil Resistivity Survey 20
9.2 Earth Electrode Resistance Measurement 20
9.3 Earth Surface Potential Measurement 20
9.4 Earth Continuity and Bonding 20

10. DOCUMENTATION AND TRAINING 21
10.1 General 21
10.2 Drawings for Acceptance by the Engineer 21
10.3 Testing Documentation and Reports 21
10.4 Operating and Maintenance Manual 21

Tables
Table 1: Reference Standards 2
Table 2: MV and LV Cable earthing standards 14

Figures
Figure 1: Earthing Bar 7
Figure 2: Distribution Transformer Earthing 10
Figure 3: Earthing at MV/LV transformer pole mounted transformer 11
Figure 4: Mini Sub Earthing 13
Figure 5: Earthing of MV Overhead Surge Arresters 15
Figure 6: Earthing of Equipment Yard Fences 16

Copyright 2015 Aurecon South Africa (Pty) Ltd. All rights reserved.
The contents of this Document are both privileged and confidential and may not be disclosed or reproduced, except as expressly permitted in writing by Aurecon South Africa (Pty) Ltd. All requests should be sent to the attention of the Legal Department, Aurecon South Africa (Pty) Ltd, PO Box 74381, Lynnwood Ridge, 0040. In this regard the attention of every reader or recipient of this document is drawn to the provisions of the paragraph, which follows, the contents of which shall be binding on such reader and/or recipient.

Copyright subsists in this Document and all attachments hereto, which shall include all and/or any ideas, plans, models and/or intellectual property contained in this Document. Any unauthorised reproduction, adaptation, alteration, translation, publication, distribution or dissemination of the whole or any part of this Document in any manner, form or medium (including, but not limited to, electronic, oral, aural, visual and tactile media) whatsoever will constitute an infringement of Aurecon’s copyright and other intellectual property rights. Aurecon reserves the right to take appropriate legal action in the event of any such unauthorised use.]
1. **SCOPE**

1.1 **Application**

1.1.1 This Standard Specification covers the materials, components and installation requirements for earthing systems of industrial medium- and low voltage electrical installations.

1.1.2 General standard requirements are dealt with in this specification, and the project-specific requirements are dealt with in the Project Specification.

1.1.3 This standard specification covers protective earthing and bonding, but not functional earthing and bonding which shall be provided in accordance with the specifications of electrical and electronic equipment suppliers.

1.1.4 This standard specification does not cover electromagnetic compatibility (EMC) earthing and bonding, which shall be provided as specified in the Project Specification if required.

1.1.5 Whilst this specification covers earth termination systems for a building lightning protection system (LPS), it does not cover the LPS itself and surge protection for equipment.

1.1.6 The following does not fall within the scope of this standard specification:

a) The earthing of outdoor open-terminal MV substations.
b) The earthing of electronic systems and equipment.

1.2 **General Requirements**

1.2.1 The completed earthing systems shall incorporate all materials and components necessary to provide the required protective earthing and bonding.

1.2.2 All materials and components shall be new and unused, shall be of current manufacture, and shall be free from any defects or imperfections.
2. **STANDARDS**

2.1 **Associated Documentation**

2.1.1 This Specification contains standard amendments and requirements, which shall be applied to the referenced statutory and national standards. The project-specific requirements are provided in the Project Specification, which shall be read in conjunction with this Specification.

2.1.2 The design, construction, installation, inspection, testing and commissioning of the earthing systems shall comply with all relevant statutory regulations, and the latest editions (current at the time of tender) of all relevant South African National Standards.

2.2 **Statutory Requirements**

2.2.1 The earthing systems shall comply with the following:

   a) Occupational Health and Safety Act of 1993 and Regulations
   b) SANS 10142-1 The Wiring of Premises Part 1: Low-voltage Installations
   c) SANS 10142-2 The Wiring of Premises Part 2: Medium-voltage Installations

2.3 **Reference Standards**

2.3.1 The following national standards shall be complied with as applicable:

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SANS 1063</td>
<td>Earth rods, couplers and connections</td>
</tr>
<tr>
<td>SANS 1411-1</td>
<td>Materials of insulated electric cables and flexible cords - Part 1: Conductors</td>
</tr>
<tr>
<td>SANS 10198-3</td>
<td>Power cables up to 33 kV: Earthing systems - General provisions</td>
</tr>
<tr>
<td>SANS 10198-12</td>
<td>Power cables up to 33 kV: Installation of earthing system</td>
</tr>
<tr>
<td>SANS 10199</td>
<td>The design and installation of earth electrodes</td>
</tr>
<tr>
<td>SANS 10200</td>
<td>Neutral earthing in medium-voltage industrial power systems</td>
</tr>
<tr>
<td>SANS 10292</td>
<td>Earthing of low-voltage distribution systems</td>
</tr>
<tr>
<td>SANS 62305-3</td>
<td>Protection against lightning: Physical damage to structures and life hazard</td>
</tr>
</tbody>
</table>
3. **EARTHING OF TRANSFORMER AND GENERATOR NEUTRALS**

3.1 **Distribution Transformers**

3.1.1 The neutrals of distribution transformers shall be either solidly- (directly) or resistively earthed as specified in the Project Specification.

3.1.2 Unless otherwise specified in the Project Specification, the earthing connection shall be made with 70 mm² bare copper earth conductor to the installation's main earthing bar(s) or to dedicated combined MV and LV earth electrodes in the case of remotely installed transformers or minisubs (refer Clauses 6.2 and 6.3).

3.1.3 Where artificial neutrals are required for transformers with delta-connected secondary windings, neutral electromagnetic couplers /neutral earthing compensators (NECs) shall be provided as specified in the Project Specification.

3.1.4 Where neutral earthing resistors (NERs) are required to limit earth fault current, they shall be provided as specified in the Project Specification, either as separate units or in combination with NECs (and referred to as NECRs).

3.2 **Standby Generators**

3.2.1 LV standby generators shall be earthed in accordance with SANS 10142-1: The Wiring of Premises Part 1: Low-voltage Installations unless otherwise specified in the Project Specification.

3.2.2 The neutrals of MV standby generators shall be resistively earthed with NERs dedicated to the individual generators unless otherwise specified in the Project Specification.

3.2.3 Unless otherwise specified in the Project Specification, the earthing connection shall be made with 70 mm² bare copper earth conductor via the installation’s main earthing bar(s).
4. **EARTH ELECTRODES**

4.1 **General**

4.1.1 Earth electrodes shall be provided as specified in the Project Specification for power systems, electrical equipment and LPS earthing.

4.1.2 The earth electrodes shall be constructed in accordance with Sub-clauses 4.2 to 4.8 of this specification as relevant.

4.1.3 Earth electrodes shall be tested in accordance with Clause 9 of this specification and shall be extended as directed by the Engineer in writing if required to achieve a lower earth resistance.

4.2 **Earth Grids**

4.2.1 Earth grids for electrical equipment yards shall be constructed in the form of a large rectangular arrangement of conductors buried in trenches and divided by longitudinal and transverse conductors into a number of smaller rectangles having mesh dimensions as specified in the Project Specification.

4.2.2 The horizontal conductors shall be high-conductivity, annealed, stranded copper conductors with a cross-sectional area of 70 mm² unless otherwise specified in the Project Specification.

4.2.3 Where horizontal conductors cross each other they shall be joined by exothermic welding or oxy-acetylene brazing.

4.2.4 Horizontal conductors shall be buried directly in the ground at 500 mm below finished ground level (unless otherwise specified in the Project Specification), before any stone layer is put down, in 300 mm wide excavated trenches which shall be backfilled in well-compacted layers.

4.2.5 Supplementary earth rods shall be provided as specified in the Project Specification and shall comply with Clause 4.8 of the specification.

4.3 **Ring and Foundation Earth Electrodes**

4.3.1 A foundation earth electrode shall comprise a continuous length of bare copper earth conductor installed under the perimeter concrete foundation of a building, with the ends brought out to the main earthing bar to form a closed loop. The conductor shall be fixed to the top of the blinding layer just before the concrete foundation is poured to avoid theft of the conductor.

4.3.2 At each corner of the building a 2 m conductor tail shall be exothermically welded to the foundation earth electrode and buried in an accessible location to allow the electrode to be extended if required.

4.3.3 Supplementary earth rods shall be provided as specified in the Project Specification and shall comply with Clause 4.8 of the specification.

4.3.4 A ring earth electrode shall be similar to a foundation earth electrode, except that it shall be external to the structure and in contact with soil for at least 80 % of its total length. Unless otherwise specified in the Project Specification, the ring earth electrode shall be installed 500 mm below finished ground level and 1000 mm from external walls. Ring earth electrodes shall only be provided in place of specified foundation earth electrodes with the Engineer’s written approval.

4.3.5 Horizontal conductors shall be as specified for earth grids in Clause 4.2.2 of this specification.
4.4 Array of Rods

4.4.1 An array of rods interconnected with horizontal conductor in the form of a “T” shall be constructed with horizontal conductor lengths and rod quantities and lengths as specified in the Project Specification to achieve the required earth resistance.

4.4.2 The horizontal conductor shall comply with Clause 4.2.2 of this specification.

4.4.3 The earth rods shall comply with Clause 4.8 of this specification.

4.4.4 The horizontal conductor and the tops of the earth rods shall be 500 mm below finished ground level.

4.5 Trench Electrodes (Cable-route Earth Electrodes)

4.5.1 Trench earth electrodes shall comprise buried horizontal conductor and supplementary earth rods installed in a linear arrangement in MV/LV cable trenches.

4.5.2 The conductor lengths and rod quantities and lengths shall be as specified in the Project Specification to achieve the required earth resistance.

4.5.3 The horizontal conductor shall comply with Clause 4.2.2 of this specification.

4.5.4 The earth rods shall comply with Clause 4.8 of this specification.

4.6 Earth Termination Systems for Lightning Protection

4.6.1 Earth termination systems (ETSs) for lightning protection systems (LPSs) for structures shall be either Type A or Type B arrangements (defined in SANS 62305-3) as specified in the Project Specification.

4.6.2 Ring- and foundation earth electrodes as specified in Clause 4.3 of this specification meet the requirements for Type B arrangements and shall be provided where called for in the Project Specification.

4.6.3 Type A arrangements shall comprise horizontal and/or vertical electrodes (i.e. conductors and/or rods) installed outside the structure to be protected, connected to down conductors, and not forming a closed loop. The required arrangement for a particular structure shall be as specified in the Project Specification.

4.7 Earth Mats

4.7.1 Earth mats shall be provided as called for in the Project Specification where required to provide an extra protective measure to minimize the danger of exposure to high step or touch potentials for operators of outdoor electrical equipment.

4.7.2 Earth mats shall be constructed out of 70 mm² bare copper conductor in the form of a grid with outer dimension 1500 mm x 1500 mm and with longitudinal and transverse conductors spaced 100 mm apart. Crossovers shall be exothermically welded.

4.7.3 Earth mats shall be buried 500 mm below finished ground level.

4.8 Earth Rods

4.8.1 Earth rods used for the earthing system shall be of the “A” grade and shall have a 250 micron copper jacket. Unless otherwise specified in the Project Specification, the rods shall comply with the following:
a) The earth rods shall be extendible, copper clad, high tensile steel (500 MPa) rods and shall bear the SABS mark of approval. They shall be at least 16mm in diameter and shall have hardened steel tips with driving caps.

b) Individual rods shall not have a length of more than 1.5 m.

c) Connections between individual rods shall be by screwed joints in accordance with one of the following:

   i) The ends of the rods shall be externally threaded and be joined by a counter bored, threaded coupler designed to completely enclose the threaded section of the rod. The external threads shall be roll-formed with a minimum copper coating thickness of 0.05 mm at the root of the threads. Couplers shall be manufactured from high strength silicon or aluminium bronze; or

   ii) The ends of the rods shall be internally threaded and joined by a screwed phosphor bronze dowel. A corrosion inhibiting paste shall be applied to the threads before assembly.

d) A single earth rod assembly shall be not more than 6 m long and the separation between adjacent earth rod positions shall be not less than 1.25 times the length of the longest earth rod assembly.

e) The absence of any buried services, down to the maximum driving depth, shall be established before rods are driven into the ground.
5. **EARTHING BARS AND CONDUCTORS**

5.1 **Earthing Bars**

5.1.1 A main earthing bar shall be provided in every MV switchroom or in the main LV switchroom for installations with an LV bulk electricity supply. Supplementary earthing bars shall be provided in other electrical rooms as specified in the Project Specification.

5.1.2 All earthing bars connected to earth electrodes shall have one disconnecting terminal to allow for testing of the associated earth electrodes and shall be constructed in accordance with Standard Drawing for Earthing Bar (Figure 1).

5.1.3 Unless otherwise specified in the Project Specification, earthing bars shall be mounted on the side walls of cable trenches in the positions indicated on the layout drawings.

5.1.4 The earthing bar arrangement shall be as per the following detail sketch:

![Figure 1: Earthing Bar](image)

5.2 **Earthing-, Parallel Earthing-, and Earth Continuity Conductors**

5.2.1 Earthing conductors shall be provided to link earthing bars to earth electrodes, except where the conductor ends of ring- and foundation earth electrodes are terminated at the earth bars. Earthing conductors shall be bare 70 mm² annealed stranded copper conductors, unless otherwise specified in the Project Specification.

5.2.2 Parallel earthing conductors shall be provided as specified in the Project Specification to provide a low impedance connection between separate earthing arrangements. Unless otherwise specified, the conductors shall be laid along cable routes, and shall be bare 70 mm² annealed stranded copper conductors.

5.2.3 Earth continuity conductors (ECCs) shall be provided:

a) With supply cables to MV switchgear and to LV Assemblies

b) To earth the exposed conductive parts of all electrical equipment in accordance with SANS 10142: The Wiring of Premises.
5.2.4 ECCs for MV equipment shall be connected from the MV earthing bar and ECCs for LV equipment shall be connected from the earthing bars in the LV Assemblies from which the equipment receives supply.

5.2.5 ECCs shall be separate conductors or shall form part of the equipment supply cables as specified in the Project Specification. ECCs which does not form part of a cable shall be annealed copper stranded conductors of the specified cross-sectional area and shall be either bare or PVC-insulated as specified in the Project Specification.
6. EARTHING OF MV AND LV EQUIPMENT AND ELECTRICAL YARD FENCES

6.1 MV Switchgear

6.1.1 The earthing bars of MV switchgear shall be connected to the main earthing bar by means of two 70 mm² bare copper earth conductors, unless otherwise specified in the Project Specification. These protective earthing conductors shall be taken from opposite ends of the switchgear earthing bars.

6.1.2 For ring main units (RMUs) in minisubs, the RMU and cable termination enclosure earthing bars shall be bonded to the mini-sub's MV earth bar and to each other in accordance with SANS 1874: Metal-enclosed ring main units.

6.1.3 For RMUs in outdoor steel kiosks, the steel enclosure shall be bonded to the RMU earth bar with 70 mm² bare copper earth conductor.

6.2 Distribution Transformers

6.2.1 Outdoor ground-mounted distribution transformers shall be provided with an equipotential earth electrode in accordance with the Standard Drawing for Distribution Transformer Earthing (Figure 2).

6.2.2 Unless otherwise specified in the Project Specification, the transformer tank earthing terminal shall be separately connected to the closest indoor main earthing bar with a 70 mm² bare copper earth conductor.

6.2.3 Unless otherwise specified in the Project specification, remotely-installed transformers (i.e. which are not installed close to indoor main earthing bars) shall be provided with dedicated combined MV- and LV earth electrodes in accordance with the Standard Drawing for Distribution Transformer Earthing (Figure 2).

6.2.4 Transformer LV neutrals shall be bonded to the earthing terminal in the LV terminal box.

6.2.5 Distribution transformers shall be earthed and bonded in accordance with the Standard Drawing for Distribution Transformer Earthing (Figure 2):
Figure 2: Distribution Transformer Earthing
6.2.6 Pole-mounted transformers shall be earthed in accordance with the Standard Drawing for Pole-Mounted Transformer Earthing (Figure 3):

![Figure 3: Earthing at MV/LV transformer pole mounted transformer](image-url)
6.3 **Miniature Substations (Minisubs)**

6.3.1 Minisubs shall be provided with an equipotential earth electrode in accordance with Figure 4.

6.3.2 Unless otherwise specified in the Project Specification, the mini-sub MV earth bar shall be separately connected to the closest indoor main earthing bar with a 70 mm² bare copper earth conductor.

6.3.3 The internal earthing arrangement of minisubs shall be in accordance with SANS 1029: Miniature Substations as applicable to combined MV- and LV earth electrodes.

6.3.4 Unless otherwise specified in the Project Specification, remotely-installed minisubs (i.e. which are not installed close to indoor main earthing bars) shall be provided with a combined MV- and LV earth electrode, to which the mini-sub MV earth bar shall be connected, in accordance with Figure 4.
Figure 4: Mini Sub Earthing

**Note:** MV and LV TRENCH EARTH ELECTRODE TO BE PROVIDED FOR REMOTELY-INSTALLED TRANSFORMER (REFER CLAUSE 6.3)
6.4 Motors

6.4.1 Where the protective earth conductor forms part of the supply cable to an LV motor, it shall be connected to the earth terminal inside the motor terminal box.

6.4.2 Separate protective earthing conductors shall be connected to the external frame earth terminal of a motor and a jumper shall be provided from the frame terminal to the motor’s terminal box. The jumper shall be crimped to the protective earth conductor and not separately bolted to the frame terminal.

6.4.3 Separate protective earthing conductors shall be PVC-insulated copper conductors with cross-sectional areas as specified in the Project Specification.

6.4.4 Earthing connections to converter-fed motors shall be in accordance with the Standard Drawing for Converter-Fed Motor Earthing.

6.5 PFC Capacitor Banks and Harmonic Filters

6.5.1 The capacitor casings and metal support frames of free-standing PFC capacitor banks shall be earthed in accordance with the supplier’s installation instructions.

6.5.2 The support base/insulators of free-standing air-cored reactors shall be earthed in accordance with the supplier’s installation instructions, with care being taken to not create closed loops within which currents can be induced.

6.5.3 Free-standing iron-cored reactors and filter resistors shall be earthed in accordance with the supplier’s installation instructions.

6.5.4 Where equipment is installed indoors, the earthing connections shall be made with copper earthing continuity conductors to the main earthing bar.

6.5.5 Where the equipment is installed outdoors in a fenced yard, the earthing connections shall be made to the earth grid of the yard.

6.6 MV and LV Cables

6.6.1 The metal components of cables shall be earthed in accordance with the following standards:

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SANS 10142-1</td>
<td>The Wiring of Premises Part 1: Low-voltage Installations</td>
</tr>
<tr>
<td>SANS 10198-9</td>
<td>Power Cables Up To 33 kV: Jointing and Termination of Extruded Solid Dielectric-Insulated Cables up to 3,3 kV</td>
</tr>
<tr>
<td>SANS 10198-10</td>
<td>Power Cables Up To 33 kV: Jointing and Termination of Paper-Insulated Cables</td>
</tr>
<tr>
<td>SANS 10198-11</td>
<td>Power Cables Up To 33 kV: Jointing and Termination of Screened Polymeric-Insulated Cables</td>
</tr>
<tr>
<td>SANS 10198-12</td>
<td>Power Cables Up To 33 kV: Installation of Earthing System</td>
</tr>
</tbody>
</table>

6.6.2 Unless otherwise specified in the Project Specification, metal sheaths, metal screens and armouring of single-core cables shall be earthed at both ends of the cables.

6.6.3 Unless otherwise specified in the Project Specification, metal sheaths, metal screens and armouring of single-core cables shall be earthed at both ends of the cables.
6.7 MV Surge Arresters

6.7.1 Surge arresters at MV overhead line supply points shall be earthed in accordance with the Standard Drawing for OHL Surge Arrester Earthing.

Figure 5: Earthing of MV Overhead Surge Arresters
6.8 Equipment Yard Fences

6.8.1 The enclosing fences of outdoor equipment yards for electrical equipment (switchgear, transformers, PFC capacitors, harmonic filters, etc.) shall be earthed in accordance with the Standard Drawing for Equipment Yard Fence Earthing.

Figure 6: Earthing of Equipment Yard Fences
6.9 LV Electrical Equipment

6.9.1 LV electrical equipment shall be earthed in accordance with SANS 10142-1: The Wiring of Premises Part 1: Low-voltage Installations.
7. EQUIPOTENTIAL BONDING

7.1 Main Equipotential Bonding

7.1.1 Main equipotential bonding shall be provided in accordance with SANS 10142-1 from the main earth bar to the following extraneous conductive parts of an installation:

a) Hot and cold water systems
b) Antennas
c) Other services in conductive material

7.1.2 Main equipotential bonding conductors to the above shall be bare copper earth conductors with a cross-sectional areas as follows:

a) Water systems: 0.5 x installation earthing conductor (6 mm² min to 25 mm² max)
b) Antennas: 2.5 mm²
c) Other services: 2.5 mm²

7.2 Supplementary Equipotential Bonding

7.2.1 Mandatory supplementary equipotential bonding shall be provided in accordance with SANS 10142-1.

7.2.2 Supplementary equipotential bonding shall be provided between exposed conductive parts of the installation where these parts are 2.5 m or less apart. The bonding conductor shall be bare copper earth conductor and shall not be smaller than the smaller of the two earth continuity conductors to the items of equipment.

7.2.3 Supplementary equipotential bonding shall be provided between exposed conductive parts and extraneous conductive parts where these are 2.5 m or less apart. The bonding conductor shall be bare copper earth conductor and shall be at least equal to the half the size of earth continuity conductor to the electrical item of equipment.

7.2.4 Bonding conductors shall be connected to equipotential bonding terminals on equipment/devices or, if these are not provided, shall be bolted to the equipment/devices to the approval of the Engineer.

7.3 Bonding of Wireways

7.3.1 A 70 mm² bare copper earth conductor shall be installed along each cable ladder/tray and each third section shall be bonded to the earth conductor with 35 mm² bare copper earth bonding conductors and purpose-made earth clips. At least one end, but where practicable both ends, of the earth conductor shall be connected to the main earthing bar.

7.3.2 Rigid metal conduiting shall be bonded in accordance with SANS 10142-1.
8. **NECR AND NER**

8.1 **Neutral Electromagnetic Coupler/Resistor Combinations**

8.1.1 Neutral electromagnetic couplers (NECs), also referred to as neutral earthing compensators, shall be provided as specified in the Project Specification to create artificial MV supply/transformer neutral points for earthing via a neutral earthing resistor (NER). The NEC and NER shall be a combined unit, referred to as an NECR.

8.1.2 NECRs shall comply with Aurecon Engineering Standard SPE-EP-0024: Neutral Electromagnetic Couplers (NEC) with NERs and Auxiliary Transformers.

8.2 **Neutral Earthing Resistors**

8.2.1 Standalone NERs shall be provided as specified in the Project Specification for resistive earthing of the neutrals of star-connected transformer secondary windings and MV generator windings.

8.2.2 NERs shall comply with Aurecon Engineering Standard SPE-EP-0024: Neutral Electromagnetic Couplers (NEC) with NERs and Auxiliary Transformers.
9. TESTING

9.1 Soil Resistivity Survey

9.1.1 A soil resistivity survey shall be carried out in accordance with SANS 10199 if specified in the Project Specification.

9.1.2 The Wenner method of measurement shall be followed unless soil depths of greater than 20 m are to be investigated.

9.1.3 The survey shall be carried out in the area where the earth electrode will be installed and readings shall be taken in at least two different directions. Unless earth rods are to be installed to greater depths than 12 m, measurements shall be taken with at least the following electrode spacings: 1/2/3/5/10/15 m.

9.1.4 The results of the survey shall be submitted to the Engineer in the form of a table showing soil resistivity in ohm.metres for the various depths of measurement, as well as in the form of a graph. If the graph shows a significant variation in soil resistivity with depth, then a two layer soil model shall be constructed.

9.2 Earth Electrode Resistance Measurement

9.2.1 The earth resistance of an earth electrode shall be measured in accordance with SANS 10199.

9.2.2 The resistance curve and the calculated earth electrode resistance shall be submitted to the Engineer who will issue a written instruction if it is necessary to extend the earth electrode to lower its resistance.

9.3 Earth Surface Potential Measurement

9.3.1 Where called for in the Project specification earth surface potential measurements shall be made by measuring touch- and step potential contact resistance at specified outdoor equipment.

9.3.2 The proposed measurement method shall be approved by the Engineer and resistance readings shall be submitted to the Engineer for the calculation of touch- and step potentials.

9.4 Earth Continuity and Bonding

9.4.1 Earth continuity and bonding tests shall be carried out in accordance with SANS 10142: The Wiring of Premises Parts 1 & 2.
10. DOCUMENTATION AND TRAINING

10.1 General

10.1.1 All Assembly drawings, documentation and reports shall be in English, and each item shall be identified with:
   a) Employer’s name and contact details
   b) Employer’s contract reference title and numbers
   c) Engineer’s name and contact details
   d) Engineer’s reference numbers
   e) Contractor’s works / contract / order references
   f) Contractor’s name and contact details

10.1.2 Drawings for acceptance shall be provided on A4 or A3 paper copies as specified.

10.2 Drawings for Acceptance by the Engineer

10.2.1 Where alternative earthing arrangement designs to those specified are proposed by the Contractor, drawings shall be submitted to the Engineer for his acceptance before construction commences.

10.3 Testing Documentation and Reports

10.3.1 Test reports for soil resistivity tests shall contain the following:
   a) Methodology statement
   b) Measurement results in tabulated form
   c) Measurement results in graphic form
   d) Overlay of measured graph on master graph as per SANS 10199
   e) Calculated resistivity results for two layer model

10.3.2 Test reports for earth resistance tests shall contain the following:
   a) Methodology statement
   b) Measurement results in tabulated form
   c) Measurement results in graphic form
   d) Calculated resistance value for earth electrode under test

10.4 Operating and Maintenance Manual

10.4.1 As-built drawings and all test reports shall be included in the Operating and Maintenance Manual which must be provided under the Contract.
ENGINEERING STANDARD PS-601

ENGINEERING SPECIFICATION

FOR

STREET AND AREA LIGHTING

aurecon
### TABLE OF CONTENTS

1. **SCOPE** .......................................................................................................................... 4  
   1.1 Application .................................................................................................................. 4  
   1.2 General ..................................................................................................................... 4  
   1.3 Electrical System Characteristics .............................................................................. 4  
   1.4 Installation Performance Requirements ................................................................. 4  
2. **STANDARDS** .................................................................................................................... 5  
   2.1 **REGULATIONS, SPECIFICATIONS AND STANDARDS** ........................................ 5  
3. **TECHNICAL SPECIFICATION** .......................................................................................... 6  
   3.1 General ..................................................................................................................... 6  
   3.2 Luminaires ................................................................................................................ 7  
   3.3 Streetlight and Area Lighting Poles............................................................................ 10  
   3.4 High Mast Lighting .................................................................................................... 12  
   3.5 Photocell (Day/Night switch) .................................................................................... 15  
   3.6 Installation ................................................................................................................ 16  
4. **TESTING AND COMMISSIONING** ............................................................................... 18  
   4.1 General ..................................................................................................................... 18
**Approval Page**

<table>
<thead>
<tr>
<th>Compiled by</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>J Pillay</td>
<td></td>
<td>2011-11-07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Checked by</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>J Hattingh</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Approved by</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Zwiegars</td>
<td></td>
</tr>
</tbody>
</table>

**Amendment History**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Amendment Section / Chapter / Page</th>
<th>Version</th>
<th>Checked By: Name And Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011-11-07</td>
<td>First Issue</td>
<td>Ver 0</td>
<td></td>
</tr>
</tbody>
</table>

**Distribution Page**

<table>
<thead>
<tr>
<th>Copy No</th>
<th>Name</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. SCOPE

1.1 Application
This document specifies the general requirements and related tests for Street and Area Lighting. It covers the classification, marking, mechanical and electrical construction of luminaires, poles and high masts.

1.2 General
The following definitions are used in this Specification:

1.2.1 The term “Employer” shall mean the person named as employer in the Appendix to tender and the legal successors in title to this person.

1.2.2 The term “Contractor” shall mean the person(s) named as contractor in the letter of Tender accepted by the employer.

1.2.3 The term “Engineer” shall mean the person appointed by the Employer as the Engineer for the purposes of the contract.

1.3 Electrical System Characteristics
The operating conditions of the electrical system for which the street and area lighting are required, are stipulated in the Particular Specification.

1.4 Installation Performance Requirements
1.4.1 The installation shall be suitable for its intended duty with respect to the operating conditions of the electrical system and the electrical load requirements.

