HANSLAB (PTY) Ltd

ENVIRONMENTAL AND GROUND ENGINEERING SPECIALIST

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME (D/EMPr)

The construction of a Clear Water Rising Main from the Ogunjini Water Treatment Works to Ogunjini Reservoir 1 North of Verulam, within the EThekwini Municipality.

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ABBREVIATIONS:

BAR	Basic Assessment Report
CO	Contractor
DEDTEA	Department of Economic Development, Tourism and Environmental Affairs
DOT	Department of Transport
DWS	Department of Water and Sanitation
EA	Environmental Authorization
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EO	Environmental Officer
ER	Engineers Representative
EIA	Environmental Impact Assessment
EA	Environmental Authorization
EMPr	Environmental Management Programme
GNR	Government Notice Regulation
I&AP's	Interested and Affected Parties
IEM	Integrated Environmental Management
NEMA	National Environmental Management Act
NWA	National Water Act
RE	Resident Engineer
WTW	Water Treatment Works
WULA	Water Use License Application

GLOSSARY OF TERMS

Applicant	Any person who applies for an Authorization to undertake an activity or to cause such activity to be undertaken as contemplated in sections 24(5), 24M and 44 of the National Environmental Management Act, 19998 (Act No. 107 of 1998).
Auditing	A systematic, documented, periodic and objective evaluation of how well the environmental management plan is being implemented and is performing with the aim of helping to safeguard the environment by: facilitating management control which would include meeting regulatory requirements. Results of the audit help the organisation to improve its environmental policies and management systems.
Conservation	Protecting, using and saving resources wisely, especially the biodiversity found in an area.
Construction Camp	The areas used for on-site staff offices (for engineers and contractors etc.). As well as to store materials, plant, equipment and ablution facilities (the location of which is to be agreed to by the developer and ECO). At these offices, administrative duties will be performed.
Ecology	The study of the interrelationships between organisms and their environments.
Environment	The surroundings within which humans exist and that are made up of – (i) the land, water and atmosphere of the earth; (ii) micro-organisms, plant and animal life; (iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and (iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing.
Environmental Impact Assessment	Systematic process of identifying, assessing and reporting environmental impacts associated with an activity and includes basic assessment and S&EIR.
Environmental Management Programme	A working document on environmental and socio-economic mitigation measures, which must be implemented by several responsible parties during all the phases of the proposed project.

Integrated Environmental Management (IEM)	A way of managing the environment by including environmental factors in all stages of development. This includes thinking about physical, social, cultural and economic factors and consulting with all the people affected by the proposed developments. Also called "IEM".
Mitigation	Measures designed to avoid, reduce or remedy adverse impacts.

PURPOSE OF THE EMPR

The main purpose of an Environmental Management Programme (EMPr) is to prevent avoidable damage and/or minimize or mitigate unavoidable environmental damage associated with any planning construction & maintenance work where there is a risk of environmental damage.

The EMPr forms part of the contractual obligations to which all developers/ contractors/ employees involved in planning, construction & maintenance.

The following EMPr:

- Identifies project activities that could cause environmental damage (risks) and provides a summary of actions required;
- Identifies persons responsible for ensuring compliance with the EMPr.
- Provides standard procedures to avoid, minimise and mitigate the identified negative environmental impacts and to enhance the positive impact of the project on the environment;
- Forms a written record of procedures, responsibilities, requirements and rules for contractor/s, their staff and any other person who must comply with the EMPr;
- Provides a monitoring and auditing programme to track and record compliance and identify and respond to any potential or actual negative environmental impacts.

SECTION 1: BACKGROUND INFORMATION

1.1 INTRODUCTION

Hanslab (Pty) Ltd was appointed as the independent environmental consultant by GIBB (Pty) Ltd consulting engineers to undertake a Basic Assessment (BA) process and Water Use License Application (WULA) and an Environmental Management Programme for the proposed upgrade of the Ogunjini Water Treatment Works on behalf of eThekwini Municipality.

The following EMPr outlines the activities that will be undertaken for the upgrade of the Water Treatment Works, including the upgrading of the abstraction facilities, and clear water rising main. However, it should be noted that since the BAR application focuses on the activity triggered relating to the pipeline, the focus of this document will be to address the impacts associated with the clear water rising main. General impacts and mitigation measures related to the Water Treatment Works and abstraction facility have also been included. Mitigation measures have been provided in section 2 which are associated with all identified sensitive areas, and non-sensitive areas.

1.2 SCOPE

The general principles contained within this document apply to the pre-construction, construction, post construction & operational phases during the project life cycle.

1.2.1 PRINCIPLES OF EMPR

This EMPr is compiled using the following concepts and implementation requirements in keeping with the principles of sustainable development:

- ***Continuous improvement:*** The project proponent, or implementing organisation, must commit to review and to continually improve environmental management, with the objective of improving overall environmental performance.
- ***Broad level of commitment*****:** A broad level of commitment is required from all levels of management as well as the workforce for the development and implementation of this EMPr to be successful and effective.

- ***Flexible and responsive:*** The implementation of the EMPr must respond to new and changing circumstances, i.e. rapid short-term responses to problems or incidents. The EMPr is a dynamic "living" document and thus regular planned review and revision of the EMPr must be carried out.

- ***Integration across operations:*** This EMPr must integrate across existing line functions and operational units such as health, safety and environmental departments in a company / project. This is done to change the redundant mindset of seeing environmental management as a single domain unit.

- ***Legislation:*** It is understood that any development project during its construction phase is a dynamic activity within a dynamic environment. The Developer, Engineer, Contractor and Sub-contractor must therefore be aware that certain activities conducted during construction may require further licensing or environmental approval, e.g. river or stream diversions, bulk fuel storage, waste disposal, etc. The Contractor must consult the ER, EO and ECO on a regular basis in this regard.

1.2.2 PROJECT DESCRIPTION AND PROPOSED ACTIVITIES

1.2.2.1. PROJECT OVERVIEW

The eThekwini Municipality (Applicant) proposes to upgrade the infrastructure at Ogunjini Water Treatment Works (WTW), north of Verulam in Kwazulu-Natal (**Refer to Figures 1 and 3**). The existing WTW has a treatment capacity of 1.3Ml/day and consists of a run-of-river abstraction system, conventional treatment process infrastructure, clear water storage and an existing 1,7 km clear water rising main delivering clear water primarily to the Ogunjini 1 Reservoir. There is an urgent need to increase the treatment capacity of the works. The proposal will entail a 1Ml/day increase in the treatment capacity resulting in the required 2.3Ml/day.

Various water use activities are triggered as a result of the proposed upgrade of Ogunjini Water Treatment Works. Therefore, the applicant must lodge a Water Use Licence Application (WULA) to the Department of Water and Sanitation (DWS).

The proposed project triggers the following listed activities in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998).

- *Section 21 (a) – taking water from a water resource;*
- *Section 21 (c) - Impeding or diverting the flow of water in a watercourse;*
- *Section 21 (i) - Altering the bed, banks or characteristics of a watercourse;*

1.2.2.2. PROJECT DESCRIPTION:

WATER TREATMENT WORKS

The upgrade of the Ogunjini WTW will entail a 1Ml/day increase in the treatment capacity resulting in the required 2.3Ml/day. The existing development line covers an area of 4505m² including the footprint of treatment facility (3900m$^{2)}$, the abstraction facility (180m²) and the clear water rising main (425m²). The upgrade of the Ogunjini Water Treatment Works will involve the construction of various new infrastructure which is to be accommodated within the boundary of the existing development line, including the construction of a clear water rising main from the treatment works to the Ogunjini 1 Reservoir.

ABSTRACTION FACILITY

The works is currently fed from a temporary system comprising 1 duty and 1 standby submersible pumps on the end of flexible rubber hoses laid directly in the river unsecured. The temporary system is reliable but requires frequent manual re-positioning in the river and is vulnerable to vandalism, theft and floods. The flexible rubber hoses are connected to a 160mmØ uPVC pipeline that runs along the eastern fence line to the No.02 raw water balancing tanks. No modifications to the existing building structure will be required for the upgrade; the work done will entail replacing the existing mechanical equipment with new mechanical equipment that will meet the daily required volume of raw water.

The scope of the abstraction tower work is as follows:

- Removing all existing pipework, pumps, motors, and fittings inside the abstraction tower
- Mounting new pumps (wet-prime type) and motors inside the abstraction tower at ground level, along with all associated pipework (laying of a 225mm HDPE raw water rising main) and fittings to connect to the existing pump delivery and suction pipelines
- Removal of strainers at the inlet to the suction pipelines.

CLEAR WATER RISING MAIN

A 200mmØ Class 25 uPVC clear water rising main will be laid adjacent to the existing pipeline and closely follow the existing alignment. The Clear Water Rising main is approximately 1,7 km in length and will primarily be located adjacent to the road reserve of district road P713. The clear water rising main will traverse a seep wetland for approximately 75-meters, and cross district road P713 at six locations, as well as a non-perennial stream i.e. B-Section channel for approximately 41-meters. The pipeline construction will be implemented as a ‘construction train’, this may occur simultaneously in a number of locations along the pipe routes. Limited lengths of pipeline will be constructed at any one time. This will

be done for each section of pipeline laid. A pre-determined length of construction corridor is prepared, excavated, the pipe placed, the trench backfilled and the area reinstated.

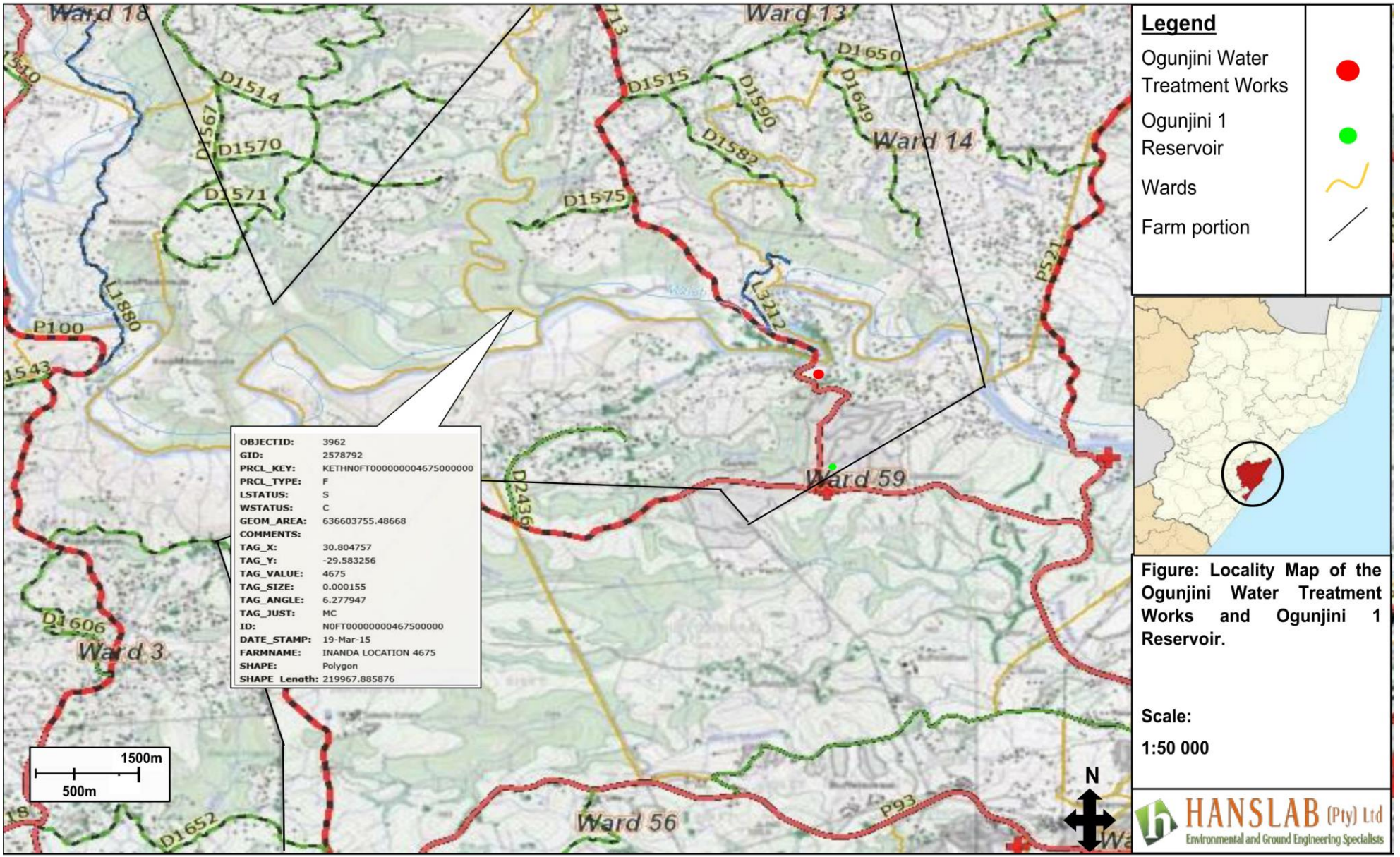


Figure 1: Topographical Map showing the position of the of the Ogunjini WTW (Red) and Reservoir 1 (Green) (Source: DOT GIS, 2017)

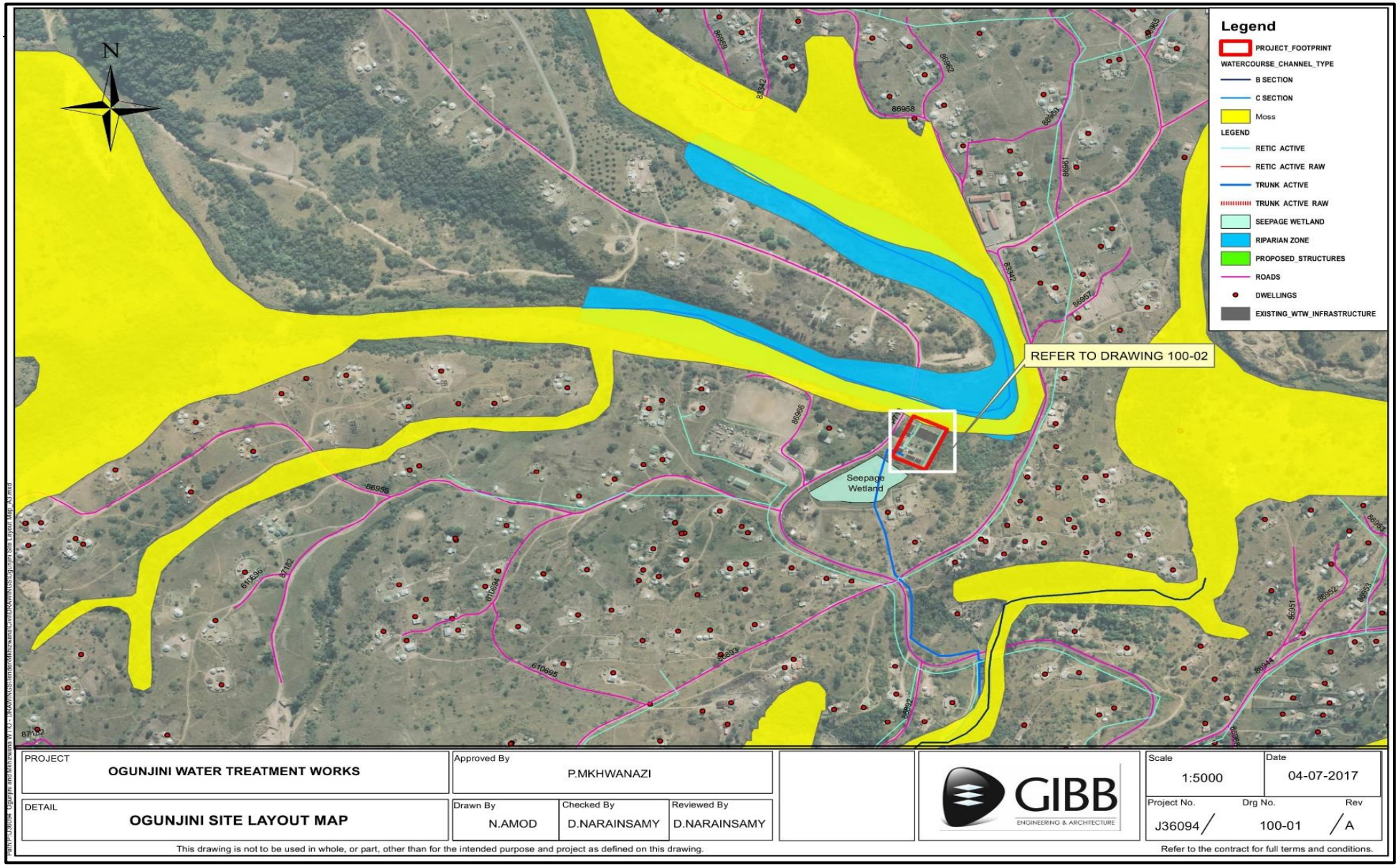


Figure 2: Ogunjini Water Treatment Works sensitivity site layout map (Source: Gibb (Pty) Ltd, 2017).

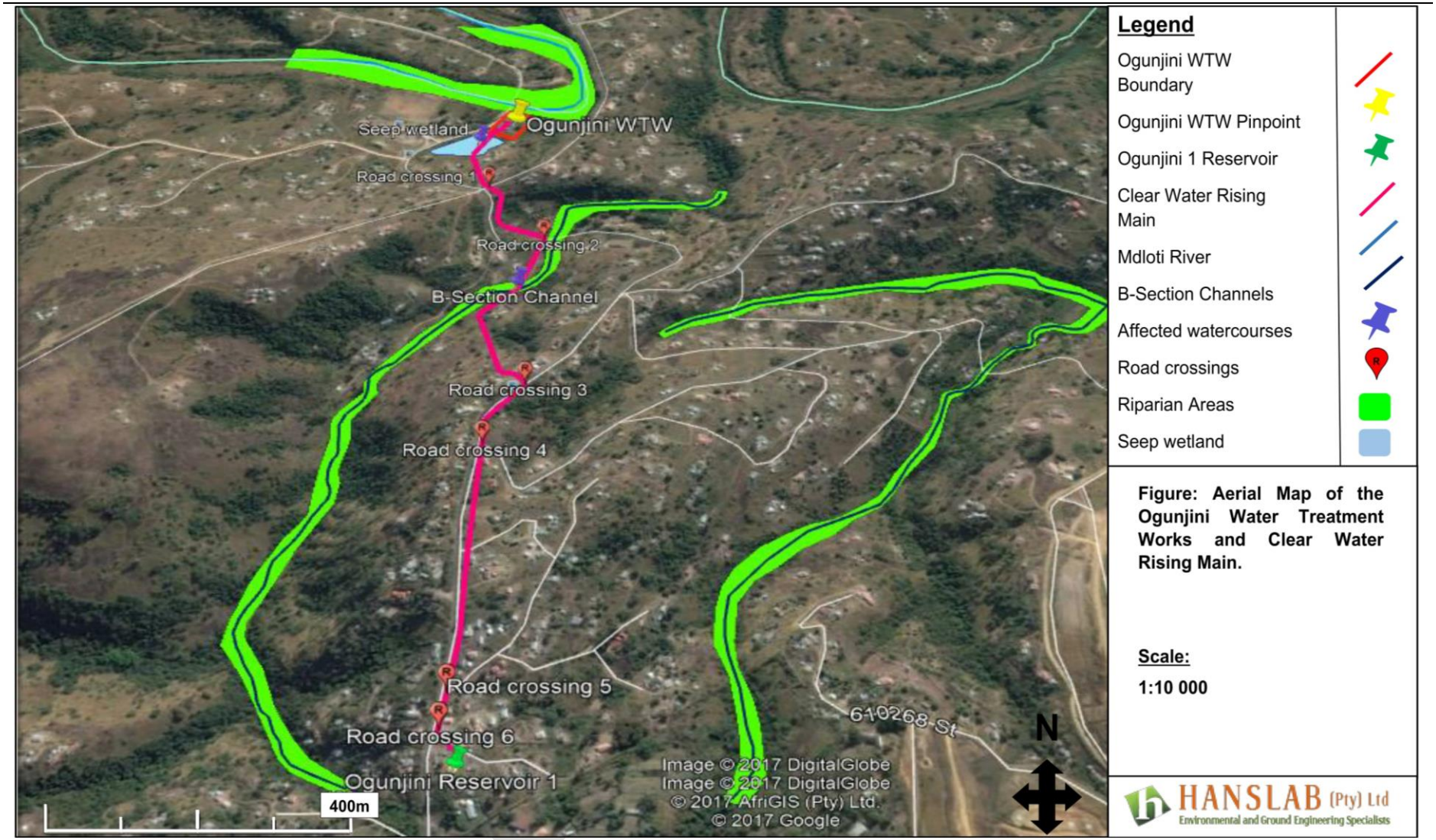


Figure 3: Aerial map of the Ogunjini Water Treatment Works (Red) and the Clear Water Rising Main (Pink) to Ogunjini Reservoir 1 (Orange) (Source: Google Earth, 2017).

