Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
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Dear Interested and Affected Party / Stakeholder,

RE: Distribution and Public Review of the Draft BAR for the Proposed Inanda Glebe Sewer Reticulation Project, Located within the eThekwini Municipality, KwaZulu-Natal.

The required Environmental Authorisation (Basic Assessment Process) for the Proposed Inanda Glebe Sewer Reticulation Project, Located within the eThekwini Municipality, KwaZulu-Natal

As per EIA Regulation GNR 326, April 2017 the Draft BAR is provided for public review and comment for a 30-day period. ***Kindly note that when a State Department is requested to comment in terms of the EIA Regulations, 2017, such a State department must submit its comments in writing within 30 days from the date on which it was requested to submit comments and if such a State department fails to submit comments within such 30 days, it will be regarded that such a State department has no comments.*** All comments received will be responded to and included in the Final version of the Basic Assessment Report, which will be submitted to the KZN DEDTEA for review and decision-making.

Closing Date – 22 April 2018

Enclosed please find a copy of the Draft Basic Assessment with appendices that include the specialist studies completed and the Environmental Management Plan (EMP) prepared.

Should there be any further enquiries please contact Roschel Maharaj on roschel@1wc.co.za or by using the numbers provided.

Yours faithfully,

Fatima Peer B.Sc. (Hons) Pr. Sci. Nat., IAIASA

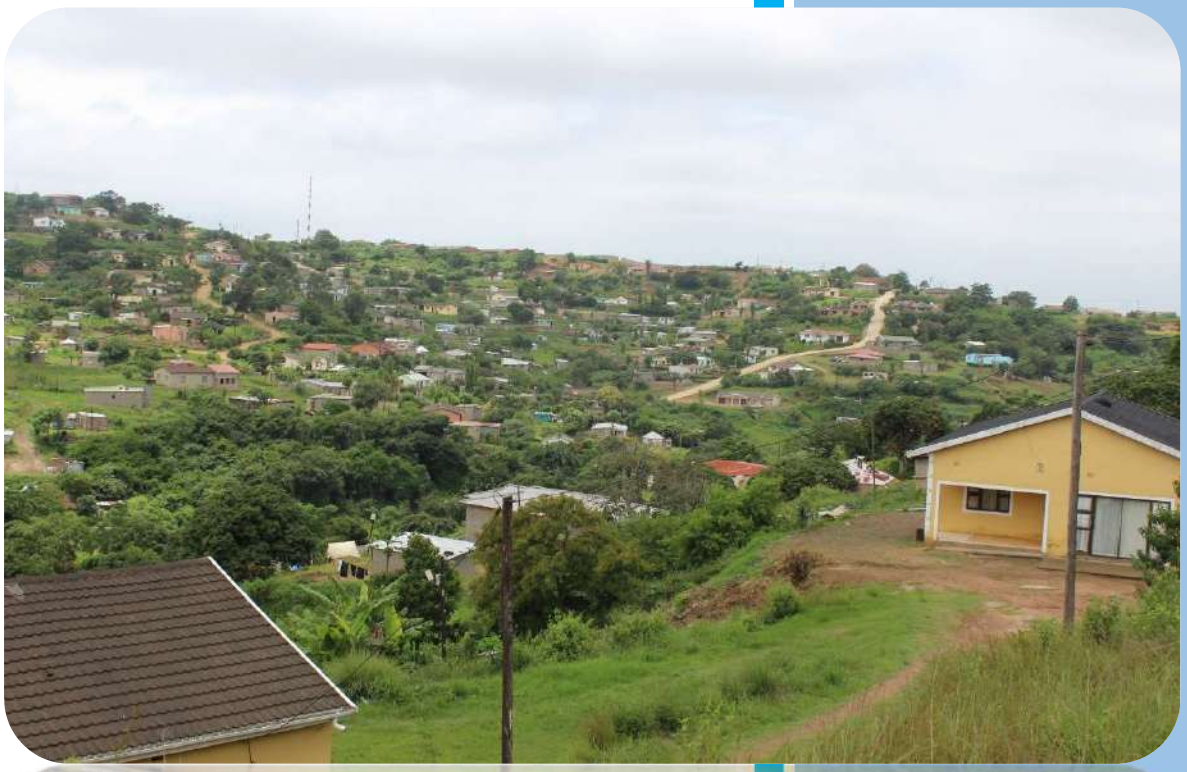
Director (Environmental Services), Senior EAP

EIA REF. NO.: DM/0004/2018

DRAFT BASIC ASSESSMENT REPORT

PROPOSED INANDA GLEBE SEWER RETICULATION PROJECT, LOCATED WITHIN THE ETHEKWINI MUNICIPALITY, KWAZULU-NATAL

[March 2018]



Prepared by:

1World Consultants (Pty) Ltd

P. O. Box 2311, Westville, 3630

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Contact: Fatima Peer

Email: fatima@1wc.co.za

Commissioned by:

eThekwini Municipality

Water & Sanitation Department

3 Prior Rd, Durban, 4001

Contact: Precious Mbhele

Email: precious.mbhele@durban.gov.za

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DRAFT BASIC ASSESSMENT REPORT

For the Proposed Inanda, Glebe Sewer Reticulation within the eThekwini Municipality

EIA Ref No.: DM/0004/2018

Verification Page			Rev 1
Report No. ENV17041	February 2018	Status	Draft
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Verification	Capacity	Name	Signature	Date
Author	EAP	Roschel Maharaj		08 January 2018
Reviewed by	EAP	Adila Gafoor		14 February 2018
Approved by	Project Manager	Fatima Peer		19 February 2018

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Executive Summary

1World Consultants (Pty) Ltd have been appointed by eThekwini Municipality Water and Sanitation (EWS) Department, to undertake the required Basic Assessment (BA) Process for the proposed Inanda Glebe Sewer Reticulation Project which proposes the construction of a 13km, 160mm diameter, HDuPVC sewer reticulation and numerous 1000mm diameter precast concrete ring manholes in Inanda Glebe, Inanda, KwaZulu-Natal. The reticulation will be situated in Ward 44 of the municipality, approximately 24km from Durban.

As a water and sanitation supplier for eThekwini Municipality, EWS is responsible for the provision of water and sanitation services, including the construction and maintenance of relevant infrastructure. The eradication of the current backlog of provision of services is crucial for EWS. In this regard, the proposed reticulation will be constructed. Thus, the project comprises the construction of sewer reticulation infrastructure which will aid in servicing the Inanda Glebe community. The proposed project will help to minimise sewage spillage and it should therefore result in improved surface and sub surface water quality. The proposed project will also enable additional housing projects to occur in the area as well as improve the local water quality.

The proposed development forms part of Phase 2, with Phase 1 incorporating the installation of a Sewer Outfall in the Ntuzuma E location, situated South of Inanda Glebe. The reticulation will feed into the Ntuzuma E Sewer Outfall located at approximately 29°43' 19.36" S; 30° 55' 04.93" E. The reticulation itself triggers the need for a Basic Assessment since it will traverse identified wetlands. The route for the proposed reticulation has been assessed based on a working servitude of 5m during construction activities for the 13km length.

The preferred route alternative runs along a combination of roads within a semi-rural residential area. The area is encompassed by built up residential areas and other privately-owned settlements. The route is in areas of disturbance and transformation by human impacts. In addition to this, the area is highly polluted and environmentally degraded. The sewage infrastructure project involves the construction of an approximately 13km long, 160mm diameter HDuPVC reticulation that will transfer sewage from the Inanda, Glebe area to the Ntuzuma E sewer outfall. Sections of the reticulation will pass through individual properties as well as intersect two wetlands and run parallel to a third.

The impacts of the establishment of the sewage infrastructure focused mostly on the impacts of traversing a wetland as this triggered the need for a Basic Assessment, with impacts of the remainder of the project (outside of the wetland) also being considered. Additionally, impacts on Biodiversity and Heritage aspects were also deliberated and this report now provides all required information to advise on the applied environmental authorisation from KZN EDTEA. Some key impacts are:

- Loss of biodiversity
- Erosion
- Traffic and access
- Hydrological Impact of temporary alteration of stream flow and disturbance of stream bed due to construction activities
- Pollution due to site operations
- Disturbance to residential area by noise and dust from construction process
- Air quality degradation as a result of dust and odours.
- Visual impacts
- Waste and litter
- Damage to existing services
- Injury to local people and construction workers
- Disturbance to existing infrastructure and impact on Heritage resources
- Socio-economic impacts

Specialist studies were conducted to aid in a thorough investigation of the impacts and included:

- **A Wetland Delineation** by Aeon Nexus (Pty) Ltd to determine the impact the proposed development will have on watercourses;
- **A Heritage Impact Assessment** by JLB Consulting to ensure that no items of cultural or historical value would be impacted on by the construction;
- **A Geotechnical Study** by Drennan Maud (Pty) Ltd to assess the prevailing geological and geotechnical conditions throughout the project area; and
- **A Biodiversity Study** by 1World Consultants (Pty) Ltd to assess, identify and record the presence of any protected fauna and flora.

A wetland delineation field survey was undertaken to accurately delineate the boundaries of the wetland and river riparian environments within the 500m buffer surrounding the site. A total of eleven (11) wetland systems were identified and delineated and one river riparian system was mapped within the 500m buffer surrounding the site. HGM's 1, 2 and 3 as well as river riparian 1 will be impacted directly by the proposed sewer reticulation as these are all located within the proposed sewer reticulation site. Buffer zones are areas of vegetation around the wetland boundaries which function as protection to the wetland from developmental or land use changes. A 25m buffer around HGM's 1, 2 and RR 1 is required and a 32m buffer is required for HGM 3.

No fatal flaws were identified by the Specialist Studies. Tree removal permits may be required and an inspection prior to construction must be undertaken to confirm. A Water Use License Application, was undertaken during Phase 1 of the project (i.e. Ntuzuma E Outfall) since the project involves excavation of the bed and banks of the wetlands it is traversing. Due to the urgent need to provide internal sewer reticulation to the Inanda Glebe and Ntuzuma E areas, the Department of Water and Sanitation (DWS) has granted a directive in terms of Section 19(1) and (2) of the National Water Act, 1998 (Act 36 of 1998) for the construction of Ntuzuma E sewer outfall and provision of internal sewer reticulation for Inanda Glebe and Ntuzuma E.

Mitigation measures to minimise or eliminate impacts were identified by the specialists and EAP which were utilised towards the preparation of the Environmental Management Plan (EMP). The EMP must be read in conjunction with this BAR and is essential towards the protection of the environmental elements whilst establishing the water infrastructure.

A Public Participation Process (PPP) to review the BAR and EMP involved consultation with the relevant authorities, the landowners affected along the way, community leaders and other identified Interested and Affected Parties (I&APs). Newspaper advertisements were published to inform the general public of the Basic Assessment Process. An advertisement was published in Isizulu on 23 March 2018 in the eThekwini Times newspaper. Site notices were erected at the site on 15 March 2018 and notification letters were distributed via hand delivery. A public meeting was not requested or held prior to the distribution of the Draft BAR.

This BAR has been prepared in Accordance with the EIA Regulations, 2017 and follows the requirements for a BAR in Appendix 1 of GNR 326.

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Double sided printing saves paper!

1. INTRODUCTION

1World Consultants (Pty) Ltd has been appointed as the independent Environmental Assessment Practitioner (EAP), by eThekwini Water and Sanitation (EWS), to undertake the Basic Assessment Process for the proposed Inanda Glebe Sewer Reticulation Project. This project proposes the construction of a 13km, 160mm diameter, HDuPVC sewer reticulation and numerous 1000mm diameter precast concrete ring manholes, in Inanda Glebe, eThekwini Municipality, KwaZulu-Natal. The purpose of this sewer reticulation project is to upgrade facilities in the area with the aim of eliminating pit latrines by constructing new waterborne sewage systems.

Table 1 below provides project specific details for the proposed sewer reticulation.

Table 1:Project Specifications

	Inanda Glebe Sewer Reticulation
Ward	44
Property Description	Middle/low income residential
Pipeline Specifications	13km long, 160mm Ø, max of 1200mm trench width, 1m trench depth, 5m construction servitude
Development Final Footprint	Length x breadth = 13 000m long x 3m wide = 39 000m^2

As per GNR 327 and 324 of the EIA Regulations, 2017, a Basic Assessment (BA) Process has been undertaken. All the environmental outcomes, impacts and residual risks of the proposed Listed Activity being applied for have been noted in this BA Report and assessed accordingly by the EAP. The requirements of the BA Process have been followed as per Appendix 1 of GNR 326 (2017) and are consequently adhered to in this report.

It must be noted that the Listed Activities in terms of GNR 327 of the 2017 EIA Regulations are applicable to this proposed project and will trigger activities in both the construction and operational phases. This BA Report focuses on the potential impacts that may arise during the construction and operational phases and provides recommended mitigation measures.

Ultimately, the outcome of a BA Process must be to provide the Competent Authority, the Department of Economic Development, Tourism and Environmental Affairs (EDTEA), with sufficient information to provide an informed decision on the Application, in terms of Environmental Authorisation (EA), in order to avoid or mitigate any detrimental impacts that the activity may inflict on the receiving environment.

1.1. Background

The Inanda Glebe area is located in the North of Durban. The proposed Inanda Glebe sewer reticulation project is situated approximately 970m away from the suburb of Soweto, located within the eThekwini Municipality, in an easterly direction and approximately 1.2km away from Ntuzuma in a south-easterly direction. The area of the study site is approximately 61.8Ha and is surrounded by several unauthorised middle to low income residential dwellings without waterborne sewage. The residents in these areas have constructed pit latrines for sanitation purposes. The lack of formal sewer infrastructure in this area poses severe health and safety hazards. An Environmental Authorisation was granted for the Ntuzuma E Sewer Outfall project 2010, the outfall sewer to which the reticulation will drain.

Refer to Appendix A for the Environmental Authorisation for Ntuzuma E sewer outfall.

A Directive in terms of Section 19 (1) and (2)(B) of the National Water Act, Act 36 of 1998 has been granted for both the Inanda Glebe and Ntuzuma outfall projects. It is understood that the directive intends to improve the status quo of the sewer system within the area in order to minimise the impact on the environment and human health.

Refer to Appendix A for a copy of the Directive.

A pre-application meeting was held on 22/09/2017 with officials from EDTEA; EWS and 1WC. The purpose of the meeting was to discuss the proposed project, the listed activities and the EIA process as well as the process that will be followed with this application.

Refer to Appendix A for minutes of the pre-application meeting.

1.2. Terms of Reference

This proposed sewer reticulation will feed into the Ntuzuma E Sewer Outfall project, which is currently underway. The scope of works entails the provision of a Basic Assessment in terms of EIA Regulations (2017) which includes and is not limited to:

- Project initiation and orientation
- Environmental Management Plan
- Close liaison with Project Manager

The Basic Assessment Report must entail any environmental/ ecological expertise required to complete the assessment.

The application for Environmental Authorisation has been lodged with EDTEA. The EIA reference number has been received and included in all documents required for public participation, i.e. newspaper advert, site notice board and the draft BAR.

Refer to Appendix A for the acknowledgment of application for environmental authorisation.

2. BASIC ASSESSMENT REPORT

2.1. Environmental Assessment Practitioner

Business name of EAP:	**1World Consultants (Pty) Ltd**		
Physical address:	**181 Winchester Drive, Reservoir Hills,**		
Postal address:	**P.O. Box 2311, Westville,**		
Postal code:	**3630**	Cell:	**082 640 4900**
Telephone:	**031 262 8327**	Fax:	**086 726 3619**
E-mail:	fatima@1wc.co.za		

Table 2: Names and Expertise of Representatives of the EAP

Name and Title	Qualifications and Affiliations	Role	Experience at Environmental Assessments
Fatima Peer	B.Sc (Hons) Pr. Sci. Nat., IAIAsa	Senior EAP	7 years
Adila Gafoor	B.Soc. Sci. (Geog) IAIAsa	EAP	3 years
Bryan Paul	B.Sc IAIAsa	Biodiversity Officer	2 years
Roschel Maharaj	B.Sc IAIAsa	Junior EAP	$2^{1}/_{2}$ years

A company profile, Project Experience and CV's for 1World Consultants (Pty) Ltd is provided in Appendix B.

Table 3: Names and Expertise of Specialists

Name of specialist	Education qualifications	Field of expertise	Section/s contributed to in this basic assessment report	Title of specialist report/s as attached in Appendix E
Suheil Malek Hoosen (Aeon Nexus) Dr. S. Pillay (Aeon Nexus)	BSc Hons. Envs Pr. Sci. Nat.	Wetland and Riparian Ecology	Wetland Delineation and Functional Assessment (Section 12)	Proposed Inanda Glebe Sewer Reticulation: Wetland Delineation and Functional Assessment.
Jean Beater	M.A (Heritage Studies) MSc (Environmental Management)	Heritage Impact Assessment	Cultural and Historic Features (Section 12)	Inanda-Glebe Reticulation Project, eThekwini Municipality, KwaZulu-Natal. Heritage Impact Assessment.
Bryan Paul (1World Consultants)	B.Sc. (Zoology and Botany with Geography) BSc Hons. (Environmental Management)	Biodiversity Officer	Vegetation Assessment (Section 12)	Biodiversity Assessment and Report. The Proposed Inanda Glebe Sewer Reticulation Project, Inanda, KwaZulu-Natal.
M. Hadlow (Drennan Maud (Pty) Ltd)	Pr. Sci. Nat.	Eng. Geology	Geotechnical Investigation (Section 12)	Report to eThekwini Municipality Water and Sanitation Unit Engineering Department Waste Water Design Branch on a

				Geotechnical Investigation for the Proposed Sewer Reticulation at Inanda Glebe

3. LOCATION OF THE PROPOSED ACTIVITY

The proposed construction of the sewer reticulation is located in Glebe which falls within the Inanda area situated in ward 44 of the eThekwini Municipality. Inanda is a township that is found in eastern KwaZulu-Natal, approximately 24 km from Durban. Inanda occupies an extensive area and is subdivided into smaller townships, such as; Inanda Newtowns A, B and C, Amaoti and Emachobeni. Towns surrounding the study area include Inanada Namibia, approximately 470m away on a north-easterly direction and Ntuzuma E, approximately 1.1km in a south-easterly direction. The study area can be accessed via the M25 in Kwa-Mashu through the settlement of Ntuzuma and along Somiso Road.

Map 1 below is a general locality map of Inanda and the surrounding area. Map 2 below is a zoomed in image of the study site, Glebe, Inanda. The locality maps can be reviewed under Appendix C.

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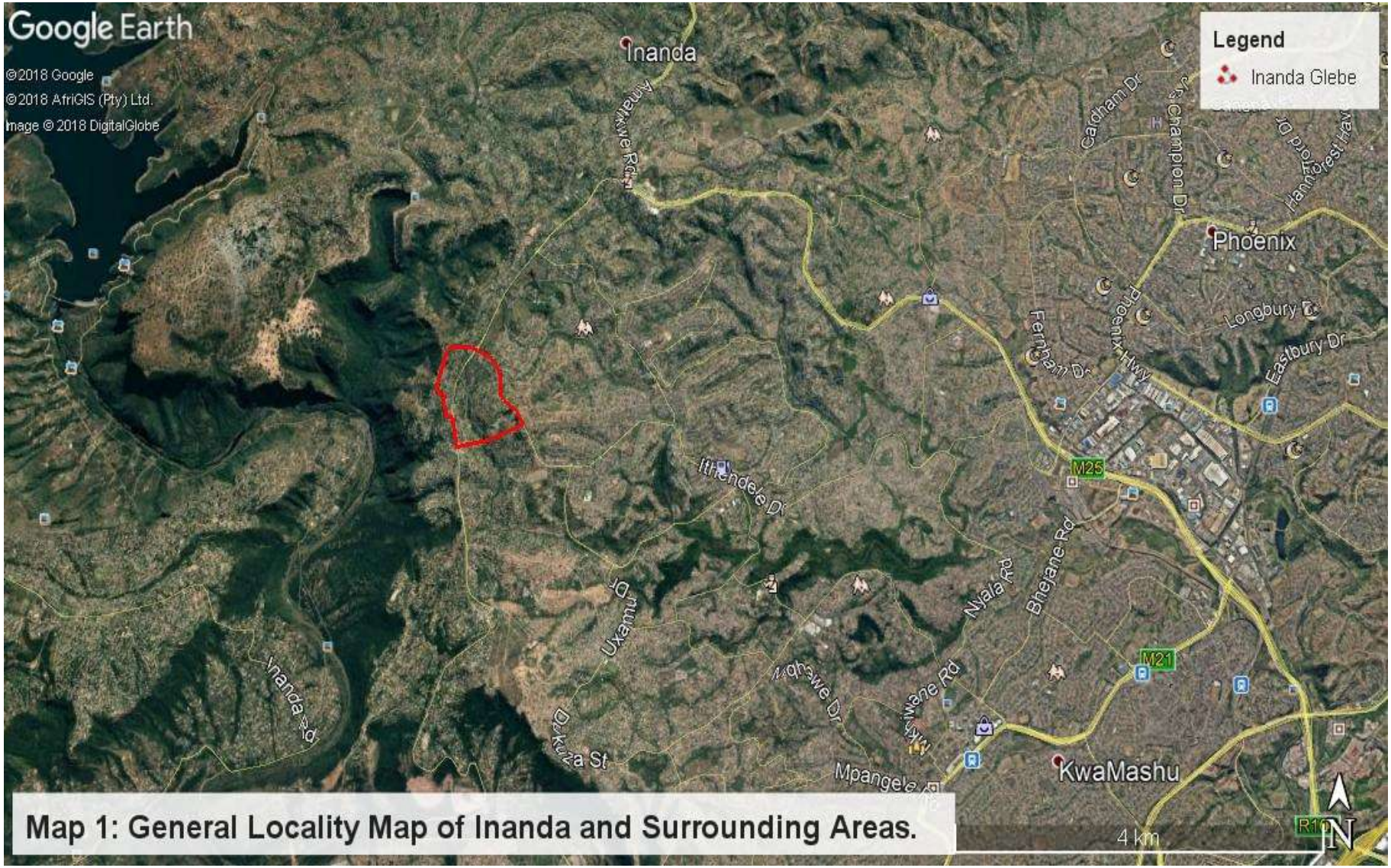

Map 1: General Locality Map of Inanda and Surrounding Areas.

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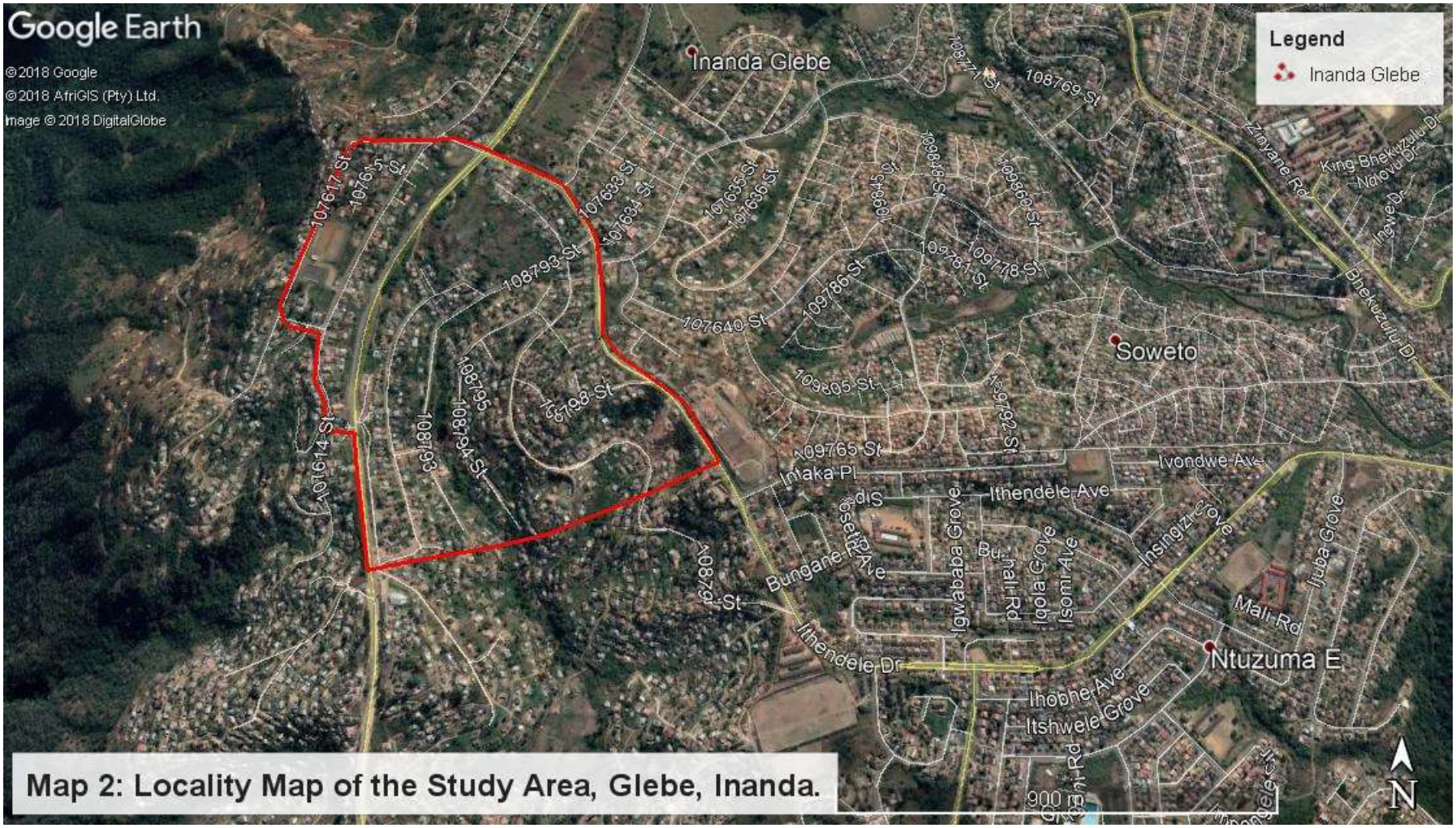


Map 2: Locality Map of the Study Area, Glebe, Inanda.

The proposed site is approximately 14.5km away from the Indian Ocean. The study area is encompassed by built up residential areas and other privately-owned settlements. Numerous developments within the study area have taken place such as residential housing projects; tar roads and pipeline projects. This has resulted to a major transformation of the terrain within the study area which then gave rise to a diverse array of alien vegetation. Durban Metropolitan Open Space System (D'MOSS) area has been identified to the west of the study site and the Mgeni river is located approximately 1km away from the study site.

The proposed development site can be regarded as greatly transformed, with very little remaining indigenous vegetation that occurs within the area and have been replaced by crop species *(Zea mays, Colocasia esculenta)* and common invasive species usually associated with disturbed KZN areas. The general lack of naturally occurring vegetation is due to the human activity subjected to this local habitat in the form of mass clearing for informal residential areas and subsistence farming found throughout this area. Section 12 will provide a summary of the specialist findings.

Map 3 below depicts the environmental sensitivities in Glebe, Inanda. The environmental sensitivities map can be reviewed under Appendix C.

Map 3: Environmental Sensitivities within the Study Area and Surrounding Area.

The 21-digit Surveyor General (SG) number for the property affected is provided below. The co-ordinates for the proposed development are also provided in Table 4.

Table 2: Coordinates of the proposed development

		Inanda Glebe Sewer Reticulation
Property Description		Informal Residential
GPS Coordinates of the center point of the reticulation		29º 43' 05.25" S; 30º 55' 01.15" E
Surveyor General (SG) Code		
Property	**Property Co-Ordinates**	**21-digit SG Code**
Pipe Jacking	29°42'54.61"S and 30°54'55.22"E	NOFT00000001609300000
Stream Crossing 1	29°42'58.73"S and 30°55'7.51"E	NOFT01530000142700000
Stream Crossing 2	29°42'57.68"S and 30°55'6.97"E	NOFT01530000142600000
Property 114	29°43'18.87"S and 30°54'59.89"E	NOFT01530000185500000
Property 81 (a)	29°43'18.45"S and 30°55'1.59"E	NOFT01530000148700000
Property 94 (Tie-in)	29°43'17.81"S and 30°55'3.76"E	NOFT01530000148500000
Property 83 (Tie-in)	29°43'18.29"S and 30°55'1.65"E	NOFT01530000148600000
Property 81 (a)	29°43'17.41"S and 30°55'5.46"E	NOFT01530000152100000
Farm 4579	29°43'19.37"S and 30°55'3.23"E	N0FT00000000457900000

4. DEVELOPMENT ACTIVITY

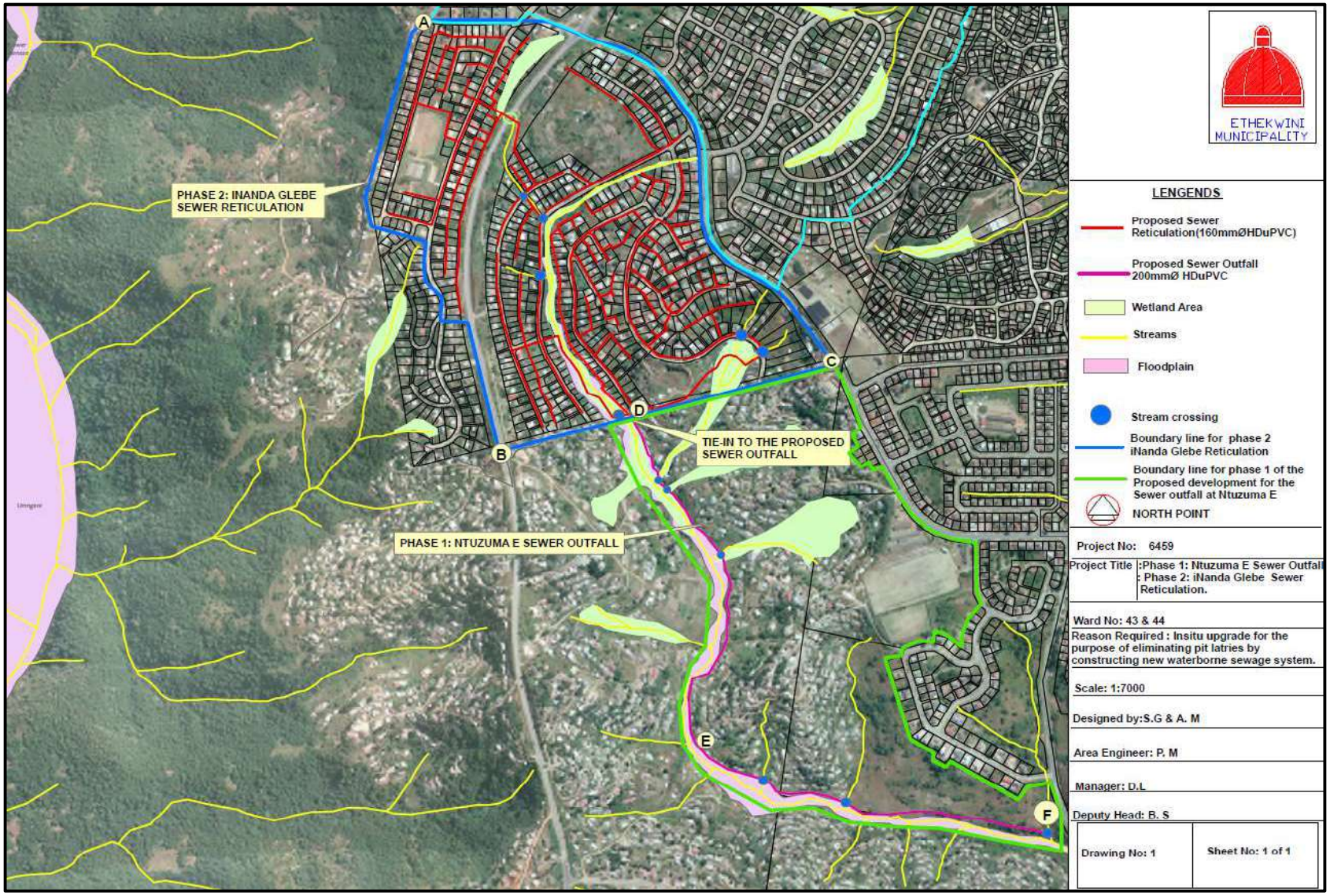
eThekwini Municipality: Water and Sanitation proposes the construction of a waterborne sewer reticulation for the existing housing units in Inanda Glebe to eliminate the use of pit latrines. The proposed project will entail the following:

- 13km long sewer reticulation
- 160mmØ HDuPVC sewer reticulation
- Numerous 1000mmØ precast concrete ring manholes

An Environmental Authorisation, DM//0002/2014, in terms of GNR543 of the EIA Regulations 2010 was granted for the Ntuzuma E Sewer Outfall project, the outfall sewer to which this Inanda Glebe reticulation drains. The Client now seeks to link the reticulation system to the abovementioned Ntuzuma E Sewer Outfall project. Upon confirmation with the competent authority (KZN-EDTEA), the project would need to follow a new application process in accordance with the 2017 EIA Regulations. An amendment to the Environmental Authorisation DM//0002/2014 in accordance with the 2014 EIA Regulations is not applicable. The project will require water, electricity and waste disposal during the construction phase only which will be provided by the contractor.