1.4.2 The installation shall be suitable for the environmental conditions, particularly with respect to corrosion resistance and ingress protection.
2. STANDARDS

2.1 REGULATIONS, SPECIFICATIONS AND STANDARDS

2.1.1 The works shall be done in accordance with the latest additions (current at the time of tender) of all relevant National and International Standards, including but not limited to:

<table>
<thead>
<tr>
<th>Specification No.</th>
<th>Year</th>
<th>Specification Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SANS 475</td>
<td>2006</td>
<td>Luminaires for interior lighting, street lighting and floodlighting - Performance requirements</td>
</tr>
<tr>
<td>ARP 035</td>
<td>2005</td>
<td>Guidelines for the installation and maintenance of street lighting</td>
</tr>
<tr>
<td>SANS 1088</td>
<td>2004</td>
<td>Luminaire entries and spigots</td>
</tr>
<tr>
<td>SANS 1250</td>
<td>1991</td>
<td>Capacitors for use with fluorescent and other discharge lamp ballasts</td>
</tr>
<tr>
<td>SANS 1266</td>
<td>2002</td>
<td>Ballasts for discharge lamps (excluding tubular fluorescent lamps)</td>
</tr>
<tr>
<td>SANS 1574</td>
<td>2004</td>
<td>Electrical cables – flexible cords and flexible cables</td>
</tr>
<tr>
<td>SABS IEC 922</td>
<td>1989</td>
<td>Ballasts for discharge lamps (excluding tubular fluorescent lamps)</td>
</tr>
<tr>
<td>SABS IEC 60923</td>
<td>2001</td>
<td>Ballasts for discharge lamps (excluding tubular fluorescent lamps) – Performance requirements</td>
</tr>
<tr>
<td>SABS IEC 926</td>
<td>1995</td>
<td>Auxiliaries for lamps – Starting devices: General and safety requirements</td>
</tr>
<tr>
<td>SABS IEC 60927</td>
<td>2005</td>
<td>Starting devices (other than glow starters) - Performance requirements</td>
</tr>
<tr>
<td>SABS IEC 61048</td>
<td>2006</td>
<td>Capacitors for use in tubular fluorescent and other discharge lamp circuits: General and safety requirements</td>
</tr>
<tr>
<td>SABS IEC 61049</td>
<td>1991</td>
<td>Capacitors for use in tubular fluorescent and other discharge lamp circuits - Performance requirements</td>
</tr>
<tr>
<td>SANS 529</td>
<td>2001</td>
<td>Heat-resisting wiring cables</td>
</tr>
<tr>
<td>SANS 1507</td>
<td>2002</td>
<td>Electric cables with extruded solid dielectric insulation for fixed installations VC 8011:1999 Lamp holders</td>
</tr>
<tr>
<td>SANS 1777</td>
<td>2004</td>
<td>Photoelectric control units for lighting</td>
</tr>
<tr>
<td>SABS ISO 1461</td>
<td>2000</td>
<td>Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods</td>
</tr>
<tr>
<td>SANS 556-1</td>
<td>2004</td>
<td>Low-voltage switchgear Part 1: Circuit-breakers</td>
</tr>
<tr>
<td>BS 1490</td>
<td>1988</td>
<td>Specification for aluminium and aluminium ingots and castings for general engineering purposes</td>
</tr>
</tbody>
</table>
3. TECHNICAL SPECIFICATION

3.1 General

3.1.1 Luminaires shall be delivered within 12 months from being manufactured and shall be delivered to site unused with protective wrappings.

3.1.2 Luminaires shall be delivered, stored and handled in accordance with the manufacturer's instructions. Where the performance of the luminaire is likely to be adversely affected, all necessary precautions shall be undertaken.

3.1.3 They shall be protected against mechanical damage.

3.1.4 Samples

If required by the Employer, a sample of every luminaire offered shall be submitted to the employer for approval. Acceptance of the samples by the employer shall not place the employer under any obligation.

3.1.5 Drawings

The following drawings shall be submitted with the tender:

(a) Street and area lighting poles

- Dimensioned drawing of the poles
- Detail drawing of the equipment mounting plate
- Fixing detail of access opening cover plate

(b) Streetlight support arm

- Dimensioned drawing of the support arm
- Dimensioned drawing of fixing bracket
3.2 Luminaires

3.2.1 Street Lights

Classification

All luminaires shall comply with SANS 60598-2-3 and shall be of the totally enclosed type. Luminaires shall be adequately and securely fixed to the pole or bracket, allowing for adjustments and when adjusted shall be fixed and remain locked in the set position. Spigot entries shall comply with Table 1 of SANS 1088.

Luminaires shall be constructed to inhibit the ingress of dirt, moisture and insects. The minimum IP rating for the lamp and control gear compartments shall be IP 65. IP rating shall comply with SANS/IEC 60529

Marking

Self-adhesive labels indicating the type and wattage of the lamp shall be stuck to the underside of the luminaire housing and shall be visible when the luminaire is mounted on a pole. Luminaires suitable for use with tubular lamps shall be indicated as such, with the letter “T” and luminaires for elliptical lamps with the letter “E”, after the wattage. Letters shall be at least 40 mm in height and be black against the following background colours:

<table>
<thead>
<tr>
<th>Lamp</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>high pressure sodium vapour</td>
<td>orange</td>
</tr>
<tr>
<td>high pressure mercury vapour</td>
<td>blue</td>
</tr>
<tr>
<td>metal halide</td>
<td>green</td>
</tr>
</tbody>
</table>

Construction

The housing shall be robustly constructed, weatherproof, hail proof, corrosion proof and vandal resistant. It shall be manufactured from filled ultraviolet stabilized engineering polymer, aluminium or dough moulding compound (DMC).

The diffuser shall be constructed from injection moulded high impact acrylic or otherwise toughened heat and impact resistant glass and shall not accumulate dirt reducing the light output. Polycarbonate shall not be used as it discours and loses its impact resistance when exposed to the UV emitted by the sun or the light source.

Luminaires with a sealed optical compartment allowing lamp replacement from above, which does not require opening the diffuser bowl for lamp replacement, shall be preferred. If the diffuser has to be opened for lamp replacement, the diffuser shall be held in place by stainless steel clips’, ensuring the diffuser is closed even if one clip is broken. The diffuser shall remain attached to the housing when opened for maintenance or lamp replacement.

A silicon rubber gasket shall be used to seal the lamp compartment. It shall be fitted into a groove in the housing and be kept in place to ensure the integrity of the IP rating. Neoprene or felt gaskets shall not be acceptable.

An exterior lip shall be provided on the housing to ensure that there is no direct rainwater contact with the gasket between the housing and the diffuser, thus ensuring that no moisture is sucked into the diffuser when the luminaire is switched off and cools down.

Anodized aluminium shall be used for a reflecting material, and the anodizing process shall comply with the requirements of BS 1615. The plate shall be thick enough not to become warped or distorted by the heat coming from the lamp. The reflector shall be permanently fitted into the housing. Luminaires shall preferably be of the semi-cut-off (SCO) distribution, unless the design requires a cut-off (CO) distribution. The luminaires shall be marked with the type of light distribution.

If a luminaire has an adjustable light distribution, either by setting of the optical system, or orientation of reflectors or of the lamp-holder, adjustment markings shall be provided on the luminaire body, and information shall be provided by the manufacturer on the light distribution classification for each setting. The marking shall be made in a clear and indelible manner.
The lamp-holder shall comply with VC 8011, shall be rated for 240 °C and shall not be susceptible to possible loosening of the lamp caused by vibrations. The lamp-holder and end caps shall be made of porcelain, having silver plated metal parts being of the GES type and able to withstand the high starting voltage. The centre contact of the lamp-holder shall be spring loaded and shall not deteriorate under normal working conditions.

All control gear shall be housed within the body of the luminaire in a separate gear compartment sealed with a hinged, non-corrosive lid. Covers and other parts that provide protection against electric shock shall have adequate mechanical strength and shall be reliably secured so that they will not work loose whilst in service. For ease of maintenance, all control gear components shall be mounted on a removable gear tray. Luminaires that have a sealed optical compartment, with lamp replacement from above, shall also have a control gear compartment accessible from above.

The control gear shall be removable and suitable for operation with the specified rating of the lamp on a 230 V ± 10 % 50 Hz single-phase system. All internal wiring shall be protected against abrasion and heat, by using appropriate insulation or sleeving. All screws, bolts and metal parts shall be of stainless steel or non-corrosive materials.

Lamp capacitors shall be manufactured fully in accordance with SANS 1250-1979 and shall be designed when used with the lamp and ballast provided to improve the overall power factor to at least 0.95 lagging. Capacitors shall be fitted with safety discharged resistors and shall be provided with approved nameplates setting out the details of the capacitors.

Lamp ballasts shall comply with the requirements of SANS 1266 and shall be rated for the service required of them and shall be suitable for use with the lamps specified. Ballasts shall be of the totally encapsulated type having terminal blocks for ease of maintenance. The ballasts shall be provided with approved nameplates setting out the particulars of the ballast. The electronic ignition device shall be of the three wire type operating on the superposed pulse principle. The circuiting shall be such that shall a lamp fail the ignition shall not continue pulsing.

3.2.2 Area (Flood) Lights

The luminaires shall be of the totally enclosed weatherproof type complete with a suitable lamp with integral mounted igniter and control gear.

The housing shall be robustly constructed of die cast LM6 aluminum alloy or other corrosion proof and UV resistance material and be effectively sealed to inhibit the ingress of dirt, moisture and insects.

The front glass cover shall be constructed from heat resistant armoured glass having retaining clips, fasteners, etc., manufactured from stainless or ferritic steel. The fitting shall incorporate a protractor scale to allow for the correct and accurate adjustment of the downward to vertical aiming angle.

The internal wiring shall be by means of high temperature grade silicone rubber insulated high quality flexible stranded cables not subject to deterioration. The low voltage wiring shall not be less than 660 volt grade and in the case of high voltage wiring the continuous voltage grade must be suitable for the open circuit voltage of the ballast.

The compartment in which the control gear is located shall be accessible to provide ease of maintenance. This compartment shall be complete with earthing terminal and 660 volts insulated line connector block.

Capacitors shall be metal clad, totally enclosed type complete with sealed in cable tails. Capacitors shall be manufactured fully in accordance with SANS 1250 and be capable of improving the overall power factor to at least 0.95 and be fitted with safety discharged resistors.

Chokes shall be of the totally encapsulated type having terminal blocks for ease of maintenance.

The electronic ignition device shall be of the three wire type operating on the superposed pulse principle.
The circuiting shall be such that shall a lamp fail the ignition shall not continue pulsing.

The lamp-holder end cap shall be porcelain, having silver plated metal parts being of the GES type and able to withstand the high starting voltage. The lamp-holder shall incorporate a spring wire type supporting device at the end of the lamp opposite the cap.
3.3 Streetlight and Area Lighting Poles

3.3.1 General

All poles shall be designed to withstand all static and dynamic loads on the fully equipped pole.

3.3.2 Design parameters

All poles shall comply with SANS 10225, under the following requirements.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrain Category</td>
<td>3</td>
</tr>
<tr>
<td>Design wind speed</td>
<td>144 km/h</td>
</tr>
<tr>
<td>Altitude (above sea level)</td>
<td>1000 m</td>
</tr>
<tr>
<td>Minimum safety factor</td>
<td>1.5</td>
</tr>
</tbody>
</table>

The horizontal and vertical deflections shall not exceed the requirements of SANS 10225.

3.3.3 Poles for streetlights

The streetlight poles shall be manufactured from either steel or glass filament wound polyester and shall be of the round cross-section (tubular) tapered type. The poles shall have a luminaire mounting height as specified in the particular specification with or without a single or double outreach.

The spigot for the mounting of the luminaire on the outreach arm shall be round with an external diameter of 40 mm and a length of 100 mm. The spigots shall be such that when the luminaires are mounted they shall be at an angle of 15° to the horizontal or as otherwise specified.

3.3.4 Poles for area lighting

The poles for the area lighting shall be manufactured from either steel or glass filament wound polyester and shall be of the straight round cross-section tapered type. The poles shall be suitable for the mounting of post top type luminaires at a mounting height as specified in the detail specification.

The spigot for the mounting of the luminaire shall be round with an external diameter of 75 mm and shall have a length of 100 mm.

3.3.5 Cable entries

The poles shall be provided with a cable access opening suitable for installing at least three 16 mm², 4-core street lighting cables.

The edges of the access opening shall be smooth to prevent any damage to the cables.

The access opening shall be positioned such that the opening is at least 500 mm below ground level after the pole has been erected.

3.3.6 Access Aperture

At a height of at least 600 mm above ground level a opening, 240 mm high by 80 mm wide, shall be provided on the poles. The opening shall be covered with a weather proof cover plate with a profile similar to that of the pole. The cover plate shall be manufactured from the same material as that of the pole and the thickness thereof shall not be less than that of the pole. The cover plate shall be fixed to the pole by 10 mm hexagonal brass nuts.

A mounting plate suitable for mounting equipment shall be fixed to the pole on the inside of the access opening. A clip tray for two circuit breakers, a clip tray for four "Clip-on" type terminal blocks and a gland plate to take up to three cables shall be installed on the mounting plate. A 10 mm earth stud of adequate length shall be either installed on the mounting plate or shall be welded on the inside of the pole.

The pole shall be fully equipped with the low voltage equipment specified in the detail specification.

3.3.7 Pole baseplates
Each of the poles shall be provided with a steel baseplate with a diameter of at least 350 mm and a thickness not less than 4 mm.

The baseplates shall be supplied complete with hook bolts and fasteners.

### 3.3.8 FINISHING

**Steel poles**

All welding on steel poles shall be smooth and neat in accordance with SANS 10225. No splatter, slag or blister shall be visible.

All parts of the streetlight pole, including cross-arms shall be hot dip galvanised in accordance with SANS 32 and SANS 121 and test certificates shall be provided if required. No welding, drilling, punching, bending or removal of burrs shall be carried out after galvanising.

For added protection against corrosion the pole shall be dipped in tar up to 500 mm above the finished ground level.

**Glass filament wound polyester poles**

The pole shall be constructed by the filament winding process to achieve optimum results for strength and rigidity. The filament winding process shall be continuously applied with uniform tension onto a rotating mandrel and shall result in a minimum mass glass to resin ratio of 70:30. The surface shall be seamless, smooth and tapered.

The material of the finishing coat shall be a gel coat that shall comply with the requirements of SANS 141 and shall be applied to a uniform thickness of between 250 and 500 microns. It shall provide a weatherproof, UV resistant, flame resistant and impact strong surface in the colour specified.

The pole shall be manufactured in accordance with SANS 1749 under the ISO 9002 quality system and shall bear the applicable mark.

If an access opening is required, the cut-out shall be covered by an access door cover manufactured from glass filled nylon impregnated in the same colour as that of the surface coat. It shall be secured to the pole by two stainless steel Allen head captive screws into M4 brass inserts embedded in the pole.

**Concrete**

Spun reinforced concrete poles shall be manufactured in accordance with SANS 470 Wood.

SANS 754 eucalyptus trees and SANS 753 pine trees comprises the specification for wooden poles used for electrical reticulation including streetlights.
3.4 High Mast Lighting

3.4.1 General

The mast shall be of octagonal cross section, tapered, with the mounting height of the luminaires specified in the detail specification. The mast shall be designed to SANS 10225 Code of Practice and when fully equipped with the luminaires shall withstand a wind velocity appropriate to the site conditions. The deflection at the top of the mast shall not exceed 2.5% of the mast height when subjected to two thirds of the maximum wind velocity.

The masts shall be designed for mounting on a reinforced concrete foundation by means of a base plate secured to bolts casted into the foundation. Additional gussets shall be provided between the base plate and the mast. No steel used in the construction of the mast shall be less than 5 mm in thickness and all steel shall comply with the requirements of BS 4360 grade 43A.

An aperture shall be provided on the side of the mast base compartment to afford ample and easy access to the equipment installed therein. The opening shall be fitted with a lockable, close fitting cover fully sealed against the weather. The perimeters of the opening shall be reinforced with fully welded sheet sections to restore the section modulus and to prevent buckling. Welding shall be in accordance with BS 135 and shall be carried out by qualified welders.

Each mast shall be provided with a bracket to mount the luminaires as specified.

All ferrous parts of the mast shall be hot dipped galvanized after fabrication in accordance with SABS 763.

Each mast shall be provided with an internal distribution board with:

- a) 3-pole main switch,
- b) a single phase earth leakage unit,
- c) 10 x 10A SP circuit breaker,
- d) 15 A, 3-pin switched socket outlet,
- e) time switch or photocell
- f) contactors for control.

Additional power requirements for the Railrow and hydro masts:

- g) One 15 amp 3 pin industrial type, switched socket outlet for the hydraulic unit.
- h) One adequately rated triple pole isolator.
- i) One 15 amp single pole and neutral moulded case breaker with integral 20 amp earth leakage protection device for control of the switched socket outlet.
- j) Three adequately rated single pole circuit breakers for the control of the luminaires.
- k) One 4 way neutral bar.
- l) One 4 way earth bar.

All design calculations are to be submitted at time of tender for evaluation by an independent structural engineer. Failure to submit this documentation will result in a disqualification from the tender.

The mast manufacturer shall be ISO 9001 2000 certified. Failure to submit the proof of certification from your mast supplier may render your tender invalid.

3.4.2 Midhinge Mast

The mast shall be constructed to form a continuously tapered, totally enclosed, octagonal shaft.

The mast must consist of a fixed lower part and a moving part hinged to the fixed part at approximately half the height of the mast. The moving part of the mast shall have the floodlight
cross-arm mounted on it and must be adequately counterbalanced. The hinge must be made from stainless steel.

The moving portion shall consist of sections fitted together on site by slip-joints. No welding on site is allowed.

During raising and lowering and while in the horizontal position, the mast must withstand the wind forces from any direction as well as its own weight and any inertial effects due to sudden stoppage.

An opening shall be provided in the base of the mast for access to the electrical distribution board. The opening shall only be accessible after the mast lid section has been hinged open. A safety chain must be provided which will ensure safe working conditions while work is conducted on the distribution board.

The mast must be lowered and raised with a lightweight, manually operated but robust portable winch which can be stored in the base compartment.

The winch unit must be securely attached to fixed lower part of the mast and the winch cable to the movable part.

A spring-loaded gravity ratchet must ensure that when the operating handle is released during the raising and lowering operation, the moving part stops in whatever position it is in. The ratchet must be fitted with a lever which must be depressed with a constant pressure during the whole operation of lowering the mast. A round bracket must be welded into the top fixed part of the mast to prevent damage to the trailing cable while lowering or raising the mast.

The luminaries must be permanently connected to the supply cable, to facilitate testing when the mast is in the lowered position. No additional cable or connections are allowed.

Masts which require any form of power disconnection while being lowered will not be considered.

### 3.4.3 Railrow Masts

The mast shaft shall be multi sectional. Each section is constructed from a steel plate, which is cut to size, bent into a 6-sided “half shell” and welded together. Rolled sections will not be accepted.

Two “half shell” sections are then welded together by means of a continuous long seam weld, to form this section of the mast shaft.

The floodlight luminaire Ring shall be manufactured in two half-sections, which are bolted together on site. The ring is of a welded steel construction and hot dipped galvanised for corrosion protection. The luminaire ring shall be manufactured from 76 x38 rolled channel section and shall be fitted with a 20mm diameter steel bumper ring below the rolled channel. The luminaire ring shall dock into three guides fixed to the top pulley assembly.

The top pulley assembly consists of a fabricated steel housing, containing the 2 X 280mm diameter; LM6 cast aluminium pulleys, over which the steel wire ropes pass. Separators – one between the pulleys and one on the outside of each pulley – are provided, to separate the wire ropes and trailing cables and to prevent these from wrapping together, shall the ring be lowered in windy conditions. Each external separator has two close-fitted guides on the outside, to prevent the wire ropes and cables from climbing off the pulleys. Additional deep-groove pulleys are fitted for the electrical trailing cables. All pulleys shall run on stainless steel shafts. The entire assembly is protected against the ingress of water, with a moulded fibreglass canopy, which is bolted to the assembly, with a bolt which incorporates a lightning spike.

Two steel wire ropes will be supplied for the purposes of lowering the luminaire ring. All rope connections are done by means of copper “TALURIT” ferrules and crimped with hydraulic crimping tools. The breaking load of the ropes shall be calculated and designed by an Engineer to adequately raise and lower the specified luminaires and luminaire mounting ring.

The portable winch, used for the raising and lowering of the luminaire ring, will be a double drum type, as this unit meets all International safety requirements, ensuring that, even in the event of one of the ropes breaking, the luminaire ring is still secured by the second rope. Single drum winch systems WILL NOT BE CONSIDERED. The worm and wheel of the winch are fully
3.4.4 Hydro Masts

The mast is made up of 2, 3 or 4 sections, each with a length of up to approximately 12m for ease of galvanizing and transportation to site. Each section is constructed from a steel plate, which is cut to size, bent into a 6 sided “half shell” and welded together. Two “half shell” sections are then welded together by means of a continuous long seam weld, to form a section of the mast.

An opening of approximately 250mm x 750mm is cut out in the base of the mast. The top and bottom of the opening are curved to avoid stress-concentrations in the corners. The opening perimeter is strongly reinforced to maintain the section modulus of the mast shaft and to prevent buckling. The door provides easy access to the Distribution board and ancillary equipment. A weather hood provides protection against ingress of water.

The size and material thickness of the base plate and gussets depend on the Height and number and type of luminaires installed on the mast. The material is carefully inspected while being flame cut and if required an ultra-sonic inspection will be carried out. The base plate is welded to the fixed lower section of the mast. Gussets disperse the stress concentrations between the bottom of the mast and the base plate. Two of these gussets (ram lugs) have holes to accept the pivoting pin for attachment of the hydraulic ram.

One or two 100mm cable sleeves must be cast in the concrete foundations. A hole in the base plate provides access to the mast for looping in and out of the supply cables.

The Hinge is situated approximately 1.25 m above the base of the mast. The mast, when lowered, will remain in a horizontal position to facilitate easy maintenance to the luminaires. Fixing points (ram lugs) for the hydraulic rams are provide on the base and the movable upper
section. The latter passes through the mast and is welded to the mast on either side. A selflocking mechanism is provided in the base of the mast, securing the upper section in the vertical position even in windy conditions with the wind blowing in any direction. The release handle can only be operated after the hydraulic ram has compressed the neoprene pads, situated between the base and the movable section of the mast.

Lowering and raising is done with a portable, double acting hydraulic ram, pulling the mast down during lowering and pushing it up during raising. The hydraulic ram can only be operated when the control lever is pushed and held in the operating position; when the control lever is released, the mast stops in whatever position it is in. The ram is securely attached to the upper and lower sections of the mast and cannot be removed during the operation. The ram is fitted with a non-return valve with a limiting oil flow bypass orifice, ensuring a carefully controlled, pre-determined speed of lowering and preventing any increase in speed in the unlikely event of a complete hydraulic failure or severing of hoses. Heavily loaded 25m and 30m masts require a double ram and the 40m three rams. The hydraulic pump with electric motor is permanently fixed on a trolley which can easily be moved from mast to mast. The ram, when not in use, is firmly attached to the trolley. One unit will serve any number of masts. With very large installations it is recommended that a trailer which can be towed by a vehicle be used, rather than a trolley.

Cross arms or luminaire brackets are provided on the top of the mast to suit the required type and number of luminaires.

The design and the dimensions of the concrete foundation depend on mast height, wind velocity, number and type of luminaires as well as the soil conditions. It is important to take into account the position of the luminaires and the direction in which the mast must be lowered when founding the foundation and foundation bolts. Foundation bolts are Hot-Dip galvanized. M39 bolts are normally used; the quantity and centres are determined by the size of the mast and the number of luminaires installed. Lighting Structures will design and construct the foundations on site if required.

A 5-core flexible neoprene mains supply trailing cable is provided between the distribution board and the weatherproof junction box on the top of the mast. The junction box is fitted with a earth and neutral bar and the required number and size of the cable glands. Each luminaire is connected to the junction box with a 3 core 1.5mm flexible neoprene cable. The luminaires can be tested in the lowered position without the need of extra cables or connections.

An earthing stud is welded to the mast structure adjacent to the distribution board. Incoming cables can be connected to this stud.

A totally enclosed fiberglass power distribution board is mounted in an easily accessible position in the base compartment of the mast. The board is provided with a front cover panel with only the operating toggles of the isolator and circuit breakers protruding.

The distribution board shall be equipped as in 3.4.1

3.5 Photocell (Day/Night switch)

The switches are to be used to control streetlights or high mast lighting and shall be fitted with switch contacts able to carry not less than 5 A. The current shall not exceed 50 mA during no-load conditions.

The units shall be suited to 240 V ± 6%, 50 Hz single-phase alternating current.

The units shall be weather proof and vibration-resistant as they are to be mounted on top of streetlight luminaires. The units shall be designed to withstand damage by either stone-throwers or hail. If the units do not possess this quality, separate wire screens shall be provided for this purpose. The units shall be supplied with a standard NEMA plug and socket. The socket shall have an arm for mounting on a pole. All parts shall be treated to be corrosion-proof. The units shall be capable of operating in dusty conditions between -5°C and +55°C.

The units shall switch on when the light intensity drops to 15 lx ± 20% and switch off when the light intensity reaches 40 lx ± 20%. When the unit is in the on position, there shall be a time delay of approximately one minute before it switches off due to a sudden increase in the light intensity.
The design of the switch shall ensure a positive on and off switching at all times.

### 3.6 Installation

#### 3.6.1 SETTING OUT OF THE WORKS

The contractor shall set out the positions of the poles and the cable route as indicated on the drawings. The distance between the poles shall be maintained as specified.

#### 3.6.2 EXCAVATIONS

The holes for poles shall be excavated to the following depths:

<table>
<thead>
<tr>
<th>Description</th>
<th>Mounting Height (m)</th>
<th>Buried Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streetlight Poles</td>
<td>&gt;10.5</td>
<td>2</td>
</tr>
<tr>
<td>Streetlight Poles</td>
<td>7.5 &gt;10.5</td>
<td>1.8</td>
</tr>
<tr>
<td>Area lighting Poles</td>
<td>&gt;3.5</td>
<td>1</td>
</tr>
</tbody>
</table>

The holes for poles shall have minimum dimensions of 1 metre by 0.5 metres. Once the poles have been erected and aligned the excavations shall be backfilled and compacted in layers of 150 mm to 95% MOD AASHO using material free of stones and vegetation. Where the soil is sandy, loose or marshy, the poles shall be planted in a 1:2 sand/cement mixture.

#### 3.6.3 PLANTING OF POLES

The steel and glass filament wound polyester poles shall be fitted with a base plate that shall be securely bolted with hook bolts before the pole is planted.

The contractor shall ensure that the poles are not strained or damaged in any way during erection.

The structures shall be vertical to a tolerance of 0.5% at the top of the pole after erection.

The streetlight poles shall be planted with the luminaire outreach extended in the direction of the roadway and so that the outreach arm is perpendicular to the centre line of the road, except if otherwise specified by the engineer.

Under no circumstances shall poles be shortened to create the impression that they have been planted to the correct depth.

#### 3.6.4 INSTALLATION

Each pole shall be fitted with an equipment mounting plate fixed inside the pole. The cables shall be terminated on the gland plate fitted to the mounting plate by means of cable glands.

A 5 A circuit breaker with a 5 kA breaking capacity shall be installed for each luminaire in each pole.

*Terminal blocks as specified and suitable for the particular cable size shall be fitted on the rail allowed therefore on the mounting plate and the conductors of the cables shall be terminated therein.*

The cable armouring and the earth continuity conductors shall be terminated on the earth stud provided in the pole by means of crimped lugs.

The connection between the terminal block on the mounting plate in the pole and the terminal block of the luminaire shall be made using two PVC insulated 1.5 mm² copper conductors, red for the phase and black for the neutral conductor, and a 1.5 mm² bare copper earth wire for the earth connection.

After the pole has been planted and the conductors have been drawn in, the streetlight luminaire shall be mounted on the spigot and securely fastened with the bolts and/or nuts to the pole.
All the bolts, nuts, screws and clips of the fitting shall be properly screwed.

3.6.5 MOUNTING OF PHOTOCELL

The photocell shall be mounted on the luminaire closest to the miniature substation the streetlight circuit is to be supplied from by making a hole in the luminaire and fixing the photocell base to the luminaire. The photocell shall be connected to the streetlight control equipment in the streetlight compartment by means of a 1.5 mm², 3 core, copper conductor, PVC, SWA, PVC, cable.

If every streetlight is to be separately supplied the photocell shall be mounted onto the luminaire and shall be directly connected to the luminaire.
4. TESTING AND COMMISSIONING

4.1 General

Testing of the streetlight luminaires and poles, area lighting luminaires and poles and high mast lighting shall comply with the specifications as set out in the Standard Specification PS-002 (Engineering Specification for Inspection and Testing of Electrical Equipment and Installations).
F1002 AURECON TYPICAL DRAWINGS

The following additional typical drawings are included:

a) 112471-0000-DRG-E-T001 – TYPICAL STREET LIGHT POLE CONNECTION DETAILS
b) 112471-0000-DRG-E-T002 – TYPICAL TRENCH FOR LOW VOLTAGE CABLES (SECTION VIEW)
c) 112471-0000-DRG-E-T003 – STREET LIGHT CIRCUIT 6 SINGLE LINE DIAGRAM
SHROUDED CIRCUIT BREAKER CLIPPED TO DIN RAIL FIXED TO BACKBOARD

POLE ACCESS DOOR OPENING

POLE EARTH TERMINATION

PHASE AND NEUTRAL CONNECTIONS MADE USING PRATLEY DINKY CONNECTORS WITH INSULATING CAPS

CABLE ARMOURING TWISTED INTO COMPACT TAILS AND BONDED USING ADEQUATELY SIZED LINE TAP
NOTES

1. WHEN TRENCHING IN SOIL FREE OF STONES, ROCKS ETC. CABLE MAY BE LAID DIRECTLY WITHOUT BEDDING. TRENCH DEPTH TO BE ADJUSTED ACCORDINGLY.