1.2.2.2. OVERVIEW OF THE EXISTING OGUNJINI WATER TREATMENT WORKS:

The infrastructure readily available at the existing WTW produces a treatment capacity of 1.3Ml/day (**Figure 4 below**). The details of the upgrade requirements are based on assessments of the capacity and performance of the various components of the existing WTW.

The existing site includes:

- Raw water supply to the WTW
- Raw water storage
- Chemical dosing and flocculation channel
- Existing process units (clarifiers and slow sand filters)
- Hypochlorite dosing facility
- Clear water storage at the command reservoir
- Clear water rising main and pump sites
- Electrical power supply and loading
- Office and guardhouse
- Access roads

Figure 4: Existing layout of the Ogunjini water treatment works (Source: Gibb (Pty) Ltd)

1.2.2.3 PROPOSED CONSTRUCTION ACTIVITIES:

The proposed activity involves the upgrading of the existing water treatment works to cater for the increased demand within the region. Construction activities associated with the works development line will include the construction of various components of the existing WTW; and where new infrastructure is required, **it is to be accommodated within the bounds of the existing WTW development line (Refer to Figures 5, 6 and 7)**.

IMPROVEMENTS TO EXISTING INFRASTRUCTURE

- Immersible pump (on guard rails) located at the bottom of the abstraction tower
- Replace raw water rising main with a 225mm HDPE pipeline
- Modify raw water balancing tank with 2 new 200mmØ outlets ±500mm off the tanks floor
- Construct new pipework to existing chemical dosing channel with branches to the new works and isolating valves.
- Built in stainless steel wedge-wire solids separating screen (3mm gaps) above splitter box to remove solids
- New in-line static flash mixer, flow regulating control valve and flow meter at the head of the flocculation channel
- Sludge outlet pipes diverted to the new system once the sludge storage facilities are in place
- Construction of internal “dry-stack” partition walls to create a “plug flow” chlorine contact tank
- Core drilling of a new 200mm outlet through the 250kl clear water reservoir wall for the proposed larger clear water pump suction manifold
- Provide a 3rd “Enviro-cell” electrolytic sodium hypochlorite generator
- Construct a clear water rising main with a 250mm Class 25 uPVC pipe (internal diameter 200mm)
- The 100-kVA generator will need to be upgraded to 350 kVA
- Possible refurbishment and/or maintenance of existing buildings

NEW INFRASTRUCTURE

- 190m³ below ground circular sludge holding tank
- A dehydrating facility with a mechanical volute dehydrator to reduce sludge volume
- 2 x 6m³ skips to collect dried sludge
- Construction of a new external access stairwell to access below ground pump room

A 1Ml/day treatment capacity “add-on” plant that will run parallel with the existing works, but will operate completely independently with the following components:

- In-line flash mixer (With proportional chemical dosing from existing chemical dosing room)
- Free standing flocculation tower
- A new modular clarifier
- New chemical dosing system
- An above ground settled water balancing tank
- Filter plant building consisting of:
    - Filter pumps and blowers leading to the sand filters
    - 2 x pressure sand filters
- 500m³ above ground SBS type clear water reservoir

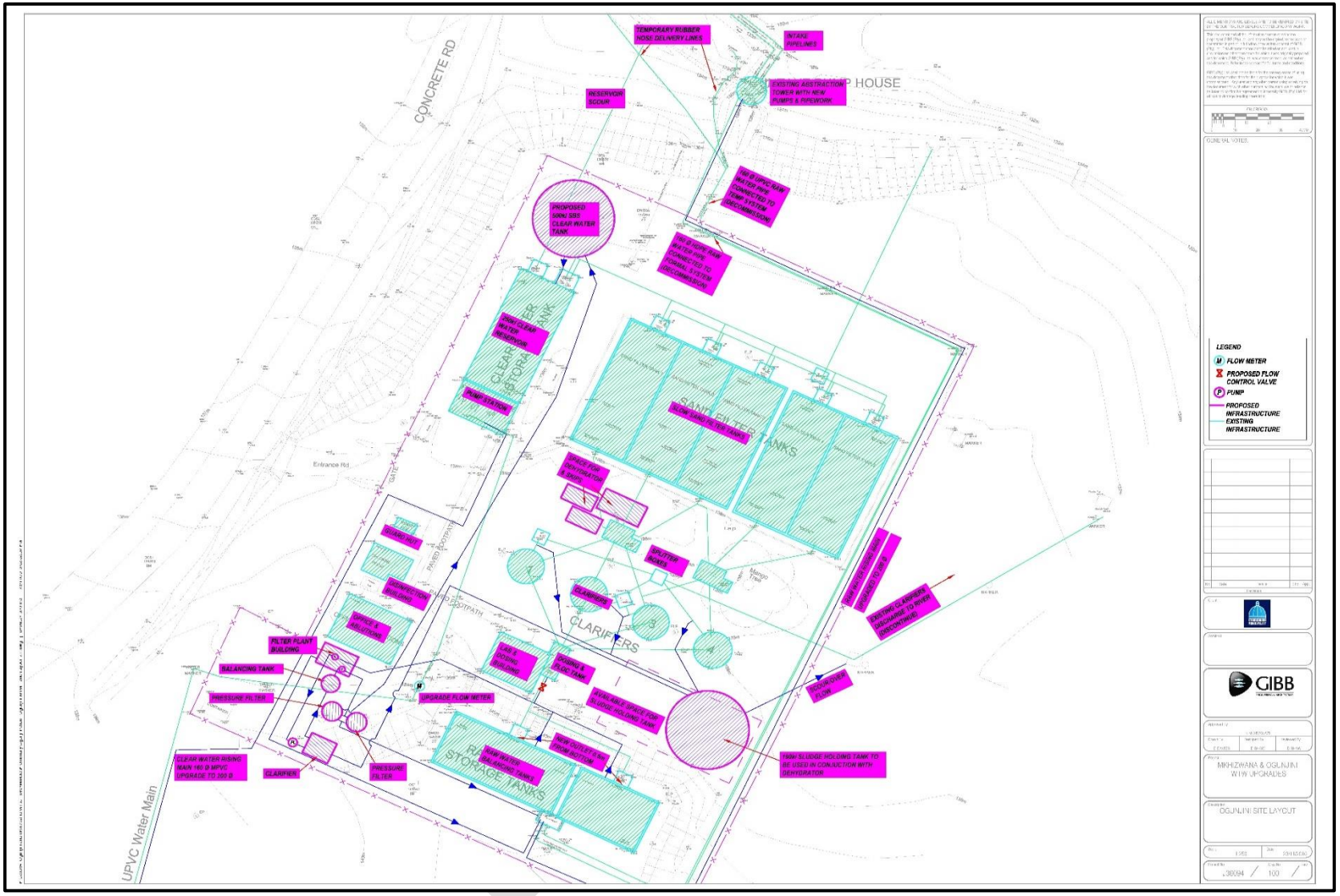


Figure 5: Design of existing infrastructure (blue) and proposed new structures (pink) (Source: Gibb (Pty) Ltd, 2017).

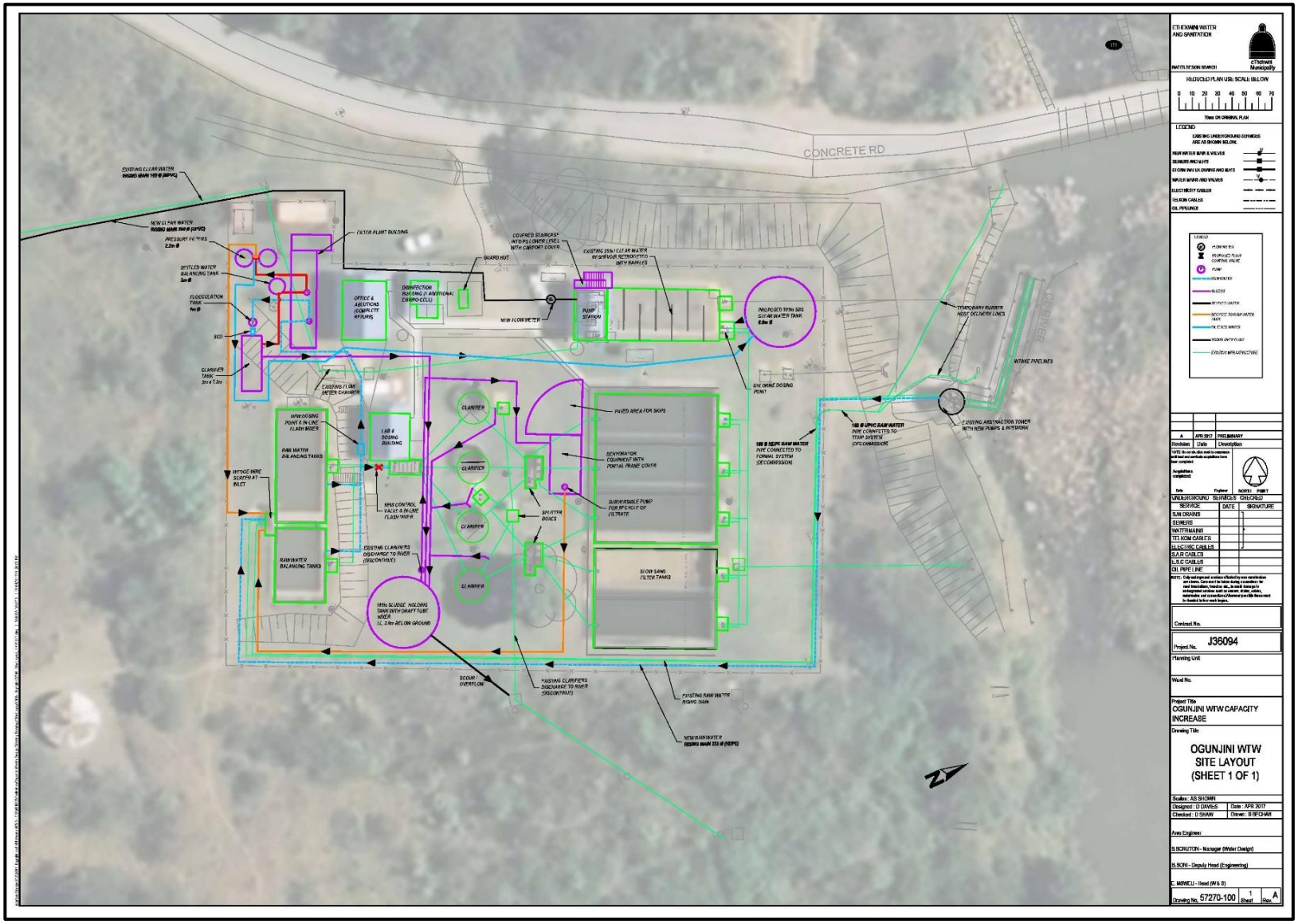


Figure 6: Aerial image depicting layout of the proposed Ogunjini water treatment works (Source: Gibb (Pty) Ltd, 2017).

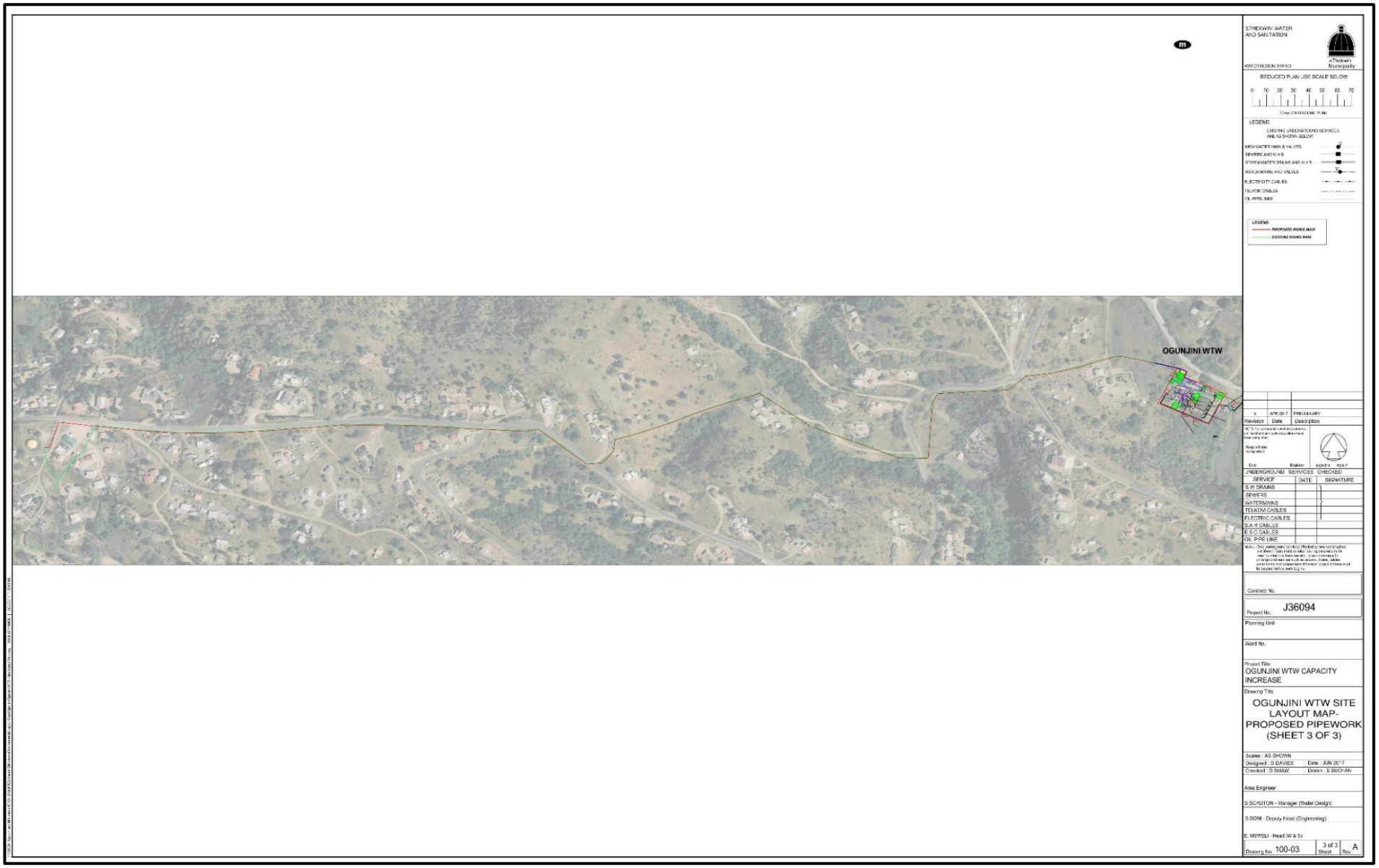


Figure 7: Ogunjini WTW site layout map depicting the proposed pipeline route in red (Source: Gibb (Pty) Ltd,2017).

1.3 PROJECT PHASES (CONSTRUCTION & OPERATIONAL)

The project will take place in two phases, namely the Construction and Operational Phase. The Construction Phase encompasses the construction related activities on site, until the contractor leaves the site. The Operational Phase encompasses all activities, including the operation and maintenance of the proposed upgrade of the Ogunjini Water Treatment Works.

1.3.1. DETAILS OF THE CONSTRUCTION PHASE

Impacts that occur during this phase will have an immediate effect, some of which include: erosion, noise, dust, including the risk of water pollution. If the development site is monitored continuously during this phase it will be possible to identify the impacts as they occur, therefore minimizing the effects. These impacts will then be mitigated through contingency plans identified in the planning phase, together with a commitment to sound environmental management from the Developer/Contractor. Cognizance must be taken to the wetland area that occurs outside of the study area that has become disturbed due to surrounding informal settlements. Mitigation measures regarding the Mdloti River as well as the seep wetland should be implemented to promote good functionality of both these sensitive areas.

The appointed Contractor will be responsible for the preparation of the Construction Site Development Plan prior to establishment on site. This plan will indicate the boundaries of the site that encompasses all construction related activities, vehicle and pedestrian access points, laydown area/s, offices, stockpile areas, storage areas, ablution facilities, etc. The Construction Site Development Plan must be approved by the appointed Environmental Control Officer (ECO) as provided for within this Environmental Management Programme (EMPr).

The Contractor will be responsible for the management and removal of all solid waste from site during the construction phase, to a designated registered landfill site i.e. **the Shongweni Landfill site is recommended for general waste only.** All hazardous waste must be disposed at a registered landfill site that receives such waste (e.g. Dolphin Coast Management Landfill Site). A method statement for the management of waste must be drafted and signed off by the ECO prior to commencement of construction activities.

Design, construction, and maintenance will be in accordance with all applicable South African standards, guidelines, and legislation, as well as certain international specifications.

1.3.2. DETAILS OF THE OPERATIONAL PHASE

By ensuring activity measures are employed during the planning and construction phases, potential environmental impacts that would predominantly occur during this phase will be minimized. By minimizing the risk, monitoring efforts will simultaneously be reduced.

1.3.3 ENVIRONMENTALLY SENSITIVE AREAS

The study site is enclosed by moderately undulating terrain and is situated approximately 20 m south of the Mdloti River. Land use surrounding the water treatment works is comprised of low density rural settlements and subsistence agricultural land including both crop cultivation and livestock grazing.

Ground truthing identified the presence of a seep system to the south of the existing WTW as well as a C-Section Channel, namely the Mdloti River and associated riparian zone to the north of the site. Further to this, Two B-Section channels were delineated within a 500-meter buffer of the rising main pipeline. The wetland system has been modified as a result of historic and current cultivation (which has resulted in the mixing of the original soil profile) as well as the creation of drains to facilitate suitable soil conditions for cropping by desiccating the soil. Further to this, the creation of the existing road has led to infilling of parts of the seep. These disturbances have allowed for the encroachment of alien invasive into this system. Despite these impacts, the majority of this system has a high basal cover (dominated by graminoid species) allowing for the provision of ecosystem services.

The current state of the riparian zone associated with the Mdloti River was assessed using the Riparian Vegetation Response Assessment Index (VEGRAI) Level 3. The riparian zones associated with the 'C' Section channel has been classified as moderately modified (PES Class C). Modifications to the riparian zone are largely due to a change in species composition as a result of the colonisation of alien invasive species and the removal of species for the creation of informal roads to gain access to the river. The current construction of the Mdloti River bridge adjacent to the existing WTW has also had an impact on the vegetation composition of the riparian zone due to the clearing of vegetation and the movement of topsoil (after rainfall events) into this system.

The wetland system has retained its functional integrity despite many impacts and provides a number of ecosystem goods and services within its catchment. The majority of the scores obtained for the Wet-EcoServices Functional Assessment were moderate; with flood attenuation, sediment trapping, erosion control, filtration properties and the provision of natural resources receiving the highest scores. An Ecological Importance and Sensitivity (EIS) assessment was undertaken to rank the water resource in terms of provision of goods and service or valuable ecosystem functions which benefit people;

biodiversity support and ecological value; and reliance of subsistence users (especially basic human needs uses). The low Ecological Importance and Sensitivity score assigned to the wetland was primarily attributed to the disturbed nature of the seep. Anthropogenic disturbances to the system through both historic and existing cultivation of crops as well as the location of the wetland adjacent to the road, limits its ability to provide suitable habitat for both floral and faunal species. The Hydrological Functional Importance of the wetland has been recorded as moderate due to the functionality of the system and its ability to provide ecological goods and services to the larger anthropogenically modified landscape. Socio-Cultural Benefits for the wetland is associated with the use of the wetland for subsistence agriculture.