Map 1 below depicts both phase 1 (Ntuzuma E Sewer Outfall) and phase 2 (Inanda Glebe Sewer Reticulation). The boundary line for the phase 1, Ntuzuma E Outfall is depicted in **green**, while the sewer outfall of 200mmØ HDuPVC is depicted in **pink.** The boundary line for the sewer reticulation, the focus of this basic assessment, is depicted in **blue**, while proposed reticulation is depicted in **red.** The proposed reticulation in red provides a clear indication on the layout in terms of servicing existing properties in the Glebe area. The "tie-in" point, point D on map 4 below, is situated within the wetland. The proposed sewer reticulation will "tie-in" at point D to the Ntuzuma E sewer outfall.

An A3 copy of the map can be reviewed under Appendix C.



Map 4: Boundary of Phase 1 Ntuzuma E Outfall (Green) and Boundary of Phase 2 Inanda Glebe Sewer Reticulation (Blue).

Table 5 below summarises features marked A to F as per map 4 above.

Table 5: Proposed Project Features and Co-ordinates

Description		Coordinates	
A	Northern Boundary	29º 42' 48.98" S	30º 54' 48.66" E
B	Main Road – P138	29º 43' 21.57" S	30º 54' 53.67" E
C	Main Road – Ithendele Drive	29º 43' 14.07" S	30º 55' 20.88" E
D	Tie in point	29º 43' 19.13" S	30º 55' 05.96" E
E	Floodplains	29º 43' 44.84" S	30º 55' 10.98" E
F	Floodplains	29º 43' 50.28" S	30º 55' 38.52" E

The proposed Inanda Glebe sewer reticulation will connect to the Ntuzuma E outfall. Construction is likely to require the use of an excavator with a rock pecker along the majority of the line. This is due to the fact that shallow bed rock is encountered over much of the area. The construction corridor where construction vehicles are permitted and outside of sensitive areas is to be 10m in total, 5m on either side of the proposed pipeline route. The final pipeline servitude width required for maintenance purposes is 3m. A construction servitude of 5m will be required to allow for access and excavation. 3 Hydrogeomorphic (HGM) units and a River Riparian environment was identified within the study site (details within section 12 below). In some areas, the reticulation will be within 32m of watercourses.

Map 5 below indicates the HGM units and river riparian (RR) habitat found within the surrounding 500m buffer of the Inanda Glebe sewer reticulation project.

Map 5 can be reviewed under Appendix C.

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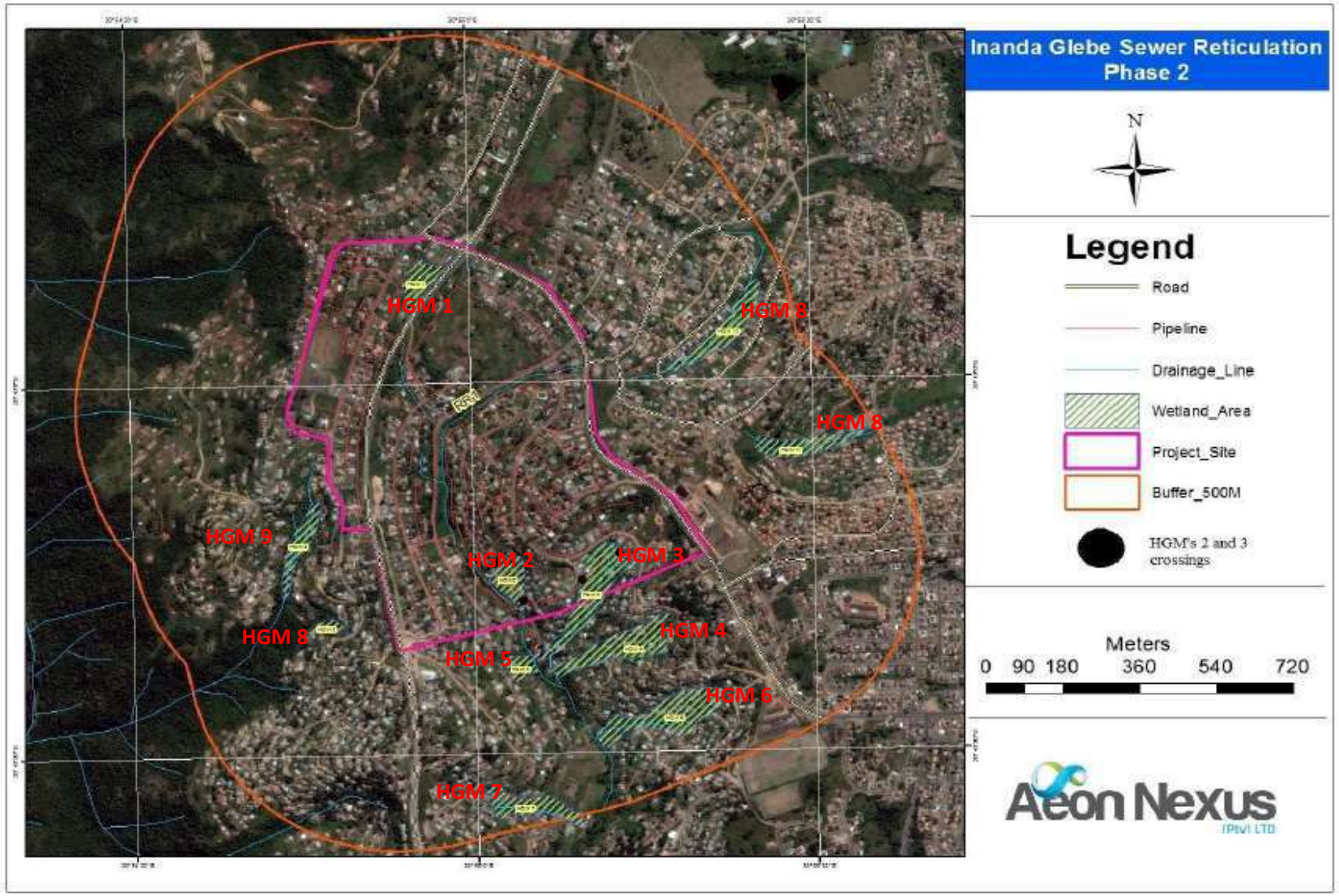

Map 5: The HGM units and river riparian habitat found within the surrounding 500m buffer of the Inanda Glebe sewer reticulation project.

To minimise impact on the environment, the Engineer has confirmed via a method statement, that particular attention, during both the design and construction stages of the project, will be given to the following aspects:

- Routine checking of machinery/plant and vehicles for oil leaks each day before construction activity begins shall be conducted. Areas in which oil is kept will be bunded.
- No vehicle will be permitted to cross drainage lines, wetlands and floodplain areas during construction.
- Access routes shall be designed to limit the potential impact on the environment, bearing in mind steep banks and areas prone soil erosion.
- Existing access roads/tracks shall be used where possible.
- Washing and cleaning of construction shall not be undertaken within the drainage lines, watercourses and wetland areas.
- Waste disposal facilities (bins) shall be provided and workers encouraged not to litter or dispose solid waste in the natural environment but to use available facilities.
- Portable toilets shall be provided where construction is occurring. Workers shall be encouraged to use these facilities and not the natural environment.
- Proper storage and handling of hazardous substances (e.g. chemicals) shall be administered.
- All employees handling fuels and other hazardous materials shall be trained properly.
- Spillage of hazardous substances shall be cleaned up immediately and contaminants properly drained and disposed to a suitable dump site.
- Any contaminated soil in the construction site shall be removed and rehabilitated timeously and appropriately.
- No stockpiling of any materials shall take place within any watercourse, including wetlands and rivers/drainage lines.
- No cement batching activities shall take place near the watercourse and wetland areas.
- Cement batching boards shall be used, and cement-based products/wash not be disposed into the natural environment.
- Soil/sand required for construction purpose shall not be derived from watercourse.
- Water for use in construction or as a drinking supply shall not be taken directly from any wetlands or streams. Where there is an abstraction of water from wetlands or rivers for construction will be approved by the Department of Water and Sanitation.
- Excavated material/sediments/spoil from the construction (including any unsuitable materials) shall not be placed or stockpiled within any watercourse (drainage line).

The method statement can be reviewed under Appendix C.

The benefits for constructing the gravity sewers in this area are as follows:

- Existing pit latrines upstream of the sewer can be made redundant.
- The sewer will allow for the development of additional housing with the catchment.

Service Level Agreement

A service level agreement (SLA) has been obtained from the KwaMashu Waste Water Treatment Works (WWTW) which confirms that the WWTW has the capacity to accommodate the additional sewage flow.

Refer to Appendix C for the SLA.

5. LEGISLATION AND GUIDELINES APPLICABLE

5.1. Applicable listed activities

In terms of the Environmental Impact Assessment (EIA) Regulations (2017), promulgated in terms of the National Environmental Management Act, 1998 (NEMA), certain Listed Activities are specified for which either a Basic Assessment (GNR 327 and 324) or a full Scoping and EIA (GNR 325) is required. The following Listed Activity in Government Notice (GN) R 327 (Listing Notice 1) are triggered, requiring a Basic Assessment (BA) Process for the proposed construction of the Inanda Glebe Sewer Reticulation.

Table 3: Relevant Activities from EIA Regulations 2017

Regulation Year	Listing Activity NEMA	Description of Activity	Applicability to the Project
2017	LN 1; Activity 19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.	The pipeline will cross the HGM 2 and HGM 3 identified on site. A total of 228.38m^3 of soil will be excavated.

Hence, a BA Process is required.

The applicable listed activities, as per Table 5 above, have been identified as triggers for the proposed development. The development triggers this activity as it traverses wetlands in the following places;

Table 4: Coordinates of various pipeline and watercourse intersections

Name of Watercourse	Coordinates		Crossing Width	Volume of Excavation (volume of depth x width x length)
	Start	End		
HGM2	29° 43' 13.91" S 30° 55' 12.95" E	29° 43' 15.67" S 30° 55' 10.27" E	84	1.75m x 0.75m x 84m = 110.25m^3
HGM3	29° 43' 14.85" S 30° 55' 02.36" E	29° 43' 17.88" S 30° 55' 04.63" E	90	1.75m x 0.75m x 90m = 118.125m^3 = 118.13m^3
Total to be excavated			**174m**	**228.38m^3**

Please refer to Map 5 above and Appendix C for points of intersection on maps.

In terms of the Environmental Impact Assessment (EIA) Regulations (2017), promulgated in terms of the National Environmental Management Act, 1998 (NEMA), the following definitions apply to this report:

"watercourse" means -
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;

(c) a wetland, pan, lake or dam into which, or from which, water flows; and any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse as defined in the National Water Act, 1998 (Act No. 36 of 1998); and a reference to a watercourse includes, where relevant, its bed and banks;

"wetland" means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

5.2. Policy and Legislative Context

Table 7 provides a list of all applicable legislation, policies and/or guidelines of any sphere of government that are relevant to the application as contemplated in the EIA regulations.

Table 7: Applicable Legislation, Policies and/or Guidelines

Title of Legislation, Policy or Guideline	*Administering authority*	*Date*
National Environmental Management Act (Act 107 of 1998) – for its potential to cause degradation of the environment (Section 28).	Department of Environmental Affairs	1998
EIA Regulations GNR 327 and 324 – for identifying the triggers for a basic assessment.	Department of Economic Development, Tourism and Environmental Affairs	2017
Environmental Conservation Act (Act 73) – for potential environmental degradation.	Department of Environmental Affairs	1989
National Water Act (Act 36 of 1998) – for potential to cause pollution of water resources defined under the Act (Section 19).	Department of Water Affairs and Forestry	1998
Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) – for protection of agricultural resources and for control and removal of alien invasive plants.	National Department of Agriculture	1983
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) – for protection of biodiversity.	Department of Agriculture and Environmental Affairs and Ezemvelo KZN Wildlife	2004
The National Heritage Resources Act (Act No 25 of 1999 as amended) – for the identification and preservation of items of heritage importance.	Department of Arts and Culture (AMAFA KwaZulu-Natal)	1999
Guideline 4: Public Participation in support of the EIA Regulations (2005) and EIA Regulations GNR 982 for Public Participation Guidelines.	Department of Economic Development, Tourism and Environmental Affairs	2006 and 2014
EIA Regulations GNR 326 – for guidelines on the process to be followed and the format of the BAR.	Department of Economic Development, Tourism and Environmental Affairs	2017
Public Participation guideline in terms of NEMA EIA Regulations	Department of Economic Development, Tourism and Environmental Affairs	2017
Spatial Development Framework	eThekwini Municipality	2016-2017

Integrated Development Plan	eThekwini Municipality	2013/12 to 2016/17
eThekwini Municipality By-Laws	eThekwini Municipality	Current

6. NEED AND DESIRABILITY

The activity is desirable in order to address an obvious general problem with pit latrines within a relatively densely developed area as well as the need to develop additional housing in the area. The proposed project will enable all houses and proposed development within the catchment to be connected to water borne sewer. Pit latrines are the most common and simplest forms of sanitation in rural areas. Pit latrines are highly inappropriate and unsanitary; however, it is promoted in rural areas in order to discourage open defecation. There are serious disadvantages of using pit latrines such as odour nuisance; flies may be attracted to lay their eggs within poorly built latrines; and improper lining of pits may lead to the collapse of the structure.

The fact that centralised treatment is proposed doesn't necessarily mean that problems relating to sewage contamination will be totally resolved within the area as; It is likely to take some time for all houses within the area to be connected to the sewer line. Sewer blockage in rural areas frequently occurs, due to pollution activities that are inevitable in rural areas that lack proper infrastructure and basic services. The response time from the municipality is generally good with blockages generally being cleared within 24 hours of reporting.

Problems with centralised systems tend to be intermittent but can result in larger spillages than from individual systems although the cumulative impact of numerous pit latrines could be comparable. The main benefit of a centralised system within eThekwini is that responses when problems are found are relatively quick and contamination periods are usually relatively short. A general reduction in contamination from pit latrines is likely to occur from the proposed development. The proposed project will help to minimise sewage spillage and it should therefore result in improved surface and sub surface water quality. The proposed project will also enable additional housing projects to occur in the area. The proposed development will also improve the local water quality.

7. MOTIVATION FOR THE PREFERRED SITE, ACTIVITY AND TECHNOLOGY ALTERNATIVE

The proposed construction of the sewer reticulation triggers Listing Notice GNR 327, Activity 19 of the EIA Regulations (2017). As per GNR 326 (2017), Appendix 1(2)(b) and 1(3)(g), alternatives for the proposed development are to be identified and considered. Chapter 1 of the EIA Regulations provides an interpretation of the word "alternatives", which are options *"in relation to a proposed activity, mean(ing) different means of meeting the general purpose and requirements of the activity, which may include alternatives to the -*

a) *Property on which or location where the activity is proposed to be undertaken;*
b) *Type of activity to be undertaken;*
c) *Design or layout of the activity;*
d) *Technology to be in the activity; or*
e) *Operational aspects of the activity;*

And includes the option of not implementing the activity."

Based on the above, the following alternatives are presented for the proposed Inanda Glebe Sewer Reticulation.

7.1. Site Photographs

Plate 1: Wetland Area 1 at 29º 42' 55"S; 30º 54' 54"E. below.

Plate 2: Identified Wetland Area.

Plate 3: Homesteads built within the wetland.

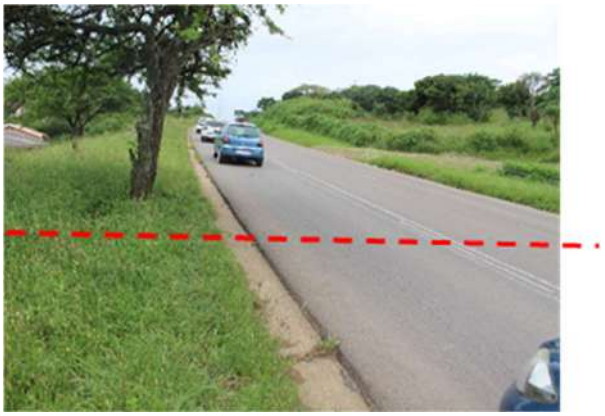

Plate 4: Pipe jacking to take place under the road (indicated by a red dotted line) following an existing stormwater pipe.

Plate 5: An identified stream at 29º 43' 02"S; 30º 54' 58"E.

Plate 6: Proposed pipeline to run along floodplain at 29º 43' 07"S; 30º 54' 57"E.

Plate 7: The proposed pipeline will cross the road at 29º 43' 18"S; 30º 55' 01"E.

Plate 8: The reticulation to tie-in to the existing pipeline (circled in red)

Plate 9: Wetland Area 2 at 29º 43' 13"S; 30º 55' 12"E.

Plate 10: Homesteads built within wetland 2.

7.2. Preferred Site

The proposed development forms part of Phase 2 of the sewage project. The project aims to address problems associated with lack of sewer reticulation in the Glebe area particularly. The proposed Inanda Glebe sewer reticulation will tie into the Ntuzuma E outfall, phase 1 of the project. Residents in these areas have constructed pit latrines for sanitation purposes. These latrines are, in some instances, constructed on rocky terrain in close proximity to the Igobhogobho river and its tributaries which poses a serious pollution risk. Watercourses in the area are utilised for both agricultural purposes and washing of clothes by the community. Therefore, no site alternatives were considered.

7.3. Route Alternative/ Layout Alternative

Alternatives take into consideration all possible means by which the purpose and the need of the proposed activity can be accomplished taking into account the interest of the applicant. Route alternatives are informed by specific circumstances of the activity and its environment. There are no route alternatives as the proposed reticulation aims to service the existing dwellings.

The general topography slopes towards the stream that cuts through the area defining the catchment area and dictating the general location of the proposed gravity fed reticulation which eventually ties in with the existing main sewer line. It is possible that in the near future, housing developments or formalisation of the existing housing may occur. It is necessary to plan links into proposed sewer. Although several wetlands (HGM units) have been identified on site, the preferred route alternative traverses the least number of wetlands as per map 5 above.

The preferred route alternative runs along a combination of roads within a semi-rural residential area. The area is encompassed by built up residential areas and other privately-owned settlements. The route is in areas of disturbance and transformation by human impacts. In addition, this area is highly polluted and environmentally degraded.

Refer to Figure 1 below which indicates the preferred layout alternative. An A3 copy of the layout plan can be reviewed under Appendix C.

Figure 1: Preferred Layout Alternative for the proposed sewage reticulation

7.4. Preferred Technology Alternative

Materials

The proposed project consists of pipelines under one flow condition – low pressure for gravity flow. The reticulation will consist of HDuPVC 160mmØ pipes which will be utilised for gravity flows. There are two stream crossings which will be undertaken by encasing the pipe with concrete.

Construction corridor and servitude

The construction corridor where construction vehicles are permitted and outside of sensitive areas is to be 10m in total, 5m on either side of the proposed pipeline route. The final pipeline servitude width required for maintenance purposes is 3m.

Pipes laid below ground

Pipelines are to be laid below ground by conventional open trench excavation except in the sensitive areas.

The depth of the various trenches varies according to location and topography of the existing ground level but generally an average depth of 1m above the top of the pipe is adhered to. The trench widths are to be in accordance with SANS 1200 - 300mm wider on either side of the pipeline. This allows for compaction with a motorised rammer. Before laying, pipes will be visually checked for scratches, puncture, ovality, correct marking. HDuPVC is to be laid on flexible bedding as shown on Figure 2 below. The selected cradle and blanket is to be river sand.

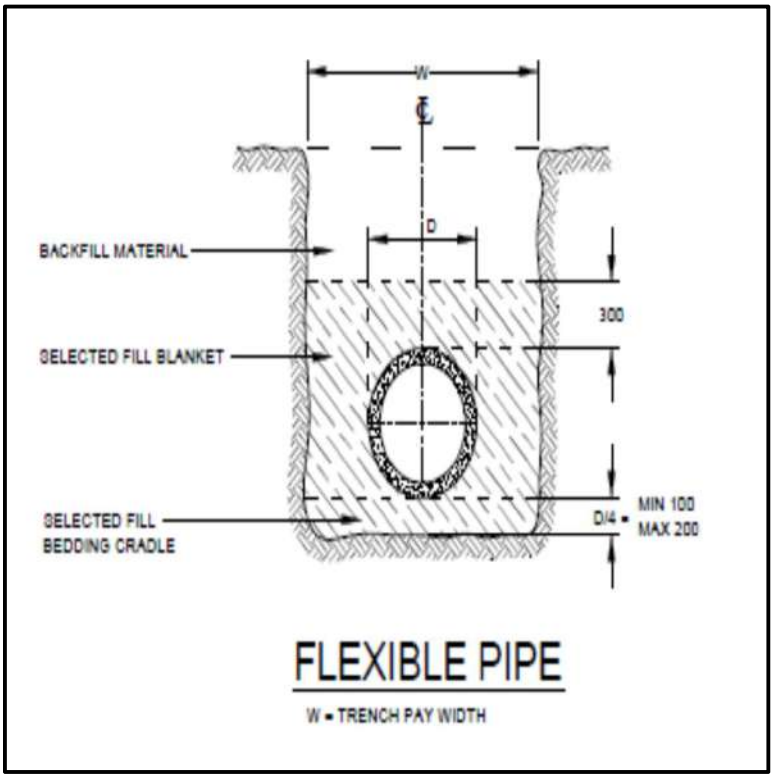

Figure 2: Proposed HDuPVC pipeline bedding

More river sand is then placed on the sides of the pipe to 100mm above the crown of pipe (bedding cradle). This is then hand stamped to secure the position of the pipe. Suitable material from the trench excavation or river sand, if the sand taken from the trench has too many large particles, it is then placed a further 200mm on top of the pipe (bedding blanket) and then compacted. The trench will then be backfilled with normal backfill material or the material excavated from the trench till the existing ground level. This backfill is compacted in 300mm layers until the ground profile is reached.

It is acknowledged that construction activities may have impacts on water quality, habitats of animals, and flow regime. The eThekwini Municipality, Water and Sanitation has identified a number of potential pollution sources that may arise as a result of construction activity in the area. The potential construction impacts along with prevention and mitigation measures are presented in Table 1 of the Method Statement and have been incorporated into the EMPr.

The Method Statement can be reviewed under Appendix C.

Stream Crossings

Stream crossings will be constructed mainly via the dam and flume method. In this method, the stream is temporarily dammed to prevent water flow in the area to be trenched. The trench is excavated as quickly as possible whilst a pipe or flume is placed over the trench, conveying water downstream. The pipe is encased in concrete (only where the concrete is founded on rock) and then backfilled up to streambed level. Silt and sediment accumulation is removed from the streambed and the bed and banks of the stream are restored to preconstruction conditions before removal of the dams.

Road Crossings

Pipe jacking which will be undertaken on the main road (P138) to avoid deep excavation of 6m. In other areas where the pipeline crosses the road, conventional open cut trenching with traffic controls will be utilised followed by temporary reinstatement. Once completed formal reinstatement will proceed. The pipeline is to be laid at a depth of 1200mm above the crown of pipe.

Wetland Crossings

The route of the pipeline crosses two wetlands and will be laid alongside a third wetland unit. All pipes which are laid in these areas will be excavated by hand. Any machines used will cause damage to these causeways and also for the most part they are inaccessible. All pipes which will cross the wetland will be laid at a minimum depth of 800mm below the river bed.

7.5. No-Go Alternative

The 'No Go' alternative in the context of this project implies that the sewer reticulation would not be constructed, and the current status quo of pit latrines would prevail. Should the sewer line not be constructed and commissioned, the region would be negatively affected by an inadequate sewage reticulation (basic service) which would inhibit future development in the area and result in the continuance of lack of decent hygiene facilities in the area. Therefore, the need for stable and reliable sewage systems to meet current and future demand will likely outweigh the potential negative impacts to the surrounding environment. It is therefore concluded that the 'No-go' option is not in the best interests of future sustainable development in this region. The 'No-Go' Alternative will also not allow for the development of new housing and will not allow the upgrade/ formalisation of existing housing.

8. ENVIRONMENTAL ATTRIBUTES (GEOGRAPHIC, PHYSICAL, BIOLOGICAL, SOCIAL, ECONOMIC, HERITAGE AND CULTURAL ASPECTS)

The eThekwini Municipality is located on the east coast of South Africa in the Province of KwaZulu-Natal. KZN is bordered by three district municipalities, namely, iLembe in the north, uGu in the south and uMgungundlovu in the west. The eThekwini Municipal Area (EMA) spans an area of approximately 2297km^2, extending from Tongaat in the North to Umkomaas in the South and from the coastline in the East to Cato Ridge in the West and is characterised by coastal plains and steep and dissected topography (eThekwini Municipality SDF, 2016-2017).

The eThekwini Municipality (EM) is situated at the center of the Maputaland-Pondoland-Albany Region, an area described as a "Biodiversity Hotspot", one of only 34 in the world. Over 50% of the world's plant species and 42% of all terrestrial vertebrate species are endemic to the 34 global biodiversity hotspots, despite these areas covering only 2.3% of Earth's land surface. The Maputaland-Pondoland-Albany biodiversity hotspot region is home to more than 7, 000 species of vascular plants, 25% of which are restricted (endemic) to this area (Conservation International, 2013).

Durban is situated at the center of this region in a transitional zone of the warm tropical and cooler temperate elements. Varied topography, climatic conditions and Durban's unique biogeographical position have resulted in a wide range of terrestrial and aquatic ecosystems that play host to a rich diversity of organisms. Marine ecosystems in Durban exist seaward of the High-Water Mark and include sandy beaches, rocky shores and the in-shore marine environment (eThekwini Municipality SDF, 2016-2017).

A **Wetland Delineation and Functional Assessment** was conducted to identify and demarcate wetland and riparian environments at risk within 500m of the proposed sewer reticulation project, as well as to assess the ecological health and functionality of these wetlands. The details pertaining to the scope of work include the following:

- To identify and delineate potential wetland and riparian environments within 500m of the proposed development site based on aerial photography and available wetland/river coverages via a desktop survey;
- To conduct a comprehensive field survey to identify and delineate wetlands using the Department of Water Affairs & Forestry guideline manual;
- To classify and describe the wetlands/riparian areas affected by the proposed sewer reticulation upgrade using the National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa;
- To undertake a rapid desktop aquatic screening and risk assessment to determine which of the desktop delineated wetlands are likely to be affected by the proposed sewer reticulation upgrade;
- To establish Present Ecological State (PES) of the instream and riparian habits using an Intermediate Habitat Integrity Assessment (IHIA);
- To establish the present Ecological State (PES) of the affected wetlands using a Level 1 WET-Health assessment tool;
- To assess the importance of the affected wetland areas in providing ecosystem goods and services using a Level 2 WET-EcoServices assessment tool;
- To assess the Ecological Importance and Sensitivity (EIS) of the affected wetland areas;
- To identify and describe the potential aquatic ecological impacts associated with the proposed development; using the risk assessment tool;
- To provide wetland buffer zone recommendations based on best-practice guidelines and available buffer zone guidelines;
- To provide suitable recommendation and mitigation measures for the wetland environments to maintain and ideally

improve the wetland ecological health status and provision of eco-services;

- To recommend the best route and method for the sewer reticulation pipeline that will be best suited for the surrounding environments.