2. A SIEVE OF 6mm MESH SIZE MAY BE USED TO SIFT SOIL.

3. BEDDING AND BLANKET TO BE COMPACTED WITH HAND COMPACTING TOOLS ONLY.

4. A MINIMUM SPACING OF 300mm BETWEEN MV CABLES AND 150mm BETWEEN LV CABLES.

5. WHEN TRENCHING IN ROCKY GROUND A MINIMUM SPACING OF 150mm TO BE KEPT BETWEEN CABLE AND TRENCH WALL.

6. CABLE LAID IN PVC PIPE FOR DISTANCE OF AT LEAST 1m EXTENDED PAST KERB. ONLY APPLICABLE TO MV AND LV POWER CABLES.

7. A SIEVE OF 80mm MESH SIZE MAY BE USED TO SIFT SOIL.

8. MINIMUM DISTANCE OF ELECTRICAL CABLES TO OTHER SERVICES AS PER DETAIL SPECIFICATIONS.

9. WHERE ELECTRICAL CABLES CROSS OTHER SERVICES, CONCRETE PROTECTIVE COVERS SHALL BE INSTALLED.

10. LV = LOW VOLTAGE CABLE; SL = STREETLIGHT CABLE; SCEW = BARE COPPER EARTH WIRE.
# PART C4: SITE INFORMATION

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>PART</th>
<th>CONTENT</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4.1</td>
<td>DESCRIPTION OF THE WORKS</td>
<td>C-269</td>
</tr>
<tr>
<td>C4.2</td>
<td>DRAWINGS</td>
<td>C-271</td>
</tr>
<tr>
<td>C4.3</td>
<td>CAMP ESTABLISHMENT, POWER SUPPLY AND OTHER SERVICES</td>
<td>C-271</td>
</tr>
<tr>
<td>C4.4</td>
<td>CONSTRUCTION IN CONFINED AREAS</td>
<td>C-271</td>
</tr>
<tr>
<td>C4.5</td>
<td>MANAGEMENT OF THE ENVIRONMENT</td>
<td>C-271</td>
</tr>
<tr>
<td>C4.6</td>
<td>TRAFFIC</td>
<td>C-272</td>
</tr>
<tr>
<td>C4.7</td>
<td>SMALL CONTRACTOR DEVELOPMENT, TRAINING AND COMMUNITY LIAISON</td>
<td>C-272</td>
</tr>
<tr>
<td>C4.8</td>
<td>CLIMATE</td>
<td>C-272</td>
</tr>
<tr>
<td>C4.9</td>
<td>REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS 2014</td>
<td>C-273</td>
</tr>
<tr>
<td>C4.10</td>
<td>SAFETY PROCEDURES</td>
<td>C-274</td>
</tr>
<tr>
<td>C4.11</td>
<td>AGREEMENT TO OCCUPY SANRAL’S PROPERTY</td>
<td>C-274</td>
</tr>
<tr>
<td>C4.12</td>
<td>APPENDICES</td>
<td>C-275</td>
</tr>
<tr>
<td></td>
<td>APPENDIX 1: LOCALITY PLAN</td>
<td>C-276</td>
</tr>
<tr>
<td></td>
<td>APPENDIX 2: WEATHER DATA</td>
<td>C-277</td>
</tr>
<tr>
<td></td>
<td>APPENDIX 3: BOREHOLE LOGS</td>
<td>C-278</td>
</tr>
</tbody>
</table>
C4.1 DESCRIPTION OF THE WORKS

The description of the works shall inter alia contain the following particulars regarding the work to be constructed and maintained under the contract. A locality plan is included in Appendix 1.

C4.1.1 ROADWORKS

The project is located on National Route 2 Section 7, within the Eden District Municipality of the Western Cape Province, near George.

It is clear from observations on site, that pedestrians are crossing the N2 at this location. Footpaths could be observed on either side of the cutting and local residents indicated that the western footpath were used extensively by school children.

This project therefore proposes the construction of a new pedestrian bridge over National Route 2 at km 25.6. Pedestrian walkways are required to guide pedestrians to the bridge and to tie in with the other NMT facilities that has recently been constructed. Directional encouragement will also be required to entice the users to make use of the crossing rather than crossing at grade.

Horizontal Alignment

The horizontal alignment is dictated by the cadastral boundaries of the township on the south of the national route as well as future intended land use. The walkway will lead pedestrians from Thembalethu, following the existing informal footpaths as closely as possible, over the pedestrian bridge. On the Ballotsview side, the paths will connect up with Blesbok Crescent in the township as well as following the top of the cutting to connect with the existing pedestrian path alongside the N2.

Vertical Alignment

The vertical alignment will follow the alignment of the natural ground level (NGL) or in situ fill, where possible. On the southern side of the road, fill will be required to align with the pedestrian bridge.

Cross Section

The width of the walkway is 2 m wide is acceptable for shared use by all pedestrians.

Drainage

Drainage will be provided at the toe of the fill in the form of a stone pitched flat bottom open drains where required.

Ancillary Works

High mast lighting will be provided at either end of the pedestrian bridge. Timber post and double rail fencing, similar to that used on the recently completed contract, will be provided between the proposed pedestrian walkway and the edge of the cutting on the north side of National Route 2. Openings will have to be created in the existing road reserve fencing to allow access from/to the townships on either end of the bridge. “Clearvu” or similar fencing will be required on the northern side of the bridge to create an alleyway between the existing properties for access to Blesbok crescent.
C4.1.2 PAVEMENT DESIGN FOR ALL PARTS OF THE VARIOUS ROADS

New pavement structure for pedestrian walkway

Roadbed preparation shall include rolling of the in situ material as preparation for the walkway layerworks.

Following adequate preparation of the in situ subgrade material, or the addition of a 150 mm G7 selected layer where required, cast in situ concrete panels will be placed for the construction of the proposed walkways. Grouted stone pitched sidedrains will be constructed where required.

- 150 mm Concrete Class 20/19
- 150 mm G7, Selected Layer.

New pavement structure for median cross-overs

Roadbed preparation shall ripping and re-compacting of the in situ material as preparation for the cross-over layerworks.

Following adequate preparation of the in situ subgrade material, a 150 mm G5 selected layer is provided, followed by an 80 mm thick Bitumin Treated Base (BTB).

- 80 mm BTB
- 150 mm G5, Subbase Layer (compacted to 95% of Maximum Dry Density).
- Rip and re-compact existing subgrade

Material Sources

All materials will be sourced from commercial sources

C4.1.3 STRUCTURAL WORKS

(a) Bridges

The Thembaletlu pedestrian bridge is part of this project:

<table>
<thead>
<tr>
<th>Location Km</th>
<th>Structure No</th>
<th>Name</th>
<th>Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.562</td>
<td>80490</td>
<td>Thembaletlu Pedestrian Bridge</td>
<td>Pedestrian over Road</td>
<td>L = 66.3 m</td>
</tr>
</tbody>
</table>

Thembaletlu Pedestrian Bridge

The proposed position of the new pedestrian bridge co-insides with a cutting of the N2 and therefore does not require long ramps. The bridge will consist of four simply supported spans, two main spans of 20.554 m long each over the carriageways with two jack-spans, each 12.6 m long. The deck will consist of two longitudinal precast concrete beams with precast transverse permanent formwork and in situ topping and cross-beams. A clear width of 2.35 m wide will be provided on the bridge.

The deck will be supported on perched abutments and column type piers, founded on spread footings on shallow residual granite. A copy of the borehole logs and photographs is included in Appendix 5.
C4.1.4 MAINTENANCE WORKS

A Routine Road Maintenance Contractor has been appointed to conduct regular maintenance on the route on which this contract is sited. The contractor’s responsibility for maintenance shall be restricted to the road reserve and shoulder of the road within the limits of this contract. The limits of the contract is from km 24.36 to km 26.76. Any potholes or other failures which occur in the shoulder shall be repaired by the contractor within 24 hours after first being noted, the contractor shall recover his costs for the execution of maintenance works through the payment items provided under section 1500.

The Routine Road Maintenance Contractor’s details are as follows:

Route Manager: Mr Johan Nel, (Qunu)  
Cell: 082 612 1980

Contractor: Mr Alec Bester, (MD Civils)  
Cell: 083 628 0272

C4.2 DRAWINGS

The drawings that form part of the tender document are issued for tender purposes only.

The contractor will be supplied with one set of paper prints plus a CD containing all the construction documentation.

Only figured dimensions may be used and drawings may not be scaled unless so instructed by the engineer. The engineer will supply all figured dimensions omitted from the drawings.

The levels given on bridge drawings are subject to confirmation on site, and the contractor shall submit all levels to the engineer for confirmation before he commences any structural construction work. It is the contractor’s responsibility to check all clearances given on the drawings and to inform the engineer of any discrepancies.

C4.3 CAMP ESTABLISHMENT, POWER SUPPLY AND OTHER SERVICES

The contractor is to make his own arrangements concerning the supply of electrical power and all other services. No direct payment will be made for the provision of electrical and other services. The cost thereof is deemed to be included in the rates and amounts tendered for the various items of work for which these services are required.

The Contractor shall provide a suitable site for his camp and for accommodating his labourers. No camp establishment will be permitted within the road reserve.

C4.4 CONSTRUCTION IN CONFINED AREAS

It will be necessary for the contractor to work within confined areas. In certain places the width of the fill material and pavement layers may decrease to zero and the working space may be confined. The method of construction in these confined areas largely depends on the contractor’s constructional plant.

Regardless, measurement and payment will be in accordance with the specified cross-sections and dimensions only, irrespective of the method used for achieving these cross-sections and dimensions. It is deemed that the rates tendered in the Pricing Schedule include full compensation for all special equipment and construction methods and for all difficulties encountered when working in confined areas and narrow widths, and at or around obstructions. No extra payment will be made nor will any claim for additional payment be considered in such cases. (Refer to project specification sub-clause B1209(g)).

C4.5 MANAGEMENT OF THE ENVIRONMENT

The contractor will be responsible for construction according to an environmental management plan in terms of Section C1000 Scope of Works.
The contractor must take the utmost care to minimise the impact of his establishment and other construction activities on the environment and must adhere to the requirements as set out in Section C of the Scope of Works. Where the contractor fails to adhere to these requirements the specifications in Section C of the Scope of Works provide the methodology and cost liability of remedy.

C4.6 TRAFFIC

The N2 is an important economic and tourist route with a high number of heavy vehicles. The latest traffic data (2010) is as follows:

<table>
<thead>
<tr>
<th></th>
<th>NBC</th>
<th>SBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT (2010)</td>
<td>6195</td>
<td>6353</td>
</tr>
<tr>
<td>AADTT (2010)</td>
<td>NBC - 597 (9.5%)</td>
<td>SBC - 605 (9.6%)</td>
</tr>
</tbody>
</table>

Traffic accommodation embargo times and dates are shown under clause B1204 (a) and described in clause B1504.

C4.7 SMALL CONTRACTOR DEVELOPMENT, TRAINING AND COMMUNITY LIAISON

The South African National Roads Agency SOC Limited is committed to the implementation of Government’s policies and in turn expects the same from its contractors. Accordingly, it is a requirement of this project that tenderers are familiar with the specifications that relate to the transformation of the construction industry through the following:

(i) adherence to the policies of the Reconstruction and Development Programme and other similar Government initiatives,
(ii) employment and/or creation of Targeted Enterprises,
(iii) arrangement of generic skills, engineering skills and entrepreneurial skills training programmes for which provision has been made in the Pricing Schedule,
(iv) construction using labour maximisation principles and,
(v) active participation with community-based structures.

Tenderers should note that liaison with adjacent communities via active participation with their leaders and constituted organisations and forums, as well as employment of their people, are essential parts of the project. A provisional sum to cover costs incurred by members of the community in the liaison process has also been included in the Pricing Schedule.

The Employer requires that a public liaison committee (PLC) be established for this project. Contact with the relevant PLC’s shall be via the Routine Route Maintenance route manager.

Section D of the Scope of Works covers the contractor’s requirements in detail, as well as defining the targets that comprise the Contract Participation Goal (CPG).

It is a requirement on this contract that the contractor actively pursues participation within local communities adjacent to the project, awareness of the need to bring work opportunities to the nearest indigent populations is a priority.

C4.8 CLIMATE

George has a mild humid temperate climate with warm summers and no dry season. Over the course of a year, the temperature typically varies from 8°C to 25°C and is rarely below 5°C or above 29°C. The warm season lasts from December 25 to March 18 with an average daily high temperature above 24°C. The hottest day of the year is January 31, with an average high of 25°C and low of 16°C.

The cold season lasts from May 31 to October 1 with an average daily high temperature below 20°C. The coldest day of the year is July 20, with an average low of 8°C and high of 18°C. A copy of available weather data has is included in Appendix 4.
The average daily temperatures are shown Figure 1 below:

**Figure 1: Daily High and Low Temperature**

![Graph of daily high and low temperatures](image)

Since the year 2000, George received an average of about 670mm of rain per year, with rainfall occurring throughout the year. It received the lowest rainfall (36mm) in May and the highest (88mm) in November. The rainfall data is shown in Figure 2:

**Figure 2: Graphical Presentation of Rainfall Data**

![Graphical presentation of rainfall data](image)

C4.9 REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS 2014

Refer to Section E of the Scope of Works for general requirements in terms of the OH&S requirements.
C4.10 SAFETY PROCEDURES

The Contractor must at all times ensure that the safety of pedestrians and road users are taken into account.

C4.11 AGREEMENT TO OCCUPY SANRAL’S PROPERTY

No SANRAL-owned land will be made available for the use of the contractor for his construction camps, offices, stores, workshops and/or testing facilities.
C4.12 APPENDICES

Appendix 1: Locality Plan
Appendix 2: Weather Data
Appendix 3: Borehole Logs
### Average Daily Maximum Temperature (°C) Data for station [0012661 7] - GEORGE WD

**Measured at 08:00**

<table>
<thead>
<tr>
<th>Year</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>24.9</td>
<td>24.6</td>
<td>22.0</td>
<td>22.3</td>
<td>20.7</td>
<td>22.1</td>
<td>19.8</td>
<td>20.6</td>
<td>20.2</td>
<td>21.1</td>
<td>22.4</td>
<td>23.1</td>
</tr>
<tr>
<td>2001</td>
<td>23.6</td>
<td>25.4</td>
<td>23.7</td>
<td>21.6</td>
<td>23.3</td>
<td>20.8</td>
<td>20.0</td>
<td>18.9</td>
<td>19.8</td>
<td>21.1</td>
<td>22.1</td>
<td>23.6</td>
</tr>
<tr>
<td>2002</td>
<td>24.5</td>
<td>25.3</td>
<td>26.1</td>
<td>23.7</td>
<td>20.7</td>
<td>19.1</td>
<td>17.6</td>
<td>20.0</td>
<td>20.6</td>
<td>21.1</td>
<td>22.5</td>
<td>24.7</td>
</tr>
<tr>
<td>2003</td>
<td>25.3</td>
<td>26.5</td>
<td>25.2</td>
<td>22.9</td>
<td>21.7</td>
<td>19.6</td>
<td>19.4</td>
<td>17.6</td>
<td>19.9</td>
<td>21.4</td>
<td>22.5</td>
<td>23.6</td>
</tr>
<tr>
<td>2004</td>
<td>25.6</td>
<td>24.9</td>
<td>23.5</td>
<td>24.2</td>
<td>22.6</td>
<td>20.6</td>
<td>18.8</td>
<td>19.5</td>
<td>19.9</td>
<td>21.0</td>
<td>23.6</td>
<td>24.7</td>
</tr>
<tr>
<td>2005</td>
<td>24.9</td>
<td>25.3</td>
<td>25.3</td>
<td>23.0</td>
<td>21.9</td>
<td>19.1</td>
<td>21.2</td>
<td>18.9</td>
<td>20.5</td>
<td>22.9</td>
<td>23.0</td>
<td>24.0</td>
</tr>
<tr>
<td>2006</td>
<td>24.3</td>
<td>25.8</td>
<td>24.7</td>
<td>22.7</td>
<td>20.8</td>
<td>20.4</td>
<td>19.6</td>
<td>17.5</td>
<td>19.8</td>
<td>20.8</td>
<td>22.1</td>
<td>23.8</td>
</tr>
<tr>
<td>2007</td>
<td>26.4</td>
<td>25.4</td>
<td>24.0</td>
<td>23.3</td>
<td>21.9</td>
<td>21.0</td>
<td>19.1</td>
<td>19.2</td>
<td>19.9</td>
<td>20.4</td>
<td>21.4</td>
<td>23.0</td>
</tr>
<tr>
<td>2008</td>
<td>23.2</td>
<td>24.8</td>
<td>23.9</td>
<td>22.3</td>
<td>23.2</td>
<td>19.3</td>
<td>19.2</td>
<td>18.6</td>
<td>19.1</td>
<td>19.4</td>
<td>20.6</td>
<td>23.3</td>
</tr>
<tr>
<td>2009</td>
<td>24.2</td>
<td>25.3</td>
<td>25.7</td>
<td>23.9</td>
<td>21.6</td>
<td>19.7</td>
<td>19.2</td>
<td>20.1</td>
<td>19.1</td>
<td>21.2</td>
<td>22.6</td>
<td>22.2</td>
</tr>
<tr>
<td>2010</td>
<td>24.9</td>
<td>25.8</td>
<td>24.6</td>
<td>21.9</td>
<td>19.2</td>
<td>20.1</td>
<td>20.8</td>
<td>19.1</td>
<td>19.9</td>
<td>20.8</td>
<td>21.9</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>23.7</td>
<td>25.4</td>
<td>24.0</td>
<td>22.2</td>
<td>20.4</td>
<td>18.3</td>
<td>18.1</td>
<td>18.6</td>
<td>19.2</td>
<td>20.3</td>
<td>20.9</td>
<td>22.8</td>
</tr>
<tr>
<td>2012</td>
<td>25.7</td>
<td>23.8</td>
<td>24.7</td>
<td>22.3</td>
<td>20.2</td>
<td>17.9</td>
<td>17.1</td>
<td>17.2</td>
<td>19.8</td>
<td>19.2</td>
<td>21.5</td>
<td>24.9</td>
</tr>
<tr>
<td>2013</td>
<td>24.2</td>
<td>25.1</td>
<td>24.4</td>
<td>23.2</td>
<td>22.0</td>
<td>19.1</td>
<td>18.7</td>
<td>18.7</td>
<td>18.7</td>
<td>20.6</td>
<td>22.1</td>
<td>23.7</td>
</tr>
<tr>
<td>2014</td>
<td>24.4</td>
<td>25.5</td>
<td>23.4</td>
<td>23.2</td>
<td>21.5</td>
<td>19.2</td>
<td>18.2</td>
<td>19.4</td>
<td>19.6</td>
<td>21.0</td>
<td>21.2</td>
<td>22.2</td>
</tr>
<tr>
<td>2015</td>
<td>25.3</td>
<td>23.5</td>
<td>24.4</td>
<td>21.3</td>
<td>21.5</td>
<td>17.9</td>
<td>15.9</td>
<td>19.2</td>
<td>19.9</td>
<td>21.7</td>
<td>21.5</td>
<td>24.6</td>
</tr>
<tr>
<td>2016</td>
<td>25.0</td>
<td>25.4</td>
<td>23.4</td>
<td>23.5</td>
<td>22.0</td>
<td>19.5</td>
<td>18.2</td>
<td>20.6</td>
<td>18.7</td>
<td>20.7</td>
<td>21.2</td>
<td>25.8</td>
</tr>
<tr>
<td>2017</td>
<td>24.7</td>
<td>25.1</td>
<td>25.2</td>
<td>24.3</td>
<td>21.7</td>
<td>20.2</td>
<td>18.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>14.3</td>
<td>16.2</td>
<td>15.0</td>
<td>11.2</td>
<td>11.2</td>
<td>9.7</td>
<td>8.6</td>
<td>8.6</td>
<td>8.5</td>
<td>9.7</td>
<td>9.9</td>
<td>10.6</td>
</tr>
<tr>
<td>2001</td>
<td>14.6</td>
<td>15.0</td>
<td>14.9</td>
<td>12.1</td>
<td>9.7</td>
<td>8.6</td>
<td>7.3</td>
<td>8.6</td>
<td>8.6</td>
<td>9.7</td>
<td>9.7</td>
<td>10.6</td>
</tr>
<tr>
<td>2002</td>
<td>15.3</td>
<td>17.0</td>
<td>14.8</td>
<td>13.8</td>
<td>11.3</td>
<td>7.5</td>
<td>6.4</td>
<td>6.2</td>
<td>6.8</td>
<td>6.9</td>
<td>11.5</td>
<td>12.9</td>
</tr>
<tr>
<td>2003</td>
<td>16.5</td>
<td>17.2</td>
<td>13.5</td>
<td>12.5</td>
<td>10.5</td>
<td>8.9</td>
<td>6.6</td>
<td>8.5</td>
<td>11.4</td>
<td>14.5</td>
<td>14.5</td>
<td>16.4</td>
</tr>
<tr>
<td>2004</td>
<td>16.3</td>
<td>16.2</td>
<td>15.0</td>
<td>12.1</td>
<td>10.6</td>
<td>7.3</td>
<td>8.4</td>
<td>6.8</td>
<td>8.9</td>
<td>10.2</td>
<td>13.0</td>
<td>13.3</td>
</tr>
<tr>
<td>2005</td>
<td>16.2</td>
<td>17.4</td>
<td>13.1</td>
<td>12.2</td>
<td>9.7</td>
<td>8.3</td>
<td>8.3</td>
<td>9.2</td>
<td>11.8</td>
<td>12.9</td>
<td>14.3</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>16.5</td>
<td>16.1</td>
<td>14.3</td>
<td>12.5</td>
<td>10.9</td>
<td>9.2</td>
<td>7.8</td>
<td>7.9</td>
<td>8.8</td>
<td>10.7</td>
<td>12.3</td>
<td>15.3</td>
</tr>
<tr>
<td>2007</td>
<td>15.8</td>
<td>15.9</td>
<td>14.3</td>
<td>11.1</td>
<td>10.8</td>
<td>9.1</td>
<td>7.1</td>
<td>7.5</td>
<td>7.6</td>
<td>10.8</td>
<td>12.7</td>
<td>14.6</td>
</tr>
<tr>
<td>2008</td>
<td>15.0</td>
<td>16.0</td>
<td>15.0</td>
<td>13.3</td>
<td>10.4</td>
<td>9.7</td>
<td>9.3</td>
<td>7.5</td>
<td>8.8</td>
<td>11.3</td>
<td>12.2</td>
<td>13.1</td>
</tr>
<tr>
<td>2009</td>
<td>15.8</td>
<td>15.8</td>
<td>15.4</td>
<td>11.6</td>
<td>11.1</td>
<td>7.8</td>
<td>7.6</td>
<td>8.4</td>
<td>8.8</td>
<td>10.5</td>
<td>12.5</td>
<td>15.1</td>
</tr>
<tr>
<td>2010</td>
<td>15.7</td>
<td>17.9</td>
<td>15.7</td>
<td>11.8</td>
<td>10.6</td>
<td>8.7</td>
<td>8.3</td>
<td>7.6</td>
<td>9.0</td>
<td>10.9</td>
<td>11.2</td>
<td>14.3</td>
</tr>
<tr>
<td>2011</td>
<td>17.2</td>
<td>14.9</td>
<td>15.4</td>
<td>11.9</td>
<td>9.2</td>
<td>8.4</td>
<td>6.7</td>
<td>8.7</td>
<td>10.9</td>
<td>12.3</td>
<td>16.0</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>15.5</td>
<td>15.3</td>
<td>14.3</td>
<td>11.0</td>
<td>10.3</td>
<td>7.9</td>
<td>8.1</td>
<td>7.8</td>
<td>7.7</td>
<td>11.5</td>
<td>13.1</td>
<td>14.9</td>
</tr>
<tr>
<td>2013</td>
<td>16.8</td>
<td>16.9</td>
<td>14.1</td>
<td>12.6</td>
<td>10.6</td>
<td>7.8</td>
<td>7.1</td>
<td>8.7</td>
<td>9.8</td>
<td>11.6</td>
<td>12.2</td>
<td>14.9</td>
</tr>
<tr>
<td>2014</td>
<td>16.4</td>
<td>14.8</td>
<td>14.6</td>
<td>11.7</td>
<td>10.6</td>
<td>7.8</td>
<td>7.3</td>
<td>8.7</td>
<td>10.0</td>
<td>12.2</td>
<td>12.2</td>
<td>15.8</td>
</tr>
<tr>
<td>2015</td>
<td>16.9</td>
<td>15.7</td>
<td>14.1</td>
<td>12.2</td>
<td>9.9</td>
<td>7.7</td>
<td>7.1</td>
<td>8.1</td>
<td>8.9</td>
<td>10.5</td>
<td>12.5</td>
<td>14.8</td>
</tr>
<tr>
<td>2016</td>
<td>14.5</td>
<td>15.2</td>
<td>13.9</td>
<td>12.4</td>
<td>10.0</td>
<td>8.1</td>
<td>6.4</td>
<td>6.4</td>
<td>6.4</td>
<td>6.4</td>
<td>6.4</td>
<td>6.4</td>
</tr>
</tbody>
</table>

---

**LEGEND**

Average of the daily maximum temperatures (in °C) by month

*** indicates data is missing or is not yet available in the current month

--- indicates that data is unavailable or was not requested

= indicates that the average is unreliable due to missing daily values
## Monthly Daily Rain (mm) Data for station [00126617] - GEORGE WO