The seep wetland occurs at an elevated topographic position and therefore the upgrade within the development line will not have an impact on the seep system. However, the construction of the rising main will have an impact on the seep system as it runs directly through it. The impacts associated with proposed upgrade of the water treatment works and construction of the clear water rising main received a low to medium risk score with the impacts associated with the watercourses and resource quality being minor to small and easily managed. The operational risks received a moderate classification due to the abstraction process from the Mdloti River and the effects it has on the functional integrity of the river system.

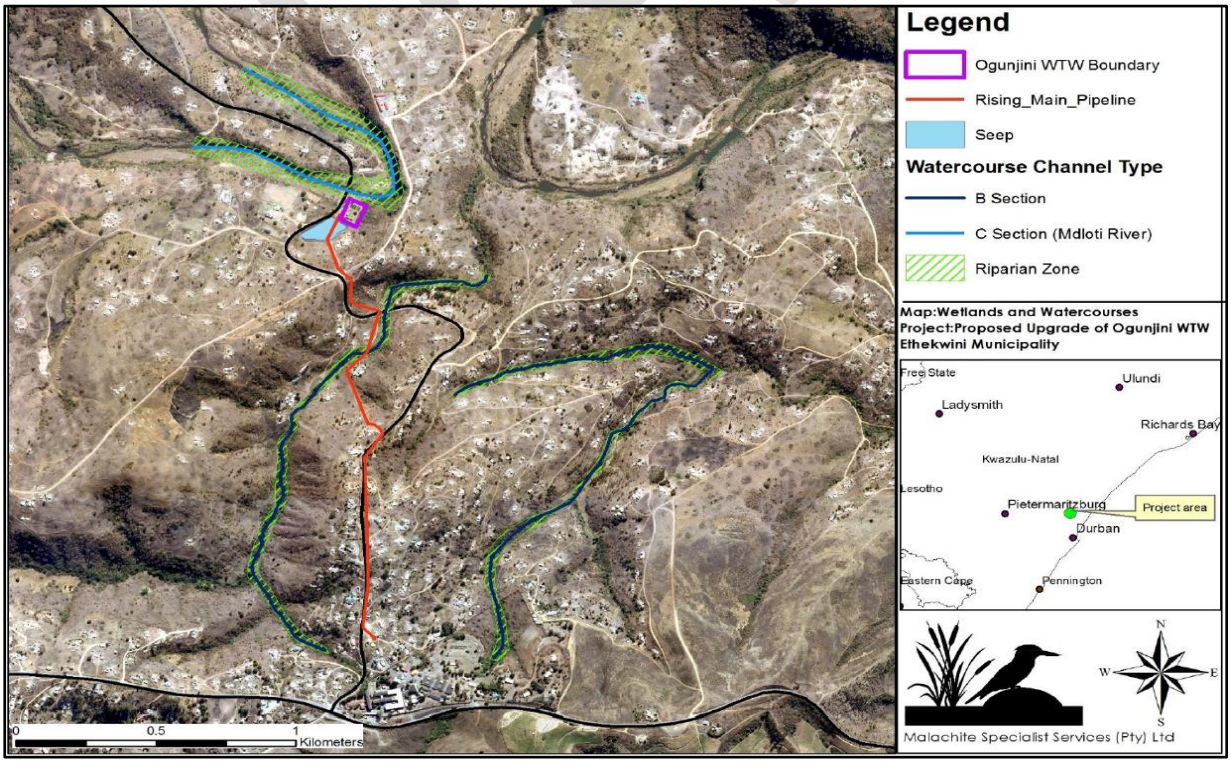


Figure 8: Showing the wetlands and watercourses delineated at the site and along the proposed route of the rising main pipeline.

1.4 ROLES AND RESPONSIBILITIES

The key to achieving the effective application of the EMPr is the cooperation amongst all the role players involved in the project. To accomplish this all the role players must fully comprehend their roles and responsibilities in the proposed project, as well as act in a professional manner, form respectful and transparent relationships, and maintain open lines of communication.

1.4.1 PRE-CONSTRUCTION AND CONSTRUCTION PHASE

The potential role players or project teams will include:

- Project proponent (client),
- The construction Project Manager (PM),
- Environmental Control Officer (ECO),
- The Contractor (CO), Environmental Site Officer (ESO),
- Engineering Representative (ER)

PROJECT PROPONENT (CLIENT)	The implementation of the EMPr during the construction and operational phases is the responsibility of the project proponent. The project proponent must appoint a contractor who will be responsible for the construction contract, including the co-ordination and implementation of the EMPr on site during the construction phase. In terms of this EMPr, the project proponent is required to: • Designate a Construction Project Manager to take day to day responsibility for the implementation of the development, and in particular this EMPr, on behalf of the company. • Ensure that the proposed principal contractor has the necessary competencies and resources to carry out the work safety. • Provide the principal contractor with the Construction EMPr as well as any other relevant sections of the EMPr document, when requesting the contractor to budget for the proposed work. • Ensure that the potential contractor has made provision for the cost of implementing the EMPr.

	• Ensure that the Construction EMPr in its entirety is implemented by the Contractor and any Sub-Contractors. • Appoint an independent Environmental Control Officer (ECO) to monitor the implementation of the EMPr during construction. • Ensure the manager appointed for the operational phase has the necessary competencies and resources to implement the EMPr.
CONSTRUCTION PROJECT MANAGER (PM)	eThekwini Local Municipality must designate a Construction Project Manager to take day to day responsibility for implementation of the project including this EMPr and to ensure that all parties fulfil their obligations in terms of this EMPr. The Construction Project Manager is responsible for ensuring that an ECO is employed, and accepts responsibility for the duration of the project before any on-site work may begin. The construction project manager: • Represents and acts on behalf of eThekwini Municipality regarding the administration of contracts; • In consultation with the Planning Engineer, determines the scope of work; • Provide scheduling, aspects of co-ordination and estimating; • Ensure implementation of the project plan within cost, time, and quality constraints; • Ensure that implementation of EMPr is executed as planned; and • Keep the asset owner informed of progress made during the life cycle of the project.
ENVIRONMENTAL CONTROL OFFICER (ECO)	The Environmental Control Officer (ECO) must be appointed by the Project Proponent (applicant) prior to commencement of operations. The ECO must monitor, audit and record compliance with the EMPr by all parties on site. The ECO must upon appointment draw up a detailed EMPr Audit Checklist, which must be completed at site establishment and at each monthly site visit, and keep *ad hoc* records of any and all incidents or events on site with significant environmental impacts.

	Significant impacts must be recorded photographically with enough supporting information to locate the image on the site. All records must be dated and accurately catalogued. As the ECO will not be on site on a full-time basis, the ECO will work closely with the Contractor/Site Supervisor/Environmental Health and Safety Officer. The ECO shall also draw up a quick daily checklist that will be of assistance to the Contractor in ensuring that key elements of the EMPr are effectively implemented on a day to day basis. The ECO must immediately communicate any significant contraventions of this EMPr, or undesirable environmental impacts to the Construction Project Manager. The ECO has the authority to recommend the stopping of works or any portion of construction related activity to the Project Proponent if in his/her opinion: • Any activity is in contravention of the requirements of this EMPr; • Any activity is in contravention of relevant environmental legislation/permits/authorisations applicable to the site and/or activity/ies, or; • The activity has caused or will imminently cause significant damage and/or harm to the environment. If urgent action is required to prevent environmental damage as a result of contravention of the requirements of this EMPr, the ECO has the authority to issue a written instruction to the Contractor, or any person on site to stop works or any portion of construction related activity required to prevent such damage. The ECO may recommend to the Project Proponent and Contractor that any employee(s) consistently not adhering to the requirements of this EMPr be removed from the site. Alternatively, the ECO may recommend that all work on site be suspended until the matter is remedied.

THE CONTRACTOR (CO)	The Contractor (CO) will be appointed by the Project Proponent (client) who will ensure that the Contractor is aware of his obligations in terms of this EMPr during the contract negotiation phase. The Contractor's obligations in terms of this EMPr are as follows: • The Contractor shall take full responsibility for protecting the natural environment and eliminating or minimizing the negative impacts of construction on the environment during construction. The Contractor shall prevent or limit the occurrence of accidents which may cause damage to the environment, prevent or limit the consequences of such accidents. • The Contractor will assume full responsibility for the on-site actions of all of its sub-contractors, employees, suppliers and agents. • The Contractor will fully adhere to the conditions of this EMPr and ensure that all sub-contractors, employees, suppliers and agents are fully aware of this EMPr, its requirements and the consequences of any breach of the requirements of this EMPr. • The Contractor will complete a rapid daily environmental checklist provided to him by the ECO to monitor and aid in the effective implementation of the EMPr. • The Contractor will report any deviation from the requirements of this EMPr and any pollution or environmental contaminant spill events to the Construction Project Manager and the ECO. An environmental incidence record will be completed in this event. • The Contractor agrees to work stoppage and/or payment of penalties as required by this EMPr and directed by the Project Proponent. • The Contractors agrees to bear full costs for any work stoppage resulting from contravention of the requirements of this EMPr and/or the full costs of remedying environmental damage resulting from their or their sub-contractors or employee's contravention of the requirements of this EMPr.

	• The requirements of this EMPr apply to all areas under the Contractor's control, including but not limited to the working area, the construction camp and offices, all access/ haul routes. • Ensure that all employees under his or her control are informed, instructed and trained by a competent person regarding any hazard and the related work procedures before any work commences and thereafter at such times as may be determined by the risk assessment. • Prohibit any employee or person to enter any site unless he or she has undergone health and safety induction training pertaining to the hazards on this site. • Hold toolbox talks on at least a weekly basis. A toolbox talk is a five- to ten-minute session with workers just prior to starting work for the day, which emphasizes and reinforces a safety-conscious attitude. Toolbox talks also give workers and the supervisor a chance to talk about safety problems likely to be encountered, as well as potential solutions to those problems. • Issue a "Stop Work" order when conditions arise that pose an imminent danger to personnel, environment or equipment. • Should the Contractor not be on site on a full time basis, he/she must appoint a suitably qualified individual (Site Supervisor and/or Environmental Health and Safety Officer) to represent him on site and fulfil the above responsibilities in his absence.
ENVIRONMENTAL SITE OFFICER (ESO)	The Environmental Site Officer (ESO) will act as a guide and advisor to employees and contractors on environmental issues associated with the construction and operational phase. This will be achieved by ongoing inspections/auditing operations, identification of problem areas and provision of action plans to ensure environmental protection. The ESO will ensure compliance to the requirements of the EMP by all parties as well as any other requirements related to environmental issues as they become known.

	Specific responsibilities of the ESO will be as follows: • To thoroughly familiarize him/herself with existing information regarding operations that are to take place and the EMPr. • Ensure protection of the environment. • Perform all of the day-to-day tasks necessary to monitor performance with regard to the requirements of the EMP and any other relevant requirements and/or commitments. • Monitor the impact of operations on the environment with particular emphasis on areas of environmental sensitivity. • To liaise with the contractor and site engineer in the case of incidents, non-compliance or any matter where the course of action is unclear.
ENGINEERS REPRESENTATIVE (ER)	The consulting engineer's representative on site. Has the power/mandate to issue site instructions and in some instances, variation orders to the contractor, following request by the EO or ECO. The ER oversees site works, liaison with Contractor and ECO.

1.5. ENFORCEMENT, MONITORING AND AUDITING

- The ECO must oversee the implementation of the EMPr.
- The ECO and the full time ESO must conduct, at a frequency as determined by the KZN DEDTEA and stipulated in the relevant EA for the project, independent environmental audits. The audits are to verify the projects compliance with the EMPr and conditions of the EA. Before any construction activities commence, the ECO must compile, for the approval by the Department, an audit checklist based on the contents of this EMPr and conditions of the EA. The ECO must at the request of the Department forward audit reports to the Department at a frequency determined by the Department which must be stipulated in the EA.
- Evidence of the following as key performance indicators must be included in the audit reports where required:
    1. Complaints received from landowners and actions taken.

2. Environmental incidents, such as oil spills, etc. and actions taken. This excludes litigation.
3. Incidents leading to litigation and legal contraventions.
4. Environmental damage that requires rehabilitation measures to be taken.
5. A copy of all ESO monitoring reports, and contractor method statements must be held by the ESO and/or the ESO on site and be made available to the Department and or the ECO upon request.

1.6. GENERAL GUIDELINES

The following measures provide guideline solutions to frequently anticipated issues on most development activities:

- The prevention of any site degradation due to non-compliance, administrative or financial problems, and inactivity during the construction phase, illegal activities, delays caused by archaeological findings, etc. is ultimately the responsibility of the applicant/developer in terms of Section 28 of NEMA.

- The study area must be clearly defined, surveyed and demarcated according to the project Authorisation. All workforce members and other construction personnel are not to go beyond the fenced footprint. Landowners are not comfortable when strangers come on to their properties. They will look for reasons to interfere with the construction process and may therefore cause delays in the process that can be very costly to the Contractor.

- The Contractors must adhere to agreed and approved access points and haul roads.

- Damage to private or public property such as fences, gates and other infrastructure may occur at any time. All damage to be repaired immediately and to the satisfaction of the owner.

- Relevant landowners and businesses must be informed of the starting date of construction as well as the phases in which the construction shall take place.

- The Contractor must adhere to all conditions of the contract including this EMPr.

- Proper planning of the construction process must be undertaken to allow for disruptions due to rain and very wet conditions.

- Where existing private roads to be utilised as access are in a bad state of repair, such roads' condition must be well documented, including photographs, before they are used for construction purposes. If necessary, some repairs must be done to prevent damage to equipment.
- All private and public manmade structures near the project site must be protected against damage at all times and any damage must be rectified immediately.
- Proper site management and regular monitoring of site works.
- Proper documentation and record keeping of all complaints and actions taken.
- Regular site inspections and good control over the construction process throughout the construction period.
- A positive attitude towards Environmental Management by all site personnel must be motivated through regular and effective awareness and training sessions (see 1.6 below).
- An ESO, on behalf of the Contractor, is to be appointed to implement this EMPr. The EO and not the Contractor or his/her ESO is to deal with any landowner related matters.
- Environmental Audits to be carried out during and upon completion of construction.

1.7. AWARENESS TRAINING

The ECO is to conduct an environmental awareness training programme prior to construction with the entire project team. Refresher courses must be conducted as and when required. The ESO must ensure daily toolbox talks which include alerting the workforce to particular environmental concerns associated with the tasks for that day or the area/habitat in which they are working. Awareness posters and handouts must be produced to create awareness throughout the site, as and when necessary.

1.8. CONTRACTOR ENVIRONMENTAL METHOD STATEMENTS

Method Statements are written submissions to the Engineer by the Contractor in collaboration with his/her ESO, in response to a request by the EO and or Engineer. The Method Statements set out the plant, materials, labour and method that the contractor proposes using to carry out an activity, identified by the EO and/or Engineer. The Method Statements contain the appropriate detail such that the EO and

Engineer are able to assess whether the Contractor's proposal is in accordance with the requirements of the EMPr. The contractor must sign each Method Statement along with the EO and Engineer to formalize the approved Method Statement.

All Method Statements including those which may be required as ad hoc or emergency construction method statements must be submitted to the Engineer for approval prior to the commencement of the activity. Any changes to the method of works must be reflected by amendments to the original approved Method Statement. Any changes in this regard must be approved by the EO and Engineer on the understanding that such changes are environmentally acceptable and in line with the requirements of this EMPr.

1.9 SITE DOCUMENTATION

The following documentation must be kept on site during construction:

- EMPr;
- Environmental Authorization;
- Licenses/permits related to any other legislation;
- Specialist rehabilitation plans;
- Storm Water Management Plan;
- Environmental Method statements compiled by the Contractor;
- Non-conformance Reports;
- Environmental register, which must include the following, but not limited to such:
    - Monitoring Results – including environmental monitoring reports, register of audits, Non-Conformance Reports (NCR); and
    - Incident book – including copies of notification of Emergencies and Incidents, this must be accompanied by a photographic record.
    - Safe disposal certificate for all types of waste disposed off-site;
    - Environmental training records;
    - Waste disposal receipts from a registered landfill site;
    - Material Safety Data Sheets for all hazardous substances;
    - Method Statements; and
    - Notification of Emergencies and Incidents.

1.10 PUBLIC COMPLAINTS REGISTER (APPENDIX A)

- Contain environmental complaints and correspondence received from the public to the Contractor;
- Nature of complaint;
- Cause of complaint;
- Party/parties in responsible for complaint;
- Immediate actions undertaken to stop/reduce/contain the causes of the complaint;
- Additional corrective or remedial action taken and/or to be taken to address and to prevent reoccurrence of the complaint;
- Timeframes and the parties responsible for the implementation of the corrective or remedial actions

1.11 ENVIRONMENTAL INCIDENTS REGISTER (APPENDIX B)

- Nature of incident;
- Causes of incident;
- Party/parties responsible for causing incident;
- Immediate actions undertaken to stop/reduce/contain the causes of the incident;
- Additional corrective or remedial action taken and/or to be taken to address and to prevent reoccurrence of the incident;
- Timeframes and the parties responsible for the implementation of the corrective or remedial actions; and
- Copies of all correspondence received regarding incidents.

The Contractor will ensure that the following information is recorded for all complaints/incidents:

- Nature of complaint/incident;
- Causes of complaint/incident;
- Party/parties responsible for causing complaint/incident;
- Immediate actions undertaken to stop/reduce/contain the causes of the complaint/incident;
- Additional corrective or remedial action taken and/or to be taken to address and to prevent reoccurrence of the complaint/incident;
- Timeframes and the parties responsible for the implementation of the corrective or remedial actions;

- Procedures to be undertaken and/or penalties to be applied if corrective or remedial actions are not implemented; and
- Copies of all correspondence received regarding complaints/incidents.

The above records will form an integral part of the Contractors' Records. These records will be kept with the EMPr.

1.12 NON-CONFORMANCE REPORT

A Non-Conformance Report will be issued to the Contractor as a final step towards rectifying a failure in complying with a requirement of the EMPr. This will be issued by the ECO to the Contractor in writing. Preceding the issuing of an NCR, the Contractor must be given an opportunity to rectify the non-conformance issues.

Should the ECO assess an incident or issue and find it to be significant (e.g. non-repairable damage to the environment), it will be reported to the relevant authorities and immediately escalated to the level of a NCR. The following information should be recorded in the NCR:

- Details of non-conformance;
- Any plant or equipment involved;
- Any chemicals or hazardous substances involved;
- Work procedures not followed;
- Any other physical aspects;
- Nature of the risk;
- Actions agreed to by all parties following consultation to adequately address the non-conformance in terms of specific control measures and should take the hierarchy of controls into account;
- Agreed timeframe by which the actions documented in the NCR must be carried out; and
- ECO should verify that the agreed actions have taken place by the agreed completion date, when completed satisfactorily; the ECO and Contractor should sign the Close-Out portion of the Non-Conformance Form and file it with the contract documentation.

1.13 ENVIRONMENTAL EMERGENCY RESPONSE

The Contractor's environmental emergency procedures must ensure appropriate responses to unexpected / accidental actions / incidents that could cause environmental impacts. Such incidents may include:

- Accidental discharges to water (i.e. into the watercourse) and land;
- Accidental spillage of hazardous substances (typically oil, petrol, and diesel);
- Accidental toxic emissions into the air; and
- Specific environmental and ecosystem effects from accidental releases or incidents.

The Environmental Emergency Response Plan is separate to the Health and Safety Plan as it is aimed at responding specifically to environmental incidents and must ensure and include the following:

- Construction employees shall be adequately trained in terms of incidents and emergency situations;
- Details of the organization (i.e. manpower) and responsibilities, accountability, and liability of personnel;
- A list of key personnel and contact numbers;
- Details of emergency services (e.g. the fire department / on-site fire detail, spill clean-up services) shall be listed;
- Internal and external communication plans, including prescribed reporting procedures;
- Actions to be taken in the event of different types of emergencies;
- Incident recording, progress reporting and remediation measures to be implemented; and
- Information on hazardous materials, including the potential impact associated with each, and measures to be taken in the event of accidental release.

The Contractor and their Sub-Contractor(s) must comply with the environmental emergency preparedness and incident and accident-reporting requirements as per the relevant legal requirements.