The Inanda Glebe and Ntuzuma E areas are located in the north of Durban and are currently occupied by middle to low income residential households. These residents have constructed pit latrines to perform basic sanitation functions, some of which are situated on rocky terrain or close to the Igobhogobho River and its tributaries posing a pollution risk. Due to the urgent need to provide internal sewer reticulation to the Inanda Glebe and Ntuzuma E areas, the Department of Water and Sanitation (DWS) has granted a directive in terms of Section 19(1) and (2) of the National Water Act, 1998 (Act 36 of 1998) for the construction of Ntuzuma E sewer outfall and provision of internal sewer reticulation for Inanda Glebe and Ntuzuma E.

The Directive can be reviewed under Appendix A.

The proposed Inanda Glebe sewer reticulation project is located in KZN approximately 14.5 km from the Indian Ocean resulting in the high humidity experienced in the area. The area usually experiences most of its rainfall during the summer season that extends from November to February. The lowest rainfall received is during winter months June and July. The average midday temperature at the study area ranges from 22.4ºC during the winter months and 27.6ºC during the summer months. The Mean Annual Precipitation (MAP), the Mean Annual Evapotranspiration (MAE) and Mean Annual Runoff of the study area are 921mm, 1214mm and 152mm respectively.

The general topography of the study site is characterized by undulating hills with gentle and steep sloping landscape cut by drainage lines. The study site is situated on several major and minor ridges, as well as a single valley in which the Gobhogobho River flows. The terrain around the study site has been drastically altered by residential housing forming major and minor ridges, some of which are in close proximity to the Gobhogobho River. Additionally, vegetation is present in dense amounts within the river riparian habitat and in areas where the land has not been altered.

A **Heritage Impact Assessment** was undertaken as the proposed sewer reticulation is longer than 300m. The proposed pipeline triggers section 38 (1) (a) which refers to the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length that could potentially require an HIA. In addition, the proposed project may impact on graves, structures, archaeological and paleontological resources that are protected in terms of sections 33, 34, 35, and 36 of the KwaZulu-Natal Heritage Act (Act No. 4 of 2008) as well as sections 34, 35, and 36 of the NHRA (National Heritage Resources Act).

In terms of Section 3 of the NHRA, heritage resources are described as follows:

(a) places, buildings, structures and equipment of cultural significance;

(b) places to which oral traditions are attached or which are associated with living heritage;

(c) historical settlements and townscapes;

(d) landscapes and natural features of cultural significance;

(e) geological sites of scientific or cultural importance;

(f) archaeological and paleontological sites;

(g) graves and burial grounds, including—

(i) ancestral graves;

(ii) royal graves and graves of traditional leaders;

(iii) graves of victims of conflict;

(iv) graves of individuals designated by the Minister by notice in the Gazette;

(v) historical graves and cemeteries; and

(vi) other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);

(h) sites of significance relating to the history of slavery in South Africa;

(i) movable objects, including-

(i) objects recovered from the soil or waters of South Africa, including archaeological and paleontological objects and material, meteorites and rare geological specimens;

(ii) objects to which oral traditions are attached or which are associated with living heritage;

(iii) ethnographic art and objects;

(iv) military objects;

(v) objects of decorative or fine art;

(vi) objects of scientific or technological interest; and

(vii) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

A Phase 1 HIA was undertaken to assess whether any heritage resources will be impacted by the proposed sewer reticulation project. The Draft BAR and the HIA has been submitted to AMAFA. Comment from AMAFA will be included in the final BAR.

A **Biodiversity Assessment** was conducted to identify and record any protected fauna and flora that may be on the site and report on the current biodiversity's susceptibility to possible impacts of the development. The proposed site has undergone 100% transformation and most of the natural vegetation expected to be in this area have been removed and replaced by exotic non-indigenous plants, predominantly alien invasive plant species. Anthropologic pressures in the area have stripped the study area of suitable habitat and resulted in the Gobhogobho River and three wetlands found on site being highly degrade and in a poor state.

The proposed site of this development does not fall within a Critical Biodiversity Area, yet there are areas within 500m of the development boundary that show irreplaceable biodiversity. It is therefore, imperative that the Contractor/Applicant ensures that impacts associated with construction are kept within the anticipated construction servitudes and areas of anticipated impact.

There are currently no faunal species of conservation importance that would be anticipated and found within this study area. Furthermore, no species of conservation importance were recorded whilst surveying all possible habitats. The overall lack of abundance and diversity of fauna would be owed to the overall lack of undisturbed habitat as well as anthropogenic pressures such as hunting, trapping and pollution. The proposed development should then not have a significant impact on any fauna that may exist in this study area.

At the time of the study there was a small quantity of indigenous flora recorded on site, of which only two were protected by the Natal Nature Conservation Ordinance, *Aloe ferox and Aloidendron barberae*. No species were recorded that are protected by the National Forest Act 1998. This is due to the ever-increasing need for space to build houses and general human induced impacts

that have encouraged the introduction of exotic (including invasive plant species). Furthermore, the development of buildings within rivers/wetlands and other habitats have also played a negative role in reducing what habitat may have been previously in existence. However, as there are three wetlands and one river found in the proposed development area, there is a small possibility that species from the Liliaceae family, such as fire lilies, gladioli and Arum lilies will be encountered during construction but only as remnant populations that have survived the surrounding pressures.

Developmental impact is anticipated to be low, given that all mitigation techniques are followed. This is owing to the fact that there is already a limited amount of biodiversity present on site and in addition to the clearing of vegetation the operational activities should not be substantially higher given that the sewage pipeline is well maintained, and that maintenance is limited to site specific zones and staff do not damage recuperating vegetation. It is therefore of the authors opinion that there is no reason why the development should not go ahead and supports the improvement of the infrastructure in this area, which will not only drastically improve the lives of the community but also reduce the pollution of locally occurring rivers, wetlands and ecosystems found on site.

9. PUBLIC PARTICIPATION PROCESS

The Public Participation Process (PPP) is a requirement in terms of the 2014 and 2017 EIA Regulations of the National Environmental Management Act, 1998 (Act 107 of 1998) and it forms an integral part of any EIA process. This section provides information pertaining to the PPP that was conducted by 1World Consultants during this Basic Assessment Process. The purpose of this process is to gather information from the community and relevant Stakeholders that could ultimately affect the decision-making process concerning the construction and operational phases of the development. The community and public have been identified as I&APs (Interested and Affected Parties) and have been given the opportunity to participate in this process. Their comments, whether positive or negative, will influence the decision of the Authorities and the developer's final actions.

9.1. Objectives of the PPP

The PPP has the following objectives:

- To inform I&APs as well as all Stakeholders of the development and the BA application;
- To provide an opportunity for I&APs and Stakeholders to raise concerns and make suggestions;
- To promote transparency and an understanding of the project and its consequences;
- To serve as a structure for liaison and communication with I&APs and Stakeholders.

Any conclusions agreed upon must be socially, financially and technically acceptable and feasible in order to meet the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), and the vision of the development.

9.2. Public Participation Process Followed

The following PPP was conducted for the development in light of the basic assessment:

9.2.1. Background Information Document (BID)

Stakeholders and Interested and Affected Parties (I&AP's) were identified and notified of the Draft BAR. A Background Information Document (BID) was prepared and distributed to stakeholders and I&AP's which provides an outline of the development and aims to:

(i) inform I&AP's on how to participate in the public participation processes,
(ii) encourage responses to documents that will be distributed for review, and
(iii) encourage I&AP's to attend any public meetings.

A copy of the distribution list and BID are included under Appendix D.

9.2.2. Newspaper Advertisement

A newspaper advertisement was published to inform the public of the proposed Inanda Glebe Sewer Reticulation. The advertisement was published in the predominant language of the project area, Isizulu in the eThekwini Times newspaper, on 23 March 2018. A copy of the advertisement will be included in the final BAR.

9.2.3. Site Notice Boards

Site notice boards have been erected on the site and in close proximity to the development site on 15 March 2018. The notice boards have been provided in Isizulu with illustrations of the plan.

Five notice board were erected on site at the following locations:

Table 5: Location of Site Notice Boards

No.:	Description of Location	Co-ordinates
1	Start Point of Reticulation Route	29˚42'49.99" S 30˚54'48.06" E
2	Inanda Service Office (Community Centre)	29˚42'56.72" S 30˚56'11.45" E
3	Identified Wetland	29˚43'13.40" S 30˚55'15.14" E
4	Near proposed Pipe Jacking	29˚42'53.26" S 30˚54'55.97" E
5	End Point Near Tie-In	29˚43'18.22" S 30˚55' 0.72" E

A copy of the site notice board and pictures can be reviewed in Appendix D of the final Basic Assessment Report. The purpose of the notice board is to inform the community members of the proposed BA Application and the proposed sewer reticulation project. Contact details of the EAP are also provided to facilitate public participation.

9.2.4. Landowner Notifications

Interested and Affected Parties (I&APs) were identified and notified of the Basic Assessment. A Background Information Document (BID) and landowner notification letters were prepared in Isizulu and distributed via hand delivery on 15 March 2018. The BID provided information on the proposed development, the site and on the process to be followed by the EAP.

Seven properties were identified for proposed landowner notification, as these were properties that could potentially be encroached upon. Landowners happily received the BID and appreciated the fact that they had been translated.

Table 6: Details of properties identified for Landowner Notification

	Property Number & Description	Co-ordinates	Signed		Comments
			Yes	No	
1	Stream Crossing 1: Property No. 5 on 108797 Street	29°42'58.73"S 30°55'7.51"E	✓		
2	Stream Crossing 2: Property No. 6 on 108797 Street	29°42'57.68"S 30°55'6.97"E		✓	Landowner did not sign
3	Property 114	29°43'18.87"S 30°54'59.89"E		✓	Landowner did not sign
4	Property 81 (a)	29°43'18.45"S 30°55'1.59"E		✓	Landowner did not sign

5	Property 81 (b)	29°43'17.41"S 30°55'5.46"E		✓	Could not gain access to property
6	Property 83 (Tie-in)	29°43'18.29"S 30°55'1.65"E		✓	Landowner did not sign
7	Property 94	29°43'17.81"S 30°55'3.76"E		✓	Could not gain access to property
8	Farm 4579	29°43'19.37"S 30°55'3.23"E	✓		Visited as no property owners signed at properties 3,4 and 6.

As can be deduced from the Table 6 above:

- 2 of the 7 identified properties agreed to sign the landowner notification letters.
- The remaining 5 landowners did not agree to sign the land owner notification letters. Reasons for this are as follows:
    - It must be pointed out that landowners were happy to engage with 1World Consultants representatives. Community members had NO objections to the project, and already had background information on the project due to the Ntuzuma E sewer outfall which the proposed reticulation will feed into.
    - The chief reason surrounding certain landowner's hesitation to sign the notification letter, was not due to objection of the project, but more hesitation to sign an official document. Landowners had not been requested to undertake such a task before which resulted in a sense of distrust.
    - It was reiterated that signing the letter merely attested to the fact that landowners had to be informed of the proposed project.
    - In addition to this, 1WC representatives pleaded with those compliant landowners to try to convince those who were more hesitant, to sign. However, this did not waiver their decision in any way.

Signed notification letters are provided in Appendix D.

9.2.5. Public Meeting

None requested or required meetings following distribution of the BID, publication of the advertisement and erection of the notice boards up to date of distribution of this Draft BAR.

Issues Raised by the I&APs

Copies of the Draft BAR were circulated to the following I&APs for review and comment:

- KZN Department of Transport
- Ezemvelo KZN Wildlife
- Department of Water and Sanitation
- AMAFA Heritage
- KZN Corporate Governance and Traditional Affairs
- Commission on Restitution of Land Rights
- KZN Department of Economic Development, Tourism and Environmental Affairs
- Eskom
- eThekwini Municipality (various departments)
- Ward Councilor – Ward 44

All registered I&APs were notified on the availability of the Draft BAR and of the deadline for comment. All I&APs were reminded

that in terms of the EIA Regulations (2017), GNR 326 43(2), all State Departments that administer a law relating to a matter affecting the environment, specific to the Application, must submit comments within 30 days to the Environmental Assessment Practitioner (1World Consultants (Pty) Ltd). Should no comment be received within the 30-day commenting period, it is to be assumed that the relevant State Department has no comment to provide.

All comments received on the BID are summarised below and those following the distribution of Draft BAR will be inserted in the Final BAR. The full report is provided as the Comments and Responses Report in Appendix D.

Issues/ Comments Raised Following Review of the BID

No comments received to date. Landowners have not requested for a copy of the DBAR following distribution of the BID and Landowner Notification letters.

Issues/ Comments Raised Following Review of the DBAR

Any issues or comments raised will be recorded in the Final BAR.

Issues/ Comments Raised Following the Pre-application Meeting:

No issues or comments have been raised to date.

Issues Raised by Landowners:

No issues or comments have been raised to date.

As per the National Environmental Management Act, 1998 and GNR 326 of the EIA Regulations (2017), the Inanda Glebe Sewer Reticulation project is a linear activity. A **Linear Activity** means: -
an activity that is arranged in or extending along one or more properties and which affects the environment or any aspect of the environment along the course of the activity, and includes railways, roads, canals, channels, funiculars, pipelines, conveyor belts, cableways, power lines, fences, runways, aircraft landing strips, firebreaks and telecommunication lines.

10. IMPACT ASSESSMENT

10.1. Methodology

EIA Regulation GNR 326 (2017) prescribes the requirements and aims of environmental impact assessments. In terms of the regulations, the following objectives are specified:

- Determine the nature, significance, consequence, extent, duration and probability of impacts; and
- The degree to which these impacts:
  - Can be reversed,
  - May cause irreplaceable loss of resources, and
  - Can be avoided, managed or mitigated

The impacts of any development including the construction and operational phases are identified, using the following definitions:

Term	Description
significant Impact	*an impact that may have a notable effect on one or more of the aspects of the environment or may result in non-compliance with accepted environmental quality standards, thresholds or targets and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as duration, magnitude, intensity and probability of occurrence.*
cumulative impact	*In relation to an activity, means the past, present and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities.*

The potential impacts are listed and assessed for significance. Significance is assessed by scoring each impact based on four variables viz. probability, severity, duration and spatial impact. The four variables, with their score criteria are detailed below:

Frequency/ Probability (FR)
(Frequency or likelihood of activities impacting on the environment)

- 1: Almost Never / impossible
- 2: Very seldom / highly unlikely
- 3: Infrequent / Seldom
- 4: Often / Regular
- 5: daily / Highly regular

Severity (SV)
(Degree of change to the baseline environment in terms of reversibility of impact; Sensitivity of receptor, duration of impact and threat to environment and health standards)

- 1: Insignificant / not harmful / totally reversible
- 2: Small / potentially harmful / reversible within 05 years
- 3: Significant / slightly harmful / needs specific mitigation to reverse in a time span of between 05 and 15 years
- 4: Great / harmful / irreversible

- 5: Disastrous / extremely harmful / totally irreversible and damaging

Duration (DR)
(Length of time over which activities will cause change to the environment)

- 1: One day to a month
- 2: One month to a year
- 3: One year to ten years
- 4: Life of project
- 5: Post closure

Spatial Scope (SS)
(Geographic overage)

- 1: Activity Specific
- 2: Site specific
- 3: Area
- 4: Regional
- 5: National

The impacts are also scored taking any mitigation into consideration. The impacts are scored and scaled for significance as follows:

- **Negligible** (scoring of 3 or less) – The impact is unimportant / indiscernible and hence insignificant – little or no mitigation adequately addresses the impact.
- **Low** (scoring of 4 to 9) – The impact is of little importance since it is easily and adequately mitigated.
- **Medium** (scoring of 10 to 15) – The impact is considerable and requires adequate mitigation to reduce potential damage to the environment.
- **High** (scoring of 16 or more) – the impact is adverse and may never be adequately mitigated. The impact has a high probability of causing cumulative effects of other less significant impacts. It may be considered to be a fatal flaw of the project and requires intense consideration.

10.2. Impacts Identified

The impacts of the construction and operation phases for the proposed construction of the Inanda Glebe Sewer Reticulation are summarised in Table 8 below. The construction period will last 18 months.

Table 8: Impacts Identified and Associated Mitigation Measures for the Construction Phase

Nature of Impact	Impact Type	Frequency		Severity		Duration	Spatial Scope	Impact Score with Mitigation	Significance
		Unmitigated	Mitigated	Unmitigated	Mitigated				
CONSTRUCTION PHASE OF THE PREFERRED ALTERNATIVE									
Loss of Biodiversity	Direct	5	4	3	2	3	3	12	Medium
Erosion	Cumulative	4	3	3	2	3	2	10	Medium
Traffic and Access	Direct	4	3	3	2	3	3	11	Medium
Hydrological Impact of temporary alteration of stream flow and disturbance of stream bed due to construction activities	Indirect	4	3	3	2	3	2	10	Medium
Pollution due to site operations	Direct	4	3	3	2	3	2	10	Medium
Disturbance to residential area by noise and dust from construction process	Direct	5	4	2	1	3	2	10	Medium
Air quality degradation as a result of dust and odours.	Direct	5	4	3	2	3	3	12	Medium
Visual impacts	Direct	5	4	3	2	3	2	11	Medium
Waste and litter	Cumulative	5	3	3	2	3	2	10	Medium
Damage to existing services	Indirect	4	3	4	2	3			
Injury to local people and construction workers	Direct	5	4	4	2	3	2	11	Medium
Disturbance to existing infrastructure and impact on Heritage resources	Indirect	4	3	2	1	3	3	10	Medium
Socio-economic impacts	Cumulative	5	4	2	3	3	3	13	Medium

Table 9 below lists the impacts identified for the Operational Phase.

Table 9: Impacts Identified and Associated Mitigation Measures for the Operational Phase

Nature of Impact	Impact Type	Frequency		Severity		Duration	Spatial Scope	Impact Score with Mitigation	Significance
		Unmitigated	Mitigated	Unmitigated	Mitigated				
OPERATIONAL PHASE OF THE PREFERRED ALTERNATIVE									
New pipelines and manholes could increase risk of contamination of water resources.	Cumulative	3	2	3	2	2	3	9	Low
Soil erosion near steep slopes	Cumulative	3	2	2	1	2	2	7	Low

(iii) Significance of Impacts

Based on the outcome of the impact assessment matrix noted in Table 8 above, the overall significance impact with mitigation measures, is considered to be Medium i.e. the impact is considerable and requires adequate mitigation to reduce potential damage to the environment.

Based on the outcome of the impact assessment matrix noted in Table 9 above, the overall significance impact with mitigation measures, is considered to be Low i.e. the impact is of little importance since it is easily and adequately mitigated.

Wetlands that have been identified to be affected by the proposed Inanda Glebe Sewer Reticulation were further assessed using the tool described below. HGM's 1, 2 and 3; and river riparian 1 were assessed to be at risk of being impacted directly by the proposed sewer reticulation. These systems were therefore functionally assessed (WET-Health Level 1; WET-EcoServices Level 2, EIS and IHIA).

Rating	Class	Management Description
1-55	(L) Low Risk	Impact to watercourses and resource quality small and easily mitigated.
56-169	(M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures.
170-300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale

The impacts that may result from the proposed sewer reticulation upgrade can be direct impacts, indirect impacts or cumulative impacts. The main causes of impacts are insufficient planning prior to development. All construction activities should be conducted outside sensitive HGM units and their recommended buffer zone to prevent direct impacts to these environments. A risk assessment was conducted for HGM's 1, 2, and 3 as seen in the tables below.

Table 10: Risk Assessment Results for HGM 1

HGM 1				
Activity	Inanda Glebe Sewer Reticulation Upgrade			
Aspects	Maintenance and repair of existing access roads	Vegetation maintenance within wetland	Introduction of foreign material	Excavating, trenching and infilling
Impacts	Erosion, sedimentation, change in geochemical regimes and loss of biodiversity			
Flow regime	1	2	3	3
Physio & Chemical (Water Quality)	0	2	3	3
Habitat (Geomorphology + Vegetation	1	2	3	3
Biota	3	2	3	3
Severity	1.75	2	3	3
Spatial scale	2	2	3	2
Duration	2	3	2	2
Consequence	5.75	7	8	7
Frequency of activity	1	1	1	1
Frequency of impact	2	2	3	3
Legal issues	1	1	1	5
Detection	2	2	3	1
Likelihood	6	6	8	1
Significance	34.5	42	64	70
Risk Rating	**L**	**L**	**M**	**M**

According to table 10 above HGM 1 will have a 'low risk' for aspects maintenance and repair of existing roads and; vegetation maintenance within wetland. A 'moderate risk' was assigned for aspects introduction of foreign material and; excavating, trenching and infilling. This is due to these aspects ability to inhibit a more severe direct and indirect impact on the wetland as a result of the close proximity of excavating, trenching and infilling and; the ability of foreign material to easily transport and deposit into the wetland environment. Therefore, implementation of mitigation measures is a necessity to prevent and reduce the impacts from occurring.

Table 11: Risk Assessment Results for HGM 2

HGM 2				
Activity	Inanda Glebe Sewer Reticulation Upgrade			
Aspects	Maintenance and repair of existing access roads	Vegetation maintenance within wetland	Introduction of foreign material	Excavating, trenching and infilling
Impacts	Erosion, sedimentation, change in geochemical regimes and loss of biodiversity			
Flow regime	2	3	4	4
Physio & Chemical (Water Quality)	2	3	4	4
Habitat (Geomorphology + Vegetation	1	2	3	4
Biota	2	3	4	5
Severity	1.75	2.75	3.75	4.25
Spatial scale	2	2	3	3
Duration	2	2	3	3
Consequence	5.75	6.75	9.75	10.25
Frequency of activity	2	2	1	3
Frequency of impact	2	2	4	4
Legal issues	1	1	5	5
Detection	2	3	2	1
Likelihood	7	8	12	13
Significance	40.25	54	117	133.25
Risk Rating	**L**	**L**	**M**	**M**

Similarly, to HGM 1 the risk assessment revealed that the HGM 2 will have a 'low risk' for aspects maintenance and repair of existing roads and; vegetation maintenance within wetland. A 'moderate risk' was assigned for aspects introduction of foreign material and; excavating, trenching and infilling. This is also due to these aspects ability to inhibit a more severe direct and indirect impact on the wetland as a result of the close proximity of excavating, trenching and infilling and; the ability of foreign material to easily transport and deposit into the wetland environment. Implementation of mitigation measures is an absolute necessity to prevent and reduce the impacts from occurring as excavating, trenching and infilling could occur in a small portion within the wetland.

Table 12: Risk Assessment Results for HGM 3

HGM 3				
Activity	Inanda Glebe Sewer Reticulation Upgrade			
Aspects	Maintenance and repair of existing access roads	Vegetation maintenance within wetland	Introduction of foreign material	Excavating, trenching and infilling
Impacts	Erosion, sedimentation, change in geochemical regimes and loss of biodiversity			
Flow regime	2	3	4	5
Physio & Chemical (Water Quality)	2	3	4	5
Habitat (Geomorphology + Vegetation	2	3	4	4
Biota	2	4	5	5
Severity	2	3.25	4.25	4.75
Spatial scale	1	2	3	3
Duration	2	2	3	4
Consequence	5	7.25	10.25	11.75
Frequency of activity	1	2	1	5
Frequency of impact	2	3	3	4
Legal issues	1	1	5	5
Detection	3	3	1	1
Likelihood	7	9	10	15
Significance	35	62.25	102.5	176.25
Risk Rating	**L**	**M**	**M**	**H**

The risk assessment revealed that the HGM 3 will have a 'low risk' for aspects maintenance and repair of existing roads. A 'moderate risk' was for aspects vegetation maintenance within wetland and; introduction of foreign material. A 'high risk' rating was assigned for excavating, trenching and infilling as a direct result of the proposed sewer reticulation upgrade pipe laying cutting through the wetland environment. This aspect will have severe impacts on the wetland environment as a result of changes in the hydrological and geomorphological regimes. Therefore, implementation of mitigation measures is a necessity to prevent and reduce the impacts from occurring.

11. MITIGATION MEASURES

Construction Phase
Loss of Biodiversity – The areas of biodiversity concern include the stream/ wetland crossings and immediate margins where there are indigenous trees. • With the correct supervision and implementation, it should be possible to ensure that these areas remain undisturbed by the works. • Disturbance and habitat loss must be kept to a minimum. • All trenches must be clearly demarcated and barricaded on site at all times. • Care must be taken to keep soils stabilized when removing vegetation during construction and as part of alien plant eradication and strict on-site soil erosion measure must be implemented. • Topsoil must be stockpiled for eventual return during top soil back-filling and rehabilitation. These must be weed free and must not stand for a prolonged period of time. • Sub-soil and topsoil must be stored separately onsite. • Care must be taken to prevent the contamination of ground water with accidental fuel and oil spills from earth-moving and construction equipment and vehicles. Adequate usage of drip trays and bunded storage zone must be implemented on site. • Trenched must have one sloped side to allow animals which fall in to get out. • Trenches must be checked daily while open for animals which may be unable to get out. • Any animals found must be returned uninjured to suitable safe habitat. • Hunting and trapping of any animals by staff must be prevented. This includes reptiles which must be handled by a professional. • A pre-construction walk-through must be implemented by the ECO at the crossing points in the wetland and river areas before excavation takes place on site. This will be used to identify any species of conservation importance that may have occupied the site after the compilation of this report. • Should any species be found that are protected, either provincially or Nationally, the correct permit should be applied for in advance and the conditions of those permits should be followed to prevent or offset impacts during construction. • Alien invasive plant eradication plan must be implemented on an ongoing basis to limit the establishment of exotic species during the rehabilitation of the disturbed areas. • The ECO must supply the Contractor with list a list of problematic alien invasive plant species that are likely to occupy the site during construction. • Regular Environmental Toolbox Talks must be implemented by the Contractor on site • Noise levels including vibrations caused by drilling must be kept to a minimum to prevent animals abandoning nearby habitats.
Erosion – Risk of erosion is greatest in areas with steep side slopes. These are generally located towards the middle of the alignment. • Minimise the extent of disturbance in high risk areas. This is probably best achieved through hand excavation and backfilling of trenches. Otherwise strict control and use of the smallest machines possible should occur. • Ensure that work progresses and trenches are backfilled rapidly. The opening of small sections of trench at any one time should help to ensure that this occurs.

- Ensure that work occurs during dry periods and that appropriate erosion protection (geo-jute, berms, etc.) is used to protect the works during wet periods.
- Soil management and rehabilitation is also important in order to ensure that vegetative cover establishes over the backfilled trench/ disturbed areas as rapidly as possible.

Wetland Crossing – All construction activities should be conducted outside sensitive HGM units and their recommended buffer zone to prevent direct impacts to these environments.

- Soil stockpiles must be protected from erosion, surrounded by suitable earthen buns and covered by erosion control blanket to prevent the transfer of sediment into HGM 1 and RR 1.
- It is recommended sewer reticulation pipeline route to be adjusted slightly away from HGM 1 and RR 1 which will in turn eliminate impacts on these systems.
- Trenching, refill and backfill must take cognizance of maintaining the hydrological flow regime of the HGM 1 and RR 1.
- All banks or slopes should be profiled to maintain to the geomorphological integrity of the HGM unit (HGM 1).
- Disturbed wetland areas should be re-vegetated immediately after construction has been undertaken with wetland vegetation indigenous to the area.
- Access to floodplain must be strictly controlled.
- Empty vessels must not be left behind and must be removed as soon as possible to minimise pollution of the soils and water.
- Mixing of cement must not be done in the flood plain.
- Water from the river must not be used for mixing and mixing must be done on an impervious structure e.g. in a wheelbarrow. Any spillage of concrete must be cleaned immediately and care must be taken to avoid spillage.

Traffic and Access – presence of construction vehicles and personnel leading to traffic congestion, dust, noise and threat of accident.

- Construction vehicles and personnel must adhere to business hours. This may be relaxed to accommodate abnormal vehicles so that they do not hinder daily life and/or regular traffic.
- Pointsmen to guide traffic for entry and exit of construction vehicles must be used. Signage for presence of construction vehicles must be erected.
- Construction phase must be as short as possible. Reliable building contractors must be employed.
- The site must be wet regularly to minimise dust. Vegetation must be removed as and where required only.
- Vehicles must park on demarcated site only.
- Contractors will access portions of land that are fenced off, by removing these fences and re-instating them at cost to the project, upon completion of works within that area.

Hydrological Impact – Temporary alteration of stream flow and disturbance of stream bed due to construction activities – seasonal drainage lines and seepage areas beside the main stream line.

- Excavation and construction should take place during the dry season.
- The movement of soil should only take place twice, to remove and replace the soil.
- During installation, the excavated soil from the trench should be placed on the upslope side of the trench, minimizing the risk of excess sediment entering the freshwater ecosystems.
- The soil profile should be restored to the natural structure with topsoil and subsoil being replaced in sequence.
- The backfill within the trench should be compacted to a similar permeability of the surrounding soils.

- The compaction of soil caused by vehicles and machinery should be reversed.
- Transplanting of plants within the freshwater ecosystems to re-vegetate the in-filled trench.
- The crossings should be rehabilitated to ensure that no barriers exist within the stream and that in-stream habitat is similar to the current situation.

Pollution due to site operations – Site, working area and adjacent watercourse. The proposed pipeline is near wetlands/ streams/ floodplain which could increase the risk of contamination entering the watercourse.

- Careful storage and handling of materials such as fuels, paints and chemicals to minimize the risk of spillage onto open ground or into surface water systems. All potentially polluting materials should be stored in closed containers away from sensitive areas.
- Storage areas that contain hazardous substances must be bunded with an appropriate impermeable material.
- Spills in bunded areas must be cleaned up, removed and disposed of safely from the bunded area as soon as after detection as possible.
- Mixing/ decanting of all chemicals and hazardous substances including concrete and asphalt must take place either on a tray or on an impermeable surface away from sensitive areas. Waste from these should then be disposed of to a suitable waste site.
- Bins and/ or skips should be provided at convenient intervals for disposal of waste within the construction area. These shall be regularly emptied. Bins should have liner bags for efficient control and safe disposal of waste. Recycling should be facilitated and encouraged. Littering on site should be prohibited and the site should be cleared of litter at the end of each day.
- Where waterborne sewerage is not available, temporary chemical toilets must be provided by a company that is approved by the Municipality/ Engineer/ Environmental Consultant. These shall be maintained in a clean state by a registered chemical waste company. These must be located within the Contractors camp and on site as agreed by the Municipality/ Engineer/ Environmental Consultant. The construction of 'long drop' toilets is forbidden.
- Provision should be made during set up for all polluted runoff to be treated to the Department of Water Affair's/ Municipality's/ Engineer's/ Environmental Consultant's approval before being discharged into the stormwater/ surface water system.
- A spill contingency plan must be prepared for the construction phase.
- The responsibility rests with the applicant to identify any sources or potential sources of pollution from his undertaking and to take appropriate measures to prevent any pollution of the environment.