Measured at 08:00

<table>
<thead>
<tr>
<th>Year</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>151.3</td>
<td>41.9</td>
<td>154.6</td>
<td>10.0</td>
<td>20.5</td>
<td>10.5</td>
<td>13.7</td>
<td>11.9</td>
<td>26.1</td>
<td>56.9</td>
<td>123.5</td>
<td>92.9</td>
</tr>
<tr>
<td>2001</td>
<td>37.9</td>
<td>28.4</td>
<td>72.4</td>
<td>144.1</td>
<td>18.6</td>
<td>8.3</td>
<td>39.3</td>
<td>92.1</td>
<td>47.2</td>
<td>64.1</td>
<td>170.3</td>
<td>30.2</td>
</tr>
<tr>
<td>2002</td>
<td>61.8</td>
<td>40.6</td>
<td>42</td>
<td>31.2</td>
<td>32.0</td>
<td>29.8</td>
<td>54.4</td>
<td>76.6</td>
<td>77.0</td>
<td>2.4</td>
<td>36.0</td>
<td>35.2</td>
</tr>
<tr>
<td>2003</td>
<td>36.6</td>
<td>44.6</td>
<td>221.4</td>
<td>57.0</td>
<td>122.0</td>
<td>21.2</td>
<td>35.0</td>
<td>45.0</td>
<td>25.1</td>
<td>67.3</td>
<td>11.2</td>
<td>35.7</td>
</tr>
<tr>
<td>2004</td>
<td>55.3</td>
<td>72.4</td>
<td>73.6</td>
<td>76.9</td>
<td>16.7</td>
<td>46.9</td>
<td>17.9</td>
<td>77.8</td>
<td>58.1</td>
<td>86.7</td>
<td>20.7</td>
<td>143.7</td>
</tr>
<tr>
<td>2005</td>
<td>80.5</td>
<td>32.8</td>
<td>70.4</td>
<td>64.8</td>
<td>33.1</td>
<td>39.7</td>
<td>8.5</td>
<td>21.9</td>
<td>32.7</td>
<td>8.2</td>
<td>69.7</td>
<td>7.7</td>
</tr>
<tr>
<td>2006</td>
<td>58.3</td>
<td>59.3</td>
<td>32.9</td>
<td>131.2</td>
<td>77.4</td>
<td>30.4</td>
<td>89.6</td>
<td>426.4</td>
<td>18.8</td>
<td>120.9</td>
<td>19.7</td>
<td>38.4</td>
</tr>
<tr>
<td>2007</td>
<td>29.1</td>
<td>39.4</td>
<td>122.7</td>
<td>36.3</td>
<td>81.2</td>
<td>46.1</td>
<td>18.4</td>
<td>14.6</td>
<td>16.1</td>
<td>31.6</td>
<td>390.1</td>
<td>132.9</td>
</tr>
<tr>
<td>2008</td>
<td>59.4</td>
<td>61.2</td>
<td>48.7</td>
<td>19.3</td>
<td>6.6</td>
<td>68.3</td>
<td>11.6</td>
<td>63.2</td>
<td>24.5</td>
<td>49.0</td>
<td>162.3</td>
<td>2.0</td>
</tr>
<tr>
<td>2009</td>
<td>9.7</td>
<td>47.3</td>
<td>4.8</td>
<td>44.0</td>
<td>51</td>
<td>50.7</td>
<td>42.8</td>
<td>14.2</td>
<td>43.4</td>
<td>43.9</td>
<td>30.3</td>
<td>38.1</td>
</tr>
<tr>
<td>2010</td>
<td>20.2</td>
<td>65.9</td>
<td>14.6</td>
<td>24.8</td>
<td>16.8</td>
<td>99.5</td>
<td>85.1</td>
<td>45.6</td>
<td>16.1</td>
<td>124.5</td>
<td>40.6</td>
<td>113.3</td>
</tr>
<tr>
<td>2011</td>
<td>47.7</td>
<td>21.9</td>
<td>37.0</td>
<td>18.8</td>
<td>84.1</td>
<td>162.0</td>
<td>120.4</td>
<td>91.4</td>
<td>6.9</td>
<td>35.8</td>
<td>93.4</td>
<td>32.4</td>
</tr>
<tr>
<td>2012</td>
<td>43.8</td>
<td>46.7</td>
<td>73.4</td>
<td>46.2</td>
<td>12.8</td>
<td>71.9</td>
<td>129.3</td>
<td>71.5</td>
<td>8.6</td>
<td>125.5</td>
<td>43.3</td>
<td>15.7</td>
</tr>
<tr>
<td>2013</td>
<td>79.3</td>
<td>62.9</td>
<td>18.0</td>
<td>27.8</td>
<td>22.3</td>
<td>34.6</td>
<td>35.2</td>
<td>88.0</td>
<td>6.4</td>
<td>156.4</td>
<td>91.5</td>
<td>15.1</td>
</tr>
<tr>
<td>2014</td>
<td>188.7</td>
<td>37.1</td>
<td>50.8</td>
<td>105.4</td>
<td>33.6</td>
<td>34.9</td>
<td>14.5</td>
<td>19.0</td>
<td>41.4</td>
<td>28.7</td>
<td>64.8</td>
<td>52.6</td>
</tr>
<tr>
<td>2015</td>
<td>40.3</td>
<td>46.2</td>
<td>60.7</td>
<td>58.7</td>
<td>38.9</td>
<td>69.2</td>
<td>87.0</td>
<td>91.7</td>
<td>122.0</td>
<td>41.9</td>
<td>99.4</td>
<td>26.0</td>
</tr>
<tr>
<td>2016</td>
<td>76.3</td>
<td>23.6</td>
<td>43.7</td>
<td>30.3</td>
<td>14.3</td>
<td>36.2</td>
<td>34.0</td>
<td>16.2</td>
<td>90.1</td>
<td>16.3</td>
<td>23.0</td>
<td>22.1</td>
</tr>
<tr>
<td>2017</td>
<td>67.6</td>
<td>24.9</td>
<td>35.1</td>
<td>16.9</td>
<td>20.2</td>
<td>10.9</td>
<td>15.8</td>
<td>38.7</td>
<td>48.9</td>
<td>52.4</td>
<td>36.5</td>
<td>49.2</td>
</tr>
</tbody>
</table>

**Total of the daily rainfall (in mm) by month**

*** indicates data is missing or is not yet available in the current month

--- indicates that data is unavailable or was not requested

= indicates that the average is unreliable due to missing daily values
### TABLE 1 - AIR TEMPERATURE IN DEGREES CELSIUS

<table>
<thead>
<tr>
<th>MONTH</th>
<th>MIN</th>
<th>MEAN</th>
<th>MAX</th>
<th>RANGE</th>
<th>HIGHEST (TX)</th>
<th>AVERAGE NUMBER OF DAYS WITH TX</th>
<th>LOWEST (TN)</th>
<th>AVERAGE NUMBER OF DAYS WITH TN</th>
<th>MIN</th>
<th>MEAN</th>
<th>MAX</th>
<th>RANGE</th>
<th>HIGHEST (TXX)</th>
<th>LOWEST (TN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>24.5</td>
<td>15.7</td>
<td>20.1</td>
<td>8.8</td>
<td>37.5</td>
<td>83/07/31</td>
<td>31.3</td>
<td>37.4</td>
<td>16.1</td>
<td>16.2</td>
<td>8.8</td>
<td>13.0</td>
<td>61/23/25</td>
<td>93/25</td>
</tr>
<tr>
<td>F</td>
<td>25.0</td>
<td>16.1</td>
<td>20.5</td>
<td>8.9</td>
<td>40.1</td>
<td>93/19/35</td>
<td>33.5</td>
<td>42.4</td>
<td>18.5</td>
<td>19.0</td>
<td>12.6</td>
<td>27.1</td>
<td>76/06/23</td>
<td>83/14</td>
</tr>
<tr>
<td>M</td>
<td>24.0</td>
<td>14.6</td>
<td>19.3</td>
<td>9.4</td>
<td>39.8</td>
<td>05/04/35</td>
<td>35.1</td>
<td>42.7</td>
<td>21.7</td>
<td>21.9</td>
<td>16.2</td>
<td>27.0</td>
<td>83/18/25</td>
<td>93/14</td>
</tr>
<tr>
<td>A</td>
<td>22.6</td>
<td>12.5</td>
<td>17.6</td>
<td>10.1</td>
<td>37.4</td>
<td>08/18/29</td>
<td>33.4</td>
<td>45.6</td>
<td>23.1</td>
<td>23.6</td>
<td>16.2</td>
<td>21.8</td>
<td>83/18/25</td>
<td>93/25</td>
</tr>
<tr>
<td>M</td>
<td>21.5</td>
<td>10.6</td>
<td>16.0</td>
<td>10.9</td>
<td>35.7</td>
<td>07/06/31</td>
<td>31.4</td>
<td>45.9</td>
<td>22.4</td>
<td>22.9</td>
<td>15.6</td>
<td>20.7</td>
<td>93/18/25</td>
<td>93/14</td>
</tr>
<tr>
<td>J</td>
<td>19.5</td>
<td>8.4</td>
<td>14.0</td>
<td>9.2</td>
<td>33.2</td>
<td>06/01/28</td>
<td>28.2</td>
<td>38.8</td>
<td>16.0</td>
<td>16.7</td>
<td>10.2</td>
<td>15.4</td>
<td>83/18/25</td>
<td>93/14</td>
</tr>
<tr>
<td>A</td>
<td>19.0</td>
<td>7.7</td>
<td>13.3</td>
<td>11.3</td>
<td>30.2</td>
<td>08/27/25</td>
<td>27.5</td>
<td>38.9</td>
<td>22.6</td>
<td>23.9</td>
<td>17.7</td>
<td>22.2</td>
<td>93/18/25</td>
<td>93/14</td>
</tr>
<tr>
<td>A</td>
<td>18.9</td>
<td>8.0</td>
<td>13.5</td>
<td>10.9</td>
<td>33.7</td>
<td>09/18/29</td>
<td>28.4</td>
<td>41.2</td>
<td>29.1</td>
<td>30.6</td>
<td>23.8</td>
<td>27.4</td>
<td>93/18/25</td>
<td>93/14</td>
</tr>
</tbody>
</table>

### TABLE 2 - PRECIPITATION (and FOG), DRY- AND WETBULB TEMPERATURES, RELATIVE HUMIDITY and CLOUD COVER

<table>
<thead>
<tr>
<th>MONTH</th>
<th>24-HOUR MAX</th>
<th>TOTAL PER MONTH</th>
<th>AVERAGE NO. OF DAYS WITHIN</th>
<th>MEAN ON THE HOUR</th>
<th>MEAN ON THE HOUR</th>
<th>MEAN ON THE HOUR</th>
<th>MEAN</th>
<th>REL. HUM. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGB</td>
<td>AVG</td>
<td>MIN</td>
<td>MAX</td>
<td>YYYY/DD</td>
<td>YYYY/DD</td>
<td>YYYY/DD</td>
<td>YY/YY</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>59</td>
<td>81</td>
<td>94</td>
<td>214</td>
<td>191</td>
<td>209</td>
<td>11.2</td>
<td>199</td>
</tr>
<tr>
<td>F</td>
<td>53</td>
<td>45</td>
<td>50</td>
<td>212</td>
<td>208</td>
<td>202</td>
<td>10.6</td>
<td>201</td>
</tr>
<tr>
<td>M</td>
<td>69</td>
<td>128</td>
<td>203</td>
<td>253</td>
<td>200</td>
<td>202</td>
<td>10.7</td>
<td>199</td>
</tr>
<tr>
<td>A</td>
<td>68</td>
<td>103</td>
<td>117</td>
<td>198</td>
<td>200</td>
<td>200</td>
<td>10.7</td>
<td>199</td>
</tr>
<tr>
<td>M</td>
<td>41</td>
<td>82</td>
<td>103</td>
<td>173</td>
<td>191</td>
<td>198</td>
<td>8.2</td>
<td>198</td>
</tr>
<tr>
<td>J</td>
<td>41</td>
<td>38</td>
<td>100</td>
<td>2010</td>
<td>218</td>
<td>204</td>
<td>8.5</td>
<td>202</td>
</tr>
<tr>
<td>A</td>
<td>44</td>
<td>76</td>
<td>231</td>
<td>1983</td>
<td>1990</td>
<td>1984</td>
<td>8.0</td>
<td>1984</td>
</tr>
<tr>
<td>O</td>
<td>96</td>
<td>102</td>
<td>235</td>
<td>2002</td>
<td>2002</td>
<td>2003</td>
<td>11.9</td>
<td>2003</td>
</tr>
<tr>
<td>N</td>
<td>76</td>
<td>206</td>
<td>307</td>
<td>2010</td>
<td>2001</td>
<td>2002</td>
<td>10.8</td>
<td>2002</td>
</tr>
</tbody>
</table>

### CLIMATE OF SOUTH AFRICA          WB 42          CLIMATE STATISTICS          1981 - 2010

**Period** = years covering the data for all the columns of both tables.

**P** = Average number of years covering the data in the columns concerned.

**TX** = Average maximum.  **TN** = Average minimum air temperature

**TXH** = Highest maximum.  **TNH** = Lowest minimum.  **TXN** = Highest minimum.  **TNN** = Lowest maximum.  **TXN** = Highest minimum.  **TNN** = Lowest maximum.  **TNN** = Highest minimum.  **TNN** = Lowest maximum.  

**TH** = Thunder.  **HA** = Hail.  **SN** = Snow.  **FOG** = FOG.
RAINFALL ANALYSIS FOR: 0012661 7 GEORGE WO Lat:-34.0200 Lon:22.3800 Height:191 m
DATA REQUESTED 2000 to 2016

Data for the Average Calculation is not used if:
There are more than five consecutive days of accumulation
The data for certain days in the month is not available
The accumulation period occurred at the end of the month

Data for the Frequency calculation is not used if:
The data for certain days in the month is not available
The accumulation period occurred at the end of the month

<table>
<thead>
<tr>
<th>Month</th>
<th>Average Monthly Rainfall (mm)</th>
<th>Standard Deviation</th>
<th>Average Number of Rain Days per Month</th>
<th>Number of Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td>63.3</td>
<td>43.9</td>
<td>12.5</td>
<td>17</td>
</tr>
<tr>
<td>FEB</td>
<td>45.5</td>
<td>14.8</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>MAR</td>
<td>64.9</td>
<td>54.7</td>
<td>11.9</td>
<td>17</td>
</tr>
<tr>
<td>APR</td>
<td>54.5</td>
<td>38.2</td>
<td>10.8</td>
<td>17</td>
</tr>
<tr>
<td>MAY</td>
<td>37.4</td>
<td>32.3</td>
<td>8.5</td>
<td>17</td>
</tr>
<tr>
<td>JUN</td>
<td>50.6</td>
<td>35.9</td>
<td>9.1</td>
<td>17</td>
</tr>
<tr>
<td>JUL</td>
<td>49.2</td>
<td>37.6</td>
<td>9.6</td>
<td>17</td>
</tr>
<tr>
<td>AUG</td>
<td>74.5</td>
<td>93</td>
<td>10.6</td>
<td>17</td>
</tr>
<tr>
<td>SEP</td>
<td>38.9</td>
<td>31.1</td>
<td>11.4</td>
<td>17</td>
</tr>
<tr>
<td>OCT</td>
<td>62</td>
<td>45.5</td>
<td>12.4</td>
<td>16</td>
</tr>
<tr>
<td>NOV</td>
<td>87.3</td>
<td>92</td>
<td>11.9</td>
<td>16</td>
</tr>
<tr>
<td>DEC</td>
<td>44.5</td>
<td>38.4</td>
<td>11.4</td>
<td>14</td>
</tr>
<tr>
<td>YR</td>
<td>672.7</td>
<td>131.1</td>
<td>45.1</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Average Number of Rain Days in the Specified Range:

<table>
<thead>
<tr>
<th>Month</th>
<th>1 - 5 mm</th>
<th>5.1 - 10mm</th>
<th>10.1 - 20mm</th>
<th>20.1 - 50mm</th>
<th>50.1 - 100mm</th>
<th>&gt; 100 mm</th>
<th>Maximum 24-hour Rainfall (mm)</th>
<th>Date of Maximum 24-hour Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td>3.8</td>
<td>1.4</td>
<td>1</td>
<td>0.6</td>
<td>0.2</td>
<td>0</td>
<td>60.5</td>
<td>1/6/2014</td>
</tr>
<tr>
<td>FEB</td>
<td>3.3</td>
<td>1.4</td>
<td>1.3</td>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>36.6</td>
<td>2/3/2013</td>
</tr>
<tr>
<td>MAR</td>
<td>4.1</td>
<td>1.4</td>
<td>0.8</td>
<td>0.6</td>
<td>0.1</td>
<td>0.1</td>
<td>114.6</td>
<td>3/24/2003</td>
</tr>
<tr>
<td>APR</td>
<td>3.3</td>
<td>1.9</td>
<td>0.8</td>
<td>0.5</td>
<td>0</td>
<td>0.1</td>
<td>102.7</td>
<td>4/16/2001</td>
</tr>
<tr>
<td>MAY</td>
<td>2.9</td>
<td>1.1</td>
<td>0.8</td>
<td>0.2</td>
<td>0.1</td>
<td>0</td>
<td>75</td>
<td>5/10/2003</td>
</tr>
<tr>
<td>JUN</td>
<td>3.5</td>
<td>1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.1</td>
<td>0</td>
<td>75.5</td>
<td>6/8/2011</td>
</tr>
<tr>
<td>JUL</td>
<td>3.6</td>
<td>1.2</td>
<td>0.5</td>
<td>0.6</td>
<td>0.1</td>
<td>0</td>
<td>65.5</td>
<td>7/13/2012</td>
</tr>
<tr>
<td>AUG</td>
<td>4.2</td>
<td>1</td>
<td>0.5</td>
<td>0.6</td>
<td>0.2</td>
<td>0.1</td>
<td>230.1</td>
<td>8/1/2006</td>
</tr>
<tr>
<td>SEP</td>
<td>4.4</td>
<td>0.9</td>
<td>0.4</td>
<td>0.3</td>
<td>0.1</td>
<td>0</td>
<td>57</td>
<td>9/9/2002</td>
</tr>
<tr>
<td>OCT</td>
<td>4.3</td>
<td>1.3</td>
<td>0.4</td>
<td>1</td>
<td>0.1</td>
<td>0</td>
<td>57.5</td>
<td>10/24/2010</td>
</tr>
<tr>
<td>NOV</td>
<td>3.8</td>
<td>1.6</td>
<td>0.9</td>
<td>0.8</td>
<td>0.1</td>
<td>0.1</td>
<td>206</td>
<td>11/21/2007</td>
</tr>
<tr>
<td>DEC</td>
<td>3.9</td>
<td>0.8</td>
<td>0.6</td>
<td>0.6</td>
<td>0</td>
<td>0</td>
<td>57.6</td>
<td>12/22/2004</td>
</tr>
<tr>
<td>YR</td>
<td>45.1</td>
<td>15.5</td>
<td>8.4</td>
<td>6.8</td>
<td>1</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Limitation**

The User shall not at any time, disclose or divulge the Specified Data to any person whomsoever except on a need to know basis to those of its employees and officers who require knowledge thereof. The User will treat the Information as private and confidential to SAWS and will take all reasonable precautions to protect the Information from unauthorised use, reproduction or distribution. The South African Weather Service (SAWS) does not give any representation or warranty that the Specified Data contains no errors, is complete or up to date or will not infringe any third party intellectual property rights.

The User assumes the sole risk of interpreting and applying the Specified Data and SAWS is not in any way liable for any loss, damage or injury suffered by the User or any other person, due to the use or possession of the Specified Data or the existence of errors in the Specified Data.
APPENDIX 3: BOREHOLE LOGS
GEOLOGICAL MAP

SITE

LITHOLOGY

- Shale, siltstone
- Phyllite, feldspathic gneis, quartzite
- Gneissic granite and granodiorite, diorite
- Weathered granite quartz sandstone, medium to coarse grained, quartzitic and argillaceous
- Weathered granite quartz sandstone, medium to coarse grained, quartzitic, feldspathic and chloritic, partly cross-beded subordinate shale
- Weathered granite sandstone, fine to coarse grained, shale

BAR SCALE

0 5 10km

Aurecon Centre, 1 Century City Drive, Waterford Precinct, Century City, 7441
Century City
Cape Town

Tel: +27 21 526 9400
Fax: +27 21 526 9500

NJ VAN GASS
T PAPE
T PAPE
**SILTY SAND**
Dark brown, probably loose, SILTY SAND with rootlets; Transported.

**SILTY SANDY GRAVEL**
Dark red, medium dense, SILTY SANDY GRAVEL with ferricrete nodules; Pedogenic.

**SANDY SILTY CLAY**
Light red orange, stiff, fissured, SANDY SILTY CLAY; Residual, completely weathered Maalgaten Granite.

**SANDY SILT**
Light red brown, dense, SANDY Silt; Residual, completely weathered Maalgaten Granite.

**GRAVELLY SILTY SAND**
Light brown, very dense, GRAVELLY SILTY SAND; Residual, completely weathered Maalgaten Granite.
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>NXM</th>
<th>SPT</th>
<th>RQD%</th>
<th>Fract. Freq.</th>
<th>SPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.59</td>
<td>12.59</td>
<td>100.00</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44.90</td>
<td>44.90</td>
<td>100.00</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.03</td>
<td>27.03</td>
<td>0.00</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>76.29</td>
<td>76.29</td>
<td>0.00</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54.05</td>
<td>54.05</td>
<td>0.00</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31.08</td>
<td>31.08</td>
<td>0.00</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>178.57</td>
<td>178.57</td>
<td>0.00</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90.91</td>
<td>47.27</td>
<td>&gt;20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85.00</td>
<td>85.00</td>
<td>77.00</td>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Granite**

Light grey, medium to coarse grained, intensely to very thinly foliated; Fractures: Highly to moderately fractured, slightly rough to rough, closed, stained light yellow, medium hard to hard rock, Maalgaten Granite.

Hole stopped. End of Log.
### Core Borehole Log

**CLIENT:** Aurecon  
**CONTRACT:** George Pedestrian Crossing KM25.6  
**CONTRACT NO.:** NRA N002-070-2016/2D SS  
**HOLE NO.:** BH1  
**JOB NUMBER:** 000  

#### NOTES

1. End of hole at 22.35m  
2. No samples taken  
3. SPT = Standard penetration test  
4. R = Refusal

---

<table>
<thead>
<tr>
<th>Core size</th>
<th>% Mat. recov.</th>
<th>% Core recov.</th>
<th>RQD%</th>
<th>Fract. Freq.</th>
<th>SPT</th>
</tr>
</thead>
</table>

**CONTRACTOR:** East Coast Drilling Services  
**MACHINE:** XY1  
**DRILLED BY:** J J  
**PROFILED BY:** I PATON Pr Sci Nat  
**TYPE SET BY:** S NGEMA  
**SETUP FILE:** SANRAL.SET  
**ELEVATION:** N/A  
**INCLINATION:** -90°  
**DIAM:**  
**DATE:** September 2016  
**X-COORD:** E22°29'07.7779"  
**Y-COORD:** S33°59'41.9695"  
**DATE:** 18/01/2017 17:06  
**TEXT:** ..ancrossingkm25.6\BH1.txt
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.42</td>
<td>Layer 1</td>
</tr>
<tr>
<td>1.00</td>
<td>Layer 2</td>
</tr>
<tr>
<td>2.00</td>
<td>Layer 3</td>
</tr>
<tr>
<td>4.00</td>
<td>Layer 4</td>
</tr>
<tr>
<td>6.00</td>
<td>Layer 5</td>
</tr>
<tr>
<td>8.00</td>
<td>Layer 6</td>
</tr>
<tr>
<td>10.00</td>
<td>Layer 7</td>
</tr>
<tr>
<td>12.00</td>
<td>Layer 8</td>
</tr>
<tr>
<td>14.00</td>
<td>Layer 9</td>
</tr>
<tr>
<td>16.00</td>
<td>Layer 10</td>
</tr>
<tr>
<td>18.00</td>
<td>Layer 11</td>
</tr>
<tr>
<td>20.00</td>
<td>Layer 12</td>
</tr>
<tr>
<td>22.00</td>
<td>Layer 13</td>
</tr>
<tr>
<td>24.00</td>
<td>Layer 14</td>
</tr>
</tbody>
</table>

CONTRACT: George Pedestrian Crossing KM25.6
CLIENT: Aurecon
BOREHOLE NO: BH1
COBLE BOREHOLE LOG

CLIENT: Aurecon
CONTRACT: George Pedestrian Crossing KM25.6
CONTRACT NO.: NRA N002-070-2016/2D SS

HOLE No: BH2
Sheet 1 of 3

JOB NUMBER: 000

**SILTY SAND**
Light brown, SILTY SAND; Transported.

**SILTY CLAYEY GRAVEL**
Dark red brown, SILTY CLAYEY GRAVEL; with minor ferricrete nodules; Transported/Pedogenic.

**CLAYEY SILT**
Dark red orange to light olive, CLAYEY SILT; Residual, completely weathered Maalgaten Granite.

**SILTY SAND**
Light brown, SILTY SAND; Residual, completely weathered Maalgaten Granite.
SANDY GRAVEL
Light grey, SANDY GRAVEL; Residual, completely weathered Maalgaten Granite.

Granite
Light grey stained dark orange, highly to slightly weathered, medium to coarse grained, very thinly foliated becoming massive. Fractures: Highly to moderately fractured, slightly rough to rough, closed, stained light yellow, medium hard to hard rock, Porphyritic Maalgaten Granite.

Hole stopped. End of Log.
## NOTES

1) End of hole at 22.12m

2) No samples taken

3) SPT = Standard penetration test

4) R = Refusal

### CORE BOREHOLE LOG

<table>
<thead>
<tr>
<th>Core size</th>
<th>% Mat. recov.</th>
<th>% Core recov.</th>
<th>RQD%</th>
<th>Fract. Freq.</th>
<th>SPT</th>
</tr>
</thead>
</table>

**CONTRACTOR:** East Coast Drilling Services  
**MACHINE:** XY1  
**DRILLED BY:** J J  
**PROFILED BY:** I PATON Pr Sci Nat  
**TYPE SET BY:** S NGEMA  
**SETUP FILE:** SANRAL.SET

**INCLINATION:** -90°  
**DIAM:**  
**DATE:** September 2016  
**DATE:**  
**DATE:** 18/01/2017 17:36  
**TEXT:** ancrossingkm25.6/BH2.txt

**ELEVATION:** N/A  
**X-COORD:** E22°29'08.1666''  
**Y-COORD:** S33°59'41.9470''

**HOLE No:** BH2

**JOB NUMBER:** 000

**CLIENT:** Aurecon  
**CONTRACT:** George Pedestrian Crossing KM25.6  
**CONTRACT NO.:** NRA N002-070-2016/2D SS
<table>
<thead>
<tr>
<th>CONTRACT: George Pedestrian Crossing KM25.6</th>
<th>BOREHOLE NO: BH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIENT: Aurecon</td>
<td></td>
</tr>
</tbody>
</table>
SILTY SAND
Light brown, probably loose, SILTY SAND; imported fill.

SANDY GRAVELLY SILT
Light yellow orange, dense to very dense, SANDY GRAVELLY SILT with cobbles & boulders; Residual, Maalgate Granite.

SILTY SAND
Light brown, dense to very dense, SILTY SAND; Residual, completely weathered Maalgate Granite.
Granite
Light grey, moderately weathered, medium to coarse grained, intensely to very intensely foliated. Fractures: Highly to moderately fractured, slightly rough to rough, closed, stained, light yellow, medium hard rock, Maalgate Granite.

Hole stopped. End of Log.

NOTES
1) End of hole at 14.67m
2) No samples taken
3) SPT= Standard penetration test
4) R=Refusal
CONTRACT: George Pedestrian Crossing KM25.6
CLIENT: Aurecon

BOREHOLE NO: BH3
CORE BOREHOLE LOG

CLIENT: Aurecon
CONTRACT: George Pedestrian Crossing KM25.6
CONTRACT NO.: NRA N002-070-2016/2D SS

HOLE No: BH4
Sheet 1 of 2

CLIENT: Aurecon
CONTRACT: George Pedestrian Crossing KM25.6
CONTRACT NO.: NRA N002-070-2016/2D SS

JOB NUMBER: 000

SILTY SAND
Light brown, SILTY SAND; imported fill.

GRAVELLY SANDY SILT
Light olive to light brown, dense, GRAVELLY SANDY SILT with cobbles; Residual, Maalgate Granite.

SLIGHTLY SILTY SAND
Light brown, dense, SLIGHTLY SILTY SAND; residual Maalgate Granite.
### Notes

1. End of hole at 15.84m
2. No samples taken
3. SPT = Standard penetration test
4. R = Refusal

---

**Granite**

Light grey to dark grey, highly to slightly weathered, medium to coarse grained, intensely foliated. Fractures: Highly to moderately fractured, rough, closed, stained light yellow, hard rock, Maalgate Granite.
CONTRACT: George Pedestrian Crossing KM25.6

CLIENT: Aurecon

BOREHOLE NO: BH4
### CORE BOREHOLE LOG

**CLIENT:** Aurecon  
**CONTRACT:** George Pedestrian Crossing KM25.6  
**CONTRACT NO.:** NRA N002-070-2016/2D SS  
**HOLE No:** BH5  
**Sheet 1 of 2**  
**JOB NUMBER:** 000

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>SILTY SAND</td>
<td>Light brown, probably loose, SILTY SAND; Transported.</td>
</tr>
<tr>
<td>1.50</td>
<td>SILTY CLAYEY GRAVEL</td>
<td>Dark red brown, very stiff, SILTY CLAYEY GRAVEL; Pedogenic, ferricrete.</td>
</tr>
<tr>
<td>2.40</td>
<td>CLAYEY SILT</td>
<td>Dark red orange, very stiff, CLAYEY SILT; Residual, completely weathered Maalgaten Granite.</td>
</tr>
<tr>
<td>3.40</td>
<td>SILTY SANDY GRAVEL</td>
<td>Light yellow orange, very dense, SILTY SANDY GRAVEL; Residual, completely weathered Maalgate Granite.</td>
</tr>
<tr>
<td>9.57</td>
<td>Granite</td>
<td>Light yellow orange, highly weathered, medium to coarse grained, intensely foliated. Fractures: Very Highly fractured, rough, closed, stained, light yellow, medium hard rock, Maalgate Granite.</td>
</tr>
</tbody>
</table>

**Core Size % Mat. recov. % Core recov. RQD% Fract. Freq. SPT**

**Scale 1:50**
NOTES

1) End of hole at 17.7m

2) No samples taken

3) SPT = Standard penetration test

4) R = Refusal
**SILTY SAND**
Light brown, probably loose, SILTY SAND; Transported.

**SILTY CLAYEY GRAVEL**
Dark red brown, very stiff, SILTY CLAYEY GRAVEL; Pedogenic, ferricrete.

**CLAYEY SILT**
Dark red orange, very stiff, CLAYEY SILT; Residual, completely weathered Maalgaten Granite.

**SILTY SANDY GRAVEL**
Light yellow sandy orange, very dense, SILTY SANDY GRAVEL; Residual, completely weathered Maalgate Granite.

**Granite**
Light yellow orange, highly weathered, medium to coarse grained, intensely foliated. Fractures: Very Highly fractured, rough, closed, stained, light yellow, medium hard rock, Maalgate Granite.
HOLE No: BH5

NOTES
1) End of hole at 17.7m
2) No samples taken
3) SPT= Standard penetration test
4) R=Refusal

Hole stopped. End of Log.