1.14 METHOD STATEMENTS

It is a statutory requirement to ensure the wellbeing of employees and the environment. To allow the mitigation measures in this document to be implemented, task-specific method statements should be developed for each set of tasks. A Method Statement details how and when a process will be carried out, detailing possible dangers/risks, and the methods of control required.

- Type of construction activity;
- Timing and location of the activity;
- Construction procedures;
- Materials and equipment to be used;
- Transportation of the equipment to / from site;
- How equipment/material will be moved while on site;
- Location and extent of construction site office and storage areas;
- Identification of impacts that might result from the construction activity;
- Methodology and/or specifications for impact prevention / containment;
- Methodology for environmental monitoring;
- Emergency/disaster incident and reaction procedures (required to be demonstrated); and
- Rehabilitation procedures and continued maintenance of the impacted environment.

The Contractor will be accountable for all actions taken in non-compliance of the approved Method Statements. As a minimum, the following Method Statements are required to be generated:

- Bunding;
- Blasting;
- Construction site and office/yard establishment;
- Cement mixing / concrete batching/bentonite mixing;
- Contaminated water;
- Dust management;
- Environmental awareness course(s);
- Environmental monitoring;
- Erosion control;
- Fire, hazardous and/or poisonous substances including their storage;
- Personnel, public and animal safety;
- Rehabilitation of modified environment(s);
- Solid and liquid waste management;
- Sources of materials (including MSDSs);
- Top-soil management;
- Storm water Management.

1.15 REGULATORY FRAMEWORK:

The common list of legislative references contained herein is by no means exhaustive but is applicable to the general principals of this document.

NATIONAL ACTS AND GUIDELINES:	
NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998)	states that the principles of Integrated Environmental Management (IEM) should be adhered to in order to ensure sustainable development. A vital underpinning of the IEM procedure is accountability to the various parties that may be interested in or affected by a proposed development. Public participation is a requirement of the IEM procedure, in terms of the identification of potentially significant environmental impacts. The IEM procedure aims to ensure that the environmental consequences of development proposals are understood and adequately considered during all stages of the EIA project cycle, and that negative aspects are resolved or mitigated and positive aspects enhanced.
NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) & WATER SERVICES ACT, 1997 (ACT NO. 108 OF 1997)	The National Water Act, 1998 (Act No. 36 of 1998) (NWA) aims to provide management of the national water resources to achieve sustainable use of water for the benefit of all water users. This requires that the quality of water resources is protected as well as integrated management of water resources with the delegation of powers to institutions at the regional or catchment level. The purpose of the Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in responsible ways. Of specific importance to this application is Section 19 of the NWA, which states that an owner of land, a person in control of land or a person who occupies or uses the land which thereby causes, has caused or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring and must therefore comply with any prescribed waste standard or management practices.

	There are various water use activities that are triggered as a result of the proposed upgrade of the existing water treatment works, that will require an Integrated Water Use License Application to be submitted to the Department of Water and Sanitation (DWS) for approval, in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998). The proposed water uses triggered: • Section 21 (c) - Impeding or diverting the flow of water in a watercourse and altering the bed, banks, course or characteristics of a watercourse. • Section 21 (i)- Altering the bed, banks or characteristics of a watercourse. • Section 21 (g)- Disposing of waste in a manner which may detrimentally impact on a water resource. An IWWMP and application has been lodged with the Department of Water and Sanitation for the above-mentioned water uses.
OTHER LEGAL REQUIREMENTS:	
CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA (ACT NO. 108 OF 1996)	The Constitution of the Republic of South Africa has major implications for environmental management. The main effects are the protection of environmental and property rights, the change brought about by the sections dealing with administrative law, such as access to information, just administrative action and broadening of the locus standing of litigants. These aspects provide general and overarching support and are of major assistance in the effective implementation of the environmental management principles and structures of the NEMA. Section 24 in the Bill of Rights of the Constitution specifically 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, for the benefit of present and future generations, through reasonable legislative and other measures that - ° Prevent pollution and ecological degradation; ° Promote conservation; and ° Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.
NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT NO. 10 OF 2004)	The purpose of the Biodiversity Act is to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA and the protection of species and ecosystems that warrant national protection. As part of its implementation strategy, the National Spatial Biodiversity Assessment was developed. This Act is applicable to this application for environmental Authorisation, in the sense that it requires the project applicant to consider the protection and management of local biodiversity.
NATIONAL HERITAGE RESOURCES ACT, 1999 (ACT NO. 25 OF 1999)	This Act legislates the necessity for cultural and heritage impact assessment in areas earmarked for development, which exceed 0.5 hectares (ha) and where linear developments (including roads) exceed 300 m in length. The Act makes provision for the potential destruction to existing sites, pending the archaeologist's recommendations through permitting procedures. Permits are administered by AMAFA KwaZulu-Natal, the Provincial Heritage Resources Authority.
OCCUPATIONAL HEALTH AND SAFETY ACT, 1993 (ACT NO. 85 OF 1993)	To provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising

	out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith.
PROMOTION OF ACCESS TO INFORMATION ACT, 2000 (ACT NO. 2 OF 2000)	The Act recognizes that everyone has a Constitutional right of access to any information held by the state and by another person when that information is required to exercise or protect any rights. The purpose of the Act is to foster a culture of transparency and accountability in public and private bodies and to promote a society in which people have access to information that enables them to exercise and protect their rights.
NATIONAL AND PROVINCIAL POLICIES AND/OR GUIDELINES:	
INTEGRATED ENVIRONMENTAL MANAGEMENT (IEM)	IEM is a philosophy for ensuring that environmental considerations are fully integrated into all stages of the development process. This philosophy aims to achieve a desirable balance between conservation and development (DEAT, 1992). The IEM guidelines intend encouraging a pro-active approach to sourcing, collating and presenting information in a manner that can be interpreted at all levels. The Department of Environmental Affairs (DEA), Integrated Environmental Management Information Series guidelines were also consulted during this BA process.
PROTECTED SPECIES – PROVINCIAL ORDINANCES	Provincial ordinances were developed to protect particular plant species within specific provinces. The protection of these species is enforced through permitting requirements associated with provincial lists of protected species. Permits are administered by the KZN Department of Forestry and Fisheries (DAFF).
ACCELERATED SHARED GROWTH INITIATIVE FOR SOUTH AFRICA (ASGISA)	ASGISA resulted from Government's commitment to halve unemployment and poverty by 2014 and was launched in February 2006. ASGISA is not a government programme but a national initiative supported by key groups in the economy *viz*, Business, Labour, State-owned enterprises, Government economic agencies, Entrepreneurs and all spheres of government.

KWAZULU-NATAL HERITAGE ACT, 2008 (ACT NO. 4 OF 2008)	KwaZulu-Natal Heritage Act provides for the conservation, protection and administration of both the physical and the living or tangible heritage resources of the Province of KwaZulu-Natal; and to establish a statutory Council to administer heritage conservation in the Province. AMAFA / Heritage Kwa-Zulu-Natali are the provincial heritage conservation agency for KwaZulu-Natal. AMAFA was established as a statutory body in terms of the KZN Heritage Act of 1997, replaced by the KZN Heritage Act of 2008.
PROVINCIAL SPATIAL ECONOMIC DEVELOPMENT STRATEGY (PSEDS)	The PSEDS is aimed at transforming the structure of the economy and narrowing and eventually eliminating the gap between the first and second economies. The four pillars of the strategy are as follows: • Increasing investment in the province; • Skills and capacity building; • Broadening participation in the economy; and • Increasing competitiveness. The PSEDS identifies the sectors of the provincial economy which will drive the growth of the province and address unemployment and poverty as follows: • Agriculture - including agri-industry (with opportunities to impact considerably on the economic needs of the poor through Land Reform); • Industry - including heavy and light industry and manufacturing; • Tourism - including domestic and foreign tourism; and • Service sector - including financial, social, transport, retail and government.

SECTION 2: ENVIRONMENTAL MANAGEMENT PROGRAMME

2.1. PREAMBLE

The reason for this EMPr is to ensure a proactive rather than reactive approach to environmental performance by addressing potential problems before they occur. This will limit corrective measures needed during the construction phase of the project. Therefore, the purpose of an EMPr is to provide management measures that must be implemented by Developers, Engineers and Contractors alike to ensure that the potential impacts of a proposed development are minimised. It must also be ensured that the EMPr is maintained and upheld as a dynamic document in order for the project team to add or improve on issues that might be considered left out or not relevant to the project. In such instances, the approving authority may authorize the ECO to make such changes.

The following tables form the core mitigation measures appropriate to the pre-construction, construction and operation phases. The tables represent the objectives to be achieved and the management actions that need to be implemented in order to mitigate the negative impacts and enhance the benefits of the project. Associated responsibilities, criteria/targets and timeframes are clearly specified.

2.2 SPECIALIST STUDIES

2.2.1. WETLAND / RIPARIAN IMPACT ASSESSMENT

Malachite Specialist Services (Pty) Ltd was appointed by Hanslab (Pty) Ltd to undertake a Wetland and Riparian Impact Assessment for the proposed upgrade of the Ogunjini Water Treatment Works (WTW).

According to the Wetland & Riparian Impact Assessment **(Refer to Appendix D2 of the D/BAR**), the proposed project falls within the quaternary catchment U30A which is part of the Mgeni Sub Water Management Area (SWA) and the Mvoti to Umzimkhulu Water Management Area (WMA). The U30A quaternary catchment is associated with a Moderate Ecological Sensitivity status. The major rivers within the U30 tertiary catchment are the **Mdloti,** Tongati and Mhlali Rivers. The Mdloti River is the main watercourse within the larger study area and is located adjacent to the existing WTW. Soil erosion within the area is due to large areas of hardened surfaces and lack of stormwater control measures. Biophysical characteristics increases impacts such as erosion, sedimentation as well as reduced water quality. The main water uses within the area include irrigation, dryland sugarcane, domestic & industrial use.

Ground truthing identified the presence of a **seep system** to the south of the existing WTW as well as a **C-Section Channel**, namely the **Mdloti River** and associated riparian zone to the north of the site. Further to this, **Two B-Section channels** were delineated within a 500-meter buffer of the rising main pipeline. The current status of the wetland system was assessed using the wetland health methodology and the wetland system was categorised as **moderately modified (PES Category C). There have been modifications to the system as a result of historic and current cultivation (which has resulted in the mixing of the original soil profile) as well as the creation of drains to facilitate suitable soil conditions for cropping by desiccating the soil. Further to this, the creation of the existing road has led to infilling of parts of the seep. These disturbances have allowed for the encroachment of alien invasive into this system**. Despite these impacts, the majority of this system has a high basal cover (dominated by graminoid species) allowing for the provision of ecosystem services.

The current state of the riparian zone associated with the Mdloti River was assessed using the Riparian Vegetation Response Assessment Index (VEGRAI) Level 3. The riparian zones associated with the 'C' Section channel has been classified as **moderately modified (PES Class C).** Modifications to the riparian zone are largely due to a change in species composition as a result of the colonisation of alien invasive species and the removal of species for the creation of informal roads to gain access to the river. The current construction of the Mdloti River bridge adjacent to the existing WTW has also had an impact on the vegetation composition of the riparian zone due to the clearing of vegetation and the movement on topsoil (after rainfall events) into this system.

Despite these impacts the wetland system to the south of the works has retained its functional integrity and provides a number of ecosystem goods and services within its catchment. The majority of the scores obtained for the Wet-EcoServices Functional Assessment were moderate; with flood attenuation, sediment trapping, erosion control, filtration properties and the provision of natural resources receiving the highest scores. An Ecological Importance and Sensitivity (EIS) assessment was undertaken to rank the water resource in terms of provision of goods and service or valuable ecosystem functions which benefit people; biodiversity support and ecological value; and reliance of subsistence users (especially basic human needs uses). The low Ecological Importance and Sensitivity score assigned to the wetland was primarily attributed to the disturbed nature of the seep. Anthropogenic disturbances to the system through both historic and existing cultivation of crops as well as the location of the wetland adjacent to the road, limits its ability to provide suitable habitat for both floral and faunal species. The Hydrological Functional Importance of the wetland has been recorded as moderate due to the functionality of the system and its ability to provide ecological goods and services to the larger anthropogenically modified

landscape. Socio-Cultural Benefits for the wetland is associated with the use of the wetland for subsistence agriculture.

The seep wetland occurs at an elevated topographic position and therefore the upgrade within the development line will not have an impact on the seep system. However, the construction of the clear water rising main will have an impact on the seep system as it runs directly through it. The impacts associated with proposed upgrade of the water treatment works and construction of the clear water rising main received a low to medium risk score with the impacts associated with the watercourses and resource quality being minor to small and easily managed. The operational risks received a moderate classification due to the abstraction process from the Mdloti River and the effects it has on the functional integrity of the river system.

The wetland specialist recommends the upgrade proceed as planned, provided the mitigation measures outlined in the report are adhered to and the seep system is rehabilitated after the construction of the existing rising main. For recommendations refer to section 2.4. of this report.

2.2.2. AQUATIC ECOLOGY IMPACT ASSESSMENT

Hanslab Pty (Ltd) appointed Malachite Specialist Services (Pty) Ltd to undertake an Aquatic Ecology Impact Assessment for the proposed upgrade of the Ogunjini Water Treatment Works (WTW)

The site investigation highlighted in this report (**Appendix E1**) focused on *in situ* water quality, temperature, conductivity, pH and dissolved oxygen in order to assess the physicochemical status of the river. Fish were not assessed as part of this assessment. All water quality parameters were found to be within acceptable parameters except for the dissolved oxygen which was below acceptable limits. This may have been due to the temperature of the water on the sampling day.

From the baseline assessment, **the section of the Mdloti River associated with the proposed WTW upgrade appears to be in a moderately modified state. This is largely due to instream and riparian habitat modification which has knock on effects on the instream biota.** The impacts that the proposed upgrading of the Ogunjini WTW were found to be of a moderate significance without mitigation measures. This dropped to low when the recommended mitigation measures are put in place. It is recommended that a biannual aquatic ecology biomonitoring plan be implemented to monitor the long-term effects that may occur due to the proposed upgrade, particularly the increased abstraction of water and identify trends with regard to the biota within the Mdloti River. **For all recommendations refer to section 2.4**

2.2.3. GEOTECHNICAL INVESTIGATION

The Geomeasure Group were appointed to conduct a geotechnical investigation on the for the Ogunjini Water Treatment Works (WTW) by GIBB (Pty) Ltd (**Refer to Appendix D3 of the D/BAR)**.

The site is situated 145m above mean sea level within the gently undulating flood plain on the southern bank of the Mdloti River. The natural ground prior to the earthworks sloped at approximately 1:20 (3°) on the lower slopes and approximately 1:5 (11°) further away from the Mdloti River. The desktop study showed the site to be underlain by sandstone bedrock of the Natal Group. Dynamic cone penetrometer tests depict soil profiles that show the lower lying portions of the WTW site to be underlain by alluvial sediments deposited on sandstone bedrock by the Mdloti River. Upper portions of the WTW site are underlain by sandstone bedrock and derived soils.

Groundwater seepage was observed in three of the excavated trial pits within the WTW at depths of 2.7 and 3.2 meters below existing ground level. The seepage occurred within residual sandstone soils. It is possible that during or after heavy or prolonged rainfall in the wet summer months, temporary perched seepage zones may occur, both within the residual soils and the alluvial soils. The colluvial and residual soils encountered along the clear water pipeline route comprise dark yellow to dark yellowish orange speckled reddish orange, medium dense to dense becoming very dense with depth, gravelly SAND that classifies as G7 to G10 quality material.

The Ogunjini WTW falls within the Lithosols soil type which is shallow soils on hard or weathering rock. The pipeline however, traverses the above soil type and follows into imperfectly drained soils which is often shallow and often with a plinthic horizon. **The trenchability along the pipeline route is anticipated to be variable and can be classified as Soft Excavation. Along the remainder of the clear water pipeline route, where steeper slopes occur, it is anticipated that Soft Excavation will only extend to a depth of about 0.3 metres below ground level.**

Based on observations on site and the nature of the materials underlying the site, it is considered that the site is stable in its current state and capable of development as proposed. **For all recommendations refer to section 2.4.**

2.2.4. STORMWATER MANAGEMENT PLAN

According to the stormwater management plan compiled by Gibb (Pty) td (**Refer to Appendix D4 of the D/BAR**), it is important to provide a system to convey & manage stormwater in order to mitigate safety hazards and minimise property losses as well as disruptions due to heavy stormwater runoff & flooding

The surrounding catchment is generally a rural catchment that drains in a north easterly direction. The primary drainage channel is the Mdloti River and all stormwater generated in the catchment and the WTW will drain into the Mdloti channel.

The existing drainage system comprises of the Mdloti River as the primary drainage system, the Mdloti River will adequately drain stormwater for any flood event away from site.

Observations on the available 1:100-year floodlines indicate that the north eastern portion of the WTW is inundated during a 1:100-year floodline. It is important to note that the stormwater drainage infrastructure is rendered ineffective during this time should the outlets be positioned below the inundation line.

On site stormwater management

There are no significant erosion problems within the proposed site, this can change once construction commences. There is a risk to receiving waters, during construction from sediment flowing into the stormwater drainage system from the construction site materials or poorly managed stockpiles.

The contractor must develop management plans detailing erosion and sedimentation control measures, and that they are maintained during construction.

Construction phase measures

Stormwater erosion is one of the most challenging factors of stormwater management as it happens quickly and destructively. With the slopes in the study area being fairly steep, surface runoff on bare soil could have negative impact in terms of transportation of erosion material to the receiving stream.

Post construction phase measures

Stormwater to be channelled by means of drainage pipes which discharge at the nearest water body.

For all recommendations refer to section 2.5.

2.2.5. HERITAGE IMPACT ASSESSMENT

Interim comments received from AMAFA (**Appendix E8**) have highlighted the need for a Phase 1 Heritage Impact Assessment. Active Heritage CC was appointed by Hanslab to conduct a Heritage Impact Assessment along the proposed clear water rising main route from the Ogunjini WTW to the Ogunjini 1 reservoir (**Refer to Appendix D6 for full report**).

A desktop study was conducted of the SAHRA inventory of heritage sites as reflected on the SAHRIS website and the archaeological database of the KwaZulu-Natal Museum was consulted. Thereafter a site investigation was completed on 23 August 2017. A ground survey following standard and accepted archaeological procedures was conducted and a transect of 50m on either side of the proposed pipeline was surveyed. Interviews were carried out with 4 residents of the area; the residents were questioned about the locality of potential heritage resources on or near the footprint and their opinions regarding the potential impact of the proposed development on heritage resources in the area. Their responses were recorded and incorporated into the study.

The area is not part of any known cultural landscape. There were 6 individual graves located during the site investigation within **50-meters of the proposed pipeline** i.e. (**Figure 20**):

- Grave 1

This grave is located at 29° 35' 44.22" S; 30° 59' 4.50" E. It is a modern grave by definition as it is less than 60 years old. It is a concrete structure that occupies an area of 2-meters x 3-meters and can be found 40-meters from the boundary of the pipeline. It is of high significance locally as all graves are protected by provincial heritage legislation. **A buffer of 20-meters is proposed around the grave site.** This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial.

- Grave 2

This grave is located at 29° 35' 38.28" S; 30° 58' 51.30" E. It is a modern grave by definition as it is less than 60 years old. It is an unmarked concrete structure that occupies an area of 3-meters x 4-meters and can be found 30-meters from the boundary of the pipeline. It is of high significance locally as all graves are protected by provincial heritage legislation. **A buffer of 20-meters is proposed around the grave site.** This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial.

- Grave 3

This grave is located at 29° 35' 38.09" S; 30° 58' 50.04" E. It is a modern grave by definition as it is less than 60 years old. It is demarcated by an unmarked shallow red brick wall that occupies an area of 1,5-meters x 2-meters and can be found 30-meters from the boundary of the pipeline. It is of high significance locally as all graves are protected by provincial heritage legislation**. A buffer of 20-meters is proposed around the grave site.** This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial.

- Grave 4

This grave is located at 29° 35' 35.34" S; 30° 58' 49.03" E. It is a modern grave by definition as it is less than 60 years old. It is demarcated by brick wall and two metal gates that occupies an area of 2-meters x 2-meters and can be found 50-meters from the boundary of the pipeline. It is of high significance locally as all graves are protected by provincial heritage legislation. **A buffer of 30-meters is proposed around the grave site.** This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial.