Disturbance to residential area by noise and dust from construction process – Construction, storage areas, site access areas and works in close proximity to houses. It is inevitable therefore is must be noted that only a degree of disturbance will occur. Impacts should only be short term and it should be possible to minimize disturbance and nuisance for residents.

- Construction operations and deliveries should be restricted to normal working hours.
- When works are to be undertaken within residential properties,
    - The extent and timing of the works shall be agreed with the property owner/ resident;
    - Photographic records shall be prepared by the contractor pre-construction detailing the condition of the site prior to the works progress and mitigation measures weekly/ monthly;
    - All necessary measures shall be in place to ensure that the property is secure;
    - A supervisor shall be on the property during all work to supervise workers;
    - Rehabilitation works shall be undertaken as quickly as possible to the same standard as existing finishes/ planting prior to disturbance by the workers.

• People from adjacent areas should be kept informed of the need and extent of noisy disruptive processes, particularly blasting activities. • The contractor should ensure that plant where appropriate is fitted with properly functioning silencers. • The Contractor's camp is to be located in a suitable location outside the residential area and approved by the Municipality.
Air quality degradation as a result of dust and odours – Site and adjacent areas. • Damping down of exposed soil areas, to reduce dust pollution. • No fires should be permitted. • Limit stripping of vegetation and existing material to necessary working areas. • Vehicles and machinery must be kept in good working order to limit emissions and oil spillage. • Chemical toilets shall be used for the workforce. • Toilets, cooking areas and waste collection areas must be located away from houses.
Visual impacts – the area is residential in parts and neighbours may not appreciate the presence of a construction site in their neighbourhood. • The site must be well maintained and neat. • The contractor must adhere to project schedule in order to minimise the length of the construction period. • Inspections of the site by an Environmental Control Officer are required. • Upon completion of the repair and maintenance activities undertaken during the operational phase, the site must be well maintained and neat. • The contractor tasked with the maintenance of the pipeline must adhere to project schedule in order to minimise the length of the maintenance and repair period.
Waste and litter – may affect neighbours as well as result to the general pollution of the area. • Mitigation measures stated as per the EMP must be implemented on site. • No dumping of any materials or storage of any equipment should be allowed within the wetland areas. • Waste must be separated especially with regard to hazardous waste. This would include soils that have been contaminated by cement, fuel, paints, etc. Care must be taken to avoid contamination of soils. • Personnel must be trained in etiquette regarding littering and waste management. • Appropriate scavenger proof vessels for wastes must be provided in suitable locations and must be adequate in number. • A waste storage area must be allocated and adhered to. • Waste must be disposed of at registered landfill sites or appropriate facilities. Proof of disposal must be provided when requested. • Staff must have a system of housekeeping to ensure litter is minimised.
Damage to existing services - existing service corridors may be affected. Trench excavation in the vicinity of the existing services will be required causing a risk of disturbance. • Check the location of all underground and above ground services as well as working requirements with all service providers prior to commencing excavation. • Proving the location of all underground service prior to trench excavation. • Working in accordance with service providers requirements adjacent to their service runs. • Should damage to service runs occur, taking all necessary measures to minimize damage, inform the relevant

service provider immediately and undertake all necessary remedial work including the employment of specialist contractors in order to minimize disruption of the service.
Injury to local people and construction workers – Pedestrians and motorists using adjacent roads run the risk of injury. Areas where the pipeline is aligned through and close to densely developed housing is more likely to result in injury. Occupational safety, security and health for construction workers and the general public. • Residents should be made aware of the works. • Trenches should not be left open and unmarked. • Supervisors are to be vigilant particularly of children who may come close to the construction works without realizing the danger to themselves. • Appropriate barricades and signs should be used where necessary. • All relevant Health and Safety legislation as required in South Africa should be strictly adhered to. This includes the Occupational Health and Safety Act. • Implementation of safety measures and work procedures. • The most dangerous operations are likely to be the operation of heavy machinery and plant and blasting. Mitigation should ensure that all plant and machinery is properly maintained and is operated in accordance with safety requirements and manufacturer's recommendations. • The engineer shall have the right to order the immediate removal from the site of any plant which he may deem to be unsatisfactory for the proper execution of the work. • All relevant Health and Safety legislation as required in South Africa should be strictly adhered to. This includes the Occupational Health and Safety Act. • Fire safety measures must be included in the design of the facility. Fire safety equipment must be provided on site during construction. • First aid kits are required on site as well as an incident records file. • Construction related vehicles must adhere to speed limits of the surrounding roads and a limit of 20km/hr on site. • Safety gear including hard hats and safety shoes must be provided and worn at all times while on site. • Emergency numbers must be clearly visible on site. • Trespassing and/or utilising the site as a thorough fare is prohibited by unauthorised persons. • Contractor staff are prohibited from trespassing over the site boundaries. • Interaction with neighbours and objecting parties at the site must be well documented. A complaints register must be readily available on site. Interaction with external parties must be courteous.
Disturbance to Existing Infrastructure and Impact on Heritage Resources – Water, electricity, telecommunications, roads and railway infrastructure must be considered. Resources of heritage significance such as grave sites and buildings older than 60 years of age must be maintained during construction as per AMAFA, the heritage agency. • Stakeholders must be notified as soon as possible. This includes the community, the municipalities, the service providers and ward councillor. • Servitudes of infrastructure must be confirmed prior to design of the development and permission granted. • No-Go areas must be demarcated. This would include any known existing grave sites. • For any chance finds, all work must cease in the area affected and the Contractor must immediately inform the Project Manager. A registered heritage specialist must be called to site for inspection. The relevant heritage resource agency (AMAFA) must also be informed about the finding. • The heritage specialist will assess the significance of the resource and provide guidance on the way forward.

• Permits to be obtained from AMAFA if heritage resources are to be removed, destroyed or altered. • All heritage resources found in close proximity to the construction area to be protected by a 10m buffer in which no construction can take place. The buffer material (danger tape, fencing, etc.) must be highly visible to construction crews. • Under no circumstances may any heritage material be destroyed or removed from site unless under direction of a heritage specialist. • Should any remains be found on site that is potentially human remains, the South African Police Service should also be contacted. • If there are chance finds of fossils during construction, a paleontologist must be called to the site in order to assess the fossils and rescue them if necessary (with an AMAFA permit). The fossils must then be housed in a suitable, recognized institute.
Socio Economic Impacts – Job creation and possible economic benefit to construction material suppliers in the area. The establishment of water infrastructure benefits the community. • Community members, leaders and taxi associations must be notified as soon as possible by posting notice boards with illustrations on site. • Local people must be employed where possible. • Traditional leaders and/or ward councillors must be involved in the public participation and they will aid in appeasing the community.
Operational Phase
The new pipelines and manholes could increase risk of contamination of water resources. • All pipelines and manholes have to be waterproof and are tested as part of the construction process.
On-going soil erosion near steep slopes that require excavation and stream crossings and areas where the pipe is laid close to a water course. • On-going rehabilitation to address areas of erosion as they occur. • The use of trench breakers in steep trenches.

12. SUMMARY OF SPECIALIST STUDY AND FINDINGS

12.1. Wetland Delineation and Functional Assessment

Aeon Nexus (Pty) Ltd conducted a wetland delineation and functional assessment for the proposed sewer reticulation. The specialist wetland report was prepared to identify the location of wetlands and river riparian on and within 500m of the study site; determine the functionality and health status of the wetlands and identify the impacts of the proposed activity on the surrounding wetlands and riparian habitats. A desktop study was initially undertaken to acquire an understanding of the general study area and identify the potential wetland and fluvial areas of interest within 500m of the site.

A wetland delineation field survey was then undertaken on the 24th April 2017 to accurately delineate the boundaries of the wetland and river riparian environments within the 500m buffer surrounding the site. The field survey included identifying wetland areas, delineating the outer boundaries of temporary zone of wetland and classifying the type of wetland. The wetlands that were identified were classified into HGM (Hydrogeomorphic) units. The River Riparian (RR) systems were divided in RR units based on topographic location, landform, hydrological characteristics and potential risk of degradation.

A total of eleven (11) wetland systems were identified and delineated and one river riparian system was mapped within the 500m buffer surrounding the site. Map 2 above is an indication of the HGM units and RR habitats that were identified on site in relation to the 500m buffer surrounding the site. A summary table of the wetlands, HGM units and river riparian together with their characteristics is provided in table 13 below.

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Table 13: Summary of Wetland and River Riparian Characteristics

Wetland/RR No.	HGM/RR No.	Wetland Type/River Riparian	Extent (Ha)	Average Slope (%)	Length of HGM/RR within buffer (m)	Pipeline	Crossing width (m)	Start	End
1	1	HS	0.67	0.01	354	•	•	•	•
2	2	HS	0.74	1.3	465	160mmØHDuPVC	84	29°43'13.91"S 30°55'12.95"E	29°43'15.67"S 30°55'10.27"E
3	3	HS	1.45	13.1	875	160mmØHDuPVC	90	29°43'14.85"S 30°55'2.36"E	29°43'17.88"S 30°55'4.63"E
4	4	HS	1.59	10.2	704	•	•	•	•
5	5	HS	0.23	0.03	172	•	•	•	•
6	6	HS	1.51	11.2	690	•	•	•	•
7	7	HS	0.90	10.8	631	•	•	•	•
8	8	HS	0.13	0.03	136	•	•	•	•
9	9	HS	0.45	9.8	426	•	•	•	•
10	10	CVB	1.32	5.6	704	•	•	•	•
11	11	CVB	0.82	8.6	590	•	•	•	•
1	1	RR	N/A	N/A	833	•	•	•	•

CVB – channelled valley bottom wetland;
UVB – un-channelled valley bottom wetland;
HS – hillslope seepage wetland;
RR – River Riparian

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Wetlands not at risk

HGM's 4, 5, 6, 7, 8, 9, 10, and 11 were assessed **not to incur impacts** (direct or indirect) from the proposed sewer reticulation. HGM's 4, 5, 6 and 7 are all located to the south of the proposed sewer reticulation but are all within the surrounding 500m buffer area. HGM's 4, 5, 6 and 7 are at a fair distance away from the proposed study site, therefore, no impacts will incur on these wetlands. HGM's 8 and 9 are located to the west of the project area while HGM's 10 and 11 are located to the east of the project area. These HGM units are separated a fair distance away from the project area.

Wetlands and River Riparian systems at risk

HGM's 1, 2 and 3 as well as river riparian 1 will be impacted directly by the proposed sewer reticulation as these are all located within the proposed sewer reticulation site. HGM 1 will be impacted by the proposed sewer reticulation as the planned pipe laying boarders the HGM unit. HGM 2 and 3 will be significantly impacted by the proposed sewer reticulation as pipe laying will occur within these wetland environments.

One river riparian (RR) habitat is located within the valley of the proposed sewer reticulation known as Gobhogobho River. The river systems flow begins from the north-east boundary of the proposed site in which several tributaries feeds into the main river channel that changes flow into a southerly direction.

Buffer zones

Buffer zones are areas of vegetation around the wetland boundaries which function as protection to the wetland from developmental or land use changes. A 25m buffer around HGM's 1, 2 and RR 1 is required and a 32m buffer is required for HGM 3. Although the proposed sewer reticulation requires some pipe laying to occur through wetland environments, implementing the recommended mitigation measures as per the specialists will aid in maintaining and improving wetland integrity.

Refer to Appendix E for the Wetland Delineation and Functional Assessment.

12.2. Heritage Impact Assessment

The proposed Inanda Glebe reticulation project is situated immediately north of and alongside the Ntuzuma E sewage outfall project. A literature research was first conducted in order to place the development area in an archaeological and historical context. A site inspection of the proposed reticulation project was undertaken on 10 April 2017. The project site is located in an urban township with existing houses, other structures (such as spaza shops) and roads. It is therefore highly disturbed by such developments. Sections of the proposed reticulation works will run close to a stream and associated wetland. This area is heavily infested with invasive vegetation which limited visibility.

A large vacant area situated immediately east of the M25 was inspected. The disturbed nature of the area indicates that the possibility of finding intact heritage sites would be low. The area to the immediate west of the M25 includes large sports field and netball court and ids highly disturbed as well. The general project area is highly disturbed as well due the fact that the area is made up of formal structures that are interspersed with some informal structures. An area where the Shembe followers worship was found should be avoided. If this area cannot be avoided, then discussions need to be held with the Shembe community. No grave sites were found on site as the residents use cemeteries to bury their dead located in Inanda and KwaMashu.

The sensitivity map generated by The South African Heritage Resources Agency (SAHRA) indicated that the project area falls within a moderately sensitive area, thus requiring a Desktop study. However, since the project area is highly disturbed, no desktop study was required.

Refer to the Heritage Impact Assessment Report under Appendix E.

12.3. Biodiversity Impact Assessment

A biodiversity assessment was conducted by Bryan Paul in summer on 10 April 2017. Here, the entire route was walked and data regarding flora and fauna was recorded and a Biodiversity report was compiled.

The proposed site environment has undergone 100% transformation and most of the natural vegetation expected to be in this area have been removed and replaced by exotic non-indigenous plants, especially in the form of alien invasive plant species. Heavy anthropological pressures have stripped the study area of suitable habitat and resulted in both the Gobhogobho River and three wetlands found on site being highly degrade and in a poor state. The poor water quality would be owed to the lack of infrastructure in the area, such as running water and adequate sewage facilities. In addition to this pollution and heavy vegetation clearing for residential expansion has played its part over the years in reducing the present ecological state of this area, which is evident by the short indigenous species list found in this report.

The site was found to not fall within a Critical Biodiversity Area, D'MOSS or any other any areas that are mapped for their contribution as crucial biodiversity areas. At the time of the inspection no animal species were recorded, nor are there any species of great conservation importance that would be expected to occur in this region.

In terms of this areas floral contribution, there is a small fraction of the remaining indigenous vegetation that would be expected in this area, most of which are common and add little to the currently degraded ecosystem. With this said, there two species recorded that are protected by the Natal Nature Conservation Ordinance and will require permit applications to be lodged with Ezemvelo KZN Wildlife, should they not be avoided or protected. The location and names of these species may be found in table 14 below:

Table 14: Species Protected by the Natal Nature Conservation Ordinance

Species	Location	Found in Watercourse	Occurrence
Aloe ferox	29°43'0.87"S and 30°54'46.04"E 29°42'51.94"S and 30°54'53.27"E	No	2
Aloidendron barberae	29°42'53.41"S and 30°54'58.15"E	No	1

No species were recorded that are protected by the National Forest Act 1998, nor were there any species that are classified as Red List Data Species and that must be specifically protected.

In conclusion of the results acquired from both the literature study and the ground study there should be no reason why this development should not go ahead. There are currently limited impacts anticipated to be caused by the development, mainly owing to the fact that this study area has been subjected to the high anthropological pressures such as vegetation clearing, subsistence farming, introduction of exotic species and intense habitat alterations for housing over a long period of time.

12.4. Stormwater Management Plan

The Environmental Authorisation has been granted for the construction of the Ntuzuma E sewer outfall, construction of low-cost housing with waterborne sewerage, which is located within the eThekwini Municipality. The Ntuzuma E area is bordered by Inanda Glebe, the focus of this BAR. Inanda Glebe is to be upgraded to waterborne sewerage from the current pit latrine system currently used by residents. The outfall sewer will cater for Inanda Glebe and the existing low cost houses in Ntuzuma E. The objectives of the stormwater management plan are to:

- minimise the threat of flooding;
- protect watercourses which are potential receiving bodies; and
- ensure proper disposal of storm water.

There is no proposed stormwater infrastructure that will be constructed under this project. There is existing storm water infrastructure in the area. The extent of the existing storm water infrastructure is depicted in Annexure 2 of the SWMP.

The Stormwater Management Plan can be reviewed under Appendix E.

12.5. Geotechnical Investigation

Drennan Maud (Pty) Ltd conducted a geotechnical investigation between 17th October 2017 and 20th October 2017. The investigation comprised of the following:

- The excavation of hand dug inspection pits (IP) extended by hand bored augers;
- Dynamic Cone Penetrometer (DCP) testing;
- Geological mapping; and
- Sampling of materials for laboratory testing.

Based on the findings of the geotechnical assessment the proposed Inanda Glebe reticulation project is considered feasible provided the geotechnical considerations and recommendations provided are taken into account.

Soft excavation is anticipated along the majority of the pipeline route to anticipated pipe trench depths (ranging between 1.2 – 3.8) within the weathered sandstone, tillite and dolerite bedrock and overlying unconsolidated material. However, it is important that provision for localised harder zones in the prevailing bedrock types should be allowed for.

A screening process will need to be passed if the weathered tillite, sandstone and sandy colluvial and alluvial material present on site are to be used as selected granular fill material. Alternatively, suitable material will need to be imported to site from a local source. Selected testing of the prevailing materials indicates that they generally range from suitable to marginally unacceptable for use as selected fill material, with the exception of the generally very clayey residual dolerite and tillite subsoils. All the materials encountered on site are likely suitable for use as general backfill material provided the material does not form into lumps upon drying and all particles greater than 30mm are removed prior to its use.

Pipe-jacking will need to be planned carefully, with caution exercised with regard to the excavation of launching and jacking pits and lateral support thereof as well as necessary dewatering measures to adequately lower the shallow ground water table. The same applies to pipeline stream crossings which will be inundated by shallow ground water seepage and likely trench sidewall collapse if not adequately shored or battered back.

Due to the shallow ground water table within the valley bottoms and heads of drainage valleys consideration must be given the upward buoyancy force that will be exerted on the pipeline and must be suitably anchored to counteract the upward force. Where the pipe trench is located entirely within loose fill, colluvium or residual material the trench sidewalls should be suitably shored to prevent localised collapse thereof whilst trenches located entirely in weathered sandstone or tillite bedrock will likely stand unsupported during pipe installation provided no excessive seepage therein is encountered.

Refer to Appendix E for the Geotechnical Investigation.

13. ENVIRONMENTAL IMPACT STATEMENT

The **Wetland Delineation and Functional Assessment** has determined that HGM 1, 2, 3 and RR 1 would be impacted on as a consequence of the proposed sewer reticulation. The Ecological Importance and Sensitivity (EIS) scores demonstrate a median score of 1 for HGM's 1, 2 and RR 1 indicating little variation in these environments comparative ecological importance. However, HGM 3 EIS score demonstrates a median score of 2 indicating moderate EIS. Hence, HGM 3 was sensitive to hydrological change which was a direct result of portions of this HGM unit being identified as NFEPA (National Freshwater Ecosystem Priority Areas) natural bench wetlands. Buffer zone analysis results indicate a buffer of 25m around HGM 1, 2 and RR 1 is adequate enough to protect the wetlands integrity and a buffer of 32m around HGM 3 as a result of this wetland being more sensitive to hydrological changes. Risk assessment results confirmed that HGM's 1, 2 and 3 are likely to suffer direct and indirect impacts as a consequence of the proposed sewer reticulation upgrade. The results indicated that excavating, trenching and infilling and; introduction of foreign material will be a moderate risk in HGM's 1 and 2 but a high risk in HGM 3. Maintenance and repair of access roads proved to be a low risk.

According to the **Heritage Impact Assessment** no heritage sites of significance were found during the site inspection apart from the Shembe worship site which is significant in terms of its importance for the Shembe community. It is recommended that the sewer reticulation works avoid this site completely. If this cannot be done, then discussions must be held with the Shembe community to address the issue. The CLO (Community Liaison Officer) indicated that the community used cemeteries in Inanda and KwaMashu to bury their dead so there were no graves to his knowledge amongst the residential dwellings. None were found during the site inspection. It is therefore recommended that the installation of the sewer reticulation proceed with the provision that the recommendations regarding the Shembe site are adhered to.

According to the **Biodiversity Assessment** there are currently limited impacts anticipated to be caused by the development, mainly owing to the fact that this study area has been subjected to the high anthropological pressures such as vegetation clearing, subsistence farming, introduction of exotic species and intense habitat alterations for housing over a long period of time. Therefore, it is the opinion of the specialist that the proposed sewer reticulation should proceed. The proposed site of this development does not fall within a Critical Biodiversity Area, yet there are areas within 500m of the development boundary that show irreplaceable biodiversity. Therefore, it is imperative that the Contractor/Applicant ensures that impacts associated with construction are kept within the anticipated construction servitudes and areas of anticipated impact.

Based on the findings of the **Geotechnical Investigation**, the proposed 160mm diameter sewer reticulation pipeline network within the Inanda Glebe area is considered feasible provided the geotechnical considerations and recommendations provided in this report are taken into account during the design and construction phases. It is anticipated that 'soft' excavation (after SABS 1200D) is anticipated along the majority of the pipeline route to anticipated pipe trench depths (ranging between 1.2 - 3.8) within the weathered sandstone, tillite and dolerite bedrock and overlying unconsolidated material. However, it is considered prudent that provision for localised harder zones, as may occur within the prevailing bedrock types, should be allowed for.

All of the materials encountered on site are likely suitable for use as general backfill material provided the material does not form into lumps upon drying and all particles greater than 30mm are removed prior to its use. Pipe-jacking where required along the route will need to be planned carefully, with all due caution exercised with regard to the excavation of launching and jacking pits and the lateral support thereof as well as necessary dewatering measures to adequately lower the shallow ground water table.

Through this basic assessment, it has been concluded that the proposed development is not expected to have significantly adverse or lasting impacts on the environment in question, provided that the EMP is implemented. The project will have positive impacts, viz:

- installation of infrastructure for the provision of sewer;

- short term skills development and job creation; and
- post construction rehabilitation of the areas along the route and wetland(s) affected.

The construction phase is approximately 18 months and is not anticipated to cause any detriment to the environment, but the post construction rehabilitation will in fact aid in the rehabilitation of the immediate vicinity of the pipeline. The EMP must be adhered to and will ensure that any negative impacts however minimal are not magnified. During the post construction phase of the project, the contractors must ensure that all hazardous materials are removed from the site and that rehabilitation of land is undertaken according to the requirements of the EMP.

14. IMPACT MANAGEMENT MEASURES FROM SPECIALIST STUDIES

General proposed recommendations and mitigation measures that should be instituted into the EMP for the development site

- Remove all category 1a and 1b invasive alien plant species at the development sites during construction of the proposed water infrastructure upgrade.
- All development footprint areas should remain as small as possible during construction and should, ideally, not encroach onto sensitive wetland/riparian areas.
- All construction staff should be educated on the importance and sensitivity of the wetland/riparian systems around the construction site. This should form part of the induction process.
- Care should be taken not to remove indigenous vegetation unnecessarily from the sensitive wetland/riparian areas and their associated buffers during all phases of construction.
- Soil excavated during construction should not be piled onto sensitive wetland/riparian areas.
- Stormwater management and erosion control measures should be applied to the construction phase of the development to prevent surface run-off and sedimentation.
- Site engineers should regularly inspect the erosion control measures to confirm their appropriateness and integrity.
- No dumping of any materials or storage of any equipment should be allowed within the wetland/riparian areas.
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms/bunds to avoid spread of any contamination into wetland/riparian areas.
- Washing and cleaning of equipment should also be done within berms or bunds, in order to trap any cement and prevent excessive soil erosion. These sites must be re-vegetated after construction has been completed.
- During all phases of the construction, appropriate sanitary facilities must be provided, and all waste removed to an appropriate waste facility.
- Frequent inspection of the site must be done to ensure that the integrity of the wetlands is maintained at all times.

All recommendations from the specialist studies must be incorporated into the development to render the proposed development as low impact as possible. The specialist recommendations are as follows:

14.1. Wetland Delineation and Functional Assessment

As per the wetland specialist recommendations, the following general mitigation measures should be applied to the area of the sewer reticulation upgrade project to limit impacts on HGM 2 and 3 which are crossed by the pipeline:

- Access control

  - Schedule laying of pipes should be conducted in the dry season to prevent increased surface runoff, erosion and sedimentation as well as to avoid disturbance to resources during critical periods i.e. periods of courtship, breeding, nesting etc.
  - As part of the induction process, all staff should be educated about the importance and sensitivity of environmental areas near or within the sewer reticulation upgrade zones. Frequent inspection of the site must be done to ensure that the integrity of sensitive areas is maintained at all times.
  - The construction zone should be restricted to a 15m construction servitude or to the engineer's specification
  - The construction zone along the pipeline, where the pipeline crosses the wetland, should be fenced off and be clearly demarcated to prevent access to other areas of the wetland. Access in and out of the wetland area should be limited as far as possible.

- Vegetation

  - All NEMBA category 1a and 1b invasive alien plant species should be removed and disposed of appropriately prior to the sewer reticulation upgrade. The sewer reticulation upgrade sites should be inspected regularly to identify and remove emerging IAP species.
  - Where possible the existing vegetation along the pipeline route should be carefully removed and stored for replacement after the pipeline has been laid and backfill process completed.
  - Care should be taken not to remove indigenous vegetation unnecessarily from the sensitive wetland areas and their associated buffers during all phases of construction.
  - The removal of alien vegetation should be undertaken manually by hand near sensitive areas. The use of heavy machinery should be kept to minimum near sensitive environments.
  - Fauna found within the sewer reticulation upgrade zones should be moved to the closest natural or semi-natural habitat zone away from any human induced anthropogenic activities.

- Erosion and sedimentation control

  - Sandbags should be utilized as a temporary diverting barrier downslope of excavation areas. The sandbags should be placed in order to minimize surface runoff ensuring the sensitive areas situated downslope does not incur any impacts as a result of sedimentation and erosion. Sandbags used to temporarily divert water should always be in good condition and inspected regularly.
  - The use of heavy machinery within the wetland should be prevented. Excavation, trenching and re-profiling should always be conducted by hand in order to limit disturbance in the wetland and must take cognizance of maintaining hydrological flow regime of the HGM unit. All banks or slopes be profiled to maintain to the geomorphological integrity of the HGM unit.
  - Soil excavated during construction should not be piled onto from top to bottom within a stipulated area away from any sensitive environment. The soil should be kept in stock piles and must be situated upslope or conveniently placed to prevent sedimentation of the sensitive environments.
  - Soil stockpiles should be conveniently placed in a position that minimises erosion. The central wetland should be kept clear of imported and excavated material to reduce the risk of downstream sedimentation.
  - Soil stockpiles must be protected from erosion, surrounded by suitable earthen buns and covered by erosion control blanket.
  - HGM's 2 and 3 are noted to be Hill-slope seepage wetlands. The proposed pipeline trenches will be located on either side of the unit. Infilling and compaction of terrestrial soils can lead to reduced soil permeability and increased surface

run-off downslope along the length of the trench. This may lead to the formation of concentrated flow paths, increased erosion and sedimentation of HGM's 2 and 3 downslope. Earthen buns should be installed across the trench 2m apart from the top of the ridges to HGM's 2 and 3. This will reduce the velocity of flowing water preventing erosion and sedimentation of HGM's 2 and 3. Flow paths created during high rainfall events should be filled immediately and monitored.

- Site engineers should regularly inspect the erosion control measures to confirm their appropriateness and integrity.
- The EO/ECO should perform regular visual inspection of surface water in order to identify any rapid increase in erosion and erosional features in the area and remedy where essential.

- Pollution control

  - No dumping of any materials or storage of any equipment should be allowed within the sensitive areas.
  - During all phases of the construction, all waste should be removed to an appropriate waste facility and under no circumstance should waste materials or contaminants be discharged into the environment or buried.
  - Washing and cleaning of equipment should also be done within berms or bunds, in order to trap any cement/sediment and prevent excessive soil erosion. These sites must be re-vegetated after construction has been completed.

- Surface water quality

  - All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms/bunds to avoid the spread of any contamination into sensitive areas.
  - Proactive measures should be enforced to ensure that work vehicles are up to standard regarding maintenance and function. These measures should include routine leak checks prior to construction and decommissioning of vehicles and machinery not up to par.
  - Dripping during the aforementioned leak checks and maintenance must be accommodated for by the provision of drip trays.
  - Handling of hazardous substances should be kept to a minimum within the construction site. Additionally, thorough training should be administered to site personnel regarding handling of the aforementioned substances.
  - Regarding sanitation – portable chemical toilets should be made available to site personal and should be located +-30m away from sensitive environments. Waste from the toilets should be collected and disposed of appropriately by a waste contractor.
  - An emergency "clean up kit" containing spillage clean up materials should be readily available on site to be used in event of a spill.
  - Fuels, chemicals and other hazardous substances should be stored in the appropriate, marked containers with closed lids.
  - All spillages or contaminations are to be immediately reported to the Site Manager and Environmental Officer so that appropriate clean up measures may be enacted.
  - Temporary noise should be kept to a minimum with equipment, machinery and vehicles, especially in sensitive areas.
  - The site must be inspected frequently (daily during the sewer reticulation upgrade and monthly thereafter) to ensure that the integrity sensitive areas is maintained at all times.
  - Additionally, readiness and professional execution of the clean-up contingency plan as well as the mitigation and rehabilitation is essential to ensure that the integrity of the sensitive areas is not compromised.

The following recommendations and mitigation measures should be applied to limit impacts to HGM 1 and RR 1 where the unit will be indirectly impacted by the installation of sewer reticulation pipelines:

- Soil stockpiles must be protected from erosion, surrounded by suitable earthen buns and covered by erosion control blanket to prevent the transfer of sediment into HGM 1 and RR 1.
- It is recommended sewer reticulation pipeline route to be adjusted slightly away from HGM 1 and RR 1 which will in turn eliminate impacts on these systems.
- Trenching, refill and backfill must take cognizance of maintaining the hydrological flow regime of the HGM 1 and RR 1.
- All banks or slopes should be profiled to maintain to the geomorphological integrity of the HGM unit (HGM 1).
- Disturbed wetland areas should be re-vegetated immediately after construction has been undertaken with wetland vegetation indigenous to the area.