Core size | % Mat. recov. | % Core recov. | RQD | Fract. Freq. | SPT
---|---|---|---|---|---
TNW 71 | 64 | >20 | 12 |
TNW 105 | 92 | 46 | 12 |
TNW 98 | 88 | 20 | 22 |
TNW 34 | 24 | 9 |
TNW 18 | 15 | 10 | 2 |
TNW 81 | 53 | 20 |
TNW 90 | 83 | 49 | 9 |

CONTRACTOR: East Coast Drilling Services
MACHINE: XY1
DRILLED BY: J J
PROFILED BY: I PATON Pr Sci Nat
TYPE SET BY: S NGEMA
SETUP FILE: SANRAL.SET

ELEVATION: N/A
X-COORD: E22°29'07.9764''
Y-COORD: S33°59'44.3526''

DATE: September 2016
DATE: 18/01/2017 17:21
CONTRACT: George Pedestrian Crossing KM25.6
CLIENT: Aurecon
BOREHOLE NO: BH5
**SILTY SAND**
Light brown, probably loose, SILTY SAND; Transported.

**SILTY SAND**
Pale red to light brown, medium dense, SILTY SAND; Transported.

**SILTY GRAVEL**
Dark red orange, medium dense, SILTY GRAVEL; Pedogenic, ferricrete.

**CLAYEY SILT**
Dark red, very stiff, CLAYEY SILT; Residual, completely weathered Maalgate Granite.

**SILTY SANDY GRAVEL**
Dark red orange to light olive, very dense, SILTY SANDY GRAVEL, Residual, completely weathered Maalgate granite; .

**Granite**
Light grey to light yellow orange, highly weathered, medium to very coarse grained, intensely foliated. Fractures: Highly fractured, rough, closed, stained, light yellow, medium hard rock, Maalgate Granite.
### CORE BOREHOLE LOG

**CLIENT:** Aurecon  
**CONTRACT:** George Pedestrian Crossing KM25.6  
**CONTRACT NO.:** NRA N002-070-2016/2D SS  
**HOLE No:** BH6  
**JOB NUMBER:** 000

#### NOTES
1. End of hole at 17.55m
2. No samples taken
3. SPT = Standard penetration test
4. R = Refusal

#### Core Characteristics

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Core size</th>
<th>% Mat. recov.</th>
<th>% Core recov.</th>
<th>RQD%</th>
<th>Fract. Freq.</th>
<th>SPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>TNW 95</td>
<td>95</td>
<td>6</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>TNW 18</td>
<td>13</td>
<td>0</td>
<td>&gt;20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>TNW 18</td>
<td>17</td>
<td>7</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>TNW 92</td>
<td>80</td>
<td>33</td>
<td>&gt;20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>TNW 96</td>
<td>96</td>
<td>62</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.55</td>
<td>Hole stopped. End of Log.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CONTRACTOR:** East Coast Drilling Services  
**MACHINE:** XY1  
**DRILLED BY:** J J  
**PROFILED BY:** I PATON Pr Sci Nat  
**TYPE SET BY:** S NGEMA  
**SETUP FILE:** SANRAL.SET  
**DATE:** 18/01/2017 17:23  
**INCLINATION:** -90°  
**ELEVATION:** N/A  
**X-COORD:** E22°29’08.3651”  
**Y-COORD:** S33°59’41.3301”  
**TEXT:** ..ancrossingkm25.6\BH6.txt  

**MACHINE:** XY1  
**DIAM:**  
**DATE:** September 2016  
**X-COORD:** E22°29’08.3651”  
**Y-COORD:** S33°59’41.3301”  
**TEXT:** ..ancrossingkm25.6\BH6.txt
<table>
<thead>
<tr>
<th>CONTRACT: George Pedestrian Crossing KM25.6</th>
<th>BOREHOLE NO: BH6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIENT: Aurecon</td>
<td></td>
</tr>
</tbody>
</table>
PART C5: ANNEXURES

TABLE OF CONTENTS

| ANNEXURE A: INTRODUCTION TO PUBLIC LIAISON COMMITTEES IN SANRAL PROJECTS | C-281 |
| ANNEXURE B: PROJECT HEALTH AND SAFETY SPECIFICATION | C-282 |
ANNEXURE A: INTRODUCTION TO PUBLIC LIAISON COMMITTEES IN SANRAL PROJECTS
Stakeholder engagement on application of procurement strategy and SANRAL’s 14 point plan for community engagement on subcontracting and labour beneficiaries in the Western Region
<table>
<thead>
<tr>
<th>TYPE OF PROCUREMENT</th>
<th>CONTRACT VALUE (INCLUDING VAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; R10 M EME</td>
<td>R10M &lt; R30M QSE</td>
</tr>
<tr>
<td><strong>GRADES 1-5</strong></td>
<td><strong>GRADES 6 &amp; 7</strong></td>
</tr>
</tbody>
</table>

1. **Engineering:**
   1. Minimum BBBEE Level 4; and
   2. Specify QSE or subcontracting a minimum of 50% to EME’s
   3. Specify that a non-QSE to subcontract a minimum of 50% to EME’s or QSE’s

80/20 PREFERENCE POINT SYSTEM

90/10 PREFERENCE POINT SYSTEM

1. Minimum BBBEE Level 4 and
   2. Specify QSE or subcontracting a minimum of 30% to EME’s or QSE’s; or
   3. Specify that a non-QSE to subcontract a minimum of 50% to EME’s or QSE’s

1. Minimum BBBEE Level 4 and
   2. Specify minimum of 8CE or subcontracting a minimum of 30% to EME’s or QSE’s; or
   3. Specify that higher grades to subcontract a minimum of 50% to EME’s or QSE’s

1. Minimum BBBEE Level 4 and
   2. Specify min of 30% subcontracting to EME’s or QSE’s
<table>
<thead>
<tr>
<th>TYPE OF PROCUREMENT</th>
<th>CONTRACT VALUE (INCLUDING VAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; R10 M EME</td>
</tr>
<tr>
<td><strong>GRADES 1-5</strong></td>
<td><strong>GRADES 6 &amp; 7</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>80/20 PREFERENCE POINT SYSTEM</th>
<th>90/10 PREFERENCE POINT SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Minimum BBBEE Level 4 and</td>
<td>1. Minimum BBBEE Level 4; and</td>
</tr>
<tr>
<td>2. Specify EME; Or</td>
<td>2. Specify QSE + minimum 30%</td>
</tr>
<tr>
<td>3. Specify QSE + Subcontracting min 50% to EME's</td>
<td>subcontracts to EME's or QSE's</td>
</tr>
<tr>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td>3. Specify that a non-QSE to subcontract minimum of 50% to EME's or QSE's</td>
<td>3. Specify non QSE's to subcontract min 50% to EME's or QSE's</td>
</tr>
</tbody>
</table>

- Contract value based on annualized cost of project
<table>
<thead>
<tr>
<th>TYPE OF PROCUREMENT</th>
<th>CONTRACT VALUE (INCLUDING VAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; R10 M EME</td>
</tr>
<tr>
<td></td>
<td>R10M &lt; R30M QSE</td>
</tr>
<tr>
<td></td>
<td>R30M &lt; R50M QSE</td>
</tr>
<tr>
<td></td>
<td>R50M &lt; R150M</td>
</tr>
<tr>
<td></td>
<td>&gt;R150M</td>
</tr>
<tr>
<td>80/20 PREFERENCE POINT SYSTEM</td>
<td>90/10 PREFERENCE POINT SYSTEM</td>
</tr>
</tbody>
</table>

3. Engineering: Conventional Projects for Consultants

1. Minimum BBBEE Level 4; and
2. Specify EME; or
3. Specify QSE + min 20% subcontracting to EME’s

1. Minimum BBBEE Level 4; and
2. Specify QSE and a minimum of 30% subcontracting to EME’s or QSE’s

1. Minimum BBBEE Level 4; and
2. Specify a minimum of 30% subcontracting requirements to EME’s and QSE’s

1. Minimum BBBEE Level 4; and
2. Specify a minimum of 30% subcontracting requirements to EME’s and QSE’s

- Consulting services for RRM and Ad-Hoc Projects not suited for subcontracting
- Costs calculated for subcontracting for Design and Supervision to be based on tendered fees and excludes Provisional Sums
## Designated Groups

<table>
<thead>
<tr>
<th>DESIGNATION</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>EME</td>
<td>Exempted Micro Enterprise (turnover &lt; R10 million)</td>
</tr>
<tr>
<td>QSE</td>
<td>Qualifying Small Business (turnover &lt; R50 million)</td>
</tr>
<tr>
<td>EME (BP)</td>
<td>Exempted Micro Enterprise where 51% owned by Black People</td>
</tr>
<tr>
<td>QSE (BP)</td>
<td>Qualifying Small Business where 51% owned by Black People</td>
</tr>
<tr>
<td>EME (BY)</td>
<td>Exempted Micro Enterprise where 51% owned by Black Youth</td>
</tr>
<tr>
<td>QSE (BY)</td>
<td>Qualifying Small Business where 51% owned by Black Youth</td>
</tr>
<tr>
<td>EME (BW)</td>
<td>Exempted Micro Enterprise where 51% owned by Black Women</td>
</tr>
<tr>
<td>QSE (BW)</td>
<td>Qualifying Small Business where 51% owned by Black Women</td>
</tr>
<tr>
<td>EME (BPD)</td>
<td>Exempted Micro Enterprise where 51% owned by Black People with Disabilities</td>
</tr>
<tr>
<td>QSE (BPD)</td>
<td>Qualifying Small Business where 51% owned by Black People with Disabilities</td>
</tr>
<tr>
<td>EME(BP-R)</td>
<td>Exempted Micro Enterprise where 51% owned by Black People in Rural areas</td>
</tr>
<tr>
<td>QSE (BP-R)</td>
<td>Qualifying Small Business where 51% owned by Black People in Rural areas</td>
</tr>
<tr>
<td>EME (BP-MV)</td>
<td>Exempted Micro Enterprise where 51% owned by Military Veterans</td>
</tr>
<tr>
<td>QSE (BP-MV)</td>
<td>Qualifying Small Business where 51% owned by Military Veterans</td>
</tr>
<tr>
<td>CO-OP(BP)</td>
<td>Co-operative which is at least 51% owned by Black People</td>
</tr>
</tbody>
</table>
14-point plan framework to engage stakeholders

1. Establish Project Liaison Committees (PLCs) in each project to create a platform for project liaison, works execution, sub-contracting and employment facilitation.

2. SANRAL to Chair PLCs and provide secretarial support Representation to comprise: SANRAL; Contractor; Consultant; Business Representatives; Traditional Representatives; Provincial and Municipal Government Representatives; Community Representatives and any other critical local stakeholder that may be deemed necessary by the PLC.

3. Community Liaison Officer (CLO) or Public Liaison Officer (PLO) selection to be done under the auspices of the PLC.

4. Definition of a target area (sometimes referred to as a Local Area or Traffic Area) to be done under the auspices of the PLC.
14-point plan (continued)

5. Set up of a database of Contractors and Suppliers (and Consultants where relevant) to be done under the auspices of the PLC. The final database to be signed off by the PLC.

6. Setup of database of local labour for the targeted area to be done under the auspices of the PLC. The final list to be signed off by the PLC. An agreed system of labour selection from the database to be agreed at the PLC.

7. Handover of signed-off databases for sub-contracting and labour to contractor for open tender process and recruitment respectively done by the PLC.

8. Tender to be conducted by Contractor using Government principles (e.g. public opening of received bids, announcement of bidders and prices). Tabling of winning bidders in the PLC.
9. Appeals on the tender process to be escalated to SANRAL for an independent review.

10. Capability assessments of contractors and suppliers to be done under auspices of PLC prior to tender stage to identify any deficiencies in skills and experience. For labour, skills assessments to be done at recruitment stage.

11. Contractor development support and training to be coordinated and conducted ahead under the auspices of the PLC prior to project commencement.

12. Identification of works areas that are deliverable by local service providers, and areas where capabilities are not available locally. All works areas where capabilities are not available locally shall be imported and locals will be given an opportunity to learn.
13. Formal contracting arrangements to be ensured for all projects.

14. Communication to be streamlined through the PLC and used to manage expectations of local business and communities. It is acknowledged that while the minimum requirements as stipulated in the New PPPFA Regulations 2017 are an imperative that must be complied with, the parties have agreed to apply the above principles as far as possible in the project to deliver percentages of black business participation that are above the minimum thresholds that are set by legislation. This agreement shall apply to all SANRAL projects while SANRAL finalises the development of its new Transformation Policy.
Unpacking and implementation of the 14-point plan

1. Establish PLCs in each project

• Agreed to one PLC per District Municipality i.t.o. RRM;
• Conventional contracts to then tie into existing PLC’s;
• The Executive Mayor of each District Municipality to guide us on who to contact in their respective areas;
• We make the Target Area for subcontractor participation a District Municipality or two (depending on the locality of a specific project);
• The Target Area for labour may be reduced to smaller areas;
• Database of required skills needed per Target Area.
2. **SANRAL to Chair PLCs and provide secretarial support**  
   
   • SANRAL Project Manager to Chair;  
   • Only use elected representatives;  
   • Chair to receive sufficient training;  
   • Mayor’s office already has structure in place as a starting point;  
   • Suggestion to utilise RRM to start the engagement process with Mayor;  
   • Keep committees as small as possible.

3. **Community Liaison Officer (CLO) or Public Liaison Officer (PLO) selection to be done under the auspices of the PLC.**  
   
   • PLC to recommend 2 options and the Consultant to appoint;  
   • Process: criteria for selection and job description must be advertised; box provided for applications.
4. **Definition of a target area (sometimes referred to as a Local Area or Traffic Area) to be done under the auspices of the PLC.**

- PLC may define target area for participation by subcontractors;
- A larger target area may be defined if no required skills within original defined target area (the Contractor however must prove this before going wider or negotiate highest points);
- SANRAL can provide skills available in specific target area to Contractor during tender time;
- Suggestion for 30% provisional sum for conventional projects (similar to RRM).
5. **Set up of a database of Contractors and Suppliers**
   - The PLC to provide names and setup database, under leadership of the Consultant;
   - Long- and short-term strategies to be considered when doing this.

6. **Setup of database of local labour for the targeted area**
   - Criteria: CIDB registered, on National Treasury’s Central Supplier Database, black-owned;
   - Regional database of subcontractors required;
   - Responsibility of PLC’s representatives to notify suppliers to register with Municipality.

7. **Handover of signed-off databases for sub-contracting and labour**
   - The target area will define eligibility.
8. **Tender to be conducted by Contractor using Government principles**
   Allow lead-time to successful Contractor (6wks period before construction works commence);

9. **Appeals on the tender process to be escalated to SANRAL for an independent review.**
   Clarity sought on “independent review” given that SANRAL will form part of the PLC.

10. **Capability assessments of contractors and suppliers**
    Noted: For labour, skills assessments to be done at recruitment stage.
11. **Contractor development, support and training**
   • Pilot training scheduled for Contractor from 14-15 July 2017 at WR;
   • Suggestion: SAFCEC training for subcontractors;
   • Suggestion: training for successful appointees, in OHS etc.

12. **Identification of works areas that are deliverable by local service providers, and areas where capabilities are not available locally.**
    Recommendation that the project design team should identify and specify works areas in the contract.

13. **Formal contracting arrangements to be ensured for all projects.**
    Noted; taking place.
14. Communication to be streamlined through the PLC and used to manage expectations of local business and communities. It is acknowledged that while the minimum requirements as stipulated in the New PPPFA Regulations 2017 are an imperative that must be complied with, the parties have agreed to apply the above principles as far as possible in the project to deliver percentages of black business participation that are above the minimum thresholds that are set by legislation. This agreement shall apply to all SANRAL projects while SANRAL finalises the development of its new Transformation Policy.

• Whilst project is out on tender, community liaison meetings should be taking place to inform local communities and businesses, as the PLC may not cover all areas;
• Project Managers to make use of Comms Team for placing of adverts in local newspapers etc. (could list of coming projects be used as a start?);
• Suggestion to use an upcoming project as a pilot; take learnings.
The PLC will be a structure specific to each district municipality, and will for the greater part be an adaptation of an existing structure that has representation from district municipality, local municipality, civil society and business.

Where projects span across more than one district municipality, the same route manager and contractor may serve on different district PLCs and give input with regard to the sourcing of labour and sub-contractors in that particular district municipality.
West Coast District Municipality
Project: N7 Melkbosstrand to Clanwilliam

SANRAL Project Manager – Michael Vinello-Lippert
Consultant - Knight Piesold (Route Manager) – Jerome Buys
Contractor – Kew Maintenance

Project: N7 Clanwilliam to Northern Cape border

SANRAL Project Manager – Derek Wilson
Consultant - Knight Piesold (Route Manager) – Louis Burger
Contractor – Talon Construction
Cape Winelands District Municipality
Project: N1 Sandhills to Laingsburg

SANRAL Project Manager – Imelda Julies
Consultant – Knight Piesold (Route Manager) – Edwin De Wee
Contractor – Kwezi Infrastructure

Project: N1 Winelands

SANRAL Project Manager – Randall Cable
Consultant - Qunu (Route Manager) – Chris Roux
Contractor – MD Civils
City of Cape Town
Project: N2, R300
SANRAL Project Manager – Randall Cable
Consultant – Qunu (Route Manager) – Chris Roux
Contractor – MD Civils

Project: N7 Melkbosstrand to Clanwilliam
SANRAL Project Manager – Michael Vinello-Lippert
Consultant - Knight Piesold(Route Manager )– Jerome Buys
Contractor – Kew Maintenance
Overberg District Municipality
Project: N2 Section 1-2 Swartkliip to Botrivier

SANRAL Project Manager – Randall Cable
Consultant – Qunu (Route Manager) – Chris Roux
Contractor – MD Civils

Project: N2 Botrivier to Riversdal

SANRAL Project Manager – Emile Du Preez
Consultant – Qunu (Route Manager) – Pierre Terblanche
Contractor – Kew Maintenance
Eden District Municipality
Project: N2 Botrivier to Riversdal

SANRAL Project Manager – Emile Du Preez
Consultant – Qunu (Route Manager) – Pierre Terblanche
Contractor – Kew Maintenance

Project: N2 Riversdal to Soutrivier

SANRAL Project Manager – Emile Du Preez
Consultant – Qunu (Route Manager) – Johan Nel
Contractor – MD Civils
Central Karoo District Municipality
Project: N1 Sandhills to Laingsburg

SANRAL Project Manager – Imelda Julies
Consultant – Knight Piesold (Route Manager) – Edwin De Wee
Contractor – Kwezi Infrastructure

Project: Laingsburg to Three Sisters

SANRAL Project Manager – Elma Lourens
Consultant – THM Engineers (Route Manager) – Ben Swart
Contractor – Rainbow Civils
Frances Baard District Municipality
Project: N12 Section 9 – 10 Hopetown to NC/NW Border
SANRAL Project Manager – Mike Vinello-Lippert
Consultant – Bovicon (Route Manager) – Zandile Gaba
Contractor – Rainbow Civils

Project: N18 Section 1 Kimberley to Hartswater
SANRAL Project Manager – Mike Vinello-Lippert
Consultant – Bovicon (Route Manager) – Zandile Gaba
Contractor – Rainbow Civils

Project: N8 Section 6-8 Groblershoop to Kimberley
SANRAL Project Manager – Imelda Julies
Consultant – QA Consulting (Route Manager) Pottie Potgieter
Contractor - VEA Roads & Civils
Project: N12 Section 5-8 Three Sister to Hopetown

SANRAL Project Manager – Imelda Julies
Consultant – EE Services (Route Manager) – Charl Muishond
Contractor – Midfran Roads

Project: N10 Section 5-8 Ludlow to Prieska

SANRAL Project Manager – Imelda Julies
Consultant – EE Services (Route Manager) Milton van Heerden
Contractor – Rainbow Civils
Namakwa District Municipality (Calvinia)
Project: R27 Section 7-9 Vanrhynsdorp to Brandvlei

SANRAL Project Manager – Mari Venter
Consultant – THM(Route Manager) – Jacques Wentzel
Contractor – Talon Construction
Namakwa District Municipality (Springbok)
Project: N7 Section 7-8 WC/NC Border to Vioolsdrif

SANRAL Project Manager – Derek Wilson
Consultant – Bvi (Route Manager) – Driaan Koegelenberg
Contractor – Kew Maintenance
Z F Mgcawu District Municipality
Project: N14 Section 1 – 3 Springbok to Keimoes
SANRAL Project Manager – Friedl van der Merwe
Consultant – BVi (Route Manager) – Claudia Jannetjies
Contractor – Midfran Roads

Project: R27 Section 10-11 Brandvlei to Keimoes
SANRAL Project Manager – Mari Venter
Consultant – THM (Route Manager) – Johannes Rakwena
Contractor – Wasserman Teerwerke

Project: N10 Section 9-12 Prieska to Nakop
SANRAL Project Manager – Friedl van der Merwe
Consultant – EE Services (Route Manager) Wilma Karsten
Contractor - Wasserman Teerwerke
John Taolo Gaetsewe District Municipality
Project: N14 Section 4-8 Keimoes to Kuruman

SANRAL Project Manager – Friedl van der Merwe
Consultant – QA Consulting (Route Manager) – Peet van Wyk
Contractor – Rainbow Civils
Thank You
Project Health and Safety Specification
In terms of Construction Regulations 2014

Client

SANRAL

Description of Project Works

NRAC005 – 016 - 2015/1 – NEW PEDESTRIAN BRIDGE CROSSING ON N2

Project Location

N2, SECTION 7, AROUND KM25.6 NEAR GEORGE

Date

04 SEPTEMBER 2017

Project Health and Safety Specification developed by:
Mark Winter PrCHSA, ROSPROF (SA), CMIOSH (UK)
Cell: 071 603 2213
Tel: 021 701 0470
Email: markw@safepractice.co.za
# PROJECT HEALTH AND SAFETY SPECIFICATION

## TABLE OF CONTENTS

1. **Specific Project Information**
   1.1 Introduction and Definitions
   1.2 Background to the Health and Safety Specification
   1.3 Purpose of the Health and Safety Specification
   1.4 Implementation of the Health and Safety Specification
   1.5 Project Directory
   1.6 Project Details
   1.7 Existing Environment
   1.8 Available Drawings
   1.9 Project Health and Safety Requirements
   1.10 Interface and Restrictions by Client
   1.11 Safety File Return to Client

2. **Further Requirements**
   2.1 Duties of Principal Contractor / Contractor in terms of Construction Regulations 2014
   2.2 Management and Supervision of Construction Work
   2.3 Notification of Intention to Commence Construction Work
   2.4 Construction Work Permit
   2.5 Assignment of Contractor’s Responsible Persons to Manage Health and Safety on Site
   2.6 Competency for Contractor’s Responsible Persons
   2.7 Compensation of Occupational Injuries Act 130 of 1993 (COIDA)
   2.8 Occupational Health and Safety Policy
   2.9 Health and Safety Organogram
   2.10 Risk Assessments
   2.11 Health and Safety Representative(s)
   2.12 Health and Safety Committee
   2.13 Medical Certificate of Fitness
   2.14 Health and Safety Training
     2.14.1 Induction
     2.14.2 Awareness
   2.15 Competency
   2.16 General Record Keeping
   2.17 General Inspection, Monitoring and Reporting
   2.18 Emergency Procedures
   2.19 First Aid Box and First Aid Equipment
   2.20 Accident / Incident Reporting and Investigation
   2.21 Hazards and Potential Situations
   2.22 Occupational Health and Safety Signage
   2.23 Management of Contractors by Principal Contractor
   2.24 Stacking of Materials
   2.25 Housekeeping and General Safeguarding on Construction Sites
   2.26 Construction Vehicles and Mobile Plant
   2.27 Electrical Installations and Machinery on Construction Sites
   2.28 Use and Temporary Storage of Flammable Liquids on Construction Sites
   2.29 Water Environments
2.30 Fire Precautions on Construction Sites
2.31 Construction Employees’ Facilities
2.32 Fall Protection
2.33 Temporary Works
2.34 Excavation
2.35 Demolition Work
2.36 Tunnelling
2.37 Scaffolding
2.38 Bulk Mixing Plant
2.39 Rope Access Work
2.40 Hazardous Chemical Substances (HCS)
2.41 Noise Induced Hearing Loss
2.42 Explosives and Blasting
2.43 Personal Protective Equipment (PPE)
2.44 Asbestos
2.45 Pressure Vessels (Including Gas Bottles)
2.46 Fire Extinguishers and Fire Fighting Equipment
2.47 Lifting Machinery and Tackle
2.48 Ladders and Ladder Work
2.49 General Machinery
2.50 Portable Electrical Tools
2.51 High Voltage Electrical Equipment
2.52 Public Health and Safety
2.53 Night Work
2.54 Environmental Conditions and Flora and Fauna
2.55 Occupational Health
2.56 Suspended Scaffolds
2.57 Material Hoists
2.58 Explosive Actuating Fastening Devices
2.59 Confined Spaces

Annexure A

- Task Completion Form

Annexure B

- Contractor’s Responsible Persons

Baseline Risk Assessments

Health and Safety Specification Acknowledgement Receipt
1.0 SPECIFIC PROJECT INFORMATION

1.1 INTRODUCTION AND DEFINITIONS


This Health and Safety Specification contains clauses that are generally applicable to construction activities, as well as imposing pro-active controls associated with activities that impact on Health and Safety as it relates to plant and machinery. Compliance to the requirements of the Occupational Health and Safety Act 1993 is in addition to the requirements of this Health and Safety Specification and is part of the Contractor’s responsibility. The Client will monitor that the Contractors comply with the requirements of such legislation.

ALL REFERENCES TO CLIENT IN THIS HEALTH AND SAFETY SPECIFICATION ALSO REFER TO SAFETY AGENT, WHERE SO APPOINTED.

Definitions (as per the Construction Regulations 2014) applicable to this Health and Safety Specification:

"agent" means a competent person who acts as a representative for a client;

"angle of repose" means the steepest angle of a surface at which a mass of loose or fragmented material will remain stationary in a pile on the surface, rather than sliding or crumbling away;

"bulk mixing plant" means machinery, appliances or other similar devices that are assembled in such a manner so as to be able to mix materials in bulk for the purposes of using the mixed product for construction work;

"client" means any person for whom construction work is being performed;

"competent person" means a person who has, in respect of the work or task to be performed, the required knowledge, training and experience and, where applicable, qualifications, specific to that work or task: Provided that where appropriate qualifications and training are registered in terms of the provisions of the National Qualification Framework Act, 2000 (Act No.67 of 2000), those qualifications and that training must be regarded as the required qualifications and training; and is familiar with the Act and with the applicable regulations made under the Act;

"construction manager" means a competent person responsible for the management of the physical construction processes and the coordination, administration and management of resources on a construction site;

"construction site" means a work place where construction work is being performed;

"construction supervisor" means a competent person responsible for supervising construction activities on a construction site;

"construction vehicle" means a vehicle used as a means of conveyance for transporting persons or material, or persons and material, on and off the construction site for the purposes of performing construction work;
"construction work" means any work in connection with-
- the construction, erection, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure; or
- the construction, erection, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system; or the moving of earth, clearing of land, the making of excavation, piling, or any similar civil engineering structure or type of work;

"construction work permit" means a document issued in terms of regulation 3;

"contractor" means an employer who performs construction work;

"demolition work" means a method to dismantle, wreck, break, pull down or knock down of a structure or part thereof by way of manual labour, machinery, or the use of explosives;

"design" in relation to any structure, includes drawings, calculations, design details and specifications;

"designer" means a competent person who-
- prepares a design;
- checks and approves a design;
- arranges for a person at work under his or her control to prepare a design, including an employee of that person where he or she is the employer; or
- designs temporary work, including its components;
- an architect or engineer contributing to, or having overall responsibility for a design;
- a building services engineer designing details for fixed plant;
- a surveyor specifying articles or drawing up specifications;
- a contractor carrying out design work as part of a design and building project; or
- an interior designer, shop-fitter or landscape architect;

"excavation work" means the making of any man-made cavity, trench, pit or depression formed by cutting, digging or scooping;

"explosive actuated fastening device" means a tool that is activated by an explosive charge and that is used for driving bolts, nails and similar objects for the purpose of providing fixing;

"fall arrest equipment" means equipment used to arrest a person in a fall, including personal equipment, a body harness, lanyards, deceleration devices, lifelines or similar equipment;

"fall prevention equipment" means equipment used to prevent persons from falling from a fall risk position, including personal equipment, a body harness, lanyards, lifelines or physical equipment such as guard-rails, screens, barricades, anchorages or similar equipment;

"fall protection plan" means a documented plan, which includes and provides for-
- all risks relating to working from a fall risk position, considering the nature of work undertaken;
- the procedures and methods to be applied in order to eliminate the risk of falling; and
- a rescue plan and procedures;

"fall risk" means any potential exposure to falling either from, off or into;

"health and safety file " means a file, or other record containing the information in writing required by these Regulations;

"health and safety plan" means a site, activity or project specific documented plan in accordance with the client's health and safety specification;

"health and safety specification" means a site, activity or project specific document prepared by the client pertaining to all health and safety requirements related to construction work;
"material hoist" means a hoist used to lower or raise material and equipment, excluding passengers;

"medical certificate of fitness" means a certificate contemplated in regulation 7(8);

"mobile plant" means any machinery, appliance or other similar device that is able to move independently, and is used for the purpose of performing construction work on a construction site;


"person day" means one normal working shift of carrying out construction work by a person on a construction site;

"principal contractor" means an employer appointed by the client to perform construction work;

"Professional Engineer or Professional Certificated Engineer" means a person holding registration as either a Professional Engineer or Professional Certificated Engineer in terms of the Engineering Profession Act, 2000 (Act No. 46 of 2000);

"Professional Technologist" means a person holding registration as a Professional Engineering Technologist in terms of the Engineering Profession Act, 2000;

"provincial director" means the provincial director as defined in regulation 1 of the General Administrative Regulations, 2003;

"scaffold" means a temporary elevated platform and supporting structure used for providing access to and supporting workmen or materials or both;

"shoring" means a system used to support the sides of an excavation and which is intended to prevent the cave-in or the collapse of the sides of an excavation;

"structure" means-

- any building, steel or reinforced concrete structure (not being a building), railway line or siding, bridge, waterworks, reservoir, pipe or pipeline, cable, sewer, sewage works, fixed vessels, road, drainage works, earthworks, dam, wall, mast, tower, tower crane, bulk mixing plant, pylon, surface and underground tanks, earth retaining structure or any structure designed to preserve or alter any natural feature, and any other similar structure;
- any falsework, scaffold or other structure designed or used to provide support or means of access during construction work; or
- any fixed plant in respect of construction work which includes installation, commissioning, decommissioning or dismantling and where any construction work involves a risk of a person falling;

"suspended platform" means a working platform suspended from supports by means of one or more separate ropes from each support;

"temporary works" means any falsework, formwork, support work, scaffold, shoring or other temporary structure designed to provide support or means of access during construction work;

"the Act" means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993);

"tunneling" means the construction of any tunnel beneath the natural surface of the earth for a purpose other than the searching for or winning of a mineral.
Reference should be made to the following documentation in conjunction with this Safety Specification (including existing surveys, drawings and reports):

<table>
<thead>
<tr>
<th>Tender documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawings</td>
</tr>
</tbody>
</table>

**IMPORTANT NOTE:**
This Health and Safety Specification has been prepared to comply with the requirements of the Construction Regulations 2014.