- Grave 5

This grave is located at 29° 36' 12.84" S; 30° 58' 57.45" E. It is a grave older than 60 years old. It is demarcated by an unmarked square concrete structure that occupies an area of 2-meters x 2,5-meters and can be found 30-meters from the boundary of the pipeline. It is of high significance locally as all graves are protected by provincial heritage legislation. **A buffer of 20-meters is proposed around the grave site.** This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial.

- Grave 6

This grave is located at 29° 36' 18.75" S; 30° 58' 55.67" E. It is a modern grave by definition as it is less than 60 years old. It is marked and indicated by a grave head stone and structure that occupies an area of 2-meters x 3-meters and can be found 50-meters from the boundary of the pipeline. It is of high significance locally as all graves are protected by provincial heritage legislation. **A buffer of 20-meters is proposed around the grave site**. This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial.

The graves have a social significance in that it has a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons. The site has been rated as locally significant and as such the site should be retained as a heritage site. No mitigation measures were

deemed necessary for this site; however, recommendations are made to ensure that the buffers are maintained and the heritage sites are not compromised. The pipeline will be laid approx. 50m from the proposed grave sites. The contractor must be made aware of all buffers outlined by the heritage specialist. **For all recommendations refer to section 2.5.**

2.3 STRUCTURE AND CONTENTS OF TABLES

The tables consist of six parts as follows:

Phase of development	This row will identify either pre-construction (planning) or actual construction phase etc.
Impact/activity	This row will identify the issue being addressed, e.g. materials, site demarcation, heritage, etc.
Mitigation measure	This column will include all the necessary mitigation measures for each impact/issue.
Responsible Party	This column will indicate the party responsible for implementing the mitigation measures.
Frequency of actions	These columns provide time guidelines for the 'Responsible party' by which he/she is to action or manage the required mitigation.

2.4 SUMMARY OF THE IMPACTS ASSOCIATED WITH THE PROPOSED ACTIVITY

The following impacts (negative and positive) associated with the proposed activity where identified. Refer to **Section D** of the Basic Assessment Report for a detailed assessment of the impacts.

PLANNING PHASE ACTIVITIES

- Project Contract and Programme
- Appointments and duties of project team
- Method statements
- Emergencies, non-compliance and communication
- Construction Plans and Schedules
- Campsite Establishment

- Establishing
- Storage Areas
- Hazardous Substances
- Waste Management

CONSTRUCTION PHASE ACTIVITIES

CLEAR WATER RISING MAIN

Biophysical Impacts

- Soil erosion & sedimentation of the watercourse
- Disturbance allowing for the encroachment of alien invasive species.
- Impeding or diverting the flow of water within the watercourse
- Altering the beds, banks, or characteristics of the
- watercourse Handling of hazardous materials, solid waste & stockpiling
- Disruption of access to grazing areas
- Noise Pollution
- Dust Emissions

Social Impacts

- Heritage resources
- Socio-cultural Impacts

WATER TREATMENT WORKS AND ASSOCIATED INFRASTRUCTURE

Biophysical Impacts

- Soil erosion & sedimentation of the watercourse
- Pollution of the water resources and soil
- Alien invasive species encroachment
- Stormwater erosion control
- Soil disturbance from the earthworks
- Handling of hazardous materials, solid waste
- Noise Pollution
- Dust Emissions

Social Impacts

- Socio-cultural Impacts

POST CONSTRUCTION PHASE

- Water resource management
- Pollution Control Structures
- Waste removal/ disposal
- Materials and Infrastructure
- Alien Vegetation
- Alien Plant Control
- General
- Stormwater management

REHABILITATION PHASE

- Soil erosion & sedimentation of the watercourse
- Construction Camp Rehabilitation
- Re-Vegetation
- Land Rehabilitation

OPERATIONAL PHASE – BIOPHYSICAL IMPACTS

CLEAR WATER RISING MAIN

- Degradation of wetlands
- Pollution of water resources and soil
- Alien invasive species encroachment

WATER TREATMENT WORKS AND ASSOCIATED INFRASTRUCTURE

- Degradation of wetland system
- Pollution of water resources

2.5 LIST OF RECOMMENDATIONS AS PER SPECIALIST STUDIES:

2.5.1 WETLAND REPORT 2017

- **The delineated seep occurs at an elevated topographic position to the south of the existing WTW and the upgrade of this facility will therefore not have an impact on this wetland system,** Best practice methods must therefore be placed into the EMPr to ensure the seep is not used for the construction camp site or storage area. **However, the construction of the clear water rising main pipeline will have an impact on the seep system.**
- The findings of the wetland report recommended that the upgrade proceeds, provided the mitigation measures outlined in this report are adhered to and the seep system is rehabilitated after the construction of the existing rising main pipeline.
- The detailed list of recommendations and mitigation measures can be found in **section 2.6** below.

2.5.2 AQUATIC ASSESSMENT 2017

- All storage of stockpiled material must be kept at the greatest distance from the river system as possible.
- Sediment traps are to be installed prior to any construction activities taking place.
- Temporary berms must be installed to reduce the risk of loose sediment being transported via wind or surface runoff into the river.
- Construction must take place during the dry season, if longer is required it is imperative that the in-river construction (if required for the abstraction pipe) takes place during the lowest flow period i.e. late winter.
- Only hand tools that do not contain grease are to be used within the river.
- Only manual labour and not heavy machinery must be used to lay the new intake pipe for the proposed Ogunjini WTW project.
- An aquatic ecology biomonitoring plan should be implemented on a biannual basis to monitor against the findings of this report and determine if the WTW are having an undue impact on the river.
- The following indices should be monitored:
  - In situ water quality
  - SASS5 (by an accredited practitioner)
  - MIRAI
  - IHIA
  - IHAS; and

- The Fish response assessment index should be included within the monitoring program.
- An additional site may be required downstream.

- It is recommended that **a biannual aquatic ecology biomonitoring plan** be put in place to monitor the long-term effects that may occur due to the proposed upgrade and identify trends with regard to the biota within the Mdloti River.

2.5.3 GEOTECHNICAL REPORT 2017

- **Excavatability**
  - Cut excavations up to about 5 metres may be required to construct the proposed reservoir /tank. The DCP tests and pits excavated on the site platform generally extended to depths of at least 3.5 metres and 4.5 metres respectively. Where shallower refusal occurred, it is considered to be due to the presence of boulders.
- **Construction of fills and cuts**
  - No major earthworks are required to create level building platforms for the proposed new structures. It is recommended that all earthworks be carried out in accordance with SABS 1200. In general, it is recommended that any cut and fill embankments required have a maximum slope of 1 vertical to 1.7 horizontal to promote stability. Fills should be benched into the in situ residual soils. The benches should be approximately 2.0 m to 4.0 m wide and at least 1.0 m to 2.0 m deep. The need for subsoil drainage both beneath and in fills will have to be assessed during the earthworks, taking into account the height and locality of individual fills.
  - Both during and after construction, the site should be well graded to permit water to drain readily away and to prevent ponding of water anywhere on the ground surface. All terraces and earthworks in general should be sloped to a gradient of not less than 1 vertical in 50 horizontal to prevent ponding and ingress of water into the subsoils. Surface drainage should be directed away from the crests of fill and cut embankments to prevent over-topping and erosion of the slopes.
  - Cut and fill slopes should be topsoiled and planted with grass with deep root systems such as vetiver. This will limit erosion of these slopes and the problems associated with washaways of fill embankments.
- **Foundations**
  - It is strongly recommended that Geomeasure Group inspect and approve in writing all foundation excavations to confirm depth of founding and bearing pressure.
  - **500kl SBS Clear Water Tank:**

- It is recommended that the clear water tank structure be founded on a reinforced concrete raft supported on a compacted soil raft foundation.
- **The following procedure should be observed after the site has been excavated to final floor level:**
  - The in-situ soils beneath the structure should be undercut or boxed out to a minimum depth of 1.0 m beneath the base.
  - The area of excavation for this procedure should exceed the footprint of the structure on all sides by at least 1 m.
  - The exposed subgrade in the box cut should be ripped to at least 300 mm depth, wet and recompacted with eight passes of a heavy roller.
  - The 1.0 m thick backfill operation should comprise G6/G7 for the first 0.5 m compacted in layers to at least 95% MDD followed by a 0.5 m thick G5 material compacted to minimum 98% MDD.
  - Thereafter the structure may be founded on a reinforced concrete raft supported on the soil raft. A maximum safe bearing pressure of 350 kPa can be adopted.

- **Dehydrator and Skip Area:**
  - As the proposed dehydrator structure and concrete slab for the skip area are relatively light structures, it is considered that they may be supported on normal strip footings at a minimum depth of 0.9 metres below existing ground level. However, some ground improvement is recommended, as the underlying cohesionless sandy soils are loose in consistency.
  - **The following procedure should be observed with regard to founding and construction:**
    - Remove in situ material below foundations to a depth and width of 1.5 times the foundation width or to a competent horizon and replace with suitable granular material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content.
    - Normal construction with lightly reinforced strip foundation and light reinforcement in masonry.
  - **Alternatively, the structure / slab can be supported on stiffened strip footings or a stiffened or cellular raft, as follows:**
    - Foundations to comprise stiffened strip footings or stiffened or cellular raft with articulation joints or solid, lightly reinforced masonry.
    - Bearing pressures not to exceed 50kPa.
    - Fabric reinforcement in floor slabs.

- Site drainage and service / plumbing precautions.

- **190 kl Sludge Holding Tank:**
  - **As with the clear water tank, it is recommended that the sludge holding tank structure be founded on a reinforced concrete raft supported on a compacted soil raft foundation. The following procedure should be observed after the site has been excavated to final floor level:**
    - The in situ soils beneath the structure should be undercut or boxed out to a minimum depth of 1.0 m beneath the base.
    - The area of excavation for this procedure should exceed the footprint of the structure on all sides by at least 1 m.
    - The exposed subgrade in the box cut should be ripped to at least 300 mm depth, wet and recompacted with eight passes of a heavy roller.
    - The 1.0 m thick backfill operation should comprise G6/G7 for the first 0.5 m compacted in layers to at least 95% MDD followed by a 0.5 m thick G5 material compacted to minimum 98% MDD.
    - Thereafter the structure may be founded on a reinforced concrete raft supported on the soil raft. A maximum safe bearing pressure of 350 kPa can be adopted.

- **Complex of Clarifier, Pressure Tanks, Balancing Tank and Filter Plant Building:**
  - As the structures comprising the proposed complex of the clarifier, pressure tanks, balancing tank and filter plant building are also relatively light structures, it is considered that they maybe supported on normal strip footings at a minimum depth of 0.9 metres below existing ground level. However, some ground improvement is recommended, as the underlying cohesionless sandy soils are loose in consistency.
  - The same procedures as for the dehydrator and skip area should be observed with regard to founding and construction

- **Pipelines**
  - The proposed pipelines will be constructed of 200mm diameter MPVC pipe. The final trench depths have not been confirmed, but trench depths of 1.5 metres have been assumed. Typical trench widths, and bedding and blanketing requirements have been determined in accordance with SABS 1200 DB Earthworks (Pipe Trenches) as follows:

- External diameter of pipe barrel of over 125mm and up to 700mm, the side allowance on each side is 300mm, giving a minimum trench width of 0.8 metres.
- The minimum thickness of selected granular material is 200mm for the bed and 300mm for the blanket. Suitable pipe bedding material will need to be imported to site, as none of the materials occurring on site are considered to be suitable.
- The minimum thickness of general backfill including selected backfill is 800mm.

- **Trenchability**
  - The excavation or trenchability requirements for the materials encountered along the proposed pipeline routes have been classified according to SABS1200DM.
  - **Raw Water Pipeline:** Based on the results of the excavated trial pits and DPL tests, it is anticipated that to at least 3.0 metres below existing ground level, trenchability along the pipeline route can be classified as Soft Excavation. However, localised areas of boulders can be expected that will require Intermediate Excavation for removal.
  - **Clear Water Pipeline:** The trenchability along this pipeline route is anticipated to be variable. On the lower slopes adjacent to the WTW and on the gentler slopes either side of DPL 9, and in the areas adjacent to TP 8 and DPL 11, it is anticipated that to at least 3.0 metres below existing ground level, trenchability along the pipeline route can be classified as Soft Excavation.
  - Along the remainder of the clear water pipeline route, where steeper slopes occur, it is anticipated that Soft Excavation will only extend to a depth of about 0.3 metres below ground level. Below these depths, Intermediate Excavation will occur, rapidly becoming Hard excavation / Blasting with depth.

- **Trench stability**
  - The safety issues regarding excavation and working in open, unsupported trenches should fall in line with the requirements of the **General Safety Regulations promulgated by Government Notice No. R1031 of 30 May 1986, as amended.**
  - It is generally required that trenches **deeper than 1.5m** must be adequately shored where there is a possibility of collapse. With pipeline trenches in particular there is a tendency to open the trench over significant lengths thereby increasing the risk of sidewall collapse. In any event there must be provision for safe access, or exit, not more than every 20m along the trench length.

- **Key issues regarding the stability of trench sidewalls are:**
  - Soft wet soil conditions
  - Surcharge loading at edges of trenches whether by soil or equipment
  - Groundwater seepage
  - Rainwater runoff
- Of these both surcharge loading and control of rainwater runoff can be managed. Surcharge in the form of stockpiling of backfill, or trenching machinery (pipe laying rigs), must be placed well away from the edge of the trench.
- Soft/loose soils and groundwater ingress must fall under **daily audits** by professionals well experienced in these matters, otherwise shoring must be introduced.
- It is necessary to place controls on the length of trench and in this instance consideration will need to be given to pipe lengths. Trench lengths should be agreed on prior to the start of the contract especially where depths exceed 1.5 m.
- The acceptance of trench lengths must go hand in hand with regular audits on site of trench stability by Geotechnical specialists.

– **Backfill and Erosion Aspects:**
- Uncompacted trench backfill, particularly in hilly/undulating terrain, can lead to erosion as the trench sidewalls can form a preferential route for surface water discharge and with time could develop into a donga feature with resultant failure of the pipeline. Therefore, it will be **important to vegetate the clear water pipeline trench outline as soon as possible after backfill is complete**.
- It is proposed that **anchor blocks be used to hold the pipe in place together with a drainage release system such as subsoil drains**. Water would then be diverted from the trench by means of appropriate subsoil drainage towards drainage lines or the local drainage system.

2.5.4 STORMWATER MANAGEMENT PLAN 2017

- The stormwater networks must be designed and constructed in such a manner that storm water of a suitable quality should drain into the surrounding system.
- Cut-off catchwater berms should be constructed around the perimeter of the plant to channel stormwater generated from up catchment away from the plant.

- Minimise the area to be cleared and keep as much of the area surrounding the road and associated infrastructure vegetated (preferably retain indigenous vegetation). Most importantly, maximise the buffer/ 'no-go' area surrounding the wetlands.
- Removal of vegetation cover must be carried out with care and attention to the effect, whether temporary or long term, that this removal could have on erosion potential.
- Stormwater must not be allowed to pond for extended periods in excavations.
- Concrete lined storm water channels must discharge onto gabion mattresses upstream of any culverts, to mitigate and reduce velocities of storm water.
- Any damage and loss of soil resulting from stormwater is to be remediated immediately.
- After construction, any disturbed areas should be graded and revegetated to promote the infiltration of runoff and reduce the amount of sediment reaching the stream.
- Drainage must be controlled to ensure that runoff from the site should not culminate in off-site pollution or cause water damage to properties and systems further down from the site.
- The stormwater Management Plan should ensure that the ultimate flow from the development does not result in any negative impacts on the downstream properties or wetlands/ watercourses and must be therefore ensure that stormwater is managed within the overall site as effectively as possible.

2.5.5. HERITAGE IMPACT ASSESSMENT 2017

- It is important that the developers maintain a buffer zone around all the identified graves in the project area. Due to the proximity of graves 1, 2, 3, & 5 to the proposed pipeline trajectory a buffer zone of at least 20m must be maintained around these heritage features. A buffer zone of at least 30m must be maintained around graves 4 & 6.
- There is no need to initiate a grave exhumation and reburial exercise. However, should it not be possible to maintain the integrity of the proposed buffer zones then a Phase Two Heritage Impact Assessment may be initiated. However, it must be emphasised that the grave exhumation process is the least favourite option and the process will have to include a lengthy community consultation.
- The paleontologist reports that no significant fossils are expected in the Ordovician to Silurian aged rocks on site. However, if terrace fossils are discovered the HIA specialist and Palaeontologist or local heritage authorities must be informed as such finds will be highly significant.

- The consultant did not identify any other heritage resources or associated cultural landscapes. The project may thus proceed from a heritage perspective once the above-mentioned mitigation aspects have been applied.
- It should, however, be pointed out that the KwaZulu-Natal Heritage Act requires that operations exposing archaeological and historical residues (including graves) as well as fossil material should cease immediately pending an evaluation by the heritage authorities.

2.5. IMPACT ASSESSMENT AND MITIGATION MEASURES FOR THE LIFE-CYCLE OF THE DEVELOPMENT

A. PLANNING PHASE ACTIVITIES

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
A.1.	**Project Contract and Programme**	• The EMPr must be included as part of the tender documentation and included within any service level agreements made, thereby making it part of the enquiry document to make the recommendations & constraints as set out in this document, enforceable under the general conditions of contract. • A copy of this EMPr must be available on site. The Contractor must ensure that all the personnel on site, subcontractors and their team, suppliers, etc. are familiar with and understand the specifications contained in the EMPr. • The EMPr will advise the design phase of the project in terms providing the environmental requirements with regards to routing options, construction methodologies, access choices and mitigation/management options. • The appointments associated with the project team required to implement this EMPr will be made prior to the construction phase of the project.	CO; ECO, ESO	Beginning of the proposed project (First month)

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
A.2.	**Appointments and duties of project team**	• The contact details for the ECO, ER, EO, Contractor and ESO (as applicable) must be recorded and a copy kept on site. This document must be made available to the approving authority on request. The ECO's details should be displayed on a notice board at the entrance to the site so members of the public can report perceived transgressions of conditions, such as excessive dust after hours. • Before construction activities commence, role players must have a clear indication of their role in the implementation of this EMPr as indicated in section 1.3. • Subcontractor(s) contracts with the principle contractor must contain a clause to the effect that the disposal of all construction-generated refuse/waste to an officially registered landfill site is the responsibility of the subcontractor in question and that the subcontractors are bound to the management activities stipulated in this EMPr. The contractor must keep all copies of waybills to prove that waste was dumped legally at a registered landfill site.	CO; ECO, ESO, PM	Beginning of the proposed project (First month)
A.3.	**Method statements**	• All activities which require method statements may only commence once the method statements have been approved by the Engineer and or ECO as applicable. Where applicable, the contractor will provide job-specific training on an ad hoc basis when workers are engaged in activities, which require method statements. • The method statements must clearly take into account the recommended buffers from the specialist reports as stated within this EMPr	CO; ECO, ESO	Beginning of the proposed project (First month)

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
A.4.	**Emergencies, non-compliance and communication**	• The contractor must provide method statements on the protocols to be followed, and contingencies to be implemented. • Communication in emergencies must follow the prescribed lines of protocol. • The contractor understands that failure to adhere to the requirements of the EMPr will result in the contractor being responsible for over and above the costs incurred for any remediation required as result of the specific non-compliance.	CO; ECO, ESO	Beginning of the proposed project (First month)
A.5.	**Construction Plans and Schedules**	• The contractor is to provide the scheduling for construction that considers, the mitigation measures of the EMPr which affects the timing of the construction activities, such as scheduling the riparian crossings, wetland crossings, and working in dust prone areas during the rainy season. • The construction plans must clearly take into account the recommended buffers from the specialist reports as stated within this EMPr • Appropriate locations for pipe and fabrication yards, site offices and construction camps are to be determined and approved prior to activities occurring. • Appropriate access routes are to be determined and approved prior to activities occurring.	CO	Beginning of the proposed project (First month)