14.2. Heritage Impact Assessment

- For any chance finds, all work will cease in the area affected and the Contractor will immediately inform the Project Manager. A registered heritage specialist must be called to site for inspection. The relevant heritage resource agency (AMAFA) must also be informed about the finding/s.
- The heritage specialist will assess the significance of the resource and provide guidance on the way forward.
- Permits must be obtained from AMAFA if heritage resources are to be removed, destroyed or altered.
- All heritage resources found in close proximity to the construction area are to be protected by a 5m buffer in which no construction can take place. The buffer material (danger tape, fencing, etc.) must be highly visible to construction crews.
- Under no circumstances may any heritage material be destroyed or removed from site unless under direction of a heritage specialist.
- Should any remains be found on site that is potentially human remains, the South African Police Service should also be contacted.
- If there are chance finds of fossil deposits during construction, a palaeontologist must be called to the site in order to assess the fossils and rescue them if necessary (with an AMAFA permit). The fossils must then be housed in a suitable, recognised institute.

14.3. Biodiversity Assessment and Report

- Disturbance and habitat loss must be kept to a minimum.
- All trenches must be clearly demarcated and barricaded on site at all times.
- Care must be taken to keep soils stabilized when removing vegetation during construction and as part of alien plant eradication and strict on-site soil erosion measure must be implemented.
- Topsoil must be stockpiled for eventual return during top soil back-filling and rehabilitation. These must be weed free and must not stand for a prolonged period of time.
- Sub-soil and topsoil must be stored separately onsite.
- Care must be taken to prevent the contamination of ground water with accidental fuel and oil spills from earth-moving and construction equipment and vehicles. Adequate usage of drip trays and bunded storage zone must be implemented on site.
- Trenched must have one sloped side to allow animals which fall in to get out.
- Trenches must be checked daily while open for animals which may be unable to get out.
- Any animals found must be returned uninjured to suitable safe habitat.
- Hunting and trapping of any animals by staff must be prevented. This includes reptiles which must be handled by a professional.

- A pre-construction walk-through must be implemented by the ECO at the crossing points in the wetland and river areas before excavation takes place on site. This will be used to identify any species of conservation importance that may have occupied the site after the compilation of this report.
- Should any species be found that are protected, either provincially or Nationally, the correct permit should be applied for in advance and the conditions of those permits should be followed to prevent or offset impacts during construction.
- Alien invasive plant eradication plan must be implemented on an ongoing basis to limit the establishment of exotic species during the rehabilitation of the disturbed areas.
- The ECO must supply the Contractor with list a list of problematic alien invasive plant species that are likely to occupy the site during construction.
- Regular Environmental Toolbox Talks must be implemented by the Contractor on site
- Noise levels including vibrations caused by drilling must be kept to a minimum to prevent animals abandoning nearby habitats.

14.4. Stormwater Management Plan

- The following measures will be implemented before construction:
  - Environmental awareness training of the contractor and his workers will take place wherein acceptable construction methods and stormwater management practices will be discussed.

- The following measures will be implemented during the construction phase to mitigate the impact of storm water run-off on the environment and the works:
  - The length of open trench excavations will be limited to a maximum of 100m.
  - Cut-off catch water berms will be constructed on the high side of the trench. This will be particularly relevant for areas with steep slopes. For the steep areas, berms will be positioned so that the velocity of the storm water run-off will be reduced.
  - Where material is highly erodible, sand bags will be used to channel the flows.
  - Storm water run-off will be directed on to vegetated buffer zones and not directly into water courses.
  - Trench barricading will have openings to prevent the build-up of storm water run-off behind them.
  - In areas with a high water table, there will be adequate battering and shoring to prevent trench collapses.
  - Pumps will be available at all times on site for dewatering of trenches after storm events.
  - The open ends of the pipe will be blocked with end caps or geo-textile fabric (Bidim) to prevent debris from entering the pipe.
  - Sediment traps and fencing will be utilised to prevent excess levels of sediments entering watercourses from work areas and afterwards disposed of in a lawful manner. The contractor will check weather forecasts to mitigate potential storm damage.
  - During rehabilitation process, in steep areas, sand bags will be placed perpendicular to the trench.

14.5. Geotechnical Investigation

Based on the assessment of the site area and the prevailing subsoil conditions as well as intended pipeline development, geotechnical considerations that should be bourne in mind during the planning and construction phases should be included, but are not limited to the following;

- **Slope Stability**

  - Caution must be taken during excavation of pipe trenches or pipe jack pits and should incorporate the following preventative measures as a minimum;
    - Stormwater run-off and any subsoil seepage must be adequately managed.
    - Vegetation removal should be limited to a minimum.
    - The subsoil removed from the trench excavation should be stockpiled a minimum distance equal to the height of the trench away from the cuff of the excavation.
    - The trench should be excavated, and pipe installed in sections along potentially unstable areas with the trench not left open for any extended period of time.
    - Suitable shoring/lateral support used where excavation depths require.

- **Excavatability along the Proposed Sewer Reticulation Route**

  - The pipe invert level is likely to range between 1.2 – 3.8m below existing ground level with an average depth of 2.5m below existing ground level. In this regard, depth to weathered bedrock along the pipeline route generally ranges from between 0.5 – 1.5m across the eastern portion of the site underlain by sandstone and slightly greater depths of 1.5 - . 2.8m across the western portion of the site underlain by Dwyka tillite bedrock and deeply weathered dolerite. The following excavatability methods are proposed;
    - Manual excavation across the site generally met with refusal either at the soil rock interface or within a depth of ,1.0m into the respective weathered bedrock materials.
    - 'soft excavation' as defined by SABS 1200D is anticipated within the highly weathered sandstone and highly weathered tillite bedrock to the inferred average pipe invert level below existing ground level along the majority of the proposed pipeline network route.
    - Due to the highly weathered nature of the dolerite bedrock, 'soft excavation' (after SABS 1200D) is expected to the proposed pipe invert level in areas underlain by dolerite bedrock.
    - The weathered tillite, sandstone and dolerite bedrock prevailing across the project area are prone to erratic weathering and thus relatively harder zones may occur, wherein relatively harder excavation (intermediate to hard) may be encountered to required pipe depth.
    - If slightly weathered dolerite and/ or tillite corestone boulders be encountered locally, these will required greater effort to remove and may require chiselling or in extreme cases blasting to remove.
    - Excavation in all overlying colluvial, residual, alluvial and fill material present along the route will classify as 'soft' excavation through out the respective materials entire depths and therefore manual excavation is likely to be achievable.
    - Excavation by hand within the weathered bedrock is likely to be highly onerous and time consuming.
    - Where weathered bedrock is removed as relatively large blocks or rounded to semi rounded dolerite and/ or tillite boulders are removed, these should be placed carefully adjacent the trench excavation to ensure that the boulders are not allowed to roll down slope as this may cause significant damage to property and potential loss of life of residents or livestock.

- **Trench Sidewall Stability**

  - According to The Standard Engineering Specifications for Earthworks for Pipe Trenches, pare DB, trenches must be excavated in narrow sidewall conditions with vertical sides necessitating the use of adequate shoring methods to prevent erosion and consequent slope instability along any section of the proposed route. Hence, the following trench sidewall stability methods are proposed;

- Where weathered bedrock is located at shallow depths below existing ground level (0.5m), vertically cut trench side walls in the weathered bedrock to depths in the order of 2.5m are considered to stand with no shoring during pipe installation.
- In areas where the depth to highly weathered bedrock exceeds 1.0m, trench sidewalls in typically loose to medium dense, sandy fill and colluvium as well as clayey/sandy residual or completely weathered material where present will be prone to collapse if left open for extended periods of time and allowed to either dry out or become saturated. As such sidewalls in the unconsolidated materials should be suitably shored or battered back to a maximum batter of 1:1,5 (33°) for the entire thickness of the unconsolidated material to ensure safe working conditions therein.

Material Suitability

- **Pipe-Bediding / Backfill Material**

  - The bedding cradle must comprise compacted selected granular material with a compacted selected fill blanket. The pipe bedding material requirements should conform to the following;
    a) Selected Granular Material: Non-cohesive, singularity graded between 0.6mm -19mm, having a compactability factor not exceeding 0.4.
    b) Selected fill material: Material with a plasticity index not exceeding 6 and free of vegetation and lumps or stones exceeding 30mm.
    In terms of the above the suitability of the typical materials encountered on site is as follows;

    - Laboratory testing carried out for highly weathered sandstone and sandy colluvial material returned suitable compactability factors ranging between 0.36 – 0.39.
    - Based on previous testing of highly weathered tillite bedrock and sandy alluvial material, these materials are also likely to return a suitable compactability factor of less than 0.4.
    - Residual dolerite, tillite and clayey/silty sandstone material is unlikely to meet the minimum compactability requirements for pipe bedding material.

    None of the material mentioned above encountered on site meet the minimum grading requirements for the material to be suitable for use as a selected granular material. It is more prudent to import a suitable selected granular material to site from a local source.

  - The samples of weathered sandstones, residual sandstone, colluvium, alluvium and fill material range from being non-plastic to slightly plastic to plastic and therefore considered only selectively suitable for use as selected fill blanket material provided all particles greater than 30mm are removed prior to placement and compaction.
  - Residual tillite and dolerite material is considered unsuitable due to its high plasticity indices.
  - Th selective use of local on-site material for selected fill blanket material is feasible, however it will require a well-trained eye to discern suitable material and constant confirmatory laboratory testing.
  - It is practical to acquire suitable selected fill blanket material from a local suitable source.
  - The weathered sandstone and tillite bedrock, colluvium, fill and alluvium as well as sandy varieties of residual material are considered suitable as general backfill provided any potential large rock fragments are removed such that the material can be suitably compacted, and the material does not cake or form lumps upon drying out.

- **General Construction Use**

  - The sandy to clayey sandy hillwash/colluvium and alluvial materials encountered on site generally classify according to the TRH 14-1985 standards as G9-G10+ materials and thus range from being acceptable to unacceptable for use as subgrade and bulk fill material depending on the materials relative clay content.
  - Samples of residual sandstone, residual dolerite and likely residual tillite do not meet minimum requirements of a G10 type material and thus are considered not suitable for use as bulkfill or subgrade material.
  - Highly to completely weathered sandstone samples classify as G10 to G10+ material depending on the weathered state thereof and clay content and thus range from suitable to not suitable for use as bulk fill material and subgrade material. Less weathered material encountered at depth will likely classify as G7 to G8 material and thus may be used as construction material if encountered.
  - Highly to completely weathered tillite bedrock is classified as G8 – G10+ material and thus can be used as construction material if required depending on the weathered state thereof.
  - The granular fill material encountered within the site areas classifies as G8 and G9 type material and thus considered suitable as lower selected layer material, subgrade and bulk fill if required, provided all foreign materials that may occur within are removed prior to its use.

- **Subsoil Seepage**

  - Where groundwater seepage is encountered within the pipe trench excavation it should be dealt with symptomatically when it occurs. This may require the installation of temporary cut off drains/berms or sump and pump measures to be adopted locally.
  - Along the lower portions of the sideslopes, valley bottoms and heads of drainage valleys, ground water seepage will be encountered, and ground water seepage management measures mentioned above will need to be adopted during pipe installation, in addition to dewatering measures, especially at the proposed stream crossing and pipe-jack positions.

- **Stream Crossing**

  - 'Soft excavation' in terms of SABS 1200D standards is anticipated within the alluvial, residual and completely weathered bedrock material at the stream crossing locations to depths of at least 2.5 – 3.5m below existing ground level, thereunder potentially classifying as 'intermediate' excavation in the inferred weathered bedrock, depending on the degree of weathering. In this regard, excavatability at the stream crossing positions is unlikely to be problematic and the required pipe invert level is likely to be easily achievable by mechanical means.
  - Significant subsoil seepage should be anticipated at the stream crossing positions and within the marshy/wetland areas along the flanks thereof. Thus, in addition, to carrying out the excavation of this section of the route during the relatively drier winter months, it recommended that stream diversion and dewatering practices be allowed for during the planning and design phases of the project.
  - The provision of a rock pioneer horizon may be prudent to facilitate ingress and egress of plant from the site as well provide a medium on which anchoring structures can be founded to counteract buoyancy forces on sections of the pipeline.
  - Given the saturated nature of the near surface clayey sandy to sandy alluvial soils, shoring of the trench sidewalls will be imperative to prevent certain sidewall collapse thereof. For general earthworks operations at the stream crossing areas, cut embankments should be restricted to a maximum temporary batter of 1:2 (26°) in the alluvium, residual and completely weathered materials, but may be temporarily steepened at the engineer's discretion to 1:1,5 (33°) in highly weathered bedrock if encountered, provided the cut embankment does not exceed a height of 3m.

- **Pipe Jacking**

    - Pipe jacking will be required where the proposed pipeline crosses the Crnick Ndlovu highway towards the northern western portion of the site area, at the PJ1-PJ2 positions indicated on the site plan.
    - Sufficient space is available on either side of the main road for the establishment of the launching and receiving pipe jack excavations.
    - Excavatability is considered to classify as 'soft excavation' to depths in the order of 3.5-4.5m below existing ground level and therefore likely to be non-problematic.
    - The presence of slightly weathered, potentially very large, very hard rock tillite corestone boulders within the residual and/or completely weathered bedrock requires significant greater effort remove via chiseling/breaking with pneumatic tools or even blasting if possible and may in extreme cases even require the pipeline alignment to be relocated accordingly.
    - Ground water seepage at the pipe jack location will require constant dewatering efforts to lower the shallow ground water table and prevent water from entering the pipe jack excavations.
    - A sump and pump method can be implemented at the discretion of the pipe-jack contractor/design engineer, or alternatively a series of dewatering well points can be installed.
    - To aid in dewatering efforts the pipe-jacking operation must be carried out during the relatively drier winter months.
    - The launching pit should be positioned on the lower eastern side of the road and progress in a slight upwards direction to give the pipe-jack excavation a slight fall and allow any seepage encountered at the face of the excavation to drain naturally out of the pipe excavation and into a sump in the launching pit where it can be pumped out downslope.
    - Suitable shoring of the pipe-jack launching and receiving pits should be provided to prevent the sidewall collapse in the upper alluvial, residual and completely weathered bedrock material present to inferred depths in the order of 3.0 - 4.5m below existing ground level. The lateral support should be suitably designed by a Structural Engineer familiar with such projects and subsoil conditions.

- **Buoyancy Control**

    - The proposed pipeline will be subject to an upward buoyancy force along the lower slope areas and where it crosses the stream valley due to the shallow groundwater table located at depths in the order of 0.5 – 1.0m below existing ground level along the valley bottom areas. Therefore, the pipeline should be suitably anchored in place using a concrete saddle or similar structure to resist the upward force, the design of which must be carried out by a Structural Engineer based on appropriate buoyancy calculations.

14.6. Method Statement

According to the method statement which is based on the assessment of the site area and the intended pipeline development, The following rehabilitation options were recommended for non-sensitive and sensitive areas;

- **Rehabilitation Non-Sensitive Areas**

    There are three rehabilitation options.

    The options are:

- For gentle slopes (>1:10) and not in the path of high flows.

  A product produced by Macafferri called Biomac will be installed, Biomac is a bio-degradable product used after reinstating banks and promotes vegetation growth. After the backfilling of the trench is complete the surrounding bank is then shaped and trimmed. A sheet of Biomac is then placed on this area and is anchored down by either steel or wooden pegs. Topsoil of about 20mm thick is then raked over and this area is then hydo-seeded.

- For steeper slopes (between 1:2 and 1:10) and where there is medium velocity flows

  A product produced by Macafferri called Mac-mat will be installed. Mac-mat is a woven mesh application which can take a tensile force of up to 30kN (kilonewtons) and is used after reinstating banks and promotes vegetation growth. After the backfilling of the sewer trench is complete the surrounding bank is then shaped and trimmed. A sheet of Mac-mat is then placed on this area and is anchored down by either steel or wooden pegs. Topsoil of about 20mm thick is then raked over and this area is then hydro seeded.

- For steeps banks ($> 1:2$) and in areas of high flows

  A stepped terrace of gabion baskets will be installed along the banks width, if required, Reno mattress will be constructed on the river bed at its existing level. This is specially for areas which run through private property were not much care or inadequate river protection was placed and as a result of flooding has washed away some of the banks.

- **Rehabilitation-Sensitive Areas**

  Rehabilitation for these areas will be in accordance with the EMPr and Plant Rescue and rehabilitation. The EMP can be reviewed under Appendix F of this BAR.

15. CONDITION OF AUTHORISATION

In terms of Monitoring and Auditing, the following are recommended to ensure protection of the environment during construction:

- An ECO must monitor the construction site and activities on a monthly basis,
- An ECO must document the findings and submit a monthly report to the Competent Authority;
- The Project Manager and Contractor are responsible for the implementation of the EMP and protection of the environment for the duration of the construction period.
- An ECO must monitor the facility on a bimonthly basis for the operational phase, for a period of 6 months following completion of construction to ensure that rehabilitation has been successful.

16. ASSUMPTIONS, UNCERTAINTIES AND GAPS IN THE KNOWLEDGE

Assumptions and limitations as per the **Wetland Delineation and Functional Assessment** are as follows:

- The hydrogeomorphic units were assessed in their entirety, even if it included sections of artificial wetland or extended beyond the boundary of the study area; the latter assessed from aerial imagery with limited infield verification and assumed to be accurate within specialist expertise.
- Monitoring and management of any wetland impacts/remediation/rehabilitation will be advised in accordance with best practice.
- Due to the scale of the imagery (1:10 000 orthophotos and Google Earth® Imagery), as well as the accuracy of the handheld Global Positioning System (GPS) Unit, the delineated wetland boundaries have a marginal error of

approximately 5m.

Assumptions and limitations as per the **Biodiversity Assessment** are as follows:

- Due to the nature of the survey and the requirements for the Basic Assessment, it can be said that this survey would be more biased towards more common and dominant fauna and flora within the area. In order for the rarer and less common species to be identified a more intense survey would be required but none recommended for this study area.
- The season and current conditions of the areas posed a constraint to the survey, a significant number of species would either not be in flower and/or not be visible within this area. Therefore, the species list for this survey cannot be regarded a report that has listed all species accruing within the area but reflects those accruing predominantly at the time and season.
- Due to the combination of scattered private homesteads and inaccessibility due to harsh terrain not all of the study area could be accessed by foot. However, the specialist attained vantage points along the route to view these specific areas and ensured that all the riparian areas were properly assessed through ground truthing.

Assumptions and limitations as per the **Geotechnical Investigation** are as follows:

- The ground conditions described in the report refer specifically to those encountered in the subsoil excavations and exposures along the proposed pipeline route. It is therefore quite possible that conditions at variance with those in the excavations could be encountered elsewhere on site during pipeline installation.
- The information in geotechnical report is given in good faith, as an indication of materials and conditions likely to be encountered during construction along the pipeline route.
- There is no warranty that the information is totally representative of the whole route and no responsibility will be accepted for any consequences arising from actual conditions being different from those indicated in the report.

17. RECOMMENDATIONS OF THE EAP

The information contained in this report and the documentation attached hereto, in the view of the EAP, is sufficient for the Public Participation Process (PPP). Should the Competent Authority request additional studies to be conducted, this shall be conducted and obtained to assist the Competent Authority in making and informed decision.

The EMP, which includes recommended conditions and mitigation measures that should be considered for inclusion in any authorisation that may be granted by the competent authority in respect of the application, is provided.

Refer to Appendix F for a full Environmental Management Plan. The EMP must be read in conjunction with the BAR.

18. TIMEFRAMES

An environmental authorisation is valid for five (05) years. Commencement of construction begin at any time within this 5-year period.

19. UNDERTAKING UNDER OATH OR AFFIRMATION BY THE EAP

(i) 1World Consultants (Pty) Ltd hereby confirms that the information provided in this Basic Assessment Report is correct at the time of the compilation and distribution for review. Input from specialists was utilised in the compilation of the Report.

(ii) 1World Consultants (Pty) Ltd confirms that all comments received from Stakeholder and I&APs have been included in this report. It is to be noted that in terms of the EIA Regulations (2014), GNR 982 43(2), all State Departments that administer a law relating to a matter affecting the environment, specific to the Application, must submit comments within 30 days to the EAP. Should no comment be received within the 30-day comment period, it will be assumed that the relevant State Department has no comment to provide.

(iii) All information from the specialist studies have been included in this Basic Assessment Report. Recommendations from the specialists have been included in the EMP.

(iv) All information and comments received in response to this Basic Assessment Report will be summarised and responded to in a final version of the Report, which will be submitted to EDTEA for consideration in terms of issuing Environmental Authorisation.

For 1World Consultants (Pty) Ltd:

Fatima Peer B.Sc. (Hons) Pr. Sci. Nat.
SENIOR ENVIRONMENTAL ASSESSMENT PRACTITIONER

APPENDICES

The following appendixes must be attached as appropriate:

Appendix	Description of Contents
A	Environmental Authorisation for Ntuzuma E Sewer Outfall WULA Directive for Ntuzuma E Sewer Outfall and Inanda Glebe Sewer Reticulation Minutes of the Pre-application Meeting with EDTEA Acknowledgement of Receipt of the Application for Environmental Authorisation
B	Company Profile of EAP Project Experience of EAP EAP Declaration Curricula Vitae of EAP Team Specialist Declarations
C	Map 1: General Locality Map of Inanda and Surrounding Area Map 2: Locality Map of the Study Area, Glebe, Inanda Map 3: Environmental Sensitivities Map 4: Proposed plans for Phase 1 and Phase 2 of Development Map 5: HGM units Method Statement Service Level Agreement Preferred Layout Alternative
D	Distribution list Background Information Document Newspaper advertisement Copy of notice board Photograph of notice boards at site Landowner notification letters Comments and Responses Report Copies of correspondence with I&AP's
E	Wetland Delineation and Functional Assessment Heritage Impact Assessment Biodiversity Assessment and Report Storm Water Management Plan Geotechnical Investigation
F	Draft Environmental Management Plan

1world consultants
Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 3619

Appendix A

1world consultants
Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 3619

Environmental Authorisation for Ntuzuma E Sewer Outfall

edtea
Department :
Economic Development, Tourism and Environmental Affairs
PROVINCE OF KWAZULU-NATAL

Enquiries	: Ms Vanessa Maclou	Telephone	: 031 302 2800	Private Bag	: X9152
Imibuzo	:	Ucingo	:	Isikhwama Seposi	: Pietermaritzburg
Navrae	:	Telefoon	:	Privaat Sak	: 3200
Reference	: DM/0002/2013	Fax	: 031 302 2824	Date	:
Inkomba	:	IFeksi	:	Usuku	: 13 / 08 / 2014
Verwysing	:	Faks	:	Datum	:

Fax Transmission

eThekwini Municipality – Water and Sanitation Department
3 Prior Road
Durban
4000

Attention: Mr. Frank Stevens
Fax no: 031 311 8549

Dear Sir

DM/0002/2013: ENVIRONMENTAL AUTHORISATION FOR THE CONSTRUCTION OF THE NTUZUMA E SEWER OUTFALL ON FARM 4579 OF INANDA MISSION, LOWER MANAZA, MATABETULE, FARM 0449 OF ERF 1492 OF NTUZUMA E, NTUZUMA AND FARM 17504 OF NTUZUMA, LINDELANI D, NTUZUMA, WHICH IS LOCATED WITHIN THE ETHEKWINI MUNICIPALITY.

The KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs has authorised the above-mentioned project. This environmental authorisation and reasons for the decision are attached herewith.

ENQUIRIES
Please note that:

- All queries regarding this application for environmental authorisation (including the Department's decision) must be directed to the official of this Department with contact details provided on the letterhead above.
- **Only** queries regarding appeals must be submitted to the Office of the MEC (details provided below).

APPEALS
In terms of sub-regulation 10(2) of the EIA Regulations, 2010, you are instructed to notify all registered interested and affected parties in writing within **12 days** of this Department's decision in respect of your application. You are required to comply with the requirements of sub-regulations 10(2)(a)-(d) with regard to this notification. This includes drawing the attention of registered interested and affected parties to the fact that an appeal may be lodged against the decision in terms of Chapter 7 of the EIA Regulations, 2010.

includes drawing the attention of registered interested and affected parties to the fact that an appeal may be lodged against the decision in terms of Chapter 7 of the EIA Regulations, 2010 as amended.

In accordance with the provisions of sub-regulation 60(1) of the EIA Regulations, 2010 as amended, a notice of intention to appeal must be lodged with the **KwaZulu-Natal MEC of the Department of Economic Development, Tourism and Environmental Affairs** within **20 days** of the date of this decision by posted, faxed, e-mailed or hand delivered to the following address:

POSTAL/ FAX/ **E-MAIL:**	**PHYSICAL:**
Private Bag X001 **Bishopsgate** Durban 4008 Tel: 031 310 5300 Fax: 031 310 5416 E-Mail: mecpa@kznded.gov.za (Bongani Mkhbela)	9th Floor The Marine Building 22 Dorothy Nyembe Street Durban 4001

The appellant is reminded of the requirements of sub-regulations 60(2) and 60(3) in the EIA Regulations, 2010 as amended with regard to the notification of registered interested and affected parties and the applicant (if the appellant is not the applicant) of the notice of intention to appeal.

Yours faithfully

13/08/2014.

for: **Head of Department:**
KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs
Signed by: Ms. Vanessa Maclou

cc: Mr. Jon Marshall Messrs Environmental Planning and Design cc. Fax No.: 031 266 8241

edtea

Department :
Economic Development, Tourism and Environmental Affairs
PROVINCE OF KWAZULU-NATAL

Environmental Authorisation

In terms of sub-regulation 25(1)(a)(i) of Government Notice Regulation (GNR) 543 of the Environmental Impact Assessment (EIA) Regulations, June 2010 (as amended)

Project Title:
The construction of the Ntuzuma E Sewer Outfall on Farm 4579 of Inanada Mission, Lower Manaza, Matabetule, Farm 0449 of Erf 1492 of Ntuzuma E, Ntuzuma and Farm 17504 of Ntuzuma, Lindelani D, Ntuzuma

Local Municipality: eThekwini

Application Number	:	DM/0002/2013
NEAS Number	:	KZN/EIA/0000997/2013
Date of Issue	:	13/ 08 /2014
Environmental Authorisation Holder	:	eThekwini Municipality - Water and Sanitation Department
Location of Activity	:	Farm 4579 of Inanda Mission, Lower Manaza, Matabetule, Farm 0449 of Erf 1492 of Ntuzuma E, Ntuzuma and Farm 17504 of Ntuzuma, Lindelani D, Ntuzuma

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Decision

The **KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs** (hereafter referred to as the 'Department') is satisfied on the basis of information available to it and subject to compliance with the conditions of this environmental authorisation that the holder is authorised to undertake the activity specified below.

Details regarding the basis on which the Department reached this decision are set out in **Annexure 1.**

By virtue of the powers conferred on it by the National Environmental Management Act, 1998 (Act No. 107 of 1998) and Government Notice Regulation (GNR) 543 of the Environmental Impact Assessment (EIA) Regulations, June 2010 (as amended), the Department hereby authorises:

eThekwini Municipality - Water and Sanitation Department

(hereafter referred to as 'The Holder')

Contact person : Mr. Frank Stevens

Postal address : 3 Prior Road
Durban
3000

Telephone number : (031) 311 8602

Facsimile number : (031) 311 8549

E-mail address : frankst@dmws.durban.gov.za

to undertake the following activity (hereafter referred to as 'the activity') as described below:

1. Activity authorised

The construction of a HDuPVC (comprising of plastic and steel) sewer outfall on Farm 4579 of Inanda Mission, Lower Manaza, Matabetule, Farm 0449 of Erf 1492 of Ntuzuma E, Ntuzuma and Farm 17504 of Ntuzuma, Lindelani D, Ntuzuma, located within the eThekwini Municipality, **Refer to Annexure 2: Locality Map** attached herewith. The sewer outfall will be approximately 2180m in length, with an internal diameter of 250mm and a development footprint of 39115m², **Refer to Annexure 3: Site Layout Plan** attached herewith. Precast ring manholes with an internal diameter of 1m will be constructed at all changes in direction or in straight sections at approximately 75m centers for maintenance purposes. The sewer outfall will be laid below ground with a possibility of elevated watercourse crossings. It will gravitate from higher development areas down valley slopes and into

natural valley lines where it will connect into the existing municipal sewer pipeline/reticulation system at Ihobe Road, Ntuzuma. The working width will extend 10-20m.

The Department is granting environmental authorisation for Activities 11(xi) and 18(i) of GNR 544 of the EIA Regulations, June 2010 (as amended):

Component (or phase) of the project:	Listing Notice and Activity Number:
The construction of the sewer outfall will require the construction of infrastructure or structures covering greater than 50m² within 32m of a watercourse.	***GNR 544 Activity 11(xi):** 'The construction of -* *(xi) infrastructure or structures covering 50 square metres or more* *Where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line'.*
The construction of the sewer outfall will require the excavation and removal of more than 5m³ of soil, sand, pebbles and rock from a watercourse, as well as, the infilling of excavated trenches with more than 5m³ of material within a watercourse.	***GNR 544 Activity 18(i):** 'The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock or more than 5 cubic metres from:* *(i) a watercourse'.*

as described in the Basic Assessment Report (BAR), prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014. The site details are as follows:

Province:	KwaZulu-Natal	
Magisterial District:	eThekwini Municipality	
Name of property:	Farm 4579 of Inanada Mission, Lower Manaza, Matabetule, Farm 0449 of Erf 1492 of Ntuzuma E, Ntuzuma and Farm 17504 of Ntuzuma, Lindelani D, Ntuzuma, located within the eThekwini District	
GPS co-ordinates captured along the sewer outfall alignment/route: (Refer to Annexure 4, attached herewith)	Starting point:	29° 43' 27.13" S; 30° 55' 10.37" E
	Middle point:	29° 43' 45.18" S; 30° 55' 12.36" E
	End point:	29° 43' 50.02" S; 30° 55' 38.69" E
Total length of the sewer outfall:	approximately 2180m	
Total development footprint:	approximately 39115m²	
Present land-use zonation:	Residential with some portions un-zoned (no planning scheme)	

The granting of this environmental authorisation is subject to the conditions set out below. This environmental authorisation does not exempt the holder from compliance with any other relevant legislation that may be applicable to the carrying out of the activity as described on Page 3 and 4 of this environmental authorisation.