### 1.2 BACKGROUND TO THE HEALTH AND SAFETY SPECIFICATION

Historically, the Construction Industry has had a poor health and safety record. Due to the complex and potentially dangerous operations being undertaken, there is a high risk of incidents, accidents and injuries. In many instances poor adherence to the Act and Regulations has resulted in severe consequences for Health and Safety performance. The Client is determined that the highest Health and Safety standards will prevail throughout the Contract and that there will be full commitment from all parties involved.

To achieve this goal the Client has prepared this Health and Safety Specification. The Health and Safety Specification sets out guidelines and minimum levels of awareness and guidance for Health and Safety requirements for the project. Contractual responsibility for adhering to these requirements rests with the Contractors. All employees are encouraged to be pro-active in compliance.

The Client is committed to ensuring the highest Health and Safety standards for all work undertaken within the Contract.

**Contractors as employers are fully responsible and accountable for compliance with all Health and Safety requirements.**

**IMPORTANT NOTE:**

Compliance with the Occupational Health and Safety Act and Regulations shall not be limited to this Health and Safety Specification and definitions contained in this document.

Contractors shall be conversant with the requirements and effects of Health and Safety legislation upon their activities, in particular the Construction Regulations, 2014, and the Occupational Health and Safety Act, 1993, and to have made adequate resource in their tender submission to comply with all legislative requirements.

The Contractor’s personnel will be responsible for the auditing of the implementation of the Health and Safety Specification and maintaining the document control and record systems associated with the Health and Safety Specification. The Client will conduct Health and Safety audits of the works too.

### 1.3 PURPOSE OF THE HEALTH AND SAFETY SPECIFICATION

The purpose of this site specific Health and Safety Specification is to comply with legal requirements and to provide health and safety information about specific project risks known by the Client, Designer and Safety Agent to be applicable to this project. This document also provides minimum health and safety requirements, standards and expectations that the principal contractor and contractors must adhere to.

The Contractor must take into account all information in this specification and ensure that their tenders include adequate resource and competence to deal with the matters detailed herein so that all relevant...
contents are dealt with in a way which is in compliance with legislation and the ethical concerns for the safeguarding of employees, contractors and other persons affected by the construction activities.

The Health and Safety Specification will be implemented during construction of the works and any construction activity that the Client has control over.

This will also assist in ensuring that all the costs related to the compliance with Occupational Health Act 85 of 1993 and the Construction Regulations 2014, as well as this Health and Safety Specification, are taken into consideration at Tender stage.

No advice, approval of any document required by the Health and Safety Specification such as hazard identification and risk assessment action plans or any other form shall be construed as an acceptance by the Client of any obligation that absolves the Contractor from achieving the required level of performance and compliance with legal requirements.

Further, there is no acceptance of liability by the Client which may result from the Contractor failing to comply with the Health and Safety Specification unless the Client has issued an instruction to any requirement, i.e. the Contractor remains responsible for achieving the required performance levels.

1.4 IMPLEMENTATION OF THE HEALTH AND SAFETY SPECIFICATION

This Health and Safety Specification forms an integral part of the Contract, and Contractors shall make it an integral part of their Contracts with Sub Contractors and Suppliers. Contractors employed by the Client are to ensure that the provisions of the Health and Safety Specification are applied both on the site and in respect of all off site activities relating to the project, in particular in transport activities and project dedicated off site fabrication works.

The Contractor shall enforce the provisions of the Health and Safety Specification amongst all subcontractors and suppliers for the project.

The Contractor shall sign the acknowledgment on the last page of this safety specification that he/she has familiarized him/herself with the content of the Health and Safety Specification and shall comply with all obligations in respect thereof.

The successful Contractor will be required to compile a Health and Safety Plan based on the requirements of the Occupational Health Act 85 of 1993 and these Specifications, which will need to be approved by Client prior to commencement with construction work.

1.4.1 Client Duties

In terms of the Construction Regulations 2014 the Client (or their Agent, where appointed) has legal duties. Where an Agent (refer to “definitions” section of this document) is appointed in terms of this project, these Health and Safety duties assigned will also apply.

All references to “Client” will apply to their appointed “Safety Agent”, where so appointed, in this Health and Safety Specification.

The Client must:

- Prepare a baseline risk assessment for the construction work
- Prepare a suitable, sufficiently documented and coherent site specific Health and Safety specification for the intended construction work, based on the baseline risk assessment
- Include the health and safety specification in the tender documents
- Ensure that potential principal contractors submitting tenders have made adequate provision for the cost of health and safety measures
• Ensure that the principal contractor to be appointed has the necessary competencies and resources to carry out the construction work safely
• Take reasonable steps to ensure co-operation between all contractors appointed by the client to enable each of those contractors to comply with the regulations
• Ensure, before work commences, 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)
• Appoint each principal contractor in writing for the project, or part thereof
• Discuss and negotiate with the principal contractor the contents of the principal contractor’s safety plan and thereafter finally approve that plan for implementation
• Ensure that a copy of the principal contractor’s health and safety plan is implemented and maintained
• 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
• Ensure that a copy of the health and safety audit report is provided to the principal contractor within 7 days after the audit
• 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 principal contractor’s health and safety plan for site
• 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
• Ensure that the health and safety file is kept and maintained by the principal contractor.
• Where the client requires additional work to be performed as a result of a design change or error in construction due to the actions of the client, the client must ensure that sufficient safety information and appropriate additional resources are available to execute the required work safely.
• Where more than one principal contractor is appointed, the client must take reasonable steps to ensure co-operation between all principal contractors and contractors to ensure compliance with the Regulations
• Where the Client has appointed a Safety Agent for the project, their details for this project are contained in the Project Directory section of this health and safety specification.

1.4.2 Designer Duties

It must be noted that the Designer also has Health and Safety duties assigned in terms of the Construction Regulations. Where the contractor fulfils a design function in terms of this project (refer to “definitions” section of this document), these duties will also apply. Please refer to Regulation 6 of the Construction Regulations 2014.

Please note that the designer of temporary works must ensure that:

• all temporary works are adequately designed so that it will be capable of supporting all anticipated vertical and lateral loads that may be applied;
• the designs of temporary works are done with close reference to the structural design drawings issued by the contractor, and in the event of any uncertainty consult the contractor;
• all drawings and calculations pertaining to the design of temporary works are kept at the office of the temporary works designer and are made available on request by an inspector; and
• the loads caused by the temporary works and any imposed loads are clearly indicated in the design.
## 1.5 PROJECT DIRECTORY

<table>
<thead>
<tr>
<th>Project Client</th>
<th>SANRAL</th>
<th>Tel: 021 957 4615</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Person</td>
<td>Elma Lourens</td>
<td>Cell: TBA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e-mail: TBA</td>
</tr>
<tr>
<td>Construction Safety Agent (Pre Construction)</td>
<td>Safe Working Practice Cape Town</td>
<td>Tel: 021 701 0470</td>
</tr>
<tr>
<td>Contact Person</td>
<td>Mark Winter</td>
<td>Cell: 071 603 2213</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:markw@safepractice.co.za">markw@safepractice.co.za</a></td>
</tr>
<tr>
<td>Construction Safety Agent (Construction)</td>
<td>Safe Working Practice</td>
<td>Tel: 021 853 1556</td>
</tr>
<tr>
<td>Contact Person</td>
<td>Stiaan Burger</td>
<td>Cell: 082 968 3370</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:stiaan@safepractice.co.za">stiaan@safepractice.co.za</a></td>
</tr>
<tr>
<td>Architect</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Project Manager</td>
<td>Aurecon</td>
<td>Tel: 021 526 9569</td>
</tr>
<tr>
<td>Contact Person</td>
<td>Hennie Niehaus</td>
<td>Cell: 083 324 3195</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:hennie.niehaus@aurecongroup.com">hennie.niehaus@aurecongroup.com</a></td>
</tr>
<tr>
<td>Engineers</td>
<td>Aurecon</td>
<td>Tel: 021 526 9400</td>
</tr>
<tr>
<td>Structural Engineer</td>
<td>Rossouw Conradie</td>
<td></td>
</tr>
<tr>
<td>Electrical Engineer</td>
<td>Andries Swiegers</td>
<td></td>
</tr>
<tr>
<td>Civil Engineer</td>
<td>Noel Pietersen</td>
<td></td>
</tr>
</tbody>
</table>

## OTHER PARTIES DIRECTORY

| Department of Labour for submission of Annexure 2: Notification of Construction Work |
|----------------------------------------|----------------------------------------|
| WESTERN CAPE – Fezeka Ngalo            | Tel: 021 441 8158                      |
|                                        | Email: fezeka.ngalo@labour.gov.za      |
|                                        | Cell: 083 365 0681                     |

<table>
<thead>
<tr>
<th>Department of Labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEORGE</td>
</tr>
<tr>
<td>Private Bag X6545</td>
</tr>
<tr>
<td>George</td>
</tr>
<tr>
<td>6530</td>
</tr>
<tr>
<td>Tel: 044 801 1200</td>
</tr>
<tr>
<td>Fax: 044 8732568</td>
</tr>
</tbody>
</table>
**Telecommunications, Water and Electricity**

Contractor to apply for and refer to wayleave information from service providers for the nature and location of services. Refer all queries Project Manager.

**Gas**

n/a

### 1.6 PROJECT DETAILS

**Description of Works**

Construction of new pedestrian bridge crossing on National Road 2, Section 7, around George, including:

- Site clearance
- Construction of walkway
- Construction of bridge
- Street lighting

This description of the works is not necessarily complete and shall not limit the work to be carried out by the Contractor under this Contract.

**Provisional Start Date**

April 2018

**Anticipated Construction Duration**

9 months

**Completion Date**

January 2019

### 1.7 EXISTING ENVIRONMENT

**Hazards particular to this project by virtue of location:**

Evidence of informal footpaths on eastern and western boundary of site, crossing over the N2, pedestrian traffic may be expected.

Existing electrical services on northern boundary of site.

Existing road traffic in close proximity.

Potential security concerns.

**Overhead, Above Ground and Underground Services crossing the site:**

**Overhead:** None known

**Underground:** Electrical

**Ground level:** Electrical bollards

**Service Drawings available:** Yes, included in tender documents

**Wayleaves and Permits required:** No

**Isolations required:** May be required for electrical services
**Existing structures and surrounding land use (with a significant impact on Health & Safety):**
Site is located on N2 at Thembalethu. On northern boundary is Ballotsview low cost residential area. On southern boundary is open land with 2 fenced off commercial properties. Eastern and western boundaries are formed by the N2. There is existing fencing separating Ballotsview from the N2 on the northern boundary.

**Existing ground conditions and ground survey report:**
Geo technical report not available. Information on soil conditions included in tender. Expect dense to medium weathered granite. Water table level not known.

**Existing Traffic Systems**

**Condition:** 2 way surfaced roads in good condition

**Restrictions to access:** None known

**Speed restrictions:** Usual urban speed restrictions applicable

### 1.8 AVAILABLE DRAWINGS
Refer to tender documentation.

### 1.9 PROJECT HEALTH AND SAFETY REQUIREMENTS

**Significant health and safety hazards identified by Designer and Safety Agent:**

**Deep excavations for casting of piers** – method statement to be in place and implemented by the excavation supervisor. All workers must receive induction prior to commencement of works. Excavations must be adequately supported, braced and maintained by a competent person so that they are capable of supporting all anticipated vertical and lateral loads that may be applied to them. Support mechanisms may need to include shoring to prevent any excavation edges from collapsing, or alternative soil support method required. Proximity of road and potential undermining is an issue of concern to be taken into consideration.

Excavations must be backfilled by end of each shift as far as is reasonably practicable. If this cannot be done then appropriate safety measures must be put in place by the contractor to prevent unauthorised entry to excavations, including barriers and warning signage. Ensure there is a safe distance between employees and plant when digging excavations.

**Protection of members of the public and road traffic including Traffic Management** – the site is located near an existing low cost residential area with attendant safety issues regarding risks to members of public, road traffic and animals. There are also commercial properties in the vicinity. The health and safety of members of public and road users must be a priority at all times and all necessary steps must be taken to prevent unauthorised entry to site and to protect members of the public from any dangers associated with the construction works being undertaken. This includes the erection of 1.8m high metal fencing with warning signage.

Existing roads will remain open during works. This is a critical hazard to traffic/members of public and to workers in the road. Safety of road users and workers is crucial and must be addressed in the Traffic Management Plan to be supplied by contractor and approved by the Engineer. The Contractor is responsible for the directional signage to divert the public where existing footpaths or sidewalks are obstructed due to the construction works. All construction personnel to have high visibility clothing on at all times.
Working at height and temporary works (including use of scaffolding) – all access equipment to be built and maintained in a safe condition by competent and trained personnel. All temporary works must be designed and built and inspected as per the SANS Regulations and Construction Regulations. A Fall Protection Plan and Rescue Plan will be required for approval prior to commencement of any activities at height. All workers must have Fall Protection Plan training in the form of a toolbox talk with a signed register of attendance. Workers working at height must have appropriate and sufficient safety equipment. Safety harnesses with securely attached lanyards must be worn in areas where safety while working at height cannot be assured by other means. Edge protection in the form of guard rails and toe boards must be in place to prevent materials and people from falling and exclusion zones must be in place under works at height. Medical certificates of fitness will be required for all contractors’ staff, including those working at height.

Lifting Operations with craneage – all operators must provide copies of their competency and medical certificates and driver’s license. Loads must be slung by person with appropriate training and competence. Daily plant inspection registers to be completed and records kept in the safety file. Valid load test certificates and record of inspections by competent personnel must be available and maintained throughout the project. Rotating amber lights and reverse alarms to be active when operating mobile cranes on site. Plant must be effectively separated from members of public and unauthorised personnel. Use trained flag persons as applicable. Exclusion zone under crane operations to be enforced as applicable. Particular attention must be paid to lifting operations in windy conditions.

Other construction hazards expected are as follows:
Asphalting
Compacting and Filling
Compactor Operations
Cutting Kerbs
Cutting Off Disc
Electrical Commissioning
Electric Tools and Electrical Installations
Excavations – max 2.5m
Fire
Flammable Liquids / Gas
Hand tools
Hazardous Substances
Hot Works
Kerb Laying
Manual Handling of General Items
Noise and Dust
Plant/Vehicle and Equipment Operation
Precast Slab / Unit Laying and Fixing
Road Working – in or next to (inc Traffic Management)
Shuttering Walls, Beams, Columns
Site Strip
Skipping of Concrete
Snakes
Steel Fixing
Street Lighting
Troxler Use
Underground Services
Working at Height (excl scaffold)

NOTE: Please refer to end of this Health and Safety Specification for the baseline risk assessment for these risks.
**ACTIVITIES REQUIRING APPROVED METHOD STATEMENTS (FOR HEALTH AND SAFETY)**

<table>
<thead>
<tr>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifting operations</td>
</tr>
<tr>
<td>Public protection</td>
</tr>
<tr>
<td>Temporary works</td>
</tr>
<tr>
<td>Others TBA</td>
</tr>
</tbody>
</table>

**ACTIVITIES REQUIRING PERMITS (FOR HEALTH AND SAFETY PURPOSES)**

<table>
<thead>
<tr>
<th>Permit Type</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permit to Work with Electricity</td>
<td>Yes, contractor to obtain from service provider</td>
</tr>
<tr>
<td>Confined Space Permit</td>
<td>n/a</td>
</tr>
<tr>
<td>Hot Works Permit</td>
<td>Yes, contractor to provide</td>
</tr>
<tr>
<td>Permit to Work under Power Lines</td>
<td>n/a</td>
</tr>
<tr>
<td>Blasting</td>
<td>n/a</td>
</tr>
<tr>
<td>Temporary Works</td>
<td>Yes, formwork, support work, shoring, scaffolding</td>
</tr>
</tbody>
</table>

**CONTRACTOR SAFETY OFFICER PROVISION**

Records of safety audits undertaken by the Contractor’s Safety Officer must be kept on site in the safety file and non-conformances reported by the Safety Officer to the Contractor’s management team. All non-conformances identified by the Safety Officer must be investigated and corrective action taken by the Contractor to prevent re-occurrence.

Please note that from 7th August 2015 the safety officer must have formally applied to be professionally registered with the SACPCMP. If their registration is not yet complete, the safety officer must be in possession of a "Registration Verification Letter" which will be issued by the SACPCMP.

Contractor to note that they will be required to appoint a full time Safety Officer and full time Traffic Safety Officer for the site.

**MEDICAL CERTIFICATE OF FITNESS**

The contractor must ensure that their employees on site have a valid medical certificate of fitness, specific to the construction work being performed, issued by an occupational health practitioner in the form of an Annexure 3 template. Annexure 3 medicals must include dust and noise assessment (spirometry and audiometry).

**MANAGEMENT AND SUPERVISION OF CONSTRUCTION WORK**

A 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 by the principal contractor.

**TRAFFIC MANAGEMENT AND TRAFFIC SAFETY OFFICER PROVISION**

Traffic Management Plan required to be provided by Contractor to Engineer for approval and to be implemented on site by full time Traffic Safety Officer.
**ENVIRONMENTAL CONDITIONS**

Contractor must take into account adverse weather conditions on site activities and implement control measures to mitigate risk. This includes risk of exposure to excessive heat, cold, rain and wind. The open nature of the site works will not preclude any of the above.

Weather considerations must be allowed for on site, especially in terms of heavy rains stopping work, lightning, high winds and heat stress exposures.

For lightning the following guide exists:

- Where high level construction or maintenance work is being performed, thunder storms present a wind and rain risk to the workers in elevated positions but lightning is also a significant risk.
- To establish how far the lightning is from a work area, this distance can be determined by multiplying the time difference in seconds between the actual lightning flash seen and the hearing of the thunder rumble by 344m per second (ie. the speed of sound travel) to calculate the distance to the lightning flash in metres.
- Distance to lightning in metres = seconds time difference between the flash and its rumble x 344 m/sec
- This means that a 3 second delay represents a lightning flash just over 1 km distant. Explosives factories use a 10 second delay (a 3.4km distance) for production building evacuation because of lightning risk.

**ARRANGEMENTS FOR ACCESS, PARKING, DELIVERIES, ETC**

**Access to site by Construction Vehicles:** Contractor to liaise with Professional Team

**Access to site by Construction Workers and Visitors:** Contractor to liaise with Professional Team

**ARRANGEMENTS FOR SITE CAMP, ABLUTIONS AND YARD**

**Site camp location and set up**

- Restrictions / requirements: Contractor to advise in consultation with Engineer / Professional Team
- Storage areas:
- Security:

**Ablutions and Welfare Arrangements**

Contractor to supply ablutions and facilities in line with the Construction Regulations 2014, refer to section 2.31 of this health and safety specification regarding the below. Please note that toilets should be provided with built in facilities for hand washing:

- Toilets:
- Washing facilities:
- Drinking Water: Contractor to provide as per Regulations
- Shelter:
- Showers:
PROTECTION OF SITE AGAINST UNAUTHORISED ACCESS BY PUBLIC

Excavation Fencing: Note that excavations accessible to public, or adjacent to public roads / thoroughfares, must have (1) barrier / fence of at least 1m in height, and (2) warning illuminants at night or when visibility is poor, or have other suitable precautionary measures if both of these are not practicable.

Orange plastic mesh fencing/netting required to be used as a minimum but to be subject to contractor’s ongoing risk assessment to ensure effectiveness in keeping out unauthorised personnel (especially members of public). Metal fencing panels to be used as barriers if plastic mesh fencing/netting is not sufficient.

General Fencing of Site: Note that construction sites in built up areas adjacent to public way must be fenced off and have controlled access points.

1.8m high fencing panels to be erected to protect against unauthorised access to site.

Warning Notices: Construction warning signage must be prominently displayed to avoid unauthorised access to site and to warn of dangers associated with construction works. Traffic accommodation and management measures as per SARTSM must include appropriate and sufficient signage to warn and direct traffic and road users. Signage must also include warnings and direction for pedestrians as applicable.

Look Outs: TBA

PERSONAL PROTECTIVE EQUIPMENT (PPE)

The Client requires the Contractor to ensure that employees (and others under his/her control) wear the following minimum PPE:

Overalls: Yes

Safety Harnesses: Yes

Hard Hats: Yes

Reflective Vests: Yes

Goggles / gloves / ear defenders / respiratory protection: Yes, as per risk assessments

Safety Footwear: Yes

Specialist Equipment (eg: for confined Spaces): TBA

HAZARDOUS SUBSTANCES

The following materials and substances have, or may have, to be used in the works and are identified as potentially posing special health and / or safety hazards during the project. Appropriate measures will need to be specified for their control:

Cement Diesel Petrol Epoxy products
### 1.10 INTERFACE AND RESTRICTIONS BY CLIENT

**Contractor must note that the following Client activities will continue during construction:**

| n/a |

**The following Client safety rules and/or requirements are to be observed:**

All workers are to receive induction prior to commencement of work on site.

Other safety rules and requirements to be advised at induction.

Please also refer to tender document.

**Restrictions on times, access or other restrictions by Client**

Please refer to tender document.

Other restrictions may be advised at induction.

### 1.11 SAFETY FILE RETURN TO CLIENT

The Safety File for the Project is to be handed over by the Principal Contractor to the Client upon Project Completion in a hard copy format.
2.0 FURTHER REQUIREMENTS

2.1 Duties of Principal Contractor / Contractor in terms of Construction Regulations 2014

A 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, which plan must be applied from the date of commencement of and for the duration of the construction work and which must be reviewed and updated by the principal contractor as work progresses;

- open and keep on site a health and safety file, which must include all documentation required in terms of the Act and these Regulations, which must be made available on request to an inspector, the client, the client's agent or a contractor; and

- on appointing any other contractor, in order to ensure compliance with the provisions of the Act –
  - provide contractors who are tendering to perform construction work for the principal contractor, with the relevant sections of the health and safety specifications pertaining to the construction work which has to be performed;
  - ensure that potential contractors submitting tenders have made sufficient provision for health and safety measures during the construction process;
  - ensure that no contractor is appointed to perform construction work unless the principal contractor is reasonably satisfied that the contractor that he or she intends to appoint, has the necessary competencies and resources to perform the construction work safely;
  - ensure prior to work commencing on the site that every 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;
  - appoint each contractor in writing for the part of the project on the construction site
  - take reasonable steps to ensure that each contractor's health and safety plan is implemented and maintained on the construction site;
  - ensure that the periodic site 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;
  - stop any contractor from executing construction work 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 or which poses a threat to the health and safety of persons;
  - where changes are brought about to the design and construction, make available sufficient health and safety information and appropriate resources to the contractor to execute the work safely;
  - discuss and negotiate with the contractor the contents of their health and safety plan and finally approve that plan for implementation;
  - ensure that a copy of both the principal contractor and contractor's health and safety plan is available on request to an employee, an inspector, a contractor, the client or the client's agent;
hand over a consolidated health and safety file to the client upon completion of the construction work, to include a record of all drawings, designs, materials used and other similar information concerning the completed structure;

in addition to the documentation required in the health and safety file include and make available a comprehensive and updated list of all the contractors on site accountable to the principal contractor, the agreements between the parties and the type of work being done;

ensure that all his or her employees have a valid medical certificate of fitness specific to the construction work to be performed and issued by an occupational health practitioner in the form of Annexure 3.

A contractor must prior to performing any construction work-

provide and demonstrate to the principal contractor a suitable and sufficiently documented health and safety plan, based on the relevant sections of the client's health and safety specification and provided by the principal contractor, which plan must be applied from the date of commencement of and for the duration of the construction work and which must be reviewed and updated by the contractor as work progresses;

open and keep on site a health and safety file, which must include all documentation required in terms of the Act and these Regulations, and which must be made available on request to an inspector, the client, the client's agent or the principal contractor;

before appointing another contractor to perform construction work be reasonably satisfied that the contractor that he or she intends to appoint has the necessary competencies and resources to perform the construction work safely;

co-operate with the principal contractor as far as is necessary to enable each of them to comply with the provisions of the Act;

as far as is reasonably practicable, promptly provide the principal contractor with any information which might affect the health and safety of any person at work carrying out construction work on the site, any person who might be affected by the work of such a person at work, or which might justify a review of the health and safety plan.

Where a contractor appoints another contractor to perform construction work, the duties that apply to the principal contractor will apply to the contractor as if he or she were the principal contractor.

A principal contractor must take reasonable steps to ensure co-operation between all contractors appointed by the principal contractor to enable each of those contractors to comply with these Regulations.

No contractor may allow or permit any employee or person to enter any site, unless that employee or person has undergone health and safety induction training pertaining to the hazards prevalent on the site at the time of entry.

A contractor must ensure that all visitors to a construction site undergo health and safety induction pertaining to the hazards prevalent on the site and must ensure that such visitors have the necessary personal protective equipment.

A contractor must at all times keep on his or her construction site records of the health and safety induction training and such records must be made available on request to an inspector, the client, the client's agent or the principal contractor.
A contractor must ensure that all his or her employees have a valid medical certificate of fitness specific to the construction work to be performed and issued by an occupational health practitioner in the form of Annexure 3 (a template of which can be found in the Construction Regulations, 2014).

### 2.2 Management and Supervision of Construction Work

A 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 by the principal contractor.

A principal contractor must upon having considered the size of the project, in writing appoint one or more assistant construction managers for different sections thereof: 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 in terms of this regulation.

Where the construction manager has not appointed assistant construction managers, or, in the opinion of an inspector, a sufficient number of such assistant construction managers have not been appointed, that inspector must direct the construction manager in writing to appoint the number of assistant construction managers indicated by the inspector, and those assistant construction managers must be regarded as having been appointed.

No construction manager appointed in terms of the Regulations may manage any construction work on or in any construction site other than the site in respect of which he or she has been appointed.

A contractor must, after consultation with the client and having considered the size of the project, the degree of danger likely to be encountered or the accumulation of hazards or risks on the site, appoint a full-time or part-time construction health and safety officer in writing to assist in the control of all health and safety related aspects on the site: Provided that, where the question arises as to whether a construction health and safety officer is necessary, the decision of an inspector is decisive.

No contractor may appoint a construction health and safety officer to assist in the control of health and safety related aspects on the site unless he or she is reasonably satisfied that the construction health and safety officer that he or she intends to appoint is registered with a statutory body approved by the Chief Inspector and has necessary competencies and resources to assist the contractor.

A construction manager must in writing appoint construction supervisors responsible for construction activities and ensuring occupational health and safety compliance on the construction site.

A contractor must, upon having considered the size of the project, in writing appoint one or more competent employees for different sections thereof to assist the construction supervisor, and every such employee has, to the extent clearly defined by the contractor in the letter of appointment, the same duties as the construction supervisor: Provided that the designation of such employee does not relieve the construction supervisor of any personal accountability for failing in his or her supervisory duties.