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
A.6	**Campsite Establishment**	• A campsite plan showing layout of buildings and associated infrastructure must be developed and approved by the Engineer. • The construction camp must be sited in an area already disturbed and 100m away from any water course/drainage lines. • The construction camp must not be situated on a floodplain or on slopes greater than 1:3. • Vegetation and trees to be retained shall not be damaged or felled. • Accommodation of personnel is to include both kitchen and sanitary facilities. • Fires will only be allowed in facilities especially constructed for the purpose and no trees may be specifically felled for obtaining firewood. • Adequate ablution should be supplied to the site staff. These must be approved by the Engineer. Under no circumstances may open areas or surrounding bush be used as a toilet facility. • Regular inspections shall be carried out to ensure toilets are kept clean. • Portable water should be supplied. This will be utilized for drinking, cooking and ablution. Great care is required and should be taken to ensure that the water supply is not contaminated in any way. • Bins and/or skips shall be provided at convenient intervals for disposal of waste within the construction camp. Refuge generated from the campsite, construction area, storage area or any other area shall be collected and placed in a suitably closed container daily. Once full, the refuse container shall be emptied and contents disposed of at a licensed facility for this purpose. • The piling of any material that could rot and release unpleasant smells into the air is not permitted.	CO; ECO, ESO	Beginning of the proposed project (First month) Monitored Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
A.7.	**Establishing Storage Areas**	• Storage areas must be designated, demarcated and fenced to prevent unauthorized access to the area. It must be secure to reduce risk of crime. Fire prevention facilities must be present at all storage areas. • Materials such as fuel, cement, oil, paint herbicides, bituminous products, lubricants and drilling must be stored in bermed areas or under lock and key. • The proximity of the houses and public facilities must be considered when deciding on storage areas for hazardous substances. Material Safety Data Sheets for all chemicals and hazardous substances to be used on site must be readily available. • Fuel tanks must meet relevant specifications and must be elevated to detect leaks. • Appropriate safety measures must be taken by staff when dealing with hazardous chemicals. • In the case of pollution of hazardous substances, disposal should take place in the prescribed manner for that substance at a permitted landfill. • A spill kit must be kept on-site and easily accessible to all site workers.	CO; ECO, ESO	Beginning of the proposed project (First month) Monitored Monthly

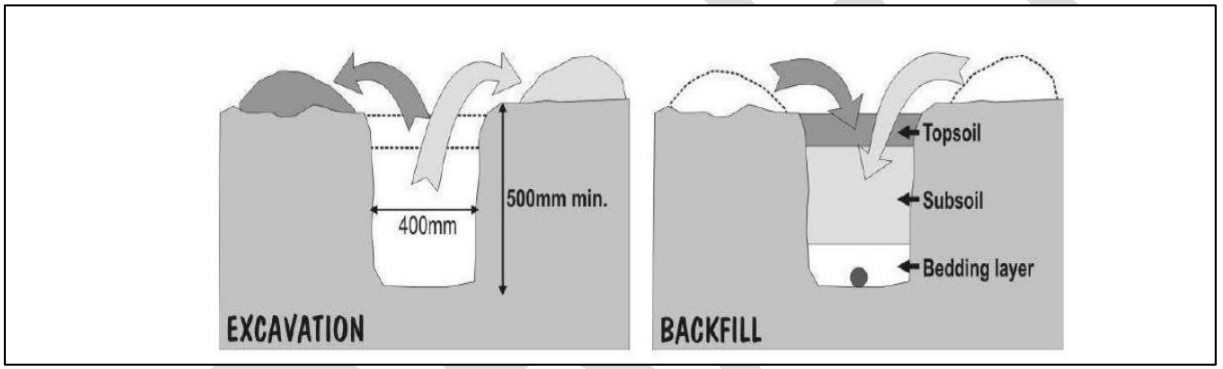
No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
A.8.	**Hazardous Substances**	• Construction vehicles are to be maintained in good working order, to reduce the probability of leakage of fuels and lubricants; • Vehicles used during the construction phase must be parked in a designated area and drip trays should be used to prevent any oil leaks; • Formal waste management and sewerage systems must be put in place for contractors; • A walled concrete platform, dedicated store with adequate flooring or bermed area should be used to accommodate chemicals such as fuel, oil, paint, herbicide, and insecticides, as appropriate, in well-ventilated areas; • Storage of potentially hazardous materials should be above the current (i.e. not historic) 1:100-year flood line, or as agreed with the ECO. These materials include fuel, oil, cement, bitumen etc.; • Sufficient care must be taken when handling these materials to prevent pollution; • Oil residue shall be treated with oil absorbent such as Drizit or similar and this material removed to an approved waste site	Contractor, PM, ESO, ECO	Beginning of the proposed project (First month) Monitored Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
A.9.	**Waste Management**	• Refuse bins must be placed at strategic positions to ensure that litter does not accumulate within the construction site. • Store all litter carefully by keeping lids closed, so it cannot be washed or blown into the water course within the proposed development; • Provide bins for construction workers and staff at appropriate locations, particularly where food is consumed; • The construction site should be cleaned daily and litter removed; • Conduct on-going staff awareness programs to reinforce the need to avoid littering; • Skip waste containers should be maintained on-site. These should be kept covered and arrangements made for them to be collected regularly from the site by the local council. • All waste must be removed from the site and transported to a landfill site as approved by the relevant municipality.	CO; ECO, ESO	Beginning of the proposed project (First month) Monitored Monthly

CLEAR WATER RISING MAIN

B. CONSTRUCTION PHASE – BIOPHYSICAL IMPACTS

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.1	**Soil erosion & sedimentation of the watercourse**	**SEEP WETLAND & RIPARIAN ZONE** • Attenuation of stormwater from the development site is important to reduce the velocity of runoff into the downstream river and riparian zone. • Attenuation measures during construction include but are not limited to - the use of sand bags, hessian sheets, silt fences, retention or replacement of vegetation and geotextiles such as soil cells which must be used in the protection of slopes. • Other mitigation options include: – Do not allow surface water or storm water to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place. – Vegetation clearing must be undertaken only in the areas to be developed and must not extend outside of the development footprint. Furthermore, vegetation clearing should be confined to the dry season to avoid high rainfalls transporting unsecured sediments down slope. – The pipeline will cross the seep system. The pipeline must stick to the planned route, where the existing pipe is located, where disturbance has already taken place; – The pipeline must be buried at a sufficient depth so that it does not interfere with surface water movement leading to erosion.	CO; ESO ECO	Daily/ weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.1	**Soil erosion & sedimentation of the watercourse (Continued from previous page…)**	– Use existing tracks and roads to gain access to the work servitude as much as possible; – When soil is excavated for the pipeline trench, the topsoil and subsoil must be separated; – In the event of infilling, replacement of subsoil must precede the topsoil replacement, and all material must be well compacted.  **Figure 9: Showing an example of the method that will be employed during excavation and backfilling**. – Disturbed sites must be rehabilitated as soon as construction in an area is complete or near complete and not left until the end of the project to be rehabilitated.	CO; ESO ECO	Daily/ weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.1	**Soil erosion & sedimentation of the watercourse (Continued from previous page…)**	**B-SECTION CHANNEL:** • Uncompacted trench backfill, particularly in hilly/undulating terrain, can lead to erosion as the trench sidewalls can form a preferential route for surface water discharge and with time could develop into a donga feature with resultant failure of the pipeline. Therefore, it will be important to vegetate the clear water pipeline trench outline as soon as possible after backfilling is complete. • It is proposed that anchor blocks be used to hold the pipe in place together with a drainage release system such as subsoil drains. Water would then be diverted from the trench by means of appropriate subsoil drainage towards drainage lines or the local drainage system.	CO; ESO ECO	Daily/ weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.2	**Disturbance allowing for the encroachment of alien invasive species.**	**B-SECTION CHANNEL & RIPARIAN ZONE:** • Any removal of vegetation within the riparian zone, particularly along the existing abstraction pipe will lead to a disturbance within the area having a negative impact on the functionality of the vegetation community. • Monitoring and removal of alien invasive species within any areas disturbed by the upgrade and operation of the WTW as well as the rising main, must be undertaken as part of the Environmental Management Programme. This requirement is in fulfilment of the terms of the National Environmental Management: Biodiversity Act. Areas which have been disturbed will be quickly colonised by invasive alien plant species.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.3	**Impeding or diverting the flow of water within the watercourse**	**B-SECTION CHANNEL & RIPARIAN ZONE:** • The stream crossing is located at coordinates **29° 35' 48,47"S, 30° 58' 56,71" E**; and the stream crossing of the rising main to Ogunjini 1 Reservoir is to be constructed below the river bed and encased in concrete. • The banks of the river are to be restored to original hydraulic profile and fitted with gabion baskets for erosion protection where necessary. • Activities include: – Temporary diversion of watercourse such that it poses no flood risk to surrounding areas. – Trenching below river bed to specified depth. – Placement of founding layers (geofabric wrapped stone or mass concrete – to be confirmed by engineer on site) – Placement of segments of pipe through river crossing. – Placement and fixing of reinforcing steel – Placement of concrete encasement, with finished level of top of encasement to match the lowest invert of the river at the crossing location. – Placement of cement-stabilized sand backfill to reconstruct banks where trenching was done. – Removal of temporary diversion measures. – Reinstatement of original stream bank profile; depending on original stream bank material, gabions may be used for this purpose. **(As per method statement submitted by the Engineer – Gibb)**	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.3	**Impeding or diverting the flow of water within the watercourse (Continued from previous page…)**	**B-SECTION CHANNEL & RIPARIAN ZONE** **ENVIRONMENTAL CONSIDERATIONS: RIVER CROSSINGS & CONSTRUCTION IN RIPARIAN ZONES:** • **As discussed in previous sections, there are two activities which will occur within riparian zones:** – Installation of a new pumps and pipework for abstraction works (the nature of this has limited impact). – New clear water rising main to Ogunjini 1 Reservoir stream crossing (to be done as a concrete encased pipe below invert of river). • The following should be considered for these construction activities relating to minimising footprint: – Areas earmarked for construction must be clearly and visibly marked to ensure a controlled disturbance footprint area. – The construction corridor will be restricted to 10m. – Minimise size of construction; work area should be as narrow as possible. – Barricade entire work area to ensure no works, plant or access ways fall outside of works area; used netting as a boundary marker. – Avoid unnecessary traversing of the wetlands in undesignated areas during construction. – Phasing of work if possible in order to limit the amount of time wetlands will be impacted. – Sequence and duration of project should be such that actual construction within wetlands should be limited to the low flow periods outside of the rain season.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.3	**Impeding or diverting the flow of water within the watercourse (Continued from previous page…)**	**<u>ENVIRONMENTAL CONSIDERATIONS: RIVER CROSSINGS & CONSTRUCTION IN RIPARIAN ZONES</u>:** • **Relating to concrete works:** – All mixing of concrete must occur outside of the riparian zone. A minimum distance of 32m for concrete mixing must be adhered to at all times. – Concrete mixing shall take place on an impermeable surface and not directly on the ground. – Runoff from the concrete mixing must be controlled and none shall enter the watercourse. – All evidence of concrete mixing must be removed as waste from site. – Materials for concrete mixing are to be stored, as a minimum, 32m away from the water course. • **Relating to pollution control:** – Ensure that no pollution enters surface water or has the potential to pollute groundwater by ensuring that there is containment of spillages (examples include: diesel, oils etc.). – No hazardous materials are to be stored within 32m of the watercourse. – No re-fuelling of plant is to be undertaken within 32m of watercourse. – No washing of planting/vehicles shall take place near river. – Drip trays must be utilised for all stationary plant. • **Relating to erosion and sedimentation control:** – Trenches and foundations will be side dug (where possible) from existing access routes. In absence of access routes, temporary routes may be considered.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.3	**Impeding or diverting the flow of water within the watercourse (Continued from previous page…)**	**ENVIRONMENTAL CONSIDERATIONS: RIVER CROSSINGS & CONSTRUCTION IN RIPARIAN ZONES:** – The soils will be removed in layers in such a way that they can be easily reinstated in the reverse order as detailed below. – To ensure correct backfilling, the soil that is removed from the trench at its deepest point will laid closest to the trench. – The first layer of topsoil will be laid furthest away from the trench. – Water from any diversions/ dewatering/ outlets will be disposed of in such a way that the erosive force of the water in the outlets is dissipated and erosion does not occur at the outlet discharge point(s). – The channels at the inlet and outlet of any diversions/ flowing river will be protected from erosion by sand bags, berms, gabions etc. – All banks shall be protected, and ensure erosion does not occur. – Adequate stormwater management and soil stabilisation measures in cleared areas must be implemented to avoid erosion that may lead to siltation of nearby watercourses. Where necessary erect water control berms and sedimentation trapping berms to prevent impacts due to surface runoff. – Any diversions and dewatering is to include erosion and soil stabilisation measures, particularly the inlet and outlet of said works.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.4	**Altering the beds, banks, or characteristics of the watercourse**	**B-SECTION CHANNEL & RIPARIAN ZONE** • **The selected pipe material:** – The selected pipe material is uPVC, class 25 material (i.e. able to withstand 250 metres of water pressure). – The total length will be approximately 1700 metres. – The new pipeline must be laid parallel to the existing pipeline and closely follow the existing alignment. – The selected pipe material for buried pipework is uPVC, ranging from 50mm to 250mm in diameter. – All interconnecting pipework is to be located within the existing boundary of the WTW. – In all cases, the existing pipework within the site and to Ogunjini Reservoir 1 must not be removed. • **Trenching and bedding:** – Staking of centreline by the surveying team.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.4	**Altering the beds, banks, characteristics of the watercourse (Continued from previous page…)**	– Removal and stockpiling of topsoil. – Excavation by earth moving equipment (backhoes and/or excavators) to specified depths. – Bedding (granular material) serves as a layer between the pipe and the underlying material. Geotechnical investigation report to indicate suitability of in-situ material for bedding; if unsuitable commercially sourced bedding material to be imported to site. – Bedding placement – Bedding for rising mains to be Class B as per SANS specifications for rigid pipework (SANS 1200 LB). – Bedding for interconnecting pipework between the structures will be class A in accordance to the SANS specifications for flexible pipework (SANS 1200 LB). – Where the pipe is to be placed underneath paved areas or tarred roads, material is only to be excavated to the exact width of the pipe trench and this material will be stored separately from other excavated materials. • **Backfilling and compaction:** – Backfilling is completed once the pipeline has been laid successfully. – The trench must be filled with suitable subsoil material and compacted to specify value with machinery, and topsoil must be replaced thereafter. – Leftover material (spoil) must be removed from site to a registered landfill or alternative suitable sites which have been vetted for spoil acceptance	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.5	**Handling of hazardous materials, solid waste & stockpiling**	• **Spill kits** are to be provided on site during all works to ensure that any spills are contained and managed appropriately. Regular monitoring of the site to ensure environmental safeguards are in place should be carried out as an ongoing task. • The construction contractor will be required to implement measures to be addressed the above as part of their environmental management plan for the weeks. • In line with the Environmental Best Specifications: Construction, for construction sites. Infrastructure upgrades and Maintenance Works, Edition 3, February 2005, some of the important elements during the construction phase are highlighted below. • **Stockpiling:** – If the stockpile material is in danger being washed away or blown away, Contactor shall spray it with Duster or cover it with suitable material such as plastic or Hessian. • **Solid Waste Management:** – No on-site dumping of waste materials, litter or refuse shall occur, as these could be washed into the stormwater drains. • **Hazardous Substance:** – If potential hazardous materials are to be stored on site, the contractor shall submit a method statement to the Engineer detailing the substances/ materials to be used, together with the transport, storage, handling and disposal procedures for the substances.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.5	**Handling of hazardous materials, solid waste & stockpiling (Continued from previous page…)**	• **Contaminated Water:** – Water containing pollutants such as chemicals, washing detergents, sewerage, fuels, paints and solvents and hydrocarbons shall be contained and discharged into an impermeable storage facility for removal from site. This particularly applies to runoff from fuel depots/ workshops/ truck washing areas. • **Cement and concrete batching:** – Cement shall not be mixed directly on the ground – The concrete batching works shall be kept neat and clean at all times. Unused cement bags are to be stored so as not to be affected by rain or runoff events. All visible remains of excess concrete shall be physically removed on completion of plaster or concrete work and disposed at an approved disposal site. All excess aggregate and sand shall also be removed. • **Fuels and oil storage:** – Fuels and oil storage areas must be at least 100m away from any drainage system inlets. Tanks onsite shall not be linked or joined via pipe work, but shall remain separate entities. Tanks shall be situated on a smooth impermeable base with a bund. Tanks and bunded areas shall be covered to prevent filling up with rain water.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.6	**Disruption of access to grazing areas**	• Selected workers must be given training on the possible fauna that may be encountered along the proposed route. • Site workers are to be informed of any sensitive fauna on the site prior to construction activities commencing and be informed that poaching or disturbance is strictly prohibited. • Under no circumstances shall any fauna be handled, removed, killed or interfered with by the Proponent, Project Manager, Resident Engineer, contractors, engineers, and their employees, including subcontractors or their subcontractors' employees. However, if construction activities are likely to injure, kill or interfere with any fauna encountered on the site, appropriate action must be taken to ensure their protection. • Any fauna found within the construction corridor must be moved to the closest point of natural or semi-natural vegetation outside the construction servitude. This includes those species perceived to be vermin (such as snakes and rats). The latter species may require the services of a specialist to catch and relocate dangerous/venomous species.	CO; ECO, ESO	Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.7	**Noise Pollution**	The noise generated by construction activities will be temporary and limited to the construction phase of the project • Working hours must be limited to day light only. • Noise related to the construction activities are to be scheduled to occur within prescribed normal working hours and must comply with the provisions of SABS 0400-1990 with respect to working hours. • In addition, construction vehicles and machinery should be fitted with the appropriate noise muffling devices and must be appropriately maintained so as to ensure that the machines and vehicles do not produce excessive noise disturbance. • Any complaints about noise must be attended to in a reasonable manner and the ECO informed of the complaint. • A complaints register should be maintained, in which any complaints regarding noise are noted.	CO, ESO	Monitor daily.

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.8.	**Dust Emissions**	• Emissions into the air can be minimised by ensuring regular maintenance of construction vehicles and equipment in order to reduce emission of exhaust fumes. • The application of best management practices for dust suppression will also aid in reducing air pollution. Dust control can be achieved by means of the periodic application of water to open sandy surfaces and to temporary dirt roads. • Loads could be covered to avoid loss of material in transport, especially if material is transported off site. • Dust and mud should be controlled at vehicle exit and entry points to prevent the dispersion of dust and mud beyond the site boundary. • Facilities for the washing of vehicles should be provided at the entry and exit points. • A speed limit of 40 km/hr should be set for all vehicles travelling over exposed areas. • During the transfer of materials, drop heights should be minimised to control the dispersion of mater being transferred.	CO; ECO, ESO	Monitor weekly.