2. General

2.1 **Compliance with the conditions of this environmental authorisation**

In terms of section 24F of the National Environmental Management Act, 1998 (Act No. 107 of 1998) failure to comply with the conditions of this environmental authorisation constitutes an offence for which a convicted person may be liable to a fine not exceeding R10 million or imprisonment for a period not exceeding 10 (ten) years or both such fine and such imprisonment.

2.2 **Contact details for the Department**

All correspondence pertaining to the development must clearly include the EIA reference number, i.e. DM/0002/2013. Unless otherwise stated in the condition, where documentation must be submitted to the Department it must be submitted to the **Control Environmental Officer** for the **Compliance Monitoring and Enforcement (CME) Component** of the Department's **eThekwini District office.** The contact details are as follows:

Fax Number : 031 302 2824
Tel Number : 031 302 2800

Postal Address : Private Bag X54321
Durban
4000

Please note that it is the responsibility of the EA holder to ensure that the above details are correct at the time of submitting any documentation, and that the documentation reaches the relevant official.

2.3 This environmental authorisation is only applicable to the activity as described in **section 1** herewith.

2.4 This environmental authorisation and the conditions are binding on the holder. The holder is responsible for adherence to the conditions stipulated in this environmental authorisation.

2.5 **Amendments to the project**

Should the need arise to expand the development or make changes to the project description, which fall within the ambit of GNR 544, 545 and 546 of the EIA Regulations[1], June 2010 (as amended) the holder must obtain environmental authorisation from the EIA Component of this Department as per the contact details specified in condition 2.2 herewith **prior** to the commencement of the expansion activities or changes to the project description. In assessing whether to grant such approval or not, the Department may request information, as it deems necessary, to evaluate the significance and impacts of such changes.

[1] The holder is advised to contact the Department to determine if any proposed changes are regarded as material or substantive prior to commencement of such changes.

2.6 Where any of the holder's contact details change, including the name of the responsible person, the physical or postal address and/or telephonic details, the holder must notify the EIA Component of this Department, in writing, as per the contact details specified in condition 2.2 herewith, as soon as the new details become known.

2.7 This environmental authorisation must be produced to any authorised official of this Department who requests to see it and must be made available for review by any employee or agent of the holder who works or undertakes work on the site.

2.8 In the event of any dispute concerning the significance of a particular impact the opinion of this Department in respect of its significance will prevail.

2.9 The Department shall not be held responsible for any damages or losses suffered by the holder in any instance where any phase of the development is temporarily or permanently stopped for reasons of non-compliance by the holder with the conditions of the environmental authorisation or any other subsequent document emanating from these conditions of environmental authorisation.

2.10 All correspondence pertaining to this application must clearly include the EIA reference number, i.e. DM/0002/2013.

3. Conditions of environmental authorisation

3.1 The activity authorised must only be carried out at the location as described in **section 1** above and as indicated in **Annexure 2: Locality Map** attached herewith.

3.2 The holder is responsible for ensuring compliance with the conditions of this environmental authorisation by any person acting on his or her behalf, including but not limited to, an agent, contractor, sub-contractor, employee or person rendering a service to the holder.

3.3 **Period of Validity**: The listed activities authorised must commence within **05 (five) years** from the date of issues of this environmental authorisation. If commencement of the authorised activities does not occur within that period, this environmental authorisation lapses and the holder must re-apply for an environmental authorisation should he or she wish to carry on the activities; unless the holder has requested an extension of time, in writing, at least **60 (sixty) calendar days** before the expiry of this environmental authorisation.

3.4 Any alteration to the bed, banks, course or character of a watercourse; the impedance or diversion of flow of a watercourse or the abstraction and or storage of water from either surface or ground is prohibited. Should it become necessary, Mr. Norman Ward of the Department of Water Affairs (DWA): Water Resources Management Section must be contacted on (031) 336 2700 in order to embark on the process to obtain the necessary authorisation.

3.5 No structures older than 60 (sixty) years or parts thereof are allowed to be demolished, altered or extended without a permit from Amafa aKwaZulu-Natali. Should any heritage objects or any sites of archaeological

and cultural significance be discovered during the construction phase, all activity on site must cease immediately and the discovery must be reported to Amafa aKwaZulu-Natali for investigation. Work on the site may only re-commence following written approval from Amafa aKwaZulu-Natali.

3.6 The removal, cutting, pruning or relocation of any indigenous or protected plant species must be authorized or permitted by the Department of Fisheries and Forestry (DAFF) and/or Ezemvelo KZN Wildlife, if applicable. If authorisation or a permit is not required, then the activities must be authorised by the appointed Environmental Control Officer (ECO) as per condition 3.54 herewith.

3.7 Any pollution must be reported to the Pollution and Waste Management (P&WM) Component of this Department as per the contact details specified in condition 2.2 herewith, and the appropriate mitigation measures must be undertaken.

3.8 Existing infrastructure within the sewer outfall route and working width (eg. electricity lines) must be identified and visibly demarcated prior to the commencement of the construction phase. Should the need arise to disrupt these services for any reason, the relevant authority must be contacted for permission.

Notification of Interested and Affected Parties (I&APs)

3.9 The holder must notify every registered I&AP, in writing, and within **12 (twelve) calendar days** from date of the Department's decision to authorise the activity.

3.10 The notification must:

3.10.1 Specify the date on which this environmental authorisation was issued;
3.10.2 Inform I&APs of the appeal procedure provided for in Chapter 7 of GNR 543 of the EIA Regulations, June 2010 (as amended); and,
3.10.3 Advise I&APs that a copy of this environmental authorisation will be made available on request from the holder.

3.11 The holder must place an advertisement in The Isolezwe newspaper (which was used during the public participation process) detailing the outcome of the application and methods by which a copy of this environmental authorisation can be obtained.

Approval of the Environmental Management Programme (EMPr)

3.12 The draft EMPr submitted together with the BAR, both prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014 compiles with regulation 33 of GNR 543 of the EIA Regulations, June 2010 (as amended) and is **hereby approved.** Non-compliance with the EMPr will constitute non-compliance with the conditions of this environmental authorisation.

3.13 The EMPr must be:

3.13.1 Considered as an extension of the conditions of this environmental authorisation;
3.13.2 Implemented, adopted and adhered to throughout the lifespan of the development;

3.13.3 Made binding on all parties operating on the site throughout the lifespan of the development;
3.13.4 Kept on site during all phases of the development;
3.13.5 Made available to I&APs on request;
3.13.6 Included in all contractual documentation; and,
3.13.7 Appended to this environmental authorisation.

3.14 Authorised officials of the Department reserve the right to:

3.14.1 Review the approved EMPr and amend/add any condition to the EMPr as it is deemed necessary; and,
3.14.2 Inspect the site throughout the lifespan of the development.

3.15 Any amendments to the approved EMPr must be submitted, in writing, to the EIA Component of this Department as per the contact details specified in condition 2.2 herewith. The amendments must only be implemented after being approved by this Department.

Written notice of the commencement of the construction and operational phases

3.16 **Fourteen (14) calendar days** written notice must be given to the CME Component of this Department (as per the contact details specified in condition 2.2 herewith) and the surrounding community that the construction phase will commence. The notice must include a date on which it is anticipated that the construction phase will commence and the EIA reference number for this environmental authorisation, i.e. DM/0002/2013.

3.17 **Fourteen (14) calendar days** written notice must be given to the CME Component of this Department (as per the contact details specified in condition 2.2 herewith) and the surrounding community, that the operational phase will commence. The notice must include a date on which it is anticipated that operation will commence and the EIA reference number for this environmental authorisation, i.e. DM/0002/2013.

Construction phase

3.18 The development must comply substantially with the **Site Layout Plan** prepared by Messrs Environmental Planning and Design cc., as depicted in **Annexure 3** attached herewith.

3.19 All staff and contractors/sub-contractors/suppliers/service providers must be trained on the environmental, occupational safety and/or legal responsibilities expected from them. The training must take into account language and literacy requirements. Proof of the training must be forwarded to the CME Component of this Department as per the contact details specified in condition 2.2 herewith.

3.20 An indigenous flora and fauna, search and rescue must be conducted by a qualified biologist **prior** to commencing with clearing activities. Species to be relocated must be done so within suitable areas within the boundaries of the site. These areas must allow for the ecological sustainability of the species. Proof of the biologist's appointment and, the search and rescue must be forwarded to the CME Component of this Department as per the contact details specified in condition 2.2 herewith.

3.21 All construction work must be supervised by a qualified civil engineer. Proof of the civil engineers appointment must be forwarded to the CME Component of this Department as per the contact details specified in condition 2.2 herewith, **07 (seven) calendar days** prior to the commencement of the construction phase.

3.22 All materials must be obtained from a registered and sustainable source and all delivery notes and slips must be made available to the ECO e.g. mined material such as stone must only be obtained from licensed quarries.

3.23 The site must be:

3.23.1 Clearly demarcated and cordoned off to the public to prevent injury; and,
3.23.2 Construction activities and camps must be kept within the demarcated area.

3.24 Adequate signage notifying the public of the construction activities being undertaken on site must be erected along the road and foot paths leading to the site.

3.25 All excavated trenches must be demarcated with barrier tape.

3.26 All earthworks must be carried out in accordance with SANS 1200.

3.27 When backfilling the soil profile must be restored to the natural structure with topsoil and sub-soil being replaced in sequence.

3.28 The backfill must be compacted to a similar permeability of the surrounding soils.

3.29 Access of heavy vehicles and construction machinery must be strictly controlled and restricted to the construction area to minimize impacts on neighbouring sites and sensitive environmental features on site.

3.30 Noise suppressors must be used on machinery during construction.

Dust and erosion control

3.31 Dust control measures, such as, shade cloths/screens must be erected along the construction area to minimize the spread of dust across the site and onto neighbouring sites.

3.32 Soil erosion prevention measures must be implemented in sensitive areas, such as, a watercourse, the edge of slopes and excavated trenches, for all phases of the development. These measures may include, but not be limited to, the following:

3.32.1 The suitable use of sand bags, hessian sheets or gabion baskets and mattresses;
3.32.2 The removal of vegetation only as it becomes necessary for work to proceed; and,
3.32.3 The retention or prompt rehabilitation of bare soil with indigenous vegetation.

3.33 Stockpiles must be positioned away from the watercourse and seepage areas.

3.34 The erosion of stockpiles must be prevented by measures, such as, the use of synthetic covers, mulching or vegetation.

Stormwater and wastewater management

3.35 Stormwater leaving the site must in no way be contaminated by any substance, whether such substance is a solid, liquid, vapour or gas or a combination thereof which is produced, used, stored, dumped or spilled on the site. All contaminated stormwater must be captured in a dirty water attenuation tank for safe disposal. Safe disposal certificates must be submitted within **14 (fourteen) calendar days** of its issue to the CME Component of this Department as per contact details specified in condition 2.2 herewith.

3.36 Increased runoff must be managed and suitable mitigation measures must be undertaken to ensure that stormwater leaving the site does not exceed pre-development levels.

3.37 Any wastewater (i.e. dirty construction water) generated must not be discharged into the natural environment. All contaminated wastewater must be captured in a dirty water attenuation tank for safe disposal. Safe disposal certificates must be submitted within **14 (fourteen) calendar days** of its issue to the CME Component of this Department as per contact details specified in condition 2.2 herewith.

Spill management

3.38 The holder must ensure that all personnel/workers during the construction phase are appropriately trained to deal with a spill or an emergency situation on site.

3.39 A Spill Contingency Plan must be compiled and must include the following actions that need to be taken into account in the event of the spillage of chemicals, fuel, or other hazardous substances during the construction phase:

3.39.1 Stop the source of the spill;
3.39.2 Contain the spill;
3.39.3 The necessary environmental precautions must be implemented to contain or absorb any spillage;
3.39.4 Remove the spilled product for treatment or authorised disposal;
3.39.5 Determine if there is any soil, groundwater or other environmental impact;
3.39.6 If necessary, remedial action must be taken in consultation with the relevant stakeholders; and,
3.39.7 The incident must be documented.

3.40 Any petrochemical spills that occur must be stored in skips and taken to a hazardous landfill site. Safe disposal certificates must be submitted within **14 (fourteen) calendar days** of its issue to the CME Component of this Department as per contact details specified in condition 2.2 herewith.

3.41 In the event of a significant spillage that cannot be contained and which poses a serious threat to the environment, the following Departments must be informed within **48 (forty-eight) hours** of the incident and in accordance with Section 30 of the National Environmental Management Act 1998, (Act No. 107 of 1998):

3.41.1 The P&WM Component of this Department as per the contact details specified in condition 2.2 herewith;
3.41.2 The eThekwini Municipality;
3.41.3 The DWA;
3.41.4 The Local Fire Department; and,
3.41.5 Any other affected Department and/or stakeholder.

3.42 Any wastewater generated as a result of a spillage and associated clean-up must be disposed off safely and in accordance with environmental legislation. All safe disposal certificates must be attached to the relevant audit reports and forwarded to the CME Component of this Department as per the contact details specified in condition 2.2 herewith.

3.43 The following conditions refer to the storage of hazardous substances on site during the construction phase:

3.43.1 Hazardous substances must be stored under lock and key;
3.43.2 Chemical storage areas must be protected by bunded areas of a volume equal to 110% of the volume of the container storing the substance. Bunded areas must be constructed of concrete blocks lined with suitably dense plastic sheeting. Fuel and oil storage tanks and drums, including internal installations and waste oil tanks, must be situated on an impermeable base within an oil-tight bund; and,
3.43.3 Chemicals or hazardous substances must not be allowed to contaminate the soil, groundwater or watercourses. In the event of this occurring, the necessary clean up measures must be undertaken immediately. Any soil/groundwater contaminated must be removed, stored in a sealed container and disposed off at a licensed disposal facility. All safe disposal certificates must be attached to the relevant audit reports and forwarded to the CME Component of this Department as per the contact details specified in condition 2.2 herewith.

3.44 Chemical ablution facilities used during the construction phase must:

3.44.1 Not cause any pollution to water resources neither should it be a health hazard to the general public;
3.44.2 Be cleaned regularly and waste disposed off at a registered waste disposal facility; and,
3.44.3 Be removed from site once the construction phase has been completed.

Solid waste management

3.45 Any form of waste generated must be disposed off at a licensed waste disposal facility in terms of section 20(b) of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). No waste material of any kind may be buried (for the sole purpose of final disposal) or burnt. The contractor responsible for the removal of the waste must supply the holder with a certificate indicating safe disposal. All safe disposal certificates must be attached to the relevant audit reports and forwarded to the CME Component of this Department as per the contact details specified in condition 2.2 herewith. Furthermore, contaminated/hazardous materials must be disposed off at a landfill site licensed to receive such waste.

3.46 All solid waste material prior to being collected for safe disposal must be stored under cover and within designated solid waste collection/storage areas which must be bunded and hard surfaced.

3.47 The recycling of suitable material (i.e. glass, paper and plastic) is encouraged provided it is properly managed and does not cause any secondary pollution.

Operational phase

3.48 An 'as built layout plan' must be forwarded to the CME Component of this Department as per contact details specified in condition 2.2 herewith within **21 (twenty-one) calendar days** of completion of the construction phase.

3.49 All alien invasive vegetation must be removed from the sewer outfall route and working width, and be replaced with indigenous vegetation suitable to the landscape within **07 (seven) calendar days** of completion of the construction phase.

3.50 Operation of the sewer outfall must only commence once the CME Component of this Department (as per contact details specified in condition 2.2 herewith) has received written proof from the Phoenix Treatment Works stating that there is sufficient capacity and will accept waste from this development.

3.51 A Sewer Leak and Overflow Contingency Plan must be compiled and must include the following actions that need to be taken into account in the event of a sewer leak or overflow during the operational phase:

3.51.1 Stop the source of the leak or overflow;
3.51.2 Contain the leak or overflow;
3.51.3 The necessary environmental precautions must be implemented to contain or absorb any leakage or overflow;
3.51.4 Remove the product for treatment or authorised disposal;
3.51.5 Determine if there is any soil, groundwater or other environmental impact;
3.51.6 If necessary, remedial action must be taken in consultation with the relevant stakeholders; and,
3.51.7 The incident must be documented.

3.52 In the event of a significant leak or overflow that cannot be contained and which poses a serious threat to the environment, the following Departments must be informed within **48 (forty-eight) hours** of the incident and in accordance with Section 30 of the National Environmental Management Act 1998, (Act No. 107 of 1998):

3.52.1 The P&WM Component of this Department as per the contact details specified in condition 2.2 herewith;
3.52.2 The eThekwini Municipality;
3.52.3 The DWA; and,
3.52.4 Any other affected Department and/or stakeholder.

3.53 The holder is responsible for the rehabilitation, management, landscaping and general upkeep of the site.

Monitoring

3.54 The holder must appoint an experienced and independent Environmental Control Officer (ECO)[2] prior to the commencement of the construction phase to ensure that the mitigation and rehabilitation measures and recommendations referred to in this environmental authorisation are implemented and to ensure compliance with the provision of the approved EMPr.

3.55 Upon appointment of the ECO, his/her details must be communicated, in writing, to the CME Component of this Department as per the contact details specified in 2.2 herewith.

3.56 The responsibilities of the ECO must include *inter alia*:

3.56.1 Performing all tasks assigned to the ECO in the approved EMPr;
3.56.2 Keeping record of all activities on site, problems identified and transgressions noted;
3.56.3 Ensuring the holder in enforcing the implementation of the approved EMPr; and,
3.56.4 Providing guidance/advice that ensures implementation of appropriate environmental management measures and adherence with environmental legislation/regulations.

3.57 Records relating to monitoring and auditing must be kept on site and made available for inspection to this Department and other relevant authorities upon request.

3.58 Should the ECO for the development change at any time, this must be communicated, in writing, to the CME Component of this Department as per contact details specified in condition 2.2 herewith within **14 (fourteen) calendar days** of appointing the new ECO.

3.59 The notification in terms of conditions 3.55 and 3.58 herewith must include contact details for the ECO, details pertaining to the ECO's relevant experience and reasons for the change in ECO (in terms of condition 3.58 herewith).

Recording and reporting to the Department

3.60 The holder must submit monthly environmental audit reports within **14 (fourteen) calendar days** of the following month during the construction phase and a post construction environmental audit report of the entire sewer outfall within **21 (twenty-one) calendar days** of completion of the construction phase. The environmental audit reports must be forwarded to the CME Component of this Department as per contact details specified in condition 2.2 herewith.

3.61 The holder must submit monthly environmental audit reports for the first **six (06) months** of operation of the sewer outfall to monitor its functioning and vegetation rehabilitation. The environmental audit reports must be forwarded to the CME Component of this Department as per contact details specified in condition 2.2 herewith **within 14 (fourteen) calendar days** of the following month.

[2] The ECO must be independent and have the necessary experience and qualifications to understand, interpret, monitor, audit and implement the EMPr and, the conditions of this environmental authorisation. Feedback must be given in the form of an audit report which must address any non-compliance that may have risen from the audit.

3.62 The environmental audit report must:

3.62.1 Be prepared by an independent environmental auditor (may be the ECO);
3.62.2 Indicate the date of the audit, the name of the auditor and the outcome of the audit in terms of compliance with the environmental authorisation conditions and requirements of the approved EMPr;
3.62.3 Include, but not limited to, any adverse changes made to the environment including the implementation of mitigation measures;
3.62.4 Identify actual impacts that have occurred versus those predicted, including an evaluation of the success of mitigatory measures implemented;
3.62.5 Recommend changes to be made in the approved EMPr for cases where unmitigated impacts have been discovered;
3.62.6 Include supporting documentation needed to confirm compliance with the environmental authorisation and approved EMPr;
3.62.7 Include measures to be implemented to address any non-compliances or degradation noted;
3.62.8 Report back on measures implemented to address any non-compliances or degradation noted;
3.62.9 Include copies of any approvals granted by other authorities that are relevant to the development; and,
3.62.10 Be submitted as a hard-copy (unless otherwise agreed with) to the CME Component of this Department as per the contact details specified in condition 2.2 herewith.

Site closure and decommissioning

3.63 The construction camp, access routes and any other areas that are disturbed during the construction phase must be rehabilitated within **07 (seven) calendar days** of completion of the construction phase.

3.64 Should the development ever cease or become redundant, the holder must contact the EIA Component of this Department as per the contact details specified in condition 2.2 herewith to determine the required actions for the rehabilitation and closure of the site.

3.65 The holder is responsible for compliance with the provisions for *Duty of care and remediation of damage* in accordance with section 28 of National Environmental Management Act, 1998, (Act No. 107 of 1998). Determination of damage vests in this Department.

Availability of the environmental authorisation

3.66 A copy of this environmental authorisation must be kept by the holder and made available to any official of the Department on request.

Date of environmental authorisation: 13 August 2014

for **Acting Head of Department:**
KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs
Signed by : Ms. Vanessa Maciou

Annexure 1: Reasons for Decision

1. Information considered in making the decision

In reaching its decision, the Department took, *inter alia*, the following into consideration –

a) The Botanical Report prepared by G. J. McDonald, dated December 2012;

b) The information contained in the prescribed application form compiled by Messrs Environmental Planning and Design cc., received by the Department on 14 January 2013;

c) The Wetland Delineation Study prepared by Messrs GroundTruth, dated February 2013;

d) The comments from Ezemvelo KwaZulu-Natal Wildlife (EKZNW), dated 20 March 2013, 30 August 2013 and 04 March 2014;

e) The Geotechnical Assessment Report prepared by Messrs Geomeasure Group, dated 12 April 2013;

f) The consolidated comments from the eThekwini Municipality, dated 12 April 2013 and 31 October 2013;

g) The comments from the Department of Human Settlements, dated 18 April 2013 and 05 August 2013;

h) The Heritage Impact Assessment Report prepared by Messrs eThembeni Cultural Heritage, dated 21 May 2013;

i) The information contained in the BAR and draft EMPr, both compiled by Messrs Environmental Planning and Design cc., received by the Department on 04 March 2014;

j) The comments from the Department of Water Affairs, dated 29 March 2013, 06 August 2013, 14 January 2014 and 14 April 2014;

k) The findings of a site visit undertaken by Ms. Adika Rambally, Ms. Sinethemba Mtolo and Ms. Natasha Brijlal representing this Department in the presence of the EAP - Mr. Jon Marshall on 04 June 2014;

l) The electronic mail correspondence received from the EAP on 05 June 2014, 09 June 2014 and 10 June 2014;

m) The comments from the eThekwini Municipality - Parks, Recreation, Cemeteries and Culture Service Unit; Parks, Leisure and Cemeteries Department, Natural Resources Division, dated 09 June 2014; and,

n) The objectives and requirements of relevant legislation, policies and guidelines, including Section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

2. Key factors considered in making the decision

a) Basic Assessment Report

i. The BAR compiled by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014 complies with the requirements of Chapter 6 of GNR 543 of the EIA Regulations, June 2010 (as amended) and has been accepted by this Department.

ii. The BAR compiled by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014 included a description of the environment that may be affected by the development and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the development.

iii. The methodology used in assessing the potential impacts identified in the BAR compiled by Messrs Environmental Planning and Design cc. and the specialist studies (both received by the Department on 04 March 2014) have been adequately indicated.

b) Public Participation

The public participation process complies with the requirements of Chapter 6 of GNR 543 of the EIA Regulations, June 2010 (as amended) and, the comments from stakeholders and I&APs have either been included in the BAR prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014 or were received after the BAR was submitted.

c) Need and desirability (as per the BAR, prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014)

The activity is desirable in order to provide the community with formal sewage disposal services. The community currently relies on pit latrines which pose a sewage contamination risk to surface and groundwater. The sewer outfall will minimise the contamination risk and improve the communities' standard of living. Furthermore, it will allow for the upgrade/formalisation of housing in the area which has been earmarked by the eThekwini Municipality.

d) Alternative sites and layouts (as per the BAR, prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014)

As the development is intended to address problems associated with lack of sewage disposal services in a specific area there are no site alternatives. However, the alternatives discussed below are deemed to be layout alternatives as they serve the same catchment and are in close proximity to each other. The preferred layout alternative is to run the sewer outfall on the northern side of the stream for its entire length as it will avoid stream crossings and the eThekwini Municipality has been earmarked this area for the upgrade/formalisation of housing. An alignment on

the southern side of the stream will result in a number of steam crossings and it is estimated that 40% of each alignment will require benching. Hence, the preferred alternative is the northern side of the stream.

e) Botanical Report (as per the BAR, prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014)

A Botanical Report was prepared by G.J. McDonald, dated December 2012. According to the report the riparian zone has been cleared of natural vegetation and has become heavily re-colonised by alien species with a preponderance of *Tithonia diversifolia* (Mexican Sunflower). Although there was an abundance of *Tithonia diversifolia* (Mexican Sunflower) up-stream other species were encountered and the density of *Tithonia* was not as great as on the slopes downstream. Many of the cultivated species found were associated with homesteads where the owners have cleared the natural vegetation to plant what appeared to be subsistence crops of Bananas, Sweet Potatoes, Pumpkins, *amaDumbe*, Mangos, Avocados, Pawpaws, Peach and Citrus. Riverine vegetation was near-absent, and vegetation associated with wetlands and flood plains were absent, with the exception of *Cyperus* species which were abundant between the numerous exotic species. A single plant of *Crinum macowanii* (River Lily) was identified on site. The plant is protected by the KZN provincial conservation ordinance (15 of 1974) and is classified as *'Declining'* on the Red List of Threatened Plants.

The necessary recommendations from the Botanical Report have been added as conditions of this environmental authorisation.

f) Wetland Assessment Report (as per the BAR, prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014)

A Wetland Delineation Study was prepared by Messrs GroundTruth, dated February 2013. According to the study the site is characterised by a riparian wetland and its associated hillslope seepage wetlands. The wetland habitat is characterised mostly by temporary zones of wetness and an incised B-channel, which is eroding. The site has undergone significant changes from a diverse landscape to a peri-urban setting, and has led to the infestation of alien invasive plant species including *inter alia* Syringa (*Melia azedarach*), Lantana (*Lantana camara*), Job's tears (*Coix lacryma-jobi*), Triffid Weed (*Chromolaena odorata*), Bugweed (*Solanum mauritianum*), Canna (*Canna indica*), and Mauritius Thorn (*Caesalpinia decapetala*).

The necessary recommendations from the Wetland Assessment Report have been added as conditions of this environmental authorisation.

g) Geotechnical Assessment Report (as per the BAR, prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014)

A Geotechnical Investigation Report was compiled by Messrs Geomeasure Group, dated 12 April 2013. According to the report the site is underlain by (clayey) sands and sandy clays of the Glenrosa Form, with the former typically considered loose to medium dense to an average depth of approximately 1.00 m bgl. Much of the upper 1.20m of the soil profile across the sewer line route consists of loose to medium dense sand. Evidence of minor slope instability was observed on-site, whilst collapse is considered possible should a perched groundwater table be intercepted (which is unlikely across much of the site). Although seepage appears uncommon across much of the site, deformation of the underlying clays in considered highly possible as a result of increased plasticity, should an increase in moisture content occur. Vegetation growth and topography will likely restrict access near the end of the pipeline route (toward the south-east) and, as such, it is recommended that the pipeline be installed on the eastern/northern bank of the river. The sand was considered appropriate as "selected fill material" and satisfactory for use as backfill.

The necessary recommendations from the Geotechnical Assessment Report have been added as conditions of this environmental authorisation.

h) Heritage Impact Assessment (as per the BAR, prepared by Messrs Environmental Planning and Design cc. and received by the Department on 04 March 2014)

A Heritage Impact Assessment was compiled by eThembeni Cultural Heritage, dated 21 May 2013. The findings of the assessment revealed no heritage resources on the site. The specialist stated that the lack of traditional burial places within the site is likely due to the cultural taboos associated with burial close to flowing or standing bodies of water.

The necessary recommendations from the Heritage Impact Assessment have been added as conditions of this environmental authorisation.

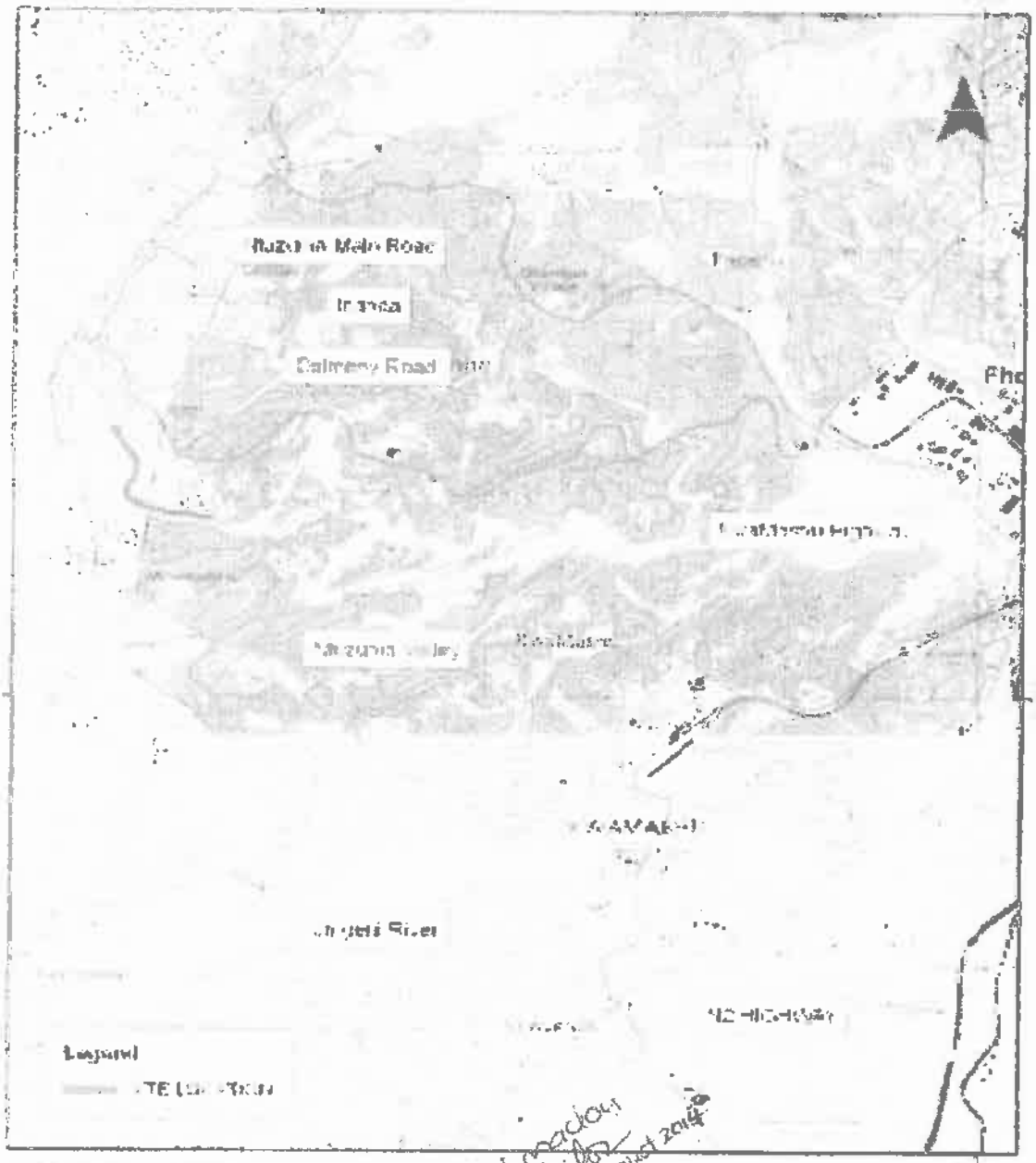
i) No-go alternative

The No-Go alternative will result in the sewage disposal services of the community remaining undeveloped and informal (by use of pit latrines). Sewage contamination of surface and groundwater will likely continue and increase with the densification of the community. The upgrade/formalisation of existing housing in the area will not be viable due to the lack of infrastructure for the provision of basic services. Furthermore, the No-Go alternative will infringe the basic human rights of the community in respect of the provision and access to sewage disposal services. The recommendations made by specialists and stakeholders aimed at ensuring the ecological management and sustainability of the site, with particular reference to soil erosion control and the removal of alien invasive vegetation will not be pursued.