Where the contractor has not appointed such an employee, or, in the opinion of an inspector, a sufficient number of such employees have not been appointed, that inspector must instruct the employer to appoint the number of employees indicated by the inspector.

No construction supervisor appointed may supervise any construction work on or in any construction site other than the site in respect of which he or she has been appointed: Provided that if a sufficient number of competent employees have been appropriately designated on all the relevant construction sites, the appointed construction supervisor may supervise more than one site.
2.3 Notification of Intention to Commence Construction Work

The Contractor shall notify the Provincial Director of the Department of Labour of the intention to commence construction work at least 7 days prior to the works commencing if the intended construction work will:

- Include excavation work
- Include work at height where there is a risk of falling
- Include the demolition of a structure, or
- Include the use of explosives to perform construction work.

If the construction work involves construction of a single storey dwelling for a client, and such client will be residing in such dwelling upon completion, the contractor must also notify the Provincial Director of the Department of Labour at least 7 days before the works commence.

This must be done on a form similar to an Annexure 2 (template of which can be found in the Construction Regulations, 2014). A copy of the notification letter to the Provincial Director shall be forwarded to the Client for record purposes.

2.4 Construction Work Permit

A client who intends to have construction work carried out, must at least 30 days before that work is to be carried out apply to the provincial director in writing for a construction work permit to perform construction work if the intended construction work starts on or after the 7th of February 2017 and the works contract is of a value exceeding R40 million or Construction Industry Grading Board (CIDB) grading level 8.

It is the Construction Health and Safety Agent’s responsibility to apply for this permit from the Provincial Director and construction work may not commence until the permit has been issued by the Provincial Director.

A copy of this permit will be required to be kept in the principal contractors safety file, and the site specific number issued by the Provincial Director must be displayed at the site entrance.

2.5 Assignment of Contractor’s Responsible Persons to Manage Health and Safety on Site

The Contractor shall submit management and supervisory appointments as well as any relevant appointments in writing (as stipulated by the Construction Regulations 2014 and the Occupational Safety and Health Act 1993), prior to commencement of work (refer to Annexure B at the end of this Health and Safety Specification).

2.6 Competency for Contractor’s Responsible Persons

The Contractor’s responsible persons shall be competent in health and safety and be familiar with the Occupational Health and Safety Act 1993, and applicable regulations. Valid proof of pertinent health and safety courses attended by such persons will be required to be presented to the Client.

2.7 Compensation of Occupational Injuries and Diseases Act 130 of 1993 (COIDA)

The successful Contractor shall submit to the Client a valid letter of good standing with the Compensation Insurer prior to appointment.

2.8 Occupational Health and Safety Policy

The Contractor shall submit their Health and Safety Policy, prior to construction commencement, signed by the Chief Executive Officer. The Policy must outline objectives and how they will be achieved and implemented within the company operations.
2.9 Health and Safety Organogram

The Contractor shall submit an organogram, prior to construction commencement, outlining the Health and Safety Site Team that will be assigned to the project, if successful with the tender. In cases where appointments have not been made, the organogram shall reflect the position. The organogram shall be updated, when there is a change in the site team.

2.10 Risk Assessments

Baseline Risk Assessment

The Client shall cause a baseline risk assessment to be conducted by a competent person before the design process and tender process commence, and the assessed risks shall form part of the health and safety specifications.

The Contractor must, before commencement of any construction work, and during construction work, have risk assessments performed by a competent person appointed in writing, which risk assessments form part of the health and safety plan to be applied on the site and must include:

- The identification of the risks and hazards to which persons may be exposed to;
- An analysis and evaluation of the risks and hazards identified; based on a documented method
- A documented plan and applicable safe work procedures to mitigate, reduce or control the risks and hazards that have been identified;
- A monitoring plan; and
- A review plan

The Contractor must ensure that, as far as is reasonably practicable, ergonomic related hazards are analysed, evaluated and addressed in a risk assessment.

The Contractor must ensure that all employees under his control are informed, instructed and trained by a competent person regarding any hazard and the related work procedures and/or control measures before any work commences and thereafter at the times determined in the risk assessment monitoring and review plan of the relevant site.

The Principal Contractor must ensure that all contractors are informed regarding any hazard that is stipulated in the risk assessment before any work commences and thereafter at the times determined in the risk assessment monitoring and review plan of the relevant site.

The Contractor must consult with the health and safety committee or with a representative trade union or representative group of employees if no health and safety committee exists, on the monitoring and review of the risk assessments for the site.

The Contractor must ensure that copies of risk assessment for this site are available on site for inspection purposes by interested parties (inspector, the client, client’s agent, any contractor, any employee, a representative trade union, a health and safety representative or safety committee member.

A Contractor must review the relevant risk assessment where changes are effected to the design and/or construction that result in a change to the risk profile, or when an incident has occurred.

Preventative measures must first address the elimination of the hazard or risk. Should PPE be required to reduce risk, the equipment or clothing to be used must be SABS approved.

In general the Contractor must ensure that the Risk Assessment involves identifying the hazards present in a work activity on site. This is followed by an evaluation of the extent of the risk involved taking into account those precautions already being taken.
The following general principle should be followed when conducting a risk assessment:

- All relevant risks and/or hazards should be systematically addressed;
- The risk assessment should address what actually happens in the workplace during the work activity;
- All employees and those who may be affected must be considered, including maintenance staff, security guards, visitors and subcontractors;
- The risk assessment should highlight those groups and individuals who may be required to work alone or who have disabilities;
- The risk assessment process should take into account the existing safety measures and controls;
- The level of detail on a risk assessment should be appropriate to the level of risk.

### 2.11 Health and Safety Representative(s)

The Contractor shall ensure that Health and Safety Representative(s) is/are elected and trained to carry out his / her functions. The appointment must be in writing. The Health and Safety Representative shall carry out regular inspections, keep records and report to the supervisor to take appropriate action. He / she shall attend Health and Safety Committee Meetings. The Health and Safety Representative shall be part of the team that will investigate incidents, accidents and non-conformances.

### 2.12 Health and Safety Committee

Where two or more health and safety representatives have been appointed on site, the Contractor shall ensure that monthly health and safety meetings are held with such representatives and minutes are kept on record. Meetings must be organized and chaired by the Contractor's Health and Safety Committee Chairperson. Minutes of these meetings must be available for the employees of the contractor to refer to.

### 2.13 Medical Certificate of Fitness

The contractor must ensure that their employees on site have a valid medical certificate of fitness, specific to the construction work being performed, issued by an occupational health practitioner in the form of an Annexure 3 template (refer to the Construction Regulations 2014 on the Department of Labour website for a sample of this form).

### 2.14 Health and Safety Training

The Contractor shall quarterly conduct a training needs analysis to ascertain what health and safety training is required. A plan of action should be devised and forwarded to the Client for records. Once the identified people have attended the training, the Contractor must provide the Client with copies of certificates obtained.

#### 2.14.1 Induction

No Contractor may allow or permit any employee or person to enter site unless they have undergone health and safety induction training pertaining to the hazards prevalent on site at the time of entry. This includes visitors to site. The Contractor must ensure that visitors to site have the necessary protective equipment (PPE). A copy of attendance registers of all employees who attend inductions shall be kept.

#### 2.14.2 Awareness

The Contractor shall conduct periodic toolbox talks on site, preferably weekly or before any hazardous work takes place. The talks shall cover the relevant activity and an attendance register must be signed by all attendees. This record of who attended and the content of the topic will be kept on the site health a safety file as evidence of training.
2.15 **Competency**

After the Contractor has identified the training to be conducted as part of the competency requirement, and based on Risk Assessment, he shall send the relevant persons on appropriate courses and keep certificates of training for reference. Familiarity with the Health and Safety Act and Regulations is an integral part of the definition of competence.

2.16 **General Record Keeping**

The Contractor shall keep and maintain Health and Safety records to demonstrate compliance with the Health and Safety Specification and the Occupational Health and Safety Act. The contractor shall ensure that all records of incidents, spot fines, training etc. are kept on site. All documents shall be available for inspection by the Client, or the Department of Labour’s Inspectors.

2.17 **General Inspection, Monitoring and Reporting**

The Contractor shall carry out inspections as required by this Health and Safety Specification, as well as by health and safety legislation.

2.18 **Emergency Procedures**

The Contractor shall submit a detailed Emergency Procedure for approval by the Client prior to commencement on site. The procedure shall detail the response plan including the following:

- List of key personnel;
- Details of emergency services;
- Actions or steps to be taken in the event of the emergency; and
- Information on hazardous materials / situations, including each material’s hazardous potential impact or risk on the environment or human and measures to be taken in the event of an accident.

Emergency procedure(s) shall include, but shall not be limited to, fire, spills, accidents to employees, use of hazardous substances, dangers as a result of riot / service deliver protests / intimidation, etc. The Contractor shall advise the Client in writing of any on-site emergencies, together with a record of action taken, within 24 hours of the emergency occurring. A contact list of all service providers (Fire Department, Ambulance, Police, Medical and Hospital, etc) must be maintained and available to site personnel.

2.19 **First Aid Box and First Aid Equipment**

The Contractor shall provide first aid box/es and appoint, in writing, First Aider(s) for this project in line with the results of the Contractor’s risk assessment for the project, this health and safety specification as well as the provisions of the General Safety Regulations. The appointed First Aider(s) are to be sent for accredited first aid training before starting on site. Valid certificates are to be kept on site. First Aid box/es must be adequately stocked at all time, accessible and be controlled by a qualified First Aider. If required by the Client, the Contractor shall have a stretcher on site to be used in case of a serious incident.

2.20 **Accident / Incident Reporting and Investigation**

The Contractor shall, in addition to the prescribed requirements of the Occupational Health and Safety Act and General Safety Regulations, investigate, record and report all Section 24 reportable incidents to the Client within 24 hours of the incident occurring. Incident investigations shall be conducted by the Contractor’s appointed Accident Investigator – this Investigator must be a competent person or persons who have sufficient knowledge to carry out an investigation.
In the event of a fatality or a permanent disabling injury the Contractor must submit proof of reporting of incident to Department of Labour as well as proof of preventative measures to the Client. The Client reserves the right to conduct investigations into any incidents that they deem fit and the Contractor is required to provide full co-operation in this regard.

2.21 **Hazards and Potential Situations**

The Contractor shall immediately notify other Contractors of any hazardous or potentially hazardous situations, which may arise during performance of the activities.

2.22 **Occupational Health and Safety Signage**

The Contractor shall ascertain and provide adequate on site health and safety signage. This signage shall include, but shall not be limited to, Hard Hat / Helmet Area; Safety Shoes to be worn on site; Dust Masks to be worn in areas where there might be exposure to excessive dust; Ear Plugs / Muffs to be worn where there might be noise exposure over 85 db; Gloves; Safety Goggles; Safety Harness, Workers in Excavation, traffic management, etc. The Contractor shall be responsible to maintain the quality and replacement of signage.

2.23 **Management Of Contractors by Principal Contractor**

The Principal Contractor shall ensure that all contractors under his control are complying with the respective Health and Safety Plans, as well as Health and Safety Legislation.

2.24 **Stacking of Materials**

In addition to the provisions for the stacking of articles in the General Safety Regulations, 2003, the contractor must ensure that –

- a competent person is appointed in writing with the duty of supervising all stacking and storage on a construction site;
- adequate storage areas are provided;
- there are demarcated storage areas; and
- storage areas are kept neat and under control.

2.25 **Housekeeping and General Safeguarding on Construction Sites**

A contractor must, in addition to compliance with the Environmental Regulations for Workplaces, 1987, promulgated by Government Notice No. R. 2281 of 16 October 1987, ensure that suitable housekeeping is continuously implemented on each construction site, including:

- the proper storage of materials and equipment;
- the removal of scrap, waste and debris at appropriate intervals;
- ensuring that materials required for use, are not placed on the site so as to obstruct means of access to and egress from workplaces and passageways;
- ensuring that materials which are no longer required for use, do not accumulate on and are removed from the site at appropriate intervals;
- ensuring that waste and debris are not disposed of from a high place with a chute, unless the chute complies with the requirements set out in the regulations;
- ensuring that construction sites in built-up areas adjacent to a public way are suitably and sufficiently fenced off and provided with controlled access points to prevent the entry of unauthorized persons; and
- ensuring that a catch platform or net is erected above an entrance or passageway or above a place where persons work or pass under, or fencing off the danger area if work is being performed above such entrance, passageway, or place so as to ensure that all persons are kept safe in the case of danger or possibility of persons being struck by falling objects.
2.26 **Construction Vehicles and Mobile Plant**

A contractor must ensure that all construction vehicles and mobile plant—

- are of an acceptable design and construction;
- are maintained in a good working order;
- are used in accordance with their design and the intention for which they were designed, having due regard to safety and health;
- are operated by a person who—
  - has received appropriate training, is certified competent and in possession of proof of competency and is authorised in writing to operate those construction vehicles and mobile plant;
  - 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.
- have safe and suitable means of access and egress;
- are properly organized and controlled in any work situation by providing adequate signalling or other control arrangements to guard against the dangers relating to the movement of vehicles and plant, in order to ensure their continued safe operation;
- are prevented from falling into excavations, water or any other area lower than the working surface by installing adequate edge protection, which may include guard-rails and crash barriers;
- are fitted with structures designed to protect the operator from falling material or from being crushed should the vehicle or mobile plant overturn;
- are equipped with an acoustic warning device which can be activated by the operator;
- are equipped with an automatic acoustic reversing alarm; and
- are inspected by the authorised 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.

A contractor must ensure that—

- no person rides or is required or permitted to ride on a construction vehicle or mobile plant otherwise than in a safe place provided thereon for that purpose;
- every construction site is organized in such a way that, as far as is reasonably practicable, pedestrians and vehicles can move safely and without risks to health;
- the traffic routes are suitable for the persons, construction vehicles or mobile plant using them, are sufficient in number, in suitable positions and of sufficient size;
- every traffic route is, where necessary, indicated by suitable signs;
- all construction vehicles and mobile plant left unattended at night, adjacent to a public road in normal use or adjacent to construction areas where work is in progress, have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, in order to identify the location of the vehicles or plant;
- all construction vehicles or mobile plant when not in use, have buckets, booms or similar appendages, fully lowered or blocked, controls in a neutral position, motors stopped, wheels chocked, brakes set and ignition secured;
- whenever visibility conditions warrant additional lighting, all mobile plant are equipped with at least two headlights and two taillights when in operation;
- tools, material and equipment are secured and separated by means of a physical barrier in order to prevent movement when transported in the same compartment with employees;
- vehicles used to transport employees have seats firmly secured and adequate for the number of employees to be carried; and
- all construction vehicles or mobile plant travelling, working or operating on public roads comply with the requirements of the National Road Traffic Act, 1996.
2.27 **Electrical Installations and Machinery on Construction Sites**

A contractor must, in addition to compliance with the Electrical Installation Regulations and the Electrical Machinery Regulations, ensure that –

- before construction commences and during the progress thereof, adequate steps are taken to ascertain the presence of and guard against danger to workers from any electrical cable or apparatus which is under, over or on the site;
- all parts of electrical installations and machinery are of adequate strength to withstand the working conditions on construction sites;
- the control of all temporary electrical installations on the construction site is designated to a competent person who has been appointed in writing for that purpose;
- all temporary electrical installations used by the contractor are inspected at least once a week by a competent person and the inspection findings are recorded in a register kept on the construction site; and
- all electrical machinery is inspected by the authorized operator or user on a daily basis using a relevant checklist prior to use and the inspection findings are recorded in a register kept on the construction site.

2.28 **Use and Temporary Storage of Flammable Liquids on Construction Sites**

A 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 –

- where flammable liquids are being used, applied or stored at the workplace concerned, it is done in a manner that does not cause a fire or explosion hazard, and that the workplace is effectively ventilated;
- no person smokes in any place in which flammable liquid is used or stored, and the contractor must affix a suitable and conspicuous notice at all entrances to any such areas prohibiting such smoking;
- an adequate amount of efficient fire-fighting equipment is installed in suitable locations around the flammable liquids store with the recognized symbolic signs;
- only the quantity of flammable liquid needed for work on one day is taken out of the store for use;
- all containers holding flammable liquids are kept tightly closed when not in actual use and, after their contents have been used up, are removed from the construction site and safely disposed of;
- where flammable liquids are decanted, the metal containers are bonded and earthed; and
- no flammable material, including cotton waste, paper, cleaning rags or similar material is stored together with flammable liquids

2.29 **Water environments**

Not thought to be applicable to this project.

2.30 **Fire precautions on Construction Sites**

A contractor must, in addition to compliance with the Environmental Regulations for Workplaces, 1987, ensure that –

- all appropriate measures are taken to avoid the risk of fire;
- sufficient and suitable storage is provided for flammable liquids, solids and gases;
- smoking is prohibited and notices in this regard are prominently displayed in all places containing readily combustible or flammable materials;
- in confined spaces and other places in which flammable gases, vapours or dust can cause danger-
  - only suitably protected electrical installations and equipment, including portable lights, are used;
  - there are no flames or similar means of ignition;
  - there are conspicuous notices prohibiting smoking;
  - oily rags, waste and other substances liable to ignite are without delay removed to a safe
place; and
• adequate ventilation is provided;
• combustible materials do not accumulate on the construction site;
• welding, flame cutting and other hot work are done only after appropriate precautions have been
taken to reduce the risk of fire;
• suitable and sufficient fire-extinguishing equipment is placed at strategic locations or as may be
recommended by the Fire Chief or local authority concerned, and that such equipment is
maintained in a good working order;
• the fire equipment contemplated above is inspected by a competent person, who has been
appointed in writing for that purpose, in the manner indicated by the manufacturer thereof;
• a sufficient number of workers are trained in the use of fire-extinguishing equipment;
• where appropriate, suitable visual signs are provided to clearly indicate the escape routes in the
case of a fire;
• the means of escape is kept clear at all times;
• there is an effective evacuation plan providing for all:
  • persons to be evacuated speedily without panic;
  • persons to be accounted for; and
  • plant and processes to be shut down; and
• a siren is installed and sounded in the event of a fire.

2.31 Construction Employees’ Facilities

A contractor must, in terms of the Construction Regulations 2014, provide:

• Shower facilities after consultation with the employees or employees representatives, or at least
  one shower facility for every 15 persons;
• at least one sanitary facility for each sex and for every 30 workers;
• changing facilities for each sex;
• and sheltered eating area.

A contractor must provide reasonable and suitable living accommodation for the workers at construction
sites who are far removed from their homes and where adequate transportation between the site and
their homes, or other suitable living accommodation, is not available.

2.32 Fall protection

The Contractor must:
• designate a competent person to be responsible for the preparation of a fall protection plan
• ensure that the fall protection plan contemplated above is implemented, amended where and when
  necessary and maintained as required; and
• take steps to ensure continued adherence to the fall protection plan.

A fall protection plan contemplated above must include:
• a risk assessment of all work carried out from a fall risk position and the procedures and
  methods used to address all the risks identified per location;
• the processes for the evaluation of the employees’ medical fitness necessary to work at a fall risk
  position and the records thereof;
• 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.
A contractor must ensure that a construction manager appointed under regulation 8(1) is in possession of the most recently updated version of the fall protection plan.

A contractor must ensure that all unprotected openings in floors, edges, slabs, hatchways and stairways are adequately guarded, fenced or barricaded or that similar means are used to safeguard any person from falling through such openings;

Also that no person is required to work in a fall risk position, unless such work is performed safely as contemplated in above and fall prevention and fall arrest equipment are approved as suitable and of sufficient strength for the purpose for which they are being used, having regard to the work being carried out and the load, including any person, they are intended to bear; and securely attached to a structure or plant, and the structure of plant and the means of attachment thereto are suitable and of sufficient strength and stability for the purpose of safely supporting the equipment and person who could fall, and fall arrest equipment is used only where it is not reasonably practicable to use fall prevention equipment.

2.33 Temporary works

A contractor must appoint a temporary works designer in writing to design, inspect and approve the erected temporary works on site before use.

A 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.

A contractor must ensure that:

- all temporary works structures are adequately erected, supported, braced and maintained by a competent person so that they are capable of supporting all anticipated vertical and lateral loads that may be applied to them, and that no loads are imposed onto the structure that the structure is not designed to withstand;
- all temporary works structures are done with close reference to the structural design drawings, and where any uncertainty exists the structural designer should be consulted;
- detailed activity specific drawings pertaining to the design of temporary works structures are kept on the site and are available on request to an inspector, other contractors, the client, the client's agent or any employee;
- all persons required to erect, move or dismantle temporary works structures are provided with adequate training and instruction to perform those operations safely;
- all equipment used in temporary works structure are carefully examined and checked for suitability by a competent person, before being used;
- all temporary works structures are inspected by a competent person immediately before, during and after the placement of concrete, after inclement weather or any other imposed load and at least on a daily basis until the temporary works structure has been removed and the results have been recorded in a register and made available on site;
- no person may cast concrete, until authorization in writing has been given by the competent person contemplated above;
- if, after erection, any temporary works structure is found to be damaged or weakened to such a degree that its integrity is affected, it is safely removed or reinforced immediately;
- adequate precautionary measures are taken in order to-
  - secure any deck panels against displacement; and
  - prevent any person from slipping on temporary works due to the application of release agents;
- as far as is reasonably practicable, the health of any person is not affected through the use of solvents or oils or any other similar substances;
- upon casting concrete, the temporary works structure is left in place until the concrete has acquired sufficient strength to safely support its own weight and any imposed load, and is not removed until authorization in writing has been given by the competent person
- the foundation conditions are suitable to withstand the loads caused by the temporary works structure and any imposed load in accordance with the temporary works design.
- provision is made for safe access by means of secured ladders or staircases for all work to be carried out above the foundation bearing level;
• a temporary works drawing or any other relevant document includes construction sequences and methods statements;
• the temporary works designer has been issued with the latest revision of any relevant structural design drawing;
• a temporary works design and drawing is used only for its intended purpose and for a specific portion of a construction site; and
• the temporary works drawings are approved by the temporary works designer before the erection of any temporary works.

No contractor may use a temporary works design and drawing for any work other than its intended purpose.

**2.34 Excavation**

A contractor must-

- ensure that all excavation work is carried out under the supervision of a competent person who has been appointed in writing for that purpose; and
- evaluate, as far as is reasonably practicable, the stability of the ground before excavation work begins.

A contractor who performs excavation work-

- must take reasonable and sufficient steps in order to prevent, as far as is reasonably practicable, any person from being buried or trapped by a fall or dislodgement of material in an excavation;
- may not require or permit any person to work in an excavation which has not been adequately shored or braced: Provided that shoring and bracing may not be necessary where-
  - the sides of the excavation are sloped to at least the maximum angle of repose measured relative to the horizontal plane; or
  - such an excavation is in stable material: Provided that-
    - permission has been given in writing by the appointed competent person contemplated above upon evaluation by him or her of the site conditions; and
    - where any uncertainty pertaining to the stability of the soil still exists, the decision from a professional engineer or a professional technologist competent in excavations is decisive and such a decision must be noted in writing and signed by both the competent person and the professional engineer or technologist, as the case may be;
- must take steps to ensure that the shoring or bracing contemplated above is designed and constructed in a manner that renders it strong enough to support the sides of the excavation in question;
- must ensure that no load, material, plant or equipment is placed or moved near the edge of any excavation where it may cause its collapse and consequently endangers the safety of any person, unless precautions such as the provision of sufficient and suitable shoring or bracing are taken to prevent the sides from collapsing;
- must ensure that where the stability of an adjoining building, structure or road is likely to be affected by the making of an excavation, steps are taken to ensure the stability of such building, structure or road and the safety of persons;
- must cause convenient and safe means of access to be provided to every excavation in which persons are required to work, and such access may not be further than six meters from the point where any worker within the excavation is working;
- must ascertain, as far as is reasonably practicable, the location and nature of electricity, water, gas or other similar services which may in any way be affected by the work to be performed, and must before the commencement of excavation work that may affect any such service, take the steps that are necessary to render the circumstances safe for all persons involved;
- must ensure that every excavation, including all bracing and shoring, is inspected -
  - daily, prior to the commencement of each shift;
  - after every blasting operation;
• after an unexpected fall of ground;
• after damage to supports; and
• after rain,
by the competent person, in order to ensure the safety of the excavation and of persons, and those results must be recorded in a register kept on site and made available on request to an inspector, the client, the client's agent, any other contractor or any employee;
• must cause every excavation which is accessible to the public or which is adjacent to public roads or thoroughfares, or whereby the safety of persons may be endangered, to be –
• adequately protected by a barrier or fence of at least one metre in height and as close to the excavation as is practicable; and
• provided with warning illuminants or any other clearly visible boundary indicators at night or when visibility is poor, or have resort to any other suitable and sufficient precautionary measure where this is not practicable;
• must ensure that all precautionary measures stipulated for confined spaces as determined in the General Safety Regulations, 2003, are complied with by any person entering any excavation;
• must, where the excavation work involves the use of explosives, appoint a competent person in the use of explosives for excavation, and must ensure that a method statement is developed by that person in accordance with the applicable explosives legislation; and
• must cause warning signs to be positioned next to an excavation within which or where persons are working or carrying out inspections or tests.

2.35 Demolition Work

Not thought to be applicable to this project.

2.36 Tunneling

Not thought to be applicable to this project.

2.37 Scaffolding

A contractor must appoint a competent person in writing who must ensure that all scaffolding work operations are carried out under his or her supervision and that all scaffold erectors, team leaders and inspectors are competent to carry out their work.

A contractor using access scaffolding must ensure that such scaffolding, when in use, complies with the safety standards incorporated for this purpose into these Regulations under section 44 of the Act.

2.38 Bulk mixing plant

Not thought to be applicable to this project.

2.39 Rope Access Work

Not thought to be applicable to this project.

2.40 Hazardous Chemical Substances (HCS)

In addition to the requirements in the HCS Regulations, the principal contractor must provide proof in the Health and Safety Plan that:

• Material Safety Data Sheets (MSDS’s) of the relevant materials / hazardous chemical substances are available prior to use by the contractor. All MSDS’s shall be available for inspection by the agent at all times.
• Risk assessments are done at least once every 6 months.
• Exposure monitoring is done according to OESSM and by an Approved Inspection Authority (AIA) and that the medical surveillance programme is based on the outcomes of the exposure monitoring.
• How the relevant HCS’s are being/going to be controlled by referring to:
  • Limiting the amount of HCS
  • Limiting the number of employees
  • Limiting the period of exposure
  • Substituting the HCS
  • Using engineering controls
  • Using appropriate written work procedures
• The correct PPE is being used.
• HCS are stored and transported according to SABS 072 and 0228.
• Training with regards to these regulations was given.

The Health and Safety plan should make reference to the disposal of hazardous waste on classified sites and the location thereof (where applicable).

The First Aider must be made aware of the MSDS and trained in how to treat HCS incidents appropriately.

2.41 **Noise Induced Hearing Loss**

Where noise is identified as a hazard the requirements of the NIHL regulations must be complied with and the following must be included / referred to in the Health and Safety Plan:

• Proof of training with regards to these regulations.
• Risk assessment done within 1 month of commencement of work.
• That monitoring carried out by an AIA and done according to SABS 083.
• Medical surveillance programme established and maintained for the necessary employees.
• Control of noise by referring to:
  • Engineering methods considered
  • Admin control (number of employees exposed) considered
  • Personal protective equipment considered/decided on
• Describe how records are going to be kept for 40 years.

2.42 **Explosives and Blasting**

Not thought to be applicable to this project.

2.43 **Personal Protective Equipment (PPE)**

The Contractor shall carry out PPE or clothing needs analysis in accordance with his risk assessment, to determine the necessary PPE or clothing to be used during construction. The Contractor shall make provision and keep adequate quantities of SABS approved PPE or clothing on site at all times.

The Contractor must ensure that personnel are trained in the correct use of PPE to be used.

The Contractor must ensure that lost, stolen, worn out or damaged PPE is replaced as required and receipt signed for by employees on site.

2.44 **Asbestos**

Not thought to be applicable to this project.
2.45 Pressure Vessels (Including Gas Bottles)

The Contractor shall comply with Pressure Vessel Regulations, including:

- Providing competency and awareness training to the operators;
- Providing PPE or clothing;
- Providing and maintain appropriate signage in areas where pressure vessels are used, as applicable;
- Inspect equipment regularly and keep records of inspections;
- Providing appropriate fire fighting equipment (Fire Extinguishers).

2.46 Fire Extinguishers and Fire Fighting Equipment

The Contractor shall provide adequate, regularly serviced fire extinguishers located at strategic points on site. The Contractor shall keep spare serviced portable fire extinguishers. The Contractor shall have adequate persons trained or competent to use the Fire Fighting Equipment.

Safety signage shall be posted up in all areas where fire extinguishers are located.