C. CONSTRUCTION PHASE – SOCIAL IMPACTS

IMPACTS ASSOCIATED WITH THE PIPELINE CONSTRUCTION (SENSITIVE AREAS):

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	Heritage resources	**HERITAGE IMPACT ASSESSMENT 2017** • **Grave 1** This grave is located at 29° 35' 44.22" S; 30° 59' 4.50" E. It occupies an area of 2-meters x 3-meters and can be found 40-meters from the boundary of the pipeline. A buffer of 20-meters is proposed around the grave site. This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial. • **Grave 2** This grave is located at 29° 35' 38.28" S; 30° 58' 51.30" E. It occupies an area of 3-meters x 4-meters and can be found 30-meters from the boundary of the pipeline. A buffer of 20-meters is proposed around the grave site. This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial. • **Grave 3** This grave is located at 29° 35' 38.09" S; 30° 58' 50.04" E. It is demarcated by an unmarked shallow red brick wall that occupies an area of 1,5-meters x 2-meters and can be found 30-meters from the boundary of the pipeline. A buffer of 20-meters is proposed around the grave site. This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	**Heritage resources cont.…**	• **Grave 4** This grave is located at 29° 35' 35.34" S; 30° 58' 49.03" E. It is demarcated by brick wall and two metal gates that occupies an area of 2-meters x 2-meters and can be found 50-meters from the boundary of the pipeline. A buffer of 30-meters is proposed around the grave site. This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial. • **Grave 5** This grave is located at 29° 36' 12.84" S; 30° 58' 57.45" E. It is demarcated by an unmarked square concrete structure that occupies an area of 2-meters x 2,5-meters and can be found 30-meters from the boundary of the pipeline. A buffer of 20-meters is proposed around the grave site. This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial. • **Grave 6** This grave is located at 29° 36' 18.75" S; 30° 58' 55.67" E. It is marked and indicated by a grave head stone and structure that occupies an area of 2-meters x 3-meters and can be found 50-meters from the boundary of the pipeline. A buffer of 20-meters is proposed around the grave site. This buffer zone is to be respected by the developer and no alteration of the grave or features within the buffer zone is allowed. There is no need for grave exhumation and reburial.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	**Heritage resources cont.…**	• The developers must maintain a buffer zone around all the identified graves in the project area. Due to the proximity of graves 1, 2, 3, & 5 to the proposed pipeline trajectory a buffer zone of at least 20m must be maintained around these heritage features. A buffer zone of at least 30m must be maintained around graves 4 & 6. • If terrace fossils are discovered the HIA specialist and Palaeontologist or local heritage authorities must be informed as such finds will be highly significant. • It should, however, be pointed out that the KwaZulu-Natal Heritage Act requires that operations exposing archaeological and historical residues (including graves) as well as fossil material should cease immediately pending an evaluation by the heritage authorities.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.2.	**Socio-cultural Impacts**	• Phased, rather than indiscriminate clearing of the site to be undertaken. • Maintenance of buffers should be adhered to. • Warning signage should be placed around the site of development informing the public of construction activities. • All water bodies around the proposed development will not be affected as strict control measures have been enforced so as to protect any water body on-site/close proximity. • Construction workers should be alerted to the importance of not littering. Apart from the potential environmental impacts of littering, it is unsightly and has a negative visual impact. • Sufficient waste bins must be provided onsite and must be emptied regularly. • Any building rubble should not be allowed to accumulate onsite, but must at regular intervals be removed to a licensed landfill site or other licensed disposal site **(Shongweni Waste Solids Landfill Site is recommended)**.	CO, ESO	Monitor daily.

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.2.	**Socio-cultural Impacts (cont.…)**	• No construction staff must be permitted to trespass on private land. Any construction personnel found to be trespassing on private land must be immediately subjected to a disciplinary hearing; • Construction workers / construction vehicles must take heed of normal road safety regulations; thus, all personnel must obey and respect the law of the road. A courteous and respectful driving manner must be enforced and maintained so as not to cause harm to any individual; • A safe designated speed limit must be set by the project managers to limit possible road strikes and accidents. • Construction workers should not be permitted into sensitive environmental areas ('B' and 'C' Section channels and seep wetland).	CO	Monitor daily.

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.2.	**Socio-cultural Impacts (cont.…)**	• Should these impacts take place, it is only anticipated to most likely occur during the construction phase of the project. It is therefore advised that construction workers who are already housed within the Social Impact Zone of the proposed site, be employed as opposed to establishing temporary housing for workers. It is not advised that temporary workers assimilate with the local communities and suitable accommodation in larger centers should be considered. • To mitigate most of these impacts, the eThekwini Municipality should consider the establishment of a Community Monitoring Forum (CMF) to monitor the construction phase and the implementation of the recommended mitigation measures. The CMF should be established before the construction phase commences, and should include key stakeholders, including representatives from local communities, local councilors, affected landowners and the contractor(s). The CMF should also be briefed on the potential risks to the local community associated with construction workers. • To address any potential health impacts, it is advised that appointed contractor(s) devise and implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase. All permanent employees should receive basic HIV/AIDS awareness training at the onset of their employment.	PM, CO	Monitor when monthly

No.	IMPACT/ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.2.	**Socio-cultural Impacts (cont.…)**	• To address this impact, the establishment of accommodation in construction camps should be avoided as far as possible, by employing local labor and by providing transport to main city centers where required. • Transporting of employees may create the opportunity for SMME entrepreneurs to provide shift-time related transport on assigned routes. Consultation with the local taxi associations will be required to discuss options for co-operation. • It is, furthermore, recommended that the South African Police Services (SAPS) be used to monitor and assist with the management of the negative social effects of incoming job seekers and strangers. Local community policing forums should also be informed of the proposed project, construction and operational timeframes and the movement of construction workers (i.e. from place of transport to construction site). • The following measures are recommended: ◦ Establish a code of conduct for workers with strict control measures ◦ Require personnel to wear identification badges to distinguish them from trespassers or unwanted loiterers.	PM, CO	Monitor weekly.

No.	IMPACT/ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.2.	**Socio-cultural Impacts (cont.…)**	◦ Life orientation programmes, explaining the dangers of drug and alcohol abuse should be organised for workers by appointed contractor. ◦ Educate employees of the detrimental effects of drug and alcohol abuse. ◦ Require mandatory testing of all persons involved in accidents. ◦ Conduct tests for reasonable suspicion of substance abuse. ◦ Provide workers with organisation policies and procedures concerning substance abuse. • Provide materials that educate workers about what constitutes substance abuse.	PM, CO	Monitor weekly.

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.2.	**Socio-cultural Impacts (cont.…)**	• Construction related public health impacts due to possible air/dust pollution, noise pollution, light pollution and vibration should also be considered. The contractor should strive to abide by the abovementioned Act, in addition to international best practice guidelines • Furthermore, it is advised that the contractor ensure that everyone working at the construction site is competent at the work they do. They must be properly trained and have the experience and knowledge to work in a safe and responsible manner. • Areas of the project where there are health or safety hazards need to be marked and treated as danger areas. All people, other than those who have been specifically authorized to enter, must be excluded from such areas, for example by erecting warning signs and barriers. The barriers should clearly identify the boundary of the danger area and make entry impossible without a conscious effort.	PM, CO, ECO, ESO	Monitor daily.

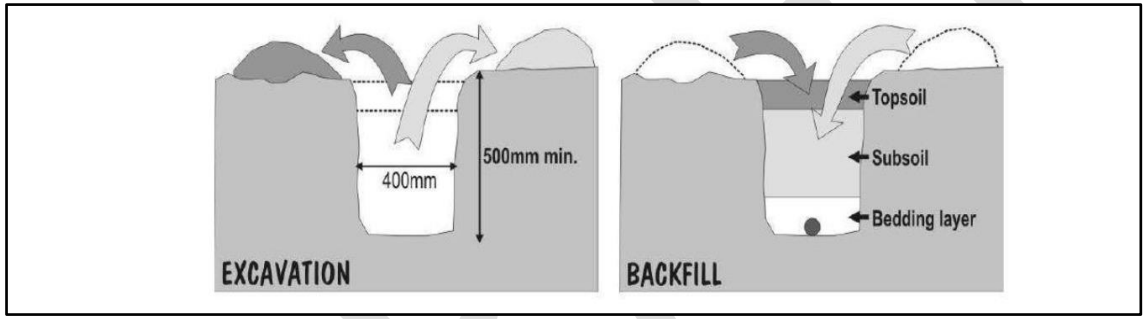
WATER TREATMENT WORKS AND ASSOCIATED INFRASTRUCTURE

B. CONSTRUCTION PHASE – BIOPHYSICAL IMPACTS

IMPACTS ASSOCIATED WITH THE WATER TREATMENT WORKS – ABSTRACTION FACILITES (SENSITIVE AREAS):

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.9	**Soil erosion & sedimentation of the watercourse**	**C-SECTION CHANNEL- WETLAND / RIPARIAN ASSESSMENT, 2017** • Long term attenuation measures are recommended in the design of the development and must include permeable paving; infiltration trenches or swales. • Do not allow surface water or storm water to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place. • Vegetation clearing must be undertaken only in the areas to be developed and must not extend outside of the development footprint or working corridor. **GEOTECHNICAL ASSESSMENT, 2017:** • Provision should be made to control surface run-off, so that it does not interfere with the stability of foundations by weakening or eroding the soils which underlie the site. • Surface drainage should be directed away from the crests of fill and cut embankments to prevent over-topping and erosion of the slopes.	CO; ECO, ESO	Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.9	**Soil erosion & sedimentation of the watercourse (cont.…)**	**SECTION C (MDLOTI RIVER) & RIPARIAN ZONES - AQUATIC ASSESSMENT, 2017:** • Attenuation of stormwater from the development site is important to reduce the velocity of runoff into the downstream river and riparian zone. • Attenuation measures during construction include but are not limited to - the use of sand bags, hessian sheets, silt fences, retention or replacement of vegetation and geotextiles such as soil cells which must be used in the protection of slopes. • Other mitigation options include: – Do not allow surface water or storm water to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place. – Vegetation clearing must be undertaken only in the areas to be developed and must not extend outside of the development footprint. Furthermore, vegetation clearing should be confined to the dry season to avoid high rainfalls transporting unsecured sediments down slope. – The pipeline will cross the seep system. The pipeline must stick to the planned route, where the existing pipe is located, where disturbance has already taken place. The pipeline must be buried at a sufficient depth so that it does not interfere with surface water movement leading to erosion; – Use existing tracks and roads to gain access to the work servitude as much as possible;	CO; ECO, ESO	Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.9	**Soil erosion and sedimentation (Continued from previous page…)**	**SECTION C (MDLOTI RIVER) & RIPARIAN ZONES - AQUATIC ASSESSMENT, 2017:** – When soil is excavated for the pipeline trench, the topsoil and subsoil must be separated. – In the event of infilling, replacement of subsoil must precede the topsoil replacement, and all material must be well compacted as depicted in the figure below.  **Figure 10:Showing an example of the method that must be employed during excavation and backfilling of soil.** – Disturbed sites must be rehabilitated as soon as construction in an area is complete or near complete and not left until the end of the project to be rehabilitated.	CO; ECO, ESO	Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.10	**Pollution of the water resources and soil**	**SECTION C (MDLOTI RIVER) & RIPARIAN ZONES - AQUATIC ASSESSMENT, 2017:** • All waste generated during construction is to be disposed of as per an Environmental Management Programme (EMPr) and washing of containers, wheelbarrows, spades, picks or any other equipment that has been contaminated with cement or chemicals in the Mdloti River must be strictly prohibited. • Proper management and disposal of construction waste must occur during the construction of the development. • Waste disposal during the operational phase must ensure no litter or other contaminants particularly chemicals stored on site are deposited in the water resource systems. • No release of any substance i.e. cement, oil, or any other substance that could be toxic to fauna or faunal habitats within the Mdloti River. • Spillages of fuels, oils and other potentially harmful chemicals must be contained and cleaned up immediately. Contaminants must be properly drained and disposed of using proper solid/hazardous waste facilities (never to be disposed of within the natural environment). Any contaminated soil must be removed and the affected area rehabilitated immediately.	CO; ECO, ESO	Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.11	**Alien invasive species encroachment**	**SECTION C (MDLOTI RIVER) & RIPARIAN ZONES - AQUATIC ASSESSMENT, 2017:** • Monitoring and removal of alien invasive species within any areas disturbed by the upgrade and operation of the WTW as well as the rising main, must be undertaken as part of the Environmental Management Programme. This requirement is in fulfilment of the terms of the National Environmental Management: Biodiversity Act. Areas which have been disturbed will be quickly colonised by invasive alien plant species.	CO; ESO ECO	Throughout development Monthly Audits

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.12	**Stormwater erosion control**	**C-SECTION CHANNEL & RIPARIAN ZONE:** • Stormwater erosion is one of the most challenging factors or Stormwater management as it happens quickly and destructively. With slopes in the study area being fairly steeply, surface runoff on bare soil could have negative impact in terms of transportation of erosion material to the receiving stream. Should erosion occur the eroded soil may need to be replaced and awareness is necessary not to use unsuitable soil which may have negative impact on the natural surrounds. • Sand bags/ straw bales may be used to prevent erosion during the construction phase before stabilising vegetation is established. Planting of rapidly growing grasses is recommended after construction to stabilise disturb soil and to retard sheet flow. • Significant reduction in Stormwater impact can be achieved by utilising a combination of improved construction practices and soil stabilisation techniques including: – Restricting access in areas of the site prone to erosion – Minimising disturbance and exposure of the soil – Careful siting of equipment and materials – Limiting use of chemicals – On site treatment of wash water • The stormwater networks must be designed and constructed in such a manner that storm water of a suitable quality should drain into the surrounding system.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.12	**Stormwater erosion control (Continued from previous page…)**	**C-SECTION CHANNEL & RIPARIAN ZONE:** • Cut-off catchwater berms should be constructed around the perimeter of the plant to channel stormwater generated from up catchment away from the plant. • Minimise the area to be cleared and keep as much of the area surrounding the road and associated infrastructure vegetated (preferably retain indigenous vegetation). Most importantly, maximise the buffer/ 'no-go' area surrounding the wetlands. • Removal of vegetation cover must be carried out with care and attention to the effect, whether temporary or long term, that this removal could have on erosion potential. • Stormwater must not be allowed to pond for extended periods in excavations. • Concrete lined storm water channels must discharge onto gabion mattresses upstream of any culverts, to mitigate and reduce velocities of storm water. • Any damage and loss of soil resulting from stormwater is to be remediated immediately. • After construction, any disturbed areas should be graded and revegetated to promote the infiltration of runoff and reduce the amount of sediment reaching the stream. • Drainage must be controlled to ensure that runoff from the site should not culminate in off-site pollution or cause water damage to properties and systems further down from the site. • The stormwater Management Plan should ensure that the ultimate flow from the development does not result in any negative impacts on the downstream properties or wetlands/ watercourses and must be therefore ensure that stormwater is managed within the overall site as effectively as possible.	CO; ESO ECO	Daily/ Weekly Monthly

IMPACTS ASSOCIATED WITH THE WATER TREATMENT WORKS – ABSTRACTION FACILITES (GENERAL):

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.13	**Soil disturbance from the earthworks**	• **Construction of fills and cuts** – No major earthworks are required to create level building platforms for the proposed new structures. It is recommended that all earthworks be carried out in accordance with SABS 1200. In general, it is recommended that any cut and fill embankments required have a maximum slope of 1 vertical to 1.7 horizontal to promote stability. Fills should be benched into the in situ residual soils. The benches should be approximately 2.0 m to 4.0 m wide and at least 1.0 m to 2.0 m deep. The need for subsoil drainage both beneath and in fills will have to be assessed during the earthworks, taking into account the height and locality of individual fills. – The in-situ materials on this site generally comprise variations of sands and silty to clayey sands. These materials generally classify as G7 to G10 quality and may be used as general fill. The fills should be placed in layers not exceeding 200 mm loose thickness, and compacted to a minimum of 95% Modified AASHTO maximum dry density. Boulders larger than 2/3 of the layer thickness must be spoiled. – Both during and after construction, the site should be well graded to permit water to drain readily away and to prevent ponding of water anywhere on the ground surface. All terraces and earthworks in general should be sloped to a gradient of not less than 1 vertical in 50 horizontals to prevent ponding and ingress of water into the subsoils. Surface drainage should be directed away from the crests of fill and cut embankments to prevent over-topping and erosion of the slopes.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.13	**Soil disturbance from the earthworks (Continued from the previous…)**	– Cut and fill slopes should be topsoiled and planted with grass with deep root systems such as vetiver. This will limit erosion of these slopes and the problems associated with washaways of fill embankments. • **Foundations:** – It is strongly recommended that Geomeasure Group inspect and approve in writing all foundation excavations to confirm depth of founding and bearing pressure. Foundation recommendations for each of the proposed structures are provided below. – **500kl SBS Clear Water Tank:** ◦ The main problem with reservoirs is their inability to tolerate differential settlement across the length of the structure. Reservoirs operate at full capacity most of the time and are susceptible to differential settlement if not uniformly founded. ◦ It is recommended that the clear water tank structure be founded on a reinforced concrete raft supported on a compacted soil raft foundation. The following procedure should be observed after the site has been excavated to final floor level: ◦ The in-situ soils beneath the structure should be undercut or boxed out to a minimum depth of 1.0m beneath the base. ◦ The area of excavation for this procedure should exceed the footprint of the structure on all sides by at least 1m. ◦ The exposed subgrade in the box cut should be ripped to at least 300 mm depth, wet and recompacted with eight passes of a heavy roller.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.13	**Soil disturbance from the earthworks (Continued from the previous…)**	◦ The 1.0 m thick backfill operation should comprise G6/G7 for the first 0.5 m compacted in layers to at least 95% MDD followed by a 0.5 m thick G5 material compacted to minimum 98% MDD. ◦ Thereafter the structure may be founded on a reinforced concrete raft supported on the soil raft. A maximum safe bearing pressure of 350 kPa can be adopted. • **Dehydrator and Skip Area:** – As the proposed dehydrator structure and concrete slab for the skip area are relatively light structures, it is considered that they may be supported on normal strip footings at a minimum depth of 0.9 metres below existing ground level. However, some ground improvement is recommended, as the underlying cohesionless sandy soils are loose in consistency. – The following procedure should be observed with regard to founding and construction: ◦ Remove in situ material below foundations to a depth and width of 1.5 times the foundation width or to a competent horizon and replace with suitable granular material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. ◦ Normal construction with lightly reinforced strip foundation and light reinforcement in masonry. – Alternatively, the structure / slab can be supported on stiffened strip footings or a stiffened or cellular raft, as follows:	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.13	**Soil disturbance from the earthworks (Continued from the previous…)**	◦ Foundations to comprise stiffened strip footings or stiffened or cellular raft with articulation joints or solid, lightly reinforced masonry. ◦ Bearing pressures not to exceed 50kPa. ◦ Fabric reinforcement in floor slabs. ◦ Site drainage and service / plumbing – **190 kl Sludge Holding Tank:** As with the clear water tank, it is recommended that the sludge holding tank structure be founded on a reinforced concrete raft supported on a compacted soil raft foundation. The following procedure should be observed after the site has been excavated to final floor level: – The in-situ soils beneath the structure should be undercut or boxed out to a minimum depth of 1.0 m beneath the base. – The area of excavation for this procedure should exceed the footprint of the structure on all sides by at least 1 m. – The exposed subgrade in the box cut should be ripped to at least 300 mm depth, wet and recompacted with eight passes of a heavy roller. – The 1.0 m thick backfill operation should comprise G6/G7 for the first 0.5 m compacted in layers to at least 95% MDD followed by a 0.5 m thick G5 material compacted to minimum 98% MDD.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.13	**Soil disturbance from the earthworks (Continued from the previous…)**	– Thereafter the structure may be founded on a reinforced concrete raft supported on the soil raft. A maximum safe bearing pressure of 350 kPa can be adopted. – **Complex of Clarifier, Pressure Tanks, Balancing Tank and Filter Plant Building:** – As the structures comprising the proposed complex of the clarifier, pressure tanks, balancing tank and filter plant building are also relatively light structures, it is considered that they may be supported on normal strip footings at a minimum depth of 0.9 metres below existing ground level. However, some ground improvement is recommended, as the underlying cohesionless sandy soils are loose in consistency. – The same procedures as for the dehydrator and skip area should be observed with regard to founding and construction. – **Stockpiling:** – If the stockpile material is in danger being washed away or blown away, Contactor shall spray it with Duster or cover it with suitable material such as plastic or Hessian.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.14	**Handling of hazardous materials, solid waste**	• **Spill kits** are to be provided on site during all works to ensure that any spills are contained and managed appropriately. Regular monitoring of the site to ensure environmental safeguards are in place should be carried out as an ongoing task. • The construction contractor will be required to implement measures to be addressed the above as part of their environmental management plan for the weeks. • In line with the Environmental Best Specifications: Construction, for construction sites. Infrastructure upgrades and Maintenance Works, Edition 3, February 2005, some of the important elements during the construction phase are highlighted below. • **Solid Waste Management:** – No on-site dumping of waste materials, litter or refuse shall occur, as these could be washed into the stormwater drains. • **Hazardous Substance:** – If potential hazardous materials are to be stored on site, the contractor shall submit a method statement to the Engineer detailing the substances/ materials to be used, together with the transport, storage, handling and disposal procedures for the substances.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.14	**Handling of hazardous materials, solid waste & stockpiling (Continued from previous page…)**	• **Contaminated Water:** – Water containing pollutants such as chemicals, washing detergents, sewerage, fuels, paints and solvents and hydrocarbons shall be contained and discharged into an impermeable storage facility for removal from site. This particularly applies to runoff from fuel depots/ workshops/ truck washing areas. • **Cement and concrete batching:** – Cement shall not be mixed directly on the ground – The concrete batching works shall be kept neat and clean at all times. Unused cement bags are to be stored so as not to be affected by rain or runoff events. All visible remains of excess concrete shall be physically removed on completion of plaster or concrete work and disposed at an approved disposal site. All excess aggregate and sand shall also be removed. • **Fuels and oil storage:** – Fuels and oil storage areas must be at least 100m away from any drainage system inlets. Tanks onsite shall not be linked or joined via pipe work, but shall remain separate entities. Tanks shall be situated on a smooth impermeable base with a bund. Tanks and bunded areas shall be covered to prevent filling up with rain water.	CO; ESO ECO	Daily/ Weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.15.	**Noise Pollution**	The noise generated by construction activities will be temporary and limited to the construction phase of the project • Working hours must be limited to day light only. • Noise related to the construction activities are to be scheduled to occur within prescribed normal working hours and must comply with the provisions of SABS 0400-1990 with respect to working hours. • In addition, construction vehicles and machinery should be fitted with the appropriate noise muffling devices and must be appropriately maintained so as to ensure that the machines and vehicles do not produce excessive noise disturbance. • Any complaints about noise must be attended to in a reasonable manner and the ECO informed of the complaint. • A complaints register should be maintained, in which any complaints regarding noise are noted.	CO, ESO	Monitor daily.