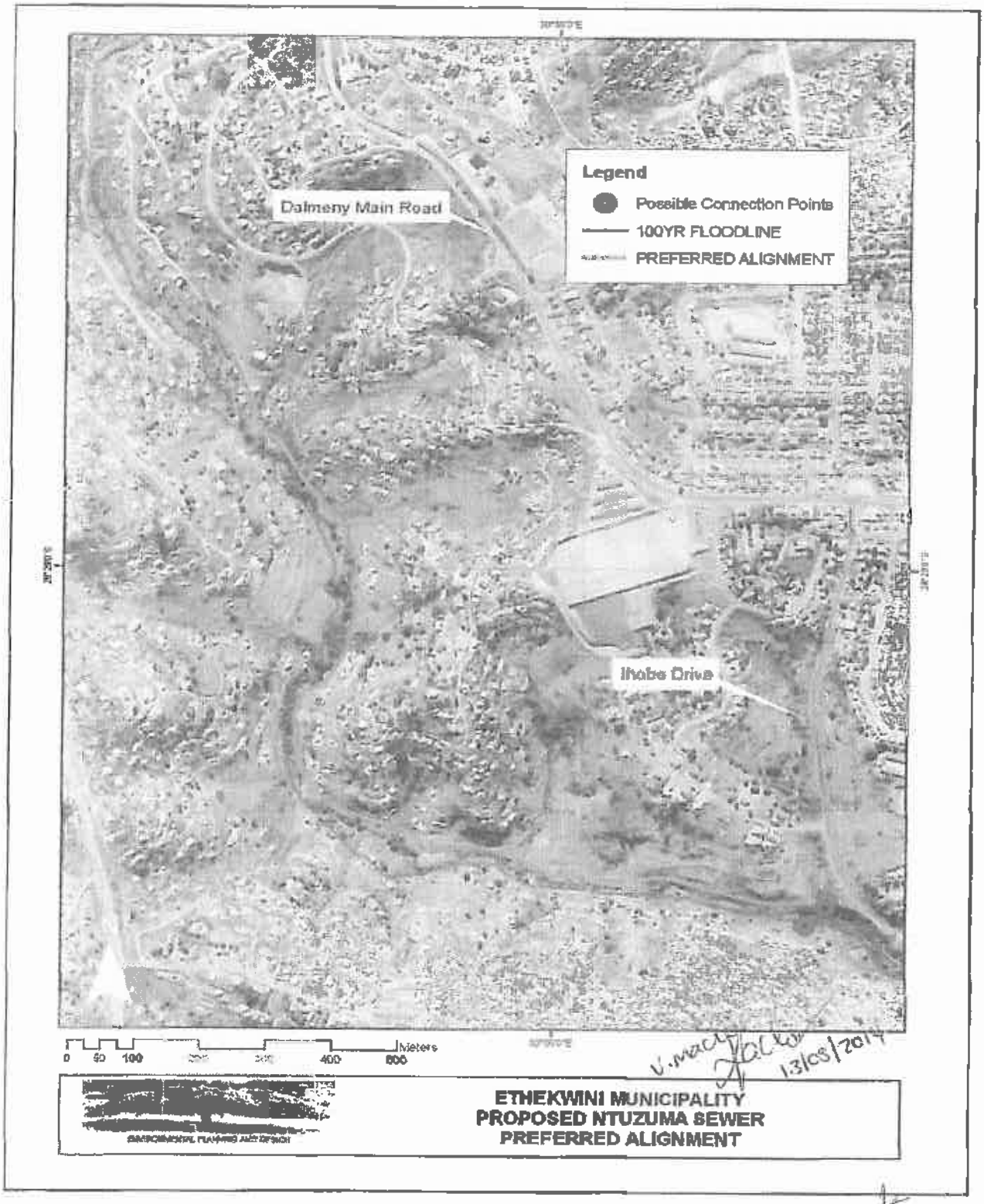
j) Objectives of Integrated Environmental Management

The Department is satisfied that subject to compliance with the conditions contained in this environmental authorisation the general objectives of integrated environmental management laid down in Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) will be met.

ANNEXURE 2: LOCALITY MAP



ANNEXURE 3: SITE LAYOUT PLAN



ANNEXURE 4: GPS CO-ORDINATES CAPTURED ALONG THE SEWER OUTFALL ALIGNMENT/ROUTE

MODEL MAKER

Ethekwini Water and Saniton 0313118190 Date : 2/12/2013 Time : 10:3

Coordinate Conversion : Datum (WGS84 to WGS84)

: Coordinate System (Gauss Conform (LO) to Geographical)

: Conversion method (2 : MMS)

System Settings : Southern Hemisphere - Degrees - WGS84 - LO31

Base Meridian for Y = LO 31

Pnt#	Code	Tag	Y	X	Lat DMS	Long DMS
1	NTU1		8119.670	3288904.340	-29 43 06.34962	30 54 57.89621
1	NTU2		8118.260	3288932.450	-29 43 07.26258	30 54 57.94791
1	NTU3		8106.210	3288947.750	-29 43 07.65975	30 54 58.39583
1	NTU4		8106.570	3288976.410	-29 43 08.69054	30 54 58.38167
1	NTU5		8112.190	3288991.350	-29 43 09.17581	30 54 58.17439
1	NTU6		8111.970	3289039.240	-29 43 10.73094	30 54 58.17905
1	NTU7		8108.420	3289049.980	-29 43 11.07982	30 54 58.31085
1	NTU8		8093.980	3289061.820	-29 43 11.46469	30 54 58.84780
1	NTU9		8087.470	3289093.310	-29 43 12.48754	30 54 59.08917
1	NTU10		8073.280	3289128.940	-29 43 13.64503	30 54 59.61618
1	NTU11		8050.940	3289147.720	-29 43 14.25547	30 55 00.44688
1	NTU12		8026.730	3289180.100	-29 43 15.30764	30 55 01.64589
1	NTU13		8038.110	3289187.350	-29 43 15.54283	30 55 00.92319
1	NTU14		8009.280	3289221.830	-29 43 16.66331	30 55 01.99496
1	NTU15		7974.240	3289268.850	-29 43 18.19119	30 55 03.29745
1	NTU16		7958.400	3289267.760	-29 43 18.15615	30 55 03.88686
1	NTU17		7943.650	3289273.120	-29 43 18.33057	30 55 04.43553
1	NTU18		7920.250	3289321.860	-29 43 19.91404	30 55 05.30490
1	NTU19		7904.730	3289361.860	-29 43 21.21347	30 55 05.88131
1	NTU20		7896.830	3289371.800	-29 43 21.53647	30 55 06.17499
1	NTU21		7893.430	3289396.020	-29 43 22.32314	30 55 06.30086
1	NTU22		7884.810	3289405.620	-29 43 22.63189	30 55 06.65131
1	NTU23		7881.930	3289431.130	-29 43 23.46367	30 55 06.72784
1	NTU24		7846.990	3289458.270	-29 43 24.34589	30 55 08.02728
1	NTU25		7833.560	3289479.300	-29 43 25.02919	30 55 08.52694
1	NTU26		7822.920	3289493.950	-29 43 25.47017	30 55 08.92180
1	NTU27		7805.220	3289528.330	-29 43 26.62218	30 55 09.57355
1	NTU28		7781.140	3289547.750	-29 43 27.25342	30 55 10.47511
1	NTU29		7740.760	3289602.630	-29 43 29.03667	30 55 11.97809
1	NTU30		7732.660	3289686.390	-29 43 30.15276	30 55 12.27961
1	NTU31		7720.940	3289667.130	-29 43 31.13187	30 55 12.71191
1	NTU32		7731.290	3289706.400	-29 43 32.40701	30 55 12.32579

1	NTU33	7725.870	3289735.570	-29 43 33.35448	30 55 12.52671
1	NTU34	7729.410	3289755.120	-29 43 33.98933	30 55 12.39445
1	NTU35	7731.150	3289792.130	-29 43 35.19126	30 55 12.32879
1	NTU36	7740.280	3289819.180	-29 43 36.06955	30 55 11.98837
1	NTU37	7771.270	3289871.620	-29 43 37.77195	30 55 10.83389
1	NTU38	7803.450	3289885.540	-29 43 38.22330	30 55 09.63613
1	NTU39	7814.340	3289931.520	-29 43 39.71634	30 55 09.22972
1	NTU40	7813.670	3289980.300	-29 43 41.30058	30 55 09.25338
1	NTU41	7812.010	3290011.730	-29 43 42.32136	30 55 09.31433
1	NTU42	7799.120	3290040.150	-29 43 43.24465	30 55 09.79323
1	NTU43	7772.130	3290068.880	-29 43 44.17832	30 55 10.79679
1	NTU44	7728.090	3290095.140	-29 43 45.03216	30 55 12.43486
1	NTU45	7663.360	3290114.930	-29 43 45.67632	30 55 14.84298
1	NTU46	7633.990	3290127.600	-29 43 46.08846	30 55 15.93552
1	NTU47	7622.960	3290147.040	-29 43 46.72005	30 55 16.34546
1	NTU48	7592.940	3290154.140	-29 43 46.95130	30 55 17.46234
1	NTU49	7545.610	3290150.060	-29 43 46.81984	30 55 19.22362
1	NTU50	7508.960	3290159.030	-29 43 47.11196	30 55 20.58716
1	NTU51	7464.520	3290175.050	-29 43 47.63320	30 55 22.24003
1	NTU52	7429.350	3290196.360	-29 43 48.32605	30 55 23.54857
1	NTU53	7376.710	3290198.380	-29 43 48.39278	30 55 25.50729
1	NTU54	7340.760	3290197.070	-29 43 48.35101	30 55 26.84505
1	NTU55	7305.280	3290194.440	-29 43 48.26635	30 55 28.16535
1	NTU56	7261.380	3290195.570	-29 43 48.30398	30 55 29.79887
1	NTU57	7230.110	3290204.630	-29 43 48.59888	30 55 30.96223
1	NTU58	7168.810	3290211.460	-29 43 48.82197	30 55 33.24304
1	NTU59	7098.630	3290228.720	-29 43 49.38398	30 55 35.85413
1	NTU60	7046.310	3290237.440	-29 43 49.66825	30 55 37.80079
1	EXSTMH	7009.250	3290251.930	-29 43 50.13960	30 55 39.1[illegible]

1world consultants
Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 3619

Directive in Terms of the National Water Act

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

KwaZulu Natal Regional Office
Southern Life Building, 88 Joe Slovo Street, Durban, 4000; PO Box 1018, Durban, 4000

Enquiries: Mr S. O Naidoo
Tel 031-336 2889

E-mail: NaidooSO@dwa.gov.za
File No : 16/2/7/Ntuzuma E Sewer

The Municipality Manager
eThekwini Municipality
Water and Sanitation Department
Durban
4000

ATTENTION: MR S SITHOLE

RE: DIRECTIVE IN TERMS OF SECTION 19(1) AND (2) (B) OF THE NATIONAL WATER ACT, 1998 (ACT 36 OF 1998) FOR THE CONSTRUCTION OF NTUZUMA E SEWER OUTFALL AND PROVISION OF INTERNAL SEWER RETICULATION FOR INANDA GLEBE AND NTUZUMA E

Reference is made to the document dated 8th July 2016 with regards to the urgent provision of Ntuzuma E sewer outfall and provision of internal sewer reticulation for Inanda Glebe and Ntuzuma E in eThekwini Municipality.

The Inanda Glebe and Ntuzuma E areas are located in the north of Durban. These areas are currently occupied by middle/low income residential without waterborne sewerage. Residents in these areas have constructed pit latrines for sanitation purposes. These latrines are, in some instances, constructed on rocky terrain and close Igobhogobho River and its tributaries which poses a serious pollution risk.

It is understood from the above-mentioned letter, that the intensions of the proposed request is to improve the status quo of the sewer system within the area in order to minimise the impact on the environment and human health.

DIRECTIVE

I, **Jayandran G Reddy,** in my capacity as Acting CEO: Pongola-Umzimkulu Proto-CMA and duly authorized in terms of the powers delegated to me by the Minister, hereby **Direct** eThekwini Municipality and, Mr S Sithole in your capacity as eThekwini Municipality

Manager with a directive in terms of Section 19 (1) (b) of the Act.

This Directive directs you to:

1. Provide sewer outfall to Ntuzuma E and also to provide internal sewer reticulation for Inanda Glebe and Ntuzuma E in eThekwini Municipality.
2. Design and implement a monitoring programme with immediate effect to monitor the impact of the proposed activity on the surface water, groundwater and wetlands.
3. Appoint a suitably qualified person to ensure compliance in terms of the National Water Act, 1998 (Act 36 of 1998).
4. Ensure that monthly reports are submitted.
5. Obtain consent from all land owners that the pipeline will cross prior to construction.
6. Note that the permissions granted above do not negate eThekwini Municipality from applying for the authorisation of these activities under other Acts.

IMPLICATIONS

1. Should you fail to comply, or comply inadequately with this directive, legal action will be taken against you, and the Department of Water and Sanitation will take the necessary action in terms of section 19(2) of the NWA to;

   (a) cease, modify or control any act or process causing the pollution;

   (b) comply with any prescribed waste standard or management practice;

   (c) contain or prevent the movement of pollutants;

   (d) eliminate any source of the pollution;

   (e) remedy the effects of the pollution; andAnd

   Section 19(5), The Catchment Management Agency may recover all reasonable costs incurred by it from every responsible person jointly and severally.
2. I would like to bring to your attention that engaging in a water use activity without authorisation constitutes an offence in terms of section 151(1)(a); failure to comply with a directive issued in terms of section 53(1) of the NWA constitutes an offence in terms of section 151(1)(d); and committing any act or omission unlawfully and intentionally or negligently which detrimentally affects or is likely to affect a water resource also constitutes an offence in terms of section 151(1)(j) of the NWA.
3. In terms of Section 151(2), "*Any person who contravenes any provision of subsection (1) is guilty of an offence and liable, on the first conviction, to a fine or imprisonment for a period not exceeding five years, or to both a fine and such imprisonment and, in the case of a second or subsequent conviction, to a fine or imprisonment for a period not exceeding ten years or to both a fine and such imprisonment*".

APPEALS TO WATER TRIBUNAL

1.1 The proponent to whom this Directive has been issued to may appeal to the Water Tribunal in terms of Section 148(1) of the NWA. Contact details of the Water Tribunal are:

The Chairperson
Water Tribunal
Private Bag X316
PRETORIA
0001

1.2 Please note that even though you may appeal against this Directive to the Water Tribunal in terms of section 148(1) of the Act, such an appeal does not suspend the Directive pending the outcome of the Tribunal regarding the Directive.

Should you have any further queries, please contact Mr SO Naidoo (031 336 2700).

Yours faithfully,

Acting CEO: Pongola-Umzimkulu Proto-CMA
Mr JG Reddy
Date: 2016/8/15

Acknowledgement of Receipt

Received by Mr. / Ms. _____ (name and surname)

On behalf of Mr S Sithole **in your capacity as** eThekwini Municipality **on this** _____ **day of** _____ **2016.**

Signature _____

1world consultants
Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 3619

Minutes of the pre-application meeting

Environmental & Engineering Consultants
Physical Address: 181 Winchester Drive, Reservoir Hills, 4091
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 361

[22 September 2017]

Attendees:	Kacy Rengasamy	(KR)	EDTEA
	Siyabonga Sikhakhane	(SS)	EDTEA
	Silondiwe Gumede	(SG)	eThekwini Water & Sanitation (EWS)
	Alex Mahlambi	(AM)	eThekwini Water & Sanitation (EWS)
	Bryan Walter Paul	(BP)	1World Consultants (Pty) Ltd
	Roschel Maharaj	(RM)	1World Consultants (Pty) Ltd
Apologies:	Natasha Brijlal	(NB)	EDTEA (Manager)

Venue: EDTEA, 40 Dr A. B. Xuma Street, Durban Central, 4001

Date: 22 September 2017

Time: 10:00

Subject: Inanda Glebe Sewer Reticulation - Pre-application meeting

1. A pre-application meeting was conducted with the Competent Authority (EDTEA), the EAP (1World Consultants) and the Client (EWS). The purpose of the pre-application meeting was to introduce the proposed project to the Competent Authority and to discuss processes; activities triggered as well as requirements to aid the decision-making process.

Item	Details	Responsible Person
Welcome and Introduction	• Attendees were welcomed • Attendees introduced themselves • Focus is the Inanda Glebe Sewer Reticulation	KR
Project Background	• 1World has been appointed by EWS to undertake the EIA process for the Inanda Glebe Sewer Reticulation. • An EA has already been granted for the Ntuzuma E outfall to which the reticulation will feed. • The EA is dated 13 August 2014. • Representatives of 1World and EWS had an informal meeting with EDTEA (Ms Nasreen Asmal & Mrs Yugeshni Govender) to discuss an amendment application. • Meeting was dated 31 January 2017. • We were advised that an amendment application does not apply as the proposed reticulation falls outside of that which is granted in the EA. • A meeting was held with Shoni (EPCPD) to discuss the outcomes of the meeting with EDTEA. • The client now seeks to link the sewer reticulation to the outfall. • Therefore, Inanda Glebe Sewer Reticulation follows a new application and forms the basis of the meeting.	RM
Project Description	• EWS proposes the construction of a 11km of 160mmØ HDuPVC sewer reticulation and numerous 1000mmØ precast concrete ring manholes, in Inanda Glebe, eThekwini Municipality, KwaZulu-Natal.	RM

	• The reticulation was presented by means of a layout map, also indicating the tie-in point.
	• A wetland study was conducted which identified that out of 11 wetlands, 3 wetlands would be affected by the proposed reticulation.
	• The location of the wetland systems (i.e. HGM units) were presented as per a map produced in the wetland report.
	• as per the map:
	  ○ HGM 1 will be impacted as the pipe laying borders the HGM unit.
	  ○ HGM 2 and 3 will be impacted as pipe laying will occur within the wetlands.
	• There are no pump stations proposed.	

Listed Activities	• The Draft Application for Environmental Authorisation was reviewed by the EDTEA case officers.
	• Based on the nature and description of the project, it is advised that Listing Notice 1, Activity 12 will fall away leaving only Listing Notice 1, Activity 19 as the only applicable trigger.
	• Ms Diane van Rensburg or Pam Ramnarain, EPCPD, should be included onto the I&AP database. EAP to contact the mentioned parties to find out who the relevant contact person is for this project.
	• It isn't necessary to have the SG numbers for linear activities included on the application for Environmental Authorisation.
	  ○ The Farm Numbers and ERF Numbers are also applicable
	  ○ Refer to Chapter 4, regulation 16, sub-regulation 6, cc, of the EIA regulations (2017) for more detail.
	  ○ EWS has obtained SG numbers
		KR
		SS

Public Participation Process (PPP)	• Glebe, Inanda is a formalised housing community.
	• The proposed Inanda Glebe Sewer Reticulation project is a Linear Activity.
	• Therefore, no landowner notification is required.
	• However, community members must be informed by means of:
	  ○ Newspaper Advertisements
	  ○ Site Notice Boards
	  ○ BID (can include a letter for property owners to sign just to indicate that they are well aware of the proposed development)
	• Community members are allowed to comment during the PPP and must be registered as an I&AP should any comment be received.
	• The EIA Reference Number must be included on all items used/ distributed for PPP.
	• A second distribution is dependent on the level of amendments made to the BAR following the initial public commenting period. This is usually guided by advice from the relevant case officer.
		KR
		SS
		RM

BAR	• There are no site and route alternatives for the project. The BAR must explain or motivate as to why no alternatives have been considered. • However, technology alternatives, if possible, can be discussed in the BAR.	KR RM

	• Design information must be properly described in the BAR.	

Engineering Designs/ Layouts and Maps	• Methods of pipe installation within the wetland must be stated. To address this concern, the wetland report provides such information and a Method Statement has been provided by EWS.
	• Maps are as follows:
	  ○ Locality Map (showing surrounding area)
	  ○ Route Plan
	  ○ Environmental Sensitivity map, which can be over laid on the pipeline
	  ○ Zoomed in images of affected/ sensitive areas with particular attention to the wetlands that will be crossed by the pipeline.
	• Ensure layouts are signed
	• Avoid the use of words such as "preliminary" and use the word "Final" instead.
		KR
		SS

Specialist Studies	• Biodiversity Assessment and Report
	  ○ The proposed reticulation will not impact upon CBA Listed areas
	  ○ Minimal indigenous vegetation is anticipated to cleared during the construction phase of the proposed development (210m^2).
	  ○ No faunal species of conservation importance are anticipated to be affected.
	  ○ Two floral species were found along the route that are protected by the Natal Nature Conservation Ordinance and will require Permit Applications once the RoD has been issued.
	• Heritage Impact Assessment
	• Wetland Delineation and Functional Assessment
	• Geotechnical Study
	  ○ EWS is currently in the process of appointing a Geotechnical Specialist.
	• Stormwater Management Plan
		KR
		RM
		BP

General	• The proposed reticulation will feed into the KwaMashu Waste Water Treatment Works. A letter was previously provided confirming that KwaMashu does have the capacity and can connect to the proposed reticulation. A more recent letter confirming such would be required for purposes of the BAR. • Only the main road is the DoT road. The rest falls under ETA. • EAP to provide EDTEA with notes or minutes of previous meetings held with EDTEA.	KR SG SS
Conclusion and Close	• It must be noted that once the Application for Environmental Authorisation is lodged, a case officer is then allocated to take the task of reviewing the application. The application is not necessarily reviewed by the case officer present for the pre-application meeting. • The EAP must provide minutes to the meeting and ensure all attendees receive a copy.	KR SS

Environmental & Engineering Consultants
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Fax: 086 726 361

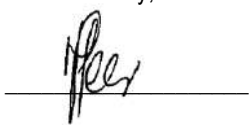
[22 September 2017]

Please do not hesitate to contact us should you require any further information or feel that any of the information captured in this minutes does not truly represent the scope of works for this project.

Your insight and/ or corrections are strongly encouraged.

The minutes of the meeting and actions are hereby captured and provided to you for your records.

Yours faithfully,



Fatima Peer
B.Sc. (Hons) Pr. Sci. Nat

ACKNOWLEDGEMENT

Date received: _____

Recipient Name: _____

Recipient Signature: _____

Comments: _____

_____

_____

edtea

Department :
Economic Development, Tourism and Environmental Affairs
PROVINCE OF KWAZULU-NATAL

ATTENDANCE REGISTER: MEETING

DATE : 22 / 09 / 2017

REFERENCE NO. : N/A

VENUE : EDTEA : eTHEKWINI DISTRICT OFFICE

PROJECT DESCRIPTION : PRE-APPLICATION MEETING : PROPOSED INANDA GLEBE SEWER RETICULATION

	FULL NAME & SURNAME	ORGANISATION / COMPANY	DESIGNATION	CONTACT NUMBER	E-MAIL	SIGNATURE
1	Kacy Rengasamy	EDTEA	E.O	031 366 7346	kacy.rengasamy@kznedtea.gov.za	
2	Byan Walter Paul	1World Consultants (Pty) Ltd	EAP	031 2628327	byan@1wc.co.za	
3	Roschel Maharaj	1World Consultants	EAP	031 2628327	roschel@1wc.co.za	
4	Alex Mathlambi	EWS	Civil Engineer	0313118798	alex.mathlambi@durban.gov.za	
5	Silondiwe Gumede	EWS	Civil Engineer	031 311 8751	Silondiwe.gumede@durbangov.za	
6	SIYABONGA SIKHAKHANE	EDTEA	ENV. OFFICER	031 3667345	SIYABONGA.SIKHAKHANE@KZNEDTEA.GOV.ZA	
7						
8						

1world consultants
Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 3619

Acknowledgement of Receipt of Application for Environmental Authorisation

edtea
Department :
Economic Development, Tourism and Environmental Affairs
PROVINCE OF KWAZULU-NATAL

Enquiries: Mavis Padayachee
Imibuzo :
Navrae :
Telephone: 033 - 2642572
Ucingo :
Telefoon :
Private Bag : X9152
Isikhwama Seposi : Pietermaritzburg
Privaat Sak : 3200

Reference: DM/0004/2018
Inkomba :
Verwysing:
Fax :
iFeksi :
Faks :
Date :
Usuku : 05 March 2018
Datum :
NEAS : KZN/EIA/0000808/2018

Fax Transmission

1World Consultants (Pty) Ltd
P.O. Box 2311
3630

Attention: Fatima Peer

Dear Sir / Madam

DM/0004/2018: ACKNOWLEDGEMENT OF RECEIPT OF AN APPLICATION FOR ENVIRONMENTAL AUTHORIZATION SUBJECT TO A BASIC ASSESSMENT FOR THE PROPOSED INANDA GLEBE SEWER RETICULATION LOCATED IN THE NORTH OF DURBAN WITHIN ETHEKWINI DISTRICT MUNICIPALITY.

The application for environmental authorization for the abovementioned activity, submitted in terms of the requirements of regulation 6(1) of the EIA Regulations, 2014, was received by this Department on 06 March 2018 .This application complies with the EIA Regulations 2014 and has been accepted.

1. **Please note that this application has been registered on the National Environmental Authorization System (NEAS) and that the final Basic Assessment Report is due on 11 June 2018.** In terms of regulation 45 of the EIA Regulations 2014, an application lapses if the applicant fails to meet any of the prescribed timeframes (unless an extension has been granted in terms of regulation 3(7)).

2. Please quote the above-mentioned reference number for this application in all future correspondence.

3. You are reminded that the activity/ies applied for may not commence prior to an environmental authorization being granted by this Department.

4. Enquiries regarding this application may be directed to the Impact Assistant Manager: Ms. Y. Govender / Ms. N. Brijlall, **Tel No: 031 – 366 7317/7319 at eThekwini District Office.**

Yours faithfully

for: **Head of Department:**
KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs
cc. Precious Mbhele, eThekwini Water and Sanitation. Precious.Mbhele@durban.gov.za

1world consultants
Environmental & Engineering Consultants
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Appendix B

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Company Profile and Project Experience

1WORLD CONSULTANTS (PTY) LTD

COMPANY PROFILE

WESTVILLE, 3630
TEL: 031 262 8327
FAX: 086 726 3619

Contents

“Always look to improve. It’s never perfect.”

Fatima Peer

Chairman's Message

"As the chairman of 1World Consultants (Pty) Ltd, my purpose is to drive our company to ever-surpassing targets of quality, professionalism, innovation and ethics that permeate our core engineering services.

With a background in electrical engineering within both the parastatal and private arenas of South Africa, I understand the industry, but more importantly I understand the requirements of our clients. We have thus identified three core areas of service, namely electrical engineering, mechanical engineering and professional environmental services. Our young and vibrant team of engineers and consultants have coupled their ambition, enthusiasm and energy, with our vision and mission.

We are committed to providing a high level of technical assistance and field support. We aim to work closely with all parties concerned, to assure that all our project deliverables are practical, technically defendable, cost-effective, and acceptable to the local government, international financial institutions, developers, the local stakeholders and the affected public.

The 1World Consultants project team is keen to work with you and will contribute our very best efforts to make all aspects of your project a success."

Mohamed Peer

Chairman, 1World Consultants (Pty) Ltd.

“We got this.”

Mohamed Peer

The Team

Electrical	Mechanical	Environmental
Mohamed Peer	**Suhayl Buksh**	**Fatima Peer**
Mohamed holds Bachelor of Engineering (Electrical) from the University of Kwa-Zulu Natal (South Africa). He has a strong background in electrical parastatal organisation operations and management. Mohamed holds a professional registration with Engineering Council of South Africa (ECSA). *His personal interests lie in science and technological advances, especially in the field of space exploration.*	*Suhayl holds Bachelor of Engineering (Mechanical) from the University of Kwa-Zulu Natal (South Africa). He has a strong background in mechanical requirements for HVAC and process designing. Suhayl holds a professional registration with Engineering Council of South Africa (ECSA).* *His personal interests lie in applying science to food and beverage activities.*	*Fatima holds Bachelor of Science degree from the University of Kwa-Zulu Natal (South Africa), with honours in Chemistry. She has a background in coal processing and mining research, as well as professional environmental services. Fatima holds a double professional registration with the South African Council for Natural Scientific Professions (SACNASP), for chemistry and environmental sciences.* *Her personal interests lie in the field of bioethics and health laws, with particularly emphasis on human rights.*
Subordinates		
❖ Ashley Naidoo ❖ Ubaidullah Pandor	❖ Mohammed Rishaad Sumar	❖ Adila Gafoor ❖ Bryan Walter Paul ❖ Roschel Maharaj

“I love pie-in-the-sky ideas. Exciting!”