2.47 Lifting Machinery and Tackle

The Contractor shall ensure that lifting machinery and tackle is inspected before use and on a monthly basis. The Contractor shall have lifting machinery and tackle inspector who will inspect the equipment at intervals required by the Driven Machinery Regulations, taking into account that:

- All lifting machinery and tackle have a safe working load clearly indicated;
- Regular inspection and servicing is carried out;
- Records are kept of inspections and of service certificates;
- Thorough examinations are carried out by competent personnel at the frequencies required by legislation;
- There is proper supervision in terms of guiding the loads which includes a trained banks man to direct and check lifting tackle if it is safe for use.

2.48 Ladders and Ladder work

The Contractor shall ensure that all ladders are numbered and inspected regularly keeping record of inspections. It should be noted that Aluminium ladders are preferred to wooden ladders.

2.49 General Machinery

The Contractor shall comply with the Driven Machinery Regulations, which include inspecting machinery regularly, appointing a competent person to inspect and ensure maintenance, issuing PPE or clothing and training those that use machinery and enforce compliance.

2.50 Portable Electrical Tools

The Contractor shall ensure that use and storage of all explosive actuating fastening devices and portable electrical tools are in compliance with relevant legislation.

The Contractor shall consider that:

- A competent person undertakes routine inspections;
- Only authorised persons use the tools;
- There are safe working procedures applied;
- Awareness training is carried out and compliance is enforced at all times; and
- PPE and clothing is provided and maintained.
2.51 **High Voltage Electrical Equipment**

The Contractor shall ensure that, where the work is under, on or near high-voltage electrical equipment the Electrical Installation Regulations, together with safety instructions (Regulations of the Owner of the Equipment) are complied with. Such equipment includes:

- Eskom and the Local Authority equipment
- The Contractor’s own power supply; and
- Electrical equipment being installed but not yet taken over from a Contractor by The Client.

2.52 **Public Health and Safety**

The Contractor shall ensure that each person working on or visiting a site, and the surrounding community, shall be made aware of the dangers likely to arise from on site activities and the precautions to be observed to avoid or minimize those dangers. Appropriate health and safety signage shall be posted at all times.

2.53 **Night Work**

Not thought to be applicable to this project.

2.54 **Environmental Conditions and Flora and Fauna**

The Contractor must be mindful of adverse weather conditions upon the health and safety of the workforce. This includes inclement weather, strong wind, heat stress, extreme cold, etc. The Contractor’s risk assessment process must take into account the risks associated with such weather conditions. The same is true when working in an environment where there is a risk to employees’ health and safety from presence of poisonous flora, or wildlife (including bees, snakes, etc). The Contractor’s risk assessment process must take these risks into account.

2.55 **Occupational Health**

Exposure of workers to occupational health hazards and risks are very common in any work environment, especially in construction. Occupational health hazards and risks exposure is a major problem and all Contractors are to ensure that proper health and hygiene measures are put in place to prevent exposure to these hazards and risks.

The occupational hazards and risks may enter the body in three ways:

- Inhalation through breathing e.g. cement dust;
- Ingestion through swallowing maybe through food intake;
- Absorption through the skin ( pores) e.g. painting or use of thinners.

The contractor is required to ensure that all his personnel are medically fit prior to being allowed onto the work site.

All Contractors should ensure that Occupational Hygiene surveys are conducted as per the Occupational Health and Safety Act to ensure employees are not exposed to hazards. Risk Assessments should identify areas where surveys are to be conducted.

2.56 **Suspended Platforms**

Not thought to be applicable to this project.
2.57  **Material Hoists**

Not thought to be applicable to this project.

2.58  **Explosive Actuated Fastening Device**

Not thought to be applicable to this project.

2.59  **Confined Spaces**

Not thought to be applicable to this project.
OTHER HEALTH AND SAFETY SPECIFICATION REQUIREMENTS

The contractor must be aware of the following additional requirements:

<table>
<thead>
<tr>
<th>What</th>
<th>When</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness training (Toolbox Talks)</td>
<td>At least fortnightly and before hazardous work is carried out</td>
<td>Attendance Register</td>
</tr>
<tr>
<td>Health and Safety Committee Meetings</td>
<td>Monthly</td>
<td>Minutes signed by the employer (Contractor) covering: a) Health and Safety Representative Checklist</td>
</tr>
<tr>
<td>Health and Safety Reports</td>
<td>Monthly</td>
<td>Report covering: a) Incidents/Accidents and Investigations b) Non conformance c) Health and Safety Training d) HIRA Updates e) Internal and External Audits</td>
</tr>
<tr>
<td>General Inspections</td>
<td>Monthly</td>
<td>Covering: a) Fire fighting Equipment b) Portable Electrical Equipment c) Ladders</td>
</tr>
<tr>
<td>Record keeping</td>
<td>Ongoing</td>
<td>Covering: a) General complaints b) Fines c) General incidents d) MSDS e) Surveillance Medicals f) Inspection Register g) Dept of Labour Notices</td>
</tr>
<tr>
<td>Permits</td>
<td>Before commencement with certain activities</td>
<td>As stipulated by the Health and Safety Specification and the OHSA / Construction Regulations</td>
</tr>
</tbody>
</table>

Key:

OHSA – Occupational Health and Safety Act, 1993
ANNEXURE A

The Contractor shall submit the info below in an Annexure 2 prior to construction commencement.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Health and Safety Specification Requirement</th>
<th>OHSA Requirement</th>
<th>Submission date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Notification of Intention to Commence Construction</td>
<td>Construction Regulations 2014</td>
<td>At least 7 days before commencement on site</td>
</tr>
<tr>
<td>2.</td>
<td>Construction Work Permit</td>
<td>Construction Regulations 2014 (in effect from August 2015, for construction work exceeding certain works contract values and at certain CIDB grading levels)</td>
<td>At least 30 days prior to project commencement</td>
</tr>
<tr>
<td>3.</td>
<td>Assignment of Responsible Person to Manage Building Work via Health and Safety Organogram</td>
<td>Construction Regulations 2014</td>
<td>Before commencement on site</td>
</tr>
<tr>
<td>4.</td>
<td>Competency for Health and Safety Positions</td>
<td>Client / Safety Agent requirement</td>
<td>Before commencement on site</td>
</tr>
<tr>
<td>5.</td>
<td>Compensation of Occupational Injuries and Diseases Act (COIDA) 130 of 1993</td>
<td>COIDA Requirement</td>
<td>Before commencement on site</td>
</tr>
<tr>
<td>6.</td>
<td>Occupational Health and Safety Policy</td>
<td>Client / Safety Agent requirement</td>
<td>Before commencement on site</td>
</tr>
<tr>
<td>7.</td>
<td>Risk Assessment, Safety Plan and Fall Protection Plan, Demolition Method Statement</td>
<td>Client / Safety Agent requirement</td>
<td>Before construction work commences</td>
</tr>
</tbody>
</table>
ANNEXURE B - The contractor shall make the following appointments, as required:

<table>
<thead>
<tr>
<th>Position</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Executive Officer (OSHACT 16(1))</td>
<td></td>
</tr>
<tr>
<td>Contract Director/Manager (OSHACT 16(2))</td>
<td></td>
</tr>
<tr>
<td>Construction Manager (CR 8(1))</td>
<td></td>
</tr>
<tr>
<td>Construction Supervisor (CR 8(7))</td>
<td></td>
</tr>
<tr>
<td>Assistant Construction Supervisor (CR 8(8))</td>
<td></td>
</tr>
<tr>
<td>Construction Safety Officer (CR 8(5))</td>
<td></td>
</tr>
<tr>
<td>Traffic Safety Officer</td>
<td></td>
</tr>
<tr>
<td>Safety Representative (where &gt; 20 employees on site)</td>
<td></td>
</tr>
<tr>
<td>Temporary work Designer (CR 12(1))</td>
<td></td>
</tr>
<tr>
<td>Temporary work Supervisor (CR12(2))</td>
<td></td>
</tr>
<tr>
<td>Construction risk assessor (CR 9(1))</td>
<td></td>
</tr>
<tr>
<td>Excavation Supervisor (CR13(1)(a))</td>
<td></td>
</tr>
<tr>
<td>Demolition Supervisor (CR14(1))</td>
<td></td>
</tr>
<tr>
<td>Scaffold Supervisor (CR16(1))</td>
<td></td>
</tr>
<tr>
<td>Suspended Platform Supervisor (CR17(1))</td>
<td></td>
</tr>
<tr>
<td>Material Hoist Inspector (CR19(8)(a))</td>
<td></td>
</tr>
<tr>
<td>Material Hoist Operator (CR19(6))</td>
<td></td>
</tr>
<tr>
<td>Bulk Mixing Plant Supervisor (CR20(1))</td>
<td></td>
</tr>
<tr>
<td>Bulk Mixing Plant Operator (CR20(2))</td>
<td></td>
</tr>
<tr>
<td>Controller of Explosive Actuated Fastening Devices Nails, Cartridges or Studs Issue and Collection (CR21(2)(g)(1))</td>
<td></td>
</tr>
<tr>
<td>Construction Vehicle and Mobile Plant Operator (CR23(1)(d)(i))</td>
<td></td>
</tr>
<tr>
<td>Controller of Temporary Electrical Installations (CR24(c))</td>
<td></td>
</tr>
<tr>
<td>Stacking Supervisor (CR28(a))</td>
<td></td>
</tr>
<tr>
<td>Fire Extinguishing Equipment Inspector (CR29(h))</td>
<td></td>
</tr>
<tr>
<td>Fall Protection Plan Developer (CR 10(1)(a))</td>
<td></td>
</tr>
<tr>
<td>Incident Investigator (OSHACT 9(2))</td>
<td></td>
</tr>
<tr>
<td>Competent Person – Confined Spaces (GAR 5(1))</td>
<td></td>
</tr>
</tbody>
</table>
Irrespective of the risk presented on site, it will be ensured that sufficient supervision is in place on site, that personnel are trained in accordance with legislation, including the requirement for site specific inductions on site to inform personnel on site of the risks and hazards applicable to the site. Site supervision is responsible for ensuring that the control measures required below are implemented on site.

<table>
<thead>
<tr>
<th>HAZARD</th>
<th>RISK</th>
<th>RISK RATING (High / Medium / Low)</th>
<th>MINIMUM CONTROL MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Asphalting</td>
<td>Fire</td>
<td>M</td>
<td>• Suitable fire extinguisher to be in place prior to commencement of works&lt;br&gt;• Ensure competent personnel using materials and competent and trained machinery/equipment operators&lt;br&gt;• Ensure there is a safe place of work at all times&lt;br&gt;• Ensure all personnel wear suitable and sufficient personal protective equipment (PPE) including safety boots, reflective vests and gloves&lt;br&gt;• Health and Safety data sheet required</td>
</tr>
<tr>
<td></td>
<td>Burns to skin</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skin disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Compacting and Filling</td>
<td>Contact with tipping materials</td>
<td>M</td>
<td>• Trained banksman to control vehicles movement&lt;br&gt;• Only trained personnel use plant&lt;br&gt;• Personal Protective Equipment to be worn&lt;br&gt;• Personnel to stand clear as materials are being tipped&lt;br&gt;• Use stop blocks and signs to warn vehicles of excavations, where applicable&lt;br&gt;• Stand clear of plant whilst materials are being compacted&lt;br&gt;• Establish position of underground services and protect services from damage</td>
</tr>
<tr>
<td></td>
<td>Contact with moving plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vehicles/personnel falling into excavations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contact with underground services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Compactor Operations</td>
<td>Crushing of feet</td>
<td>M</td>
<td>• Only trained and competent personnel to use the machine&lt;br&gt;• Ensure operative wears steel toe cap shoes or boots at all times</td>
</tr>
<tr>
<td>4. Cutting Kerbs</td>
<td>Saw slipping, Blade disintegrating, Noise and dust</td>
<td>M</td>
<td>• Only trained operators to use saw and change blades.&lt;br&gt;• Personal Protective Equipment must be worn. Gloves, goggles, dust mask and hearing protection.&lt;br&gt;• People to be kept away from the work area.&lt;br&gt;• Work to cease if people have to pass.&lt;br&gt;• Sparks etc. to be directed away from people and any flammable material.</td>
</tr>
<tr>
<td></td>
<td>Noise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Cutting Off Disc</td>
<td>Noise</td>
<td>M</td>
<td>• Use competent personnel.&lt;br&gt;• Hot works control- fire extinguisher, fire watchman. (Permit may be required)&lt;br&gt;• PPE to include gloves, eye protection, hearing protection&lt;br&gt;• Solid working position.&lt;br&gt;• Clear working area&lt;br&gt;• Correct grade of blade must be used.&lt;br&gt;• Good ventilation to be provided (forced if necessary).&lt;br&gt;• Changing of wheels to be by competent persons only&lt;br&gt;• Cut off discs must not be used for grinding (grinding disc thicker)&lt;br&gt;• Bystanders to wear hearing protection, as applicable.</td>
</tr>
<tr>
<td></td>
<td>Cuts from machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fire (particularly at refuelling)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flying debris</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blade shattering</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contamination by fume created or exhaust fume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAZARD</td>
<td>RISK</td>
<td>RISK RATING (High / Medium / Low)</td>
<td>MINIMUM CONTROL MEASURES</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------------------------------</td>
<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 6. Electrical Commissioning                 | Electric shock                            | M                                 | Personnel to comply with permits to work issued by client  
Personnel protective equipment to be worn by employees to prevent electric shock  
First aid treatment to be readily available  
Only competent and trained persons may decommission or commission electrical equipment                                                                                                                   |
| 7. Electric Tools and Electrical Installations | Electric shock                            | L                                 | Electric tools and installations to be in good condition  
Inspect electric tools before use  
Do not use electric tools in wet/damp conditions  
Use personal protective equipment such as insulated gloves  
Electrical installations register to be maintained, inspected by competent person                                                                                                                   |
| 8. Excavations (Working in and around) – max 2.5m | Toxic fumes  
Collapse of trench walls/trapping  
Falling into excavation  
Collapse of adjacent structures | M                                 | Deep excavations / monitor air for toxic fumes  
Prevent collapse by battering back sides to a safe angle or install temporary support  
Protect vehicles from falling into excavations – provide barriers, signage, etc as necessary  
Beware of undermining of other structures (eg: buildings, scaffolds)  
Record excavation inspections by competent person on daily basis  
Provide suitable means of access/egress in case of emergency  
Excavations formed by explosives must be accompanied by method statement approved by Client                                                                                                                   |
| 9. Fire                                     | Injuries to workers, pedestrians, residents, road users, damage to property through fire | L                                 | No littering on site which could become fire hazard, maintain site in clean condition  
No fires to be lit on site. Have a working fire extinguisher at hand at all times  
No smoking or naked flame near flammable substances or in unauthorised areas  
Ensure proper storage/use of Petrol/diesel/flammable substances – post warning notices                                                                                                                   |
| 10. Flammable Liquids and Gases (Use of)    | Fire                                      | L                                 | No littering on site which could become fire hazard, maintain site in clean condition  
Have a working fire extinguisher at hand at all times  
No smoking or naked flame near flammable substances or in unauthorised areas  
Ensure proper storage/use of Petrol/diesel/flammable substances – post warning notices  
Equipment must be in good condition, maintained  
Personnel using substances must be trained in safe use and risks                                                                                                                   |
<table>
<thead>
<tr>
<th>HAZARD</th>
<th>RISK</th>
<th>RISK RATING (High / Medium / Low)</th>
<th>MINIMUM CONTROL MEASURES</th>
</tr>
</thead>
</table>
| 11. Hand tools          | Injuries caused by use of hand tool Impact with the tool Falls due to  | • L                               | • Ensure:  
  access problems  
  Contamination with substance being worked  
  • Tool is correct for job  
  • Tool is in good order and suitably sharp  
  • Personnel must be competent/instructed in tool usage and tool safety  
  • Lighting is sufficient  
  • Access is safe, working platform is secure, leading edge is guarded  
  • Operative is wearing all necessary PPE |
|                         |                                                                      |                                   |                          |                                                                                                                                                                                                                                                   |
| 12. Hazardous Substances| Injuries to workers through use of hazardous substances, eg: injuries | • M                               | • Use substances in accordance with data sheet, particularly reference protective clothing required (example: gloves, goggles, etc)  
  • Know what First Aid measures are  
  • Have welfare facilities available for washing of hands, etc |
|                         | to eyes, skin, etc                                                  |                                   |                          |                                                                                                                                                                                                                                                   |
| 13. Hot Works           | Burns to eyes or other parts of the body                             | • M                               | • Personal Protective Equipment to include eye, skin and hearing protection  
  • Respirator may be required where cutting galvanized steel or anywhere else toxic fumes and gases arise. Dust can also be a problem and forced ventilation may be required. |
| 14. Kerb Laying         | Nips at joints  
  Crushing by kerbs  
  Caustic burns                                                    | • L                               | • Impervious gloves and barrier cream to be used to protect hands.  
  • Personnel should be aware of safe manual handling techniques when handling kerbs.  |
| 15. Lifting Operations  | Falling material  
  Crushing by materials  
  Hand injuries to the slinger  
  Toppling crane                                                   | • M                               | • Check test certificate  
  • Check examination certificate  
  • Check inspection have been carried out  
  • Check certificates for lifting equipment (chains, slings, shackles, etc)  
  • Ensure lifting gear is rated to carry load (SWL)  
  • Ensure materials being lifted are properly packaged and slung.  
  • Be aware that there should be a minimum clearance of 600mm between any slew ing parts of a crane and any fixed installation to prevent being trapped.  
  • Access to the work area during lifting operations is to be restricted to those involved with and trained in the work in hand. Do not allow members of the public to gain access to the area.  
  • Only trained banksmen to be used.  
  • The crane driver and the banksman are to ensure that the signals given are clearly understood. |
<table>
<thead>
<tr>
<th>HAZARD</th>
<th>RISK</th>
<th>RISK RATING (High / Medium / Low)</th>
<th>MINIMUM CONTROL MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. Manual Handling of General Items</td>
<td>Muscular skeletal injuries if the load is too heavy or awkward Operative falling/ tripping Contamination from the substance being carried Fall of material being carried</td>
<td>L</td>
<td>Personnel should be aware of safe manual handling techniques Personnel to wear Personal Protective Equipment when carrying items, e.g.: safety footwear and gloves. Ensure good housekeeping against tripping/fall hazards. Operative to get assistance if load too heavy- team lift if necessary. Utilise mechanical lifting and carrying aids where possible. Personnel to ensure access equipment, ladders will take weight of operative and load being carried. Personnel to ensure item being carried is properly bonded or is not liable to break apart whilst being manually handled.</td>
</tr>
<tr>
<td>17. Members of Public – Protection of</td>
<td>Injury to member of public and road users from site works</td>
<td>M</td>
<td>Barriers and signage to be in place Workers must warn away any members of public from the works Footpaths and bridges which are open to public must be closed off if in area of works or otherwise made safe so that no injury occurs to members of public Traffic turning into site – traffic management and signage as required. Signage to be on road at site entrance warning motorists that construction traffic turning into/out of site access. Keep roads free of mud where possible Refer to plant risk assessment for details on plant safety precautions NOTE: SIGNAGE TO BE POSTED ON SITE TO WARN OF CONSTRUCTION TRAFFIC MOVEMENTS. SAFE MEANS OF ACCESS FOR BOTH CONSTRUCTION TRAFFIC TO SITE AND PRIVATE HOMEOWNERS MUST BE AGREED.</td>
</tr>
<tr>
<td>18. Mobile Crane Erection and Dismantling and Use</td>
<td>Collapse of structure Overturning of structure Falling materials</td>
<td>M</td>
<td>Ensure emergency procedures are in place and all operative are aware of the details Only use trained and competent operators for the erection and dismantling and use of cranes Ensure crane driver is trained and holds certification as proof. Must have valid medical certificate of fitness. Ensure there is safe means of access available at all times Ensure the mobile crane driver has 360° vision if not ensure a fully trained banksman is used Banksman to wear reflector vest to identify himself to the crane driver Ensure all personnel wear suitable and sufficient personal protective equipment Consider creating exclusion areas</td>
</tr>
<tr>
<td>19. Noise and Dust</td>
<td>Breathing in dust can cause long term health problems, noise can damage hearing</td>
<td>M</td>
<td>Wear respiratory and hearing protection Dampen down and minimise dust where possible.</td>
</tr>
<tr>
<td>HAZARD</td>
<td>RISK</td>
<td>RISK RATING (High / Medium / Low)</td>
<td>MINIMUM CONTROL MEASURES</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>----------------------------------</td>
<td>--------------------------</td>
</tr>
</tbody>
</table>
| 20. Plant or Vehicles and Equipment Operation | Workers injured by passing traffic Road users and pedestrians at risk from plant operation Noise | M | • Implement traffic protection measures  
• Trained and competent operators must be used  
• Check plant and vehicles on daily basis before use and record inspections. Maintain vehicles in safe condition.  
• Medical certificates of fitness required for construction plant.  
• Crossing of road by construction vehicles or machines must be limited to the practical minimum  
• Plant and vehicles must be fitted with amber rotating beacons and reverse alarms.  
• Wear appropriate protective clothing/equipment, eg: goggles, gloves, ear defenders, etc as appropriate. |
| 21. Precast Slab / Unit Laying and Fixing | Falls Falling materials Manual Handling | M | • Emergency procedures in place and personnel explained details  
• Use competent personnel  
• Ensure suitable and sufficient access and egress is provided  
• Safe place of work must be provided  
• Ensure all personnel wear correct personal protective equipment  
• Exclusion zone may be required for protection against risk of falling objects |
| 22. Road Working – working in or next to road | Injury to workers caused by passing traffic Injury to road users and pedestrians by works | H | • Flagmen to be used where interface with construction plant with passers-by or where hazard posed by delivery vehicles turning into/out of site.  
• Traffic management plan to be approved by Municipality and, if necessary, traffic department  
• No construction activities to commence until adequate provision made to accommodate traffic in accordance with the South African Traffic Signs Manual.  
• Use safety signage to warn traffic and pedestrians of construction works  
• Where existing walk ways/pavements affected by works, must direct pedestrian traffic away to safe walking area.  
• Wear reflective waistcoats when working on or near the road or road shoulder as well as any other required personal protective clothing.  
• Crossing of road by personnel must be limited to the practical minimum  
• Use of fencing or other barriers as appropriate |
<table>
<thead>
<tr>
<th>HAZARD</th>
<th>RISK</th>
<th>RISK RATING (High / Medium / Low)</th>
<th>MINIMUM CONTROL MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>23. Scaffold Erection/ Dismantling</td>
<td>Personnel falling from a height Items of scaffold falling onto personnel Scaffold collapsing onto those below</td>
<td>M</td>
<td>• Ensure scaffold is designed to take the imposed loads • Scaffolding is constructed properly • Scaffold is not overloaded • Scaffolders are fully trained • Scaffolding is regularly checked by competent person and record of inspection retained. Written inspections to be recorded on weekly basis • Scaffolders must adhere to the safe systems of work. • All fall arrest equipment to be checked and certified in good working order • That ALL understand the safe system of work</td>
</tr>
<tr>
<td>24. Shuttering Walls, Beams, Columns</td>
<td>Falling from height Falling materials from height Cuts and abrasions from splinters and nails</td>
<td>M</td>
<td>• Ensure all personnel wear the appropriate Personal Protective Equipment • Ensure at all times there is a safe working platform • Use only trained and competent personnel • If electrical tools are being used ensure they have been tested and safe to use • Ensure timber is de-nailed after use • Ensure safety standards are followed at all times • Ensure there is a safe means of access and egress at all times</td>
</tr>
<tr>
<td>25. Site Strip</td>
<td>Overtopping Vehicles</td>
<td>L</td>
<td>• Follow standard safety procedures • Only use trained and competent personnel • Ensure there is a suitable and safe means of access and egress • Ensure banksman used when required • Ensure all personnel wear suitable reflector vests as required</td>
</tr>
<tr>
<td>26. Snakes</td>
<td>Snake bite</td>
<td>L</td>
<td>• Qualified first aider required for site who can treat snakebite • Snake bite kit to be on hand • Check area before working • Find out nearest hospital and get emergency telephone numbers.</td>
</tr>
<tr>
<td>27. Steel Fixing</td>
<td>Back injuries caused by manual handling Eye injuries from tie wire Trips / falls Falling form height</td>
<td>M</td>
<td>• PPE must include safety boots and goggles • Manual handling training may be required • Care to be taken when working near overhead lines • Use only trained personnel • Provide safe means of access • Maintain and regularly inspect all lifting appliances and equipment • Cap starter bars to prevent injuries where feasible • Construct scaffold walkways to cross reinforcing mesh, as required</td>
</tr>
<tr>
<td>HAZARD</td>
<td>RISK</td>
<td>RISK RATING (High / Medium / Low)</td>
<td>MINIMUM CONTROL MEASURES</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------------</td>
<td>-----------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>28. Street Lighting</td>
<td>Contact with vehicles</td>
<td>• M</td>
<td>- Ensure competent personnel are used</td>
</tr>
<tr>
<td></td>
<td>Electrical Shock</td>
<td></td>
<td>- Area to be kept clear – keep unauthorised persons away</td>
</tr>
<tr>
<td></td>
<td>Collapse of columns</td>
<td></td>
<td>- Plant and lifting equipment to be maintained as per risk assessments above</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Electrical connections to be done by qualified personnel only</td>
</tr>
<tr>
<td>29. Temporary Works –</td>
<td>Collapse of temporary work</td>
<td>• M</td>
<td>- Wear personal protective equipment such as gloves and goggles</td>
</tr>
<tr>
<td>shoring, scaffold,</td>
<td></td>
<td></td>
<td>- Formwork must be built by trained person and also be inspected by competent person and results entered into register on site</td>
</tr>
<tr>
<td>falsework, formwork</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Troxler – use of</td>
<td>Radiation exposure</td>
<td>• M</td>
<td>- Ensure training of Troxler gauge operators in basic radiation safety and correct operating procedure to satisfactory level of competence</td>
</tr>
<tr>
<td></td>
<td>Transportation and storage of nuclear</td>
<td></td>
<td>- An enclosed vehicle must be used for transport of the gauge</td>
</tr>
<tr>
<td></td>
<td>equipment</td>
<td></td>
<td>- After use and before storing the gauge, a visual check to be carried out to confirm shutter is properly closed</td>
</tr>
<tr>
<td></td>
<td>Working in road</td>
<td></td>
<td>- Warning signage to be displayed at entrance to store indicating presence of radioactive material</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Wear reflective vests when working in or near the road or road shoulder as well as any other required personal protective clothing</td>
</tr>
<tr>
<td>31. Underground Services</td>
<td>Striking of buried services</td>
<td>• M</td>
<td>- Make all necessary enquiries to establish what services are in the area. Consult drawings and advice from service provider (e.g. Municipality or ESKOM) when planning work.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Assume all service to be live (Unless confirmation is received to confirm that services are isolated or otherwise made safe). Do not work near live services without authorisation from site management.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Comply with the requirements of the safe system of work for underground services.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Where available, locate services with a locator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Hand dig around services</td>
</tr>
<tr>
<td>HAZARD</td>
<td>RISK</td>
<td>RISK RATING (High / Medium / Low)</td>
<td>MINIMUM CONTROL MEASURES</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------</td>
<td>------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 32. Working at Height | Personnel falling form height  
Falling debris  
Those beneath being injured | H                                  | • All access equipment is properly constructed (inspections record must be maintained)  
• Only trained personnel construct, dismantle or control the access equipment  
• All access equipment must have full toe boards and guardrails - comply with SANS 10085 on erection, use and dismantling of scaffolding  
• No access equipment may be loaded above the level of the guardrail  
• No access equipment to be loaded above its safe working load  
• Where work involves leaning out on an open leading edge, then all personnel are to be fitted with full body harness. The harness must be connected at all times  
• All fall arrest equipment to be correctly maintained  
• Ensure if ladders are being used for access, they are either footed or tied. Also the ladder must be set at the correct level of 1 in 4 or approximately 75° |
## ISSUE REGISTER

<table>
<thead>
<tr>
<th>Date of Original Safety Specification Compilation</th>
<th>Compiled By</th>
<th>Issue Date</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>04 September 2017</td>
<td>Mark Winter</td>
<td>05 September 2017</td>
<td>Original</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acknowledgement:</th>
</tr>
</thead>
<tbody>
<tr>
<td>I, ______________________________________________________ representing _______________________________________________________________ (Contractor), have satisfied myself with the content of this Health and Safety Specification and shall ensure that our employees and contractors on site comply with the requirements of this document, our safety documentation and health and safety legislation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signature of Contractor</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>______________________</td>
<td>____</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>__________________________________________________________</td>
</tr>
<tr>
<td>__________________________________________________________</td>
</tr>
<tr>
<td>__________________________________________________________</td>
</tr>
<tr>
<td>__________________________________________________________</td>
</tr>
<tr>
<td>__________________________________________________________</td>
</tr>
<tr>
<td>__________________________________________________________</td>
</tr>
<tr>
<td>__________________________________________________________</td>
</tr>
<tr>
<td>__________________________________________________________</td>
</tr>
</tbody>
</table>