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
B.16.	**Dust Emissions**	• Emissions into the air can be minimised by ensuring regular maintenance of construction vehicles and equipment in order to reduce emission of exhaust fumes. • The application of best management practices for dust suppression will also aid in reducing air pollution. Dust control can be achieved by means of the periodic application of water to open sandy surfaces and to temporary dirt roads. • Loads could be covered to avoid loss of material in transport, especially if material is transported off site. • Dust and mud should be controlled at vehicle exit and entry points to prevent the dispersion of dust and mud beyond the site boundary. • Facilities for the washing of vehicles should be provided at the entry and exit points. • A speed limit of 40 km/hr should be set for all vehicles travelling over exposed areas. • During the transfer of materials, drop heights should be minimised to control the dispersion of mater being transferred.	CO; ECO, ESO	Monitor weekly.

C. CONSTRUCTION PHASE - SOCIAL IMPACTS

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	**Socio-cultural Impacts**	• Phased, rather than indiscriminate clearing of the site to be undertaken. • Maintenance of buffers should be adhered to. • Warning signage should be placed around the site of development informing the public of construction activities. • All water bodies around the proposed development will not be affected as strict control measures have been enforced so as to protect any water body on-site/close proximity. • Construction workers should be alerted to the importance of not littering. Apart from the potential environmental impacts of littering, it is unsightly and has a negative visual impact. • Sufficient waste bins must be provided onsite and must be emptied regularly. • Any building rubble should not be allowed to accumulate onsite, but must at regular intervals be removed to a licensed landfill site or other licensed disposal site **(Shongweni Waste Solids Landfill Site is recommended)**.	CO, ESO	Monitor daily.

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	**Socio-cultural Impacts (cont.…)**	• No construction staff must be permitted to trespass on private land. Any construction personnel found to be trespassing on private land must be immediately subjected to a disciplinary hearing; • Construction workers / construction vehicles must take heed of normal road safety regulations; thus, all personnel must obey and respect the law of the road. A courteous and respectful driving manner must be enforced and maintained so as not to cause harm to any individual; • A safe designated speed limit must be set by the project managers to limit possible road strikes and accidents. • Construction workers should not be permitted into sensitive environmental areas ('B' and 'C' Section channels and seep wetland).	CO	Monitor daily.

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	**Socio-cultural Impacts (cont.…)**	• Should these impacts take place, it is only anticipated to most likely occur during the construction phase of the project. It is therefore advised that construction workers who are already housed within the Social Impact Zone of the proposed site, be employed as opposed to establishing temporary housing for workers. It is not advised that temporary workers assimilate with the local communities and suitable accommodation in larger centers should be considered. • To mitigate most of these impacts, the eThekwini Municipality should consider the establishment of a Community Monitoring Forum (CMF) to monitor the construction phase and the implementation of the recommended mitigation measures. The CMF should be established before the construction phase commences, and should include key stakeholders, including representatives from local communities, local councilors, affected landowners and the contractor(s). The CMF should also be briefed on the potential risks to the local community associated with construction workers. • To address any potential health impacts, it is advised that appointed contractor(s) devise and implement an HIV/AIDS awareness programme for all construction workers at the outset of the construction phase. All permanent employees should receive basic HIV/AIDS awareness training at the onset of their employment.	PM, CO	Monitor when monthly

No.	IMPACT/ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	**Socio-cultural Impacts (cont.…)**	• To address this impact, the establishment of accommodation in construction camps should be avoided as far as possible, by employing local labor and by providing transport to main city centers where required. • Transporting of employees may create the opportunity for SMME entrepreneurs to provide shift-time related transport on assigned routes. Consultation with the local taxi associations will be required to discuss options for co-operation. • It is, furthermore, recommended that the South African Police Services (SAPS) be used to monitor and assist with the management of the negative social effects of incoming job seekers and strangers. Local community policing forums should also be informed of the proposed project, construction and operational timeframes and the movement of construction workers (i.e. from place of transport to construction site). • The following measures are recommended: ◦ Establish a code of conduct for workers with strict control measures ◦ Require personnel to wear identification badges to distinguish them from trespassers or unwanted loiterers.	PM, CO	Monitor weekly.

No.	IMPACT/ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	**Socio-cultural Impacts (cont.…)**	◦ Life orientation programmes, explaining the dangers of drug and alcohol abuse should be organised for workers by appointed contractor. ◦ Educate employees of the detrimental effects of drug and alcohol abuse. ◦ Require mandatory testing of all persons involved in accidents. ◦ Conduct tests for reasonable suspicion of substance abuse. ◦ Provide workers with organisation policies and procedures concerning substance abuse. • Provide materials that educate workers about what constitutes substance abuse.	PM, CO	Monitor weekly.

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
C.1.	**Socio-cultural Impacts (cont.…)**	• Construction related public health impacts due to possible air/dust pollution, noise pollution, light pollution and vibration should also be considered. The contractor should strive to abide by the abovementioned Act, in addition to international best practice guidelines • Furthermore, it is advised that the contractor ensure that everyone working at the construction site is competent at the work they do. They must be properly trained and have the experience and knowledge to work in a safe and responsible manner. • Areas of the project where there are health or safety hazards need to be marked and treated as danger areas. All people, other than those who have been specifically authorized to enter, must be excluded from such areas, for example by erecting warning signs and barriers. The barriers should clearly identify the boundary of the danger area and make entry impossible without a conscious effort.	PM, CO, ECO, ESO	Monitor daily.

D. POST CONSTRUCTION PHASE

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
D.1.	**Water resource management**	• Stockpiles must be used to rehabilitate the wetland and 'B' Section channel areas • The stockpiles must be free of waste and contaminants • Disturbed sites must be rehabilitated as soon as construction in an area is complete or near complete and not left until the end of the project to be rehabilitated • Rehabilitate and revegetate river areas as soon as work is complete • The landscape profile will need to be restored, matching as closely as possible to the original land form prior to the distribution of the banks/river • All banks and areas disturbed by the works shall be re-vegetated	Engineer; Contractor	The Engineer & Contractor must monitor the site on a regular basis.

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
D.2.	**Pollution Control Structures**	• Excavate all areas of contaminated substrate, transfer the contaminated substrate to an appropriate disposal site and treat the affected areas with appropriate ameliorants. • Remove all plastic linings used for pollution control and transfer to an appropriate disposal site. • Break up all concrete structures that have been created (e.g. working and parking surfaces) and remove concrete waste to an appropriate disposal site. • The camp site must be top soiled, re-grassed, and graded to reduce surface run-off. • Indigenous grasses must be used which are suitable to the area.	Engineer; Contractor	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
D.2.	**Waste removal/ disposal**	• Remove all leftover construction materials from the storage area and construction site and either sell, auction, donate to the local community or transfer to the Contractor's base. • Drain all collection sumps and dispose of the contaminated liquid and solids at an approved disposal site. • Remove all construction debris, litter and domestic waste from the construction site and transfer to an appropriate disposal site. • Remove all waste receptacles and either donate to the local community, auction, or transfer to Contractor's base. • Burying of rubble on site, or dumping in any watercourse is prohibited. A check must be done by the contractor before the site is handed over to the applicant. The contractor is to check that the stormwater channels and the drainage pipes are free from building rubble, spoil materials and waste materials. • Surfaces are to be checked for waste products from activities such as concreting or asphalting and cleared in a manner approved by the ECO.	Contractor and ECO	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
D.3.	**Materials and Infrastructure**	• Fences, barriers and demarcations associated with the construction phase are to be removed from the site unless stipulated otherwise by the Engineer. • All residual stockpiles must be removed to spoil or spread on site as directed by the Engineer. • All leftover building materials must be returned to the depot or removed from the site. • The Contractor must repair any damage that the construction works has caused to neighboring properties.	Contractor	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
D.4.	**Alien Vegetation**	• All areas that have been disturbed by construction activities (including the construction camp area) must be cleared of alien vegetation. • Existing and newly established alien vegetation must be removed from the property and replaced, where necessary, with suitable indigenous / endemic plant species. During this process, it is imperative that indigenous vegetation is not removed or disturbed. • All vegetation that has been cleared during construction is to be removed from site or used as much as per the re-vegetation specification, (except for seeding alien vegetation).	Contractor and ECO	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
D.5.	**Alien Plant Control**	**Best practice measures that should be undertaken during clearing include the following:** 1. Cut plants as low to ground as possible. 2. All alien plants must be removed carefully and exposed soil should be covered with cut vegetation or leaf litter that is free of weed seeds to ensure that re-growth will not occur. 3. Press any loosened soil down carefully and firmly and mulch with plant material where possible. 4. All alien seeds, fruit bulbs, tubers and stems must be collected and placed in a sealable container/plastic bag for disposal at a landfill site. 5. The roots system of mature trees including alien invasive play an important role in stabilizing soil and therefore the up-rooting of large mature specimen of trees is not advocated. It is better to fell the trees and paint the stump with the relevant herbicides. **<u>Hand pulling / hoeing</u>** • Hand pulling is most effective with small (30cm), immature or shallow rooted plants. • Shake the excess sandy material from the plant, this makes the plant easier to stockpile and lighter to transport. • However, make sure there is no seed on the plant first to eliminate the spread of seed while shaking.	Contractor	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
D.5.	Alien Plant Control (Continued from previous page)	**Chopping / Cutting / Slashing** • This method is most effective for plants in the immature stage, or for plants that have relatively woody stems/ trunks. • This is an effective method for non-re-sprouters or in the case of re-sprouts (coppicing) it must be done in conjunction with chemical treatment of the cut stumps. • Cut/slash the stem of the plant as near as possible to ground level. • Stockpile removed material into piles as prescribed. **Ring barking** • Remove bark in a 30-40cm centimetre band and leave the tree to die. • Can be used with or without chemicals but is more successful when herbicide is used. **Tree Felling** • De-branch trees and where possible remove all material. • Where possible large trees that are to be felled, such that they fall uphill. • Cut the tree down as low as possible to the ground. • Apply herbicide immediately (no later than 30mins) to the cambium layer. • Ensure all the cuts in the cambium layer are treated	Contractor	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
D.6.	**General**	• A meeting is to be held on site between the Engineer, ECO and the Contractor to approve all remediation activities and to ensure that the site has been restored to a condition approved by the Engineer. • Temporary roads which were used during the construction phase must be closed and access across these blocked. • All areas where temporary services were installed are to be rehabilitated to the satisfaction of the Engineer. Once rehabilitation has been carried out in accordance with procedure agreed upon by all parties, a post-construction audit must take place to ensure final compliance. The Contractor must rectify any non-compliance found by the audit, prior to vacating the site.	Contractor, Engineer and ECO	Weekly till completion of construction activities

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
D.7	**Stormwater management**	**C-SECTION CHANNEL & RIPARIAN ZONE – STORMWATER MANAGEMENT PLAN, 2017:** • Stormwater to be channelled by means drainage pipes which discharge at the nearest water body.	**Engineer**	**Annually**

E. REHABILITATION PHASE

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
E.1	**Soil erosion & sedimentation of the watercourse**	**B-SECTION CHANNEL & RIPARIAN ZONE - METHOD STATEMENT, 2017:** • Rehabilitate and revegetate river areas as soon as work is complete. • The landscape profile will need to be restored, matching as closely as possible to the original land form prior to the distribution of the banks/river. • All banks and areas disturbed by the works shall be re-vegetated. • Revegetated shall be monitored, and where it does not occur, the contractor is to return and revegetate again. • 80% covered should be achieved from revegetation methods.	Contractor	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
E.2.	**Construction Camp Rehabilitation**	• All structures temporally constructed within the construction camp are to be removed. • Disassemble all infrastructure units and remove components from the working and storage areas. This will include temporary office and storage structures and containers, water supply pipelines, water storage containers, waste storage containers, power supply, etc. • Drain all portable chemical toilets, with no spillage of the contents. Transfer the contents to an appropriate disposal site (Shongweni Waste Solids Landfill Site). • Disassemble all fencing around the camp and either sell, auction or donate the components to the local community or transfer the waste components to a disposal site or the contractors base.	Contractor	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
E.2.	**Re-Vegetation**	• All areas of bare soil must be re-vegetated and rehabilitated. Open areas are to be re-planted as per the re-vegetation specification. • Only indigenous species should be used for landscaping. No exotic plants are to be introduced. • It is important that the re-vegetation activities be planned in advance to ensure that seed and plant stockiest are able to supply the required volume when required. Only indigenous and preferably endemic plant species will be permitted on site. • The contractor is to water and maintain all planted vegetation until the end of the defects liability period and is to submit a method statement regarding this to the Engineer.	Contractor and ECO	Weekly

NO.	ASPECT	ACTION REQUIRED	RESPONSIBLE PARTY	MONITORING FREQUENCY
E.3.	**Land Rehabilitation**	• All surfaces hardened due to construction activities are to be ripped and imported materials thereon removed. • All rubble is to be removed from the site to an approved disposal site or approved by the Engineer. • Burying of rubble on site is prohibited. Surfaces are to be checked for waste products from activities such as concreting or asphalting and cleared in a manner approved by the Engineer. • All embankments are to be trimmed, shaped and replanted to the satisfaction of the Engineer.	Contractor and ECO	Weekly

F. OPERATIONAL PHASE – BIOPHYSICAL IMPACTS

IMPACTS ASSOCIATED WITH THE PIPELINE (SENSITIVE AREAS):

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
F.1	**Degradation of wetlands**	**SEEP WETLAND & RIPARIAN ZONE – WETLAND REPORT, 2017:** • Attenuation of stormwater from the development site is important to reduce the velocity of runoff into the downstream river and riparian zone. • Do not allow surface water or storm water to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place.	CO; ESO ECO	Daily/ weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
F.2	**Pollution of water resources and soil**	**B- SECTION CHANNEL, SEEP WETLAND & RIPARIAN ZONES – WETLAND REPORT, 2017:** • Waste disposal during the operational phase must ensure no litter or other contaminants particularly chemicals stored on site are deposited in the water resource systems. • No release of any substance i.e. cement, oil, or any other substance that could be toxic to fauna or faunal habitats within the Mdloti River. • Spillages of fuels, oils and other potentially harmful chemicals must be contained and cleaned up immediately. Contaminants must be properly drained and disposed of using proper solid/hazardous waste facilities (never to be disposed of within the natural environment). Any contaminated soil must be removed and the affected area rehabilitated immediately.	CO; ESO ECO	Daily/ weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
F.3	**Alien invasive species encroachment**	**B- SECTION CHANNEL, SEEP WETLAND & RIPARIAN ZONES – WETLAND REPORT, 2017:** • Monitoring and removal of alien invasive species within any areas disturbed by the upgrade and operation of the WTW as well as the rising main, must be undertaken as part of the Environmental Management Programme. This requirement is in fulfilment of the terms of the National Environmental Management: Biodiversity Act. Areas which have been disturbed will be quickly colonised by invasive alien plant species.	CO; ESO ECO	Daily/ weekly Monthly

IMPACTS ASSOCIATED WITH THE WATER TREAMENT WORKS- ABSTRACTION WORKS ONLY (SENSITIVE AREAS):

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
F.4	**Degradation of wetland system**	**C-SECTION CHANNEL, SEEP WETLAND & RIPARIAN ZONES – AQUATIC ASSESSMENT, 2017:** • As very little work is being carried out within the river and the majority of the upgrade is confined to the already modified WTWs footprint mitigation options will focus solely on the installation of the abstraction pipe. • All work within the river and along the river banks must be done by hand. No heavy machinery should be permitted to work within the river. • As no construction methodology was supplied for the impact assessment when one is available it will need to be assessed by a qualified aquatic ecologist prior to implementation.	CO; ESO ECO	Daily/ weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
F.5	**Degradation of wetland system (Continued from previous page)**	• Sediment traps will need to be deployed before any work is conducted within the river and these will need to remain in place for the duration of that river construction. • A temporary berm must be constructed to prevent the surface water transport of sediments into the aquatic environment.	CO; ESO ECO	Daily/ weekly Monthly

No.	IMPACT/ ACTIVITY	MITIGATION/ACTION REQUIRED	RESPONSIBLE PARTY	FREQUENCY
F.6	**Pollution of water resources**	**C-SECTION CHANNEL, SEEP WETLAND & RIPARIAN ZONES – AQUATIC ASSESSMENT, 2017:** • Waste disposal during the operational phase must ensure no litter or other contaminants on site are deposited in the aquatic environment. • No release of any substance i.e. cement or oil, that could be toxic to fauna or faunal. • Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil must be removed and the affected area rehabilitated immediately.	CO; ESO ECO	Daily/ weekly Monthly

CONCLUSION

It is the project proponents' responsibility to ensure that this EMP is made binding on the contractor by including the EMP in the contract documentation. The contractor should thoroughly familiarise himself with the requirements of the EMP and appoint an Environmental Site Officer (ESO) to oversee the implementation of the EMP on a day-to-day basis. Parties responsible for transgression of this EMP should be held responsible for any rehabilitation that is deemed necessary. Parties responsible for environmental degradation through irresponsible behaviour/negligence should incur penalties and remedial action must be taken immediately. Monthly environmental audits should be undertaken by an independent ECO. These site audits will be documented in an Audit Report which should be submitted to the competent authority.

APPENDIX A – COMPLAINTS REGISTER

The following table must be completed for each reported complaint. All complaints received must be investigated and a response (even if pending further investigation) is to be given to the complainant within 7 days. Add pages as necessary.

TIME & DATE	CONTACT DETAILS OF COMPLAINANT	NATURE OF COMPLAINT	INVESTIAGTION UNDERTAKEN

APPENDIX B – ENVIRONMENTAL INCIDENT REPORTING

All environmental incidents occurring on the site must be recorded in the following table. Add pages as necessary.

DATE & TIME	LOCATION & NATURE OF INCIDENT	ACTION TAKEN

APPENDIX C – SPILL CONTINGENCY PLAN

Name, address and job title of the owner or person in charge, management or control.

NAME_____

_____

ADDRESS_____

_____

_____

JOBTITLE_____

_____

_____

Name, job title and 24-hour telephone number for the persons responsible for activating the spill contingency plan.

NAME_____

_____

JOBTITLE_____

_____

_____

24-HOUR TELEPHONE NUMBER_____

A description of the facility, including - location, size and storage capacity

_____

_____

_____

_____

_____

_____

_____

_____

A description of the type and amount of contaminants normally stored at the location.

Reporting is the notification of all parties involved. This can include internal as well as external reporting procedures. A description of a public reporting procedure used to alert anyone who may be affected by the spill is required.

REPORTING

Clean-up is the removal of the contaminant from the environment. This should consider the possible scenarios or spill incidents that could occur at the facility including a worst case scenario.

Disposal is the treatment of the contaminant such that it is no longer a threat to the environment. Contingency plans must contain appropriate disposal procedures for the materials stored at the facility.

The means by which the spill contingency plan is activated (i.e. procedures to activate appropriate response equipment and personnel).

A description of the training provided to employees to respond to a spill. A sound training program is necessary when dealing with an emergency situation. This program should include knowledge and the use of any response equipment.

APPENDIX D – SPECIALIST STUDIES

APPENDIX D1: AQUATIC IMPACT ASSESSMENT