Suhayl Buksh

INTRODUCTION

1World Consultants (Pty) Ltd is a Professional Electrical & Mechanical Engineering and Environmental services consultancy, which caters to a variety of clients in both the public and private sectors.

At 1World, we have extensive experience in the engineering and environmental sectors, developed through practical involvement in projects for utilities and private consultants. Both our divisions offer personalised attention on every project, with the aim of providing a defendable and quality service. Our consultants in the Engineering divisions have knowledge and skills, ranging across many fields of the Built Environment and Large Industry. The environmental consultants on our team have successfully executed work for large municipalities and parastatals, as well as private developers.

The unique combination of engineering and environmental knowledge, and experience enables 1World to provide holistic solutions to a vast range of projects.
1World Consultants (Pty) Ltd. prides itself on providing individual attention to every project.

VISION

To be a leading provider of consultancy services for projects in South Africa and beyond.

MISSION

We aim to deliver a quality and efficient service by:

- ✓ Using highly skilled and motivated professionals,
- ✓ Consulting with all stakeholders,
- ✓ Training and developing our staff,
- ✓ Working with local communities,
- ✓ Being honest and humble in all dealings,
- ✓ Providing best value in all aspects of our services.

FIELDS OF EXPERTISE

1World Consultants (Pty) Ltd provide a wide range of services with specialist expertise in the following key core areas and tasks:

- Electrical Engineering
- Mechanical Engineering
- Environmental Services

Additionally, we provide the following associated services:

- Civil Engineering
- Structural Engineering
- Electronic Engineering (Control & Instrumentation)
- Geotechnical Assessments
- Procurement / Supply Chain Management?
- Project Management
- Front-End Engineering & Design (FEED) Services

Electrical Engineering

Our past involvement and ongoing engagements with Eskom, especially in KZN, allow us to afford our clients the comfort of knowing that, on matters involving Eskom, the correct people are being addressed to resolve issues quickly and completely.

We offer the following professional services:

Building Services

- Supply alternatives – whether municipal power, backup or power-wheeling agreements.
- Electrical reticulation & distribution design,
- Lighting Design
- Security, Access Control,
- Standby Power generation
- Energy Efficiency Analysis – base line establishment, projects scoping, ROI analysis and roll out co-ordination.
- Building Information Management (BIM) Systems.

Reticulation & Electrification design

- Rural and urban electrification design;
- Building reticulation and refurbishment

Substation & Line design

- High and medium voltage substation design;
- High and medium voltage line design;
- High and medium voltage cable design.

Demand Side Management / Energy Audits

DSM is the process by which electric utilities achieve predictable changes in customer demand, which can be considered as alternatives to the provision of additional generation plant. The following services are offered:

- Commercial
  - Energy efficiency and load management in buildings;
  - In line water heaters;
  - Thermal energy storage;
  - Tariff analysis;
  - Power factor correction
- Industrial
  - Industrial and Power Station energy efficiency;
  - In line water heaters;
  - Industrial Load Control;
  - Tariff analysis;
  - Power factor correction

Power System modelling and simulation

1World has expertise in the following simulation software; PSS/e, DigSILENT, Reticmaster and PowaMaster providing the following broad services:

- Master planning;
- Network development planning (NDP);
- Long term load forecasting.
- System analysis and optimisation

Project management

1World offers project management and on-site supervision capabilities for any type of electrical project, especially where we are responsible for detail design of such projects.

This allows our engineers to ensure that required standards and quality is maintained during the construction/implementation phases of the project, given the budget and schedule constraints.

Mechanical Engineering

Engineering Project Management

Inspection and Evaluation; Status Quo Reports; Repair & Maintenance Programs; Facilities Management; Engineering Construction Management

HVAC Engineering

Design of a Wide Variety of HVAC Systems; Retail; Commercial; Special Process; Chilled water; Air/Water cooled; VRV Ventilation; Smoke extract; Fume/Dust extract

Rational Fire Design

Rational Fire Design, Firefighting Equipment; Fire detection, Public address, Gas Suppression; SCADA Monitoring systems; Fire Department Consultation; And National Building Regulation Fire assessments

Lifts and Escalators

Traffic study; Design of Lifts

Winches and Cranes

Design of Escalators; Winches and Cranes; Weighbridges

Occupational Health & Safety

Risk assessments, HASOP Study; Guidelines to Occupational Health & Safety; Compliance to Construction Regulations; Health & Safety Inspections & reporting

Green Building Design

Analysis of Heat transmission into Building Structures; Solar/Heat pump Hot Water Generation systems; Grey water recycling, Rain water harvesting, boreholes; Energy efficient Electrical systems; Analysis of Electrical and water usage; Compliance SANS204-2011 Energy efficiency in buildings; SANS 10400:XA calculations.

Environmental Services

Drawing on our extensive experience with private and public sector clients, we are able to offer our clients the following services:

- Environmental Planning/Risk Assessments/Screenings/ Due Diligence
- Basic Assessments
- Full scoping and Environmental Impact Assessments (EIA's) and reporting
- Strategic Environmental Assessments
- Facilitation of the Public Participation process
- Water Use License Applications (NWA)
- Waste Management License Applications (NEM:WA)
- Section 24G Rectification Applications
- Environmental Auditing and Site Compliance
- Environmental Control Officer (ECO)
- Environmental Management Plans, recommendations and advice
- Biodiversity/Vegetation Assessments

FIELDS OF EXPERTISE

KEY PERSONNEL

Electrical:	*Mohamed Peer, BSc Electrical Eng, Pr Eng* *mohamed@1wc.co.za*
Mechanical:	*Mahomed Suhale Baksh, BSc Mechanical Eng, Pr Eng* *suhale@1wc.co.za*
Environmental:	*Fatima Peer, BSc (Hons) Chemistry, Pr Sci Nat* *fatima@1wc.co.za*

Support Personnel

Environmental:	Adila Gafoor, B.Sco.Sci Environmental Management Bryan Paul, B.Sc. (Hons) Zoology Roschel Maharaj, B.Sc. Environmental Management
Electrical:	Ubaidullah Pandor, B.Sc. Electrical Eng Ashley Naidoo, B.Tech. Electrical Eng
Mechanical:	Mohammed Rishaad Sumar, B.Sc. Mechanical Eng

Professional Registrations

The team members at 1World Consultants (PTY) Ltd are affiliated to and registered with, amongst other industry specific organisations, the following recognised institutions:

- Engineering Council of South Africa (ECSA)
- South African Federation of Hospital Engineering (SAFHE)
- South African Institute of Mechanical Engineers (SAIMechE)
- South African Institute of Electrical Engineers (SAIEE)
- South African Council for Natural Scientific Professions (SACNASP)
- International Association for Impact Assessment South Africa (IAIAsa)

Company Details (South Africa)

Legal Name	*1World Consultants (Pty) Ltd.*
Operational Years	*6 years*
Company Reg No.	*2015/084540/07*
VAT Registration No.	*445 0271 756*
B-BBEE Level	*01*

Current & Previous Work Experience

Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327

Name of Contract/ Nature of Work	Duration		Value of Work		Name, Address & Telephone no. of client and/ or Project Leader
	From	To	Fee	Contract	
CURRENT PROJECTS					
Environmental authorisation, EMP and WULA for the 52km, 300mm diameter Pipeline and associated reservoirs and pump stations for the Umshwathi Bulk Infrastructure Upgrade Project. **Location:** Ndwedwe Local Municipality, KZN	May 2017	Current	R683 000	Undisclosed	Umgeni Water Name: Zethu Jili Address: 310 Burger St, Pietermaritzburg, 3201 Tel: 033 341 1083/ 083 306 7435 Email: zethu.jili@umgeni.co.za
Nonoti Abattoir - Basic Assessment, EMP for the establishment of a new bovine abattoir **Location:** Stanger, KZN	April 2017	Current	R80 000	Undisclosed	ARUP Name: Yusuf Raja Address: 167 Florida Road, Durban, 4001 Tel: 031 328 8700/ 082 734 1168 Email: yusuf.raja@arup.com
Eastmoor Crescent - Basic Assessment, EMP for the demolishing and re-building of a residential dwelling **Location:** Eastmoor Crescent, La Lucia	January 2017	Current	R80 000	Undisclosed	ARUP & Nxasana Sizwe Errol Name: Yusuf Raja Address: 167 Florida Road, Durban, 4001 Tel: 031 328 8700/ 082 734 1168 Email: yusuf.raja@arup.com
Glebe Sewer Reticulation; Amendment of Environmental Authorisation **Location:** Inanda Glebe, Inanda, Durban	November 2016	Current	R172 000	Undisclosed	eThekwini Municipality: Water & Sanitation Name: Silondiwe Gumede Address: 3 Prior Road, Durban Central, 4001 Tel: 031 311 8751 Email: Silondiwe.gumede@durban.gov.za
Lagoon Drive (Fleetwood on Sea) - Basic Assessment, EMP for the refurbishment and extension of a residential block **Location:** Umhlanga Rocks, Durban	November 2016	Current	R72 000	Undisclosed	ARUP & Dalmatian Duo Investments Name: Yusuf Raja Address: 167 Florida Road, Durban, 4001 Tel: 031 328 8700/ 082 734 1168 Email: yusuf.raja@arup.com

Current & Previous Work Experience

Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327

Vegetation Assessment, EMP, ECO Monitoring and Contractor Training **Location:** Donnelly Road, Wentworth	July 2016	Current	R60 693.60	Undisclosed	eThekwini Municipality: Department of Human Settlements & Infrastructure- Social Housing Name: Nokuthula Madondo Address: Shell House, 221 Anton Lembede Street, Durban, 4001 Tel: 031 311 - 3218 Email: nokuthula.madondo@durban.gov.za
ECO Monitoring for the Pipeline Projects, Wartburg to Bryunshill and South Coast Phases 2B & 2A and Amendment to Environmental Authorisation **Location:** Wartburg to Bruynshill and South Coast (Scottburg & Kelso)	June 2016	Current	R928 487.93	Undisclosed	Umgeni Water Name: Asha Ramjatan Address: 310 Burger St, Pietermaritzburg, 3201 Tel: 033 3411 335/ 083 679 4423 Email: Asha.Ramjatan@umgeni.co.za
Basic Assessment for the construction of a petrol station and associated infrastructure **Location:** Overport	June 2016	Current	R90 345	Undisclosed	Brickfield Investments (Pty) Ltd Name: E.C Vayej Address: 296 Jan Smuts Hwy, Durban, 4091 Tel: 031 207 5683/082 768 0700 Email: evayej@gmail.com
SANRAL National Route 2 ECO Monitoring: Routine Road Maintenance Environmental Compliance Monitoring **Location:** Umdloti	February 2016	Current	R90 288	Undisclosed	Aurecon & SANRAL Name: Johan Calitz Address: 4 Daventry Street, Lynnwood manor, 0081 Tel: 012 427 2634 Email: Johan.Calitz@aurecongroup.com
EAP & ECO Monitoring, Environmental Training **Location:** Adams Mission	March 2016	Current	R124 650	Undisclosed	eThekwini Municipality Name: Nomagugu Ncemane Address: 3 Prior Road, Durban Central, 4001 Tel: 031 311 8148 / 071 855 8124 Email: nomagugu.ncemane@durban.gov.za
Basic Assessment, Vegetation Assessment, Water Use License Application, Environmental Control Officer Monitoring and Environmental Training for a water pipeline. **Location:** Alverstone, Hillcrest, Durban	January 2016	Current	R325 500	Undisclosed	eThekwini Municipality: Water & Sanitation Name: Leisel Bowes Address: 3 Prior Road, Durban Central, 4001 Tel: 031 311 8656/ 082 395 8195

Current & Previous Work Experience

Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327

					Email: leiselbowes@durban.gov
Basic Assessment, Water Use License Application, Environmental Control Officer Monitoring and Environmental Training for a water pipeline. **Location:** Maphephetheni, Inanda, Durban	December 2015	Current	R355 000	Undisclosed	eThekwini Municipality Name: Nomagugu Ncemane Address: 3 Prior Road, Durban Central, 4001 Tel: 031 311 8148 / 071 855 8124 Email: nomagugu.ncemane@durban.gov.za
Basic Assessment, Water Use License Application, Environmental Control Officer Monitoring and Environmental Training for the Mbhele Pedestrian Bridge **Location:** Margate	November 2015	Current	R260 000	Undisclosed	PGA Consulting Name: Marcus Sadhai Address: 53 Intersite Avenue, Umgeni Business Park Tel: 031 263 2583 Email: marcus.sadhai@pgaconsulting.co.za
Basic Assessment, Water Use License Application, Environmental Control Officer Monitoring and Environmental Training for a Dressing Pedestrian Bridge **Location:** Bhomela	November 2015	Current	R260 000	Undisclosed	PGA Consulting Name: Marcus Sadhai Address: 53 Intersite Avenue, Umgeni Business Park Tel: 031 263 2583 Email: marcus.sadhai@pgaconsulting.co.za
Basic Assessment, Water Use License Application and ECO Monitoring for Burbreeze Reservoir and Pipeline **Location:** Tongaat	October 2015	Current	R280 000	Undisclosed	eThekwini Municipality & RHDHV Name: Roxanne Mans Address: 3 Prior Road, Durban Central, 4001 Tel: 083 776 0626 Email: Roxanne.mans@rhdhv.com
Training and ECO Monitoring for Reforestation Hub within Buffelsdraai Landfill Site **Location:** Buffelsdraai	September 2015	Current	R112 176	+-R20m	eThekwini Municipality (EPCPD) Name: Errol Douwes Address: 166 K.E Masinga Road, Durban, 4001 Tel: 031 311 7952 Email: Errol.Douwes@durban.gov.za
Environmental Control Monitoring **Location:** Cedara, PMB	November 2015	Current	+-R20 000	Undisclosed	Madrassa An-Noor for the Blind Name: Mohamed Timol

Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327

					Address: Lot 3 Cedara Road, Pietermaritzburg, 3201 Tel: 033 343 3301 Email: admin@mnblind.org
Basic Assessment, Water Use License Application and ECO Monitoring for Midnite Café Reservoir and Pipeline **Location:** Craigieburn	August 2015	Current	R420 889	R50m	Royal Haskoning DHV & Ethekwini Municipality Name: Roxanne Mans Address: 19 Park Lane. Umhlanga, 4319 Tel: 083 776 0626 Email: Roxanne.mans@rhdhv.com
ECO Monitoring for construction of Brookside Taxi Holding Area **Location:** Pietermaritzburg	May 2014	Current	R28 000	R10m	Msunduzi Municipality: Dept. of Transportation Name: Khethiwe Mvelase Address: 333 Church Street, AS Chetty Building, Pietermaritzburg Tel: 073 593 1885 Email: khethiwe.mvelase@msunduzi.gov.za
Formulation of EMP for Rehabilitation of Pipeline Bridge. ECO Monitoring for Rehabilitation of Pipeline Bridge **Location:** Canelands, Verulam	May 2014	Current	R94 000	R10m	eThekwini Municipality & SMEC Name: Leisel Bowes Address: 3 Prior Road, Durban Central, 4001 Tel: 031 311 8656/ 082 395 8195 Email: leiselbowes@durban.gov
PREVIOUS PROJECTS					
Environmental Screening for Strip Mall in Newlands West Inanda Square Basic Assessment **Location:** Newlands West	June 2014	June 2015	R52 500	R6.5m	Arup & SMFT Properties Name: Nadheem Sheik Address: 167 Florida Road, Durban, 4001 Tel: 072 437 8299 Email: nsa@vodamail.co.za
Environmental Screening for two sites for waste management facilities **Location:** Merebank and Verulam	May 2014	July 2014	R2 500	R5m	We're Recyclling Pty (Ltd) Name: Riaz Vanker Address: Myrtle Road, Green Office Building, New Germany, 3600 Tel: 082 080 9764

Current & Previous Work Experience

Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327

					Email: vankersinternational@telkomsa.net
Environmental Screening for Warehousing. **Location:** Newlands West	May	2014	R2 500	R6m	Eminen Architects Name: Muhammed Naroth Address: 292 Grey Street, Durban, 4001 Tel: 078 573 9970 Email: muhammed@eminen.co.za
Halpin Avenue Muslim Cemetery – Environmental Screening **Location:** Halpin Avenue, Reservoir Hills	July 2014	August 2014	R5 000	R3m	PAR Quantity Surveyors Name: Rasheed Peer Address: 2 Chesham Pl, Westville, 3630 Tel: 082 876 5887 Email: arpqs@wol.co.za
Sewage Pipeline Basic Assessment, Public Participation and EMP Water Use License Application **Location:** Pietermaritzburg	August 2014	July 2016	R182 000	R10m	Msunduzi Municipality Water and Sanitation Name: Dhamendra Ragunanthan Address: 333 Church Street, AS Chetty Building, Pietermaritzburg Tel: 033 392 2115 Email: Dhamendra.Ragoonandan@msunduzi.gov.za
EMP for Fuel Retail License **Location:** Marian Hill	July 2014	August 2014	R30 000	R5m	Woodford Motors cc Name: Owaiys Soleman Address: 41 Woodford Grove, Berea, 4001 Tel: 083 577 8600 Email: owaiys@woodford.co.za
Application of Water Use License and coordination of Specialist Study for Rehabilitation of Pipeline Bridge **Location:** Canelands, Verulam	May 2014	April 2015	R25 000	R10m	eThekwini Municipality: Water & Sanitation Name: Leisel Bowes Address: 3 Prior Road, Durban Central, 4001 Tel: 031 311 8656/ 082 395 8195 Email: leiselbowes@durban.gov
Formulation of Vegetation Rehabilitation Plan for Pipeline Bridge. ECO Monitoring for Vegetation Rehabilitation **Location:** Umgeni	July 2014	October 2015	R47 000	R10m	eThekwini Municipality & SMEC Name: Leisel Bowes Address: 3 Prior Road, Durban Central, 4001 Tel: 031 311 8656/ 076 412 8575

Current & Previous Work Experience

Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327

					Email: leiselbowes@durban.gov
Environmental screening for seven sites earmarked for places of worship. **Location:** Kwadukuza	May 2014	July 2014	R17 000	R7m	Kwadukuza Municipality Name: Nokubonga Kunene Address: 14 Chief Albert Luthuli Street, KwaDukuza, 4450 Tel: 071 897 9366 Email: nokubongak@kwadukuza.gov.za
Application for Waste Management License and related Environmental Authorisation (Basic Assessment) for sewage, contaminated stormwater and food grease storage facilities within the Proposed Drag Race Track and Entertainment Complex. **Location:** Eddie Hagen Drive, Cato Ridge, Kwazulu Natal	February 2012	May 2013	R22 000	R5m	Pilson Developers cc Name: Rajan Pillay Address: 198 Saunders Circle, Tongaat, 4400 Tel: 084 440 0887 Email: ranap@sanlamsky.co.za
Environmental Authorisation (Basic Assessment) for a Proposed Drag Race Track and Entertainment Complex. **Location**: Eddie Hagen Drive, Cato Ridge, Kwazulu Natal	January 2011	March 2013	R35 000	R5m	Pilson Developers cc Name: Rajan Pillay Address: 198 Saunders Circle, Tongaat, 4400 Tel: 084 440 0887 Email: ranap@sanlamsky.co.za
Appeals Process (S24G) for Diesel Storage facilities. **Location:** Erf 104, Cliffdale, Kwazulu Natal	November 2012	December 2012	R10 000	R5m	Trans Africa Farms Name: Rishi Sookoo Address: 20 Montague Drive, Umhlanga Ridge, 4320 Tel: 082 418 6599 Email: transafrica@mweb.co.za
Retrospective Environmental Authorisation (Basic Assessment) for unlawful clearing of vegetation and for proposed hydroponic tunnel farm and associated warehousing and facilities. **Location:** Erf 104, Cliffdale, Kwazulu Natal	January 2010	March 2011	R30 000	R5m	Trans Africa Farms Name: Rishi Sookoo Address: 20 Montague Drive, Umhlanga Ridge, 4320 Tel: 082 418 6599 Email: transafrica@mweb.co.za

Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327

Appeals Process (S24G) for unlawful clearing of vegetation in a D'MOSS protected area. **Location**: Erf 104, Cliffdale, Kwazulu Natal	March 2011	November 2011	R10 000	R5m	Trans Africa Farms Name: Rishi Sookoo Address: 20 Montague Drive, Umhlanga Ridge, 4320 Tel: 082 418 6599 Email: transafrica@mweb.co.za

1world consultants
Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 3619

EAP Team:
EAP Declaration
Curriculum Vitae

edtea
Department :
Economic Development, Tourism and Environmental Affairs
PROVINCE OF KWAZULU-NATAL

DETAILS OF EAP AND DECLARATION OF INTEREST

	(For official use only)
EIA File Reference Number:	
NEAS Reference Number:	
Waste Management Licence Number: (if applicable)	
Date Received:	

Application for environmental authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Basic Assessment Report for the Proposed Inanda Glebe Sewer Reticulation

Environmental Assessment Practitioner (EAP):[1]	Fatima Peer – 1World Consultants (Pty) Ltd		
Contact person:	Fatima Peer		
Postal address:	P.O. Box 2311, Westville		
Postal code:	3630	Cell:	082 640 4900
Telephone:	031 262 8327	Fax:	086 726 3619
E-mail:	fatima@1wc.co.za		
Professional affiliation(s) (if any)	Professional Scientist with South African Council for Natural Scientific Professionals (SACNASP) and International Association for Impact Assessment (IAIAsa)		

Project Consultant:	1World Consultants (Pty) Ltd		
Contact person:	Roschel Maharaj		
Postal address:	P.O. Box 2311, Westville		
Postal code:	3630	Cell:	063 062 7725
Telephone:	031 262 8327	Fax:	086 726 3619
E-mail:	roschel@1wc.co.za		

4.2 The Environmental Assessment Practitioner

I, **Fatima Peer**, declare that –

General declaration:

- I will comply with the requirements for EAPs as stipulated in Regulation 13(1) of the EIA Regulations, 2014;
- I act as the independent environmental practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B(1) of the National Environmental Management Act, 1998 (Act 107 of 1998)

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;

Signature of the environmental assessment practitioner:

1World Consultants (Pty) Ltd

Name of company:

13 February 2018

Date:

PROJECT ROLE: SENIOR ENVIRONMENTAL ASSESSMENT PRACTITIONER

Name:	Fatima Peer	
Telephone:	031 262 8327	
Fax:	086 726 3619	
Email:	fatima@1wc.co.za	
Professional Registration:	SACNASP – Membership No.: 400287/11 IAIAsa – Membership No.: 3974	

Nationality at birth	South African				
Present nationality	South African				
Date of birth (day,month,year)	13/12/1976				
Place of birth	Durban				
sex	Male		Female	x	

EDUCATION AND TRAINING
(ADD SEPARATE ENTRIES FOR EACH RELEVANT COURSE YOU HAVE COMPLETED, STARTING WITH MOST RECENT)

Date (from – to)	January 1995 – December 2000
Name and type of organization providing education and training	UKZN - University
Principal subject/ occupational skills covered	Chemistry and Cell Biology Environmental Management Science, Photochemistry, Wood and Paper Milling, Computational Chemistry
Title of qualification awarded	Bachelor of Science in Chemistry (Hons)

WORK EXPERIENCE
(ADD SEPARATE ENTRIES FOR EACH RELEVANT POST OCCUPIED STARTING WITH THE MOST RECENT)

Date (from- to)	August 2010- Present
Name and address of employer	1World Consultants 181 Winchester Drive, Reservoir Hills, Durban, 4091
Type of business sector	Engineering and Environmental Consultants
Occupation or position held	Owner Senior Environmental Assessment Practitioner
Main activities and responsibilities	Facilitation of environmental authorisations from Department of Environmental Affairs, Public Participation of projects for authorisation processes Water Use License Applications Waste Management Applications and/or Plans Environmental Management Plans Environmental Control Officer Monitoring Appeals processes Environmental Screening Processes and general advice to clients

Date (from- to)	2008 – May 2010
Name and address of employer	PAR Quantity Surveyors
Type of business sector	Quantity Surveying
Occupation or position held	Environmental Consultant
Main activities and responsibilities	Environmental Screening Processes and general advice to clients

Date (from- to)	May 2002 - March 2004
Name and address of employer	Sasol Ltd Research and Development
Type of business sector	Coal Research and Development
Occupation or position held	Senior Scientist
Main activities and responsibilities	Research coal processes and investigate novel equipment and/or processes. Lead teams of research. Present at conferences.

Date (from- to)	June 2002- December 2003
Name and address of employer	Sasol Ltd Research and Development
Type of business sector	Coal Research and Development
Occupation or position held	Safety Representative for Coal & Syngas Research
Main activities and responsibilities	Ensure the Coal Processing Unit adhered to safety plans and protocols, by inspections and monitoring

Date (from- to)	January 2001- April 2002
Name and address of employer	Sasol Ltd Research and Development
Type of business sector	Coal Research and Development
Occupation or position held	Grade 01 Scientist
Main activities and responsibilities	Research coal processes and investigate novel equipment and/or processes.

Date (from- to)	1999-2001
Name and address of employer	University of Natal (Durban)
Type of business sector	Academic
Occupation or position held	First Year Chemistry Laboratory Demonstrator
Main activities and responsibilities	Coach students on lab protocols Assess students on research done in laboratories

Date (from- to)	December 1998
Name and address of employer	Sasol Technology (Process Water)
Type of business sector	Research
Occupation or position held	Vacation Student
Main activities and responsibilities	Investigate used process water and attempt to mitigate it by researching novel ways to reduce the volumes released into rivers.

PERSONAL SKILLS AND COMPETENCES

(ACQUIRED IN THE COURSE OF LIFE AND CAREER BUT NOT NECESSARILY COVERED BY FORMAL CERTIFICATES AND DIPLOMA)

MOTHER TONGUE	ENGLISH
OTHER LANGUAGES	AFRIKAANS (BASIC) ZULU (BASIC)

(specify Language)	English	Afrikaans	Zulu
Reading skills	Perfect	Good	Poor
Writing skills	Perfect	Good	Poor
Verbal skills	Perfect	Good	Fair

DRIVING LICENSE(S)	Code 8

ADDITIONAL INFORMATION	**SACNASP** Member **IAIAsa** Member **Environmental Law Course** **Environmental Impact Assessment : Theory and Practice (**by Vicki King of Metamorphosis Environmental Consultants) **Roles and Responsibilities of an ECO** (by IAIAsa- International Association for Impact Assessment South Africa) **Spatial Planning and Land Use Management Act (SPLUMA)** **(**by IAIAsa- International Association for Impact Assessment South Africa)

BRIEF PROJECT HISTORY: (SELECTED PROJECTS)	**CATO RIDGE RACETRACK & ENTERTAINMENT COMPLEX** ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED DEVELOPMENT OF A DRAG RACE TRACK, WITH RECREATIONAL AND ENTERTAINMENT FACILITIES IN CATO RIDGE, KWAZULU-NATAL. • BASIC ASSESSMENT • WASTE MANAGEMENT LICENSE • ENVIRONMENTAL MANAGEMENT PLAN • PUBLIC PARTICIPATION PROCESS
	CLIFFDALE HYDROPONIC FARM & ASSOCIATED WAREHOUSING ENVIRONMENTAL CONSULTING SERVICES FOR THE DEVELOPMENT OF A HYDROPONIC FARM AND RELATED WAREHOUSING FACILITIES, IN CLIFFDALE, OUTER WEST DURBAN, KWAZULU-NATAL. • BASIC ASSESSMENT • ENVIRONMENTAL MANAGEMENT PLAN • PUBLIC PARTICIPATION PROCESS • APPEALS PROCESS
	REHABILITATION OF A PIPELINE BRIDGE ENVIRONMENTAL CONSULTING SERVICES FOR THE REHABILITATION OF A PIPELINE BRIDGE, FOR ETHEKWINI MUNICIPALITY, DEPARTMENT OF WATER & SANITATION, IN VERULAM, DURBAN, KWAZULU- NATAL. • ENVIRONMENTAL MANAGEMENT PLAN • WATER USE LICENSE • ECO MONITORING • ENVIRONMENTAL TRAINING
	SEWAGE RETICULATION SYSTEM ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED SEWAGE RETICULATION SYSTEM, FOR THE MSUNDUZI MUNICIPALITY, DEPARTMENT OF WATER & SANITATION, IN WARD 20 EDENDALE, PIETERMARITZBURG. • BASIC ASSESSMENT • WATER USE LICENSE • PUBLIC PARTICIPATION • HERITAGE IMPACT ASSESSMENT
	UMGENI VEGETATION REHABILITATION ENVIRONMENTAL CONSULTING SERVICES FOR VEGETATION REHABILITATION PLAN FOR A PIPELINE BRIDGE, IN UMGENI. • VEGETATION REHABILITATION PLAN • ECO MONITORING
	ALVERSTONE WATER PIPELINE PROJECT ENVIRONMENTAL CONSULTING SERVICES FOR A PROPOSED WATER PIPELINE FOR THE ETHEKWINI WATER & SANITATION, IN ALVERSTONE, HILLCREST, KWAZULU-NATAL. • BASIC ASSESSMENT • ECO MONITORING • WATER USE LICENSE • ECO MONITORING • ENVIRONMENTAL TRAINING
	BUFFELSDRAAI REFORESTATION HUB ENVIRONMENTAL CONSULTING SERVICES FOR A BUILDING UPGRADE PROJECT AT THE BUFFELSDRAAI LANDFILL SITE, BUFFER ZONE (COMMUNITY REFORESTATION PROJECT), BUFFELSDRAAI, VERULAM, DURBAN, KWAZULU-NATAL. • ECO MONITORING • ENVIRONMENTAL TRAINING
	FELIX DLAMINI PETROL FILLING STATION AND CONVENIENCE STORE ENVIRONMENTAL CONSULTING SERVICES FOR THE CONSTRUCTION OF A FILLING STATION AND CONVENIENCE STORE LOCATED IN OVERPORT, DURBAN, KWAZULU-NATAL. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • ENVIRONMENTAL AUTHORISATIONS
	UMGENI BULK WATER SUPPLY ENVIRONMENTAL CONSULTING SERVICES FOR UMGENI WATER BULK WATER PIPELINE PROJECT, FROM WARTBURG TO BRYUNSHILL AND SOUTH COAST. • ECO MONITORING • ENVIRONMENTAL TRAINING • PROJECT ENVIRONMENTAL EXPERT

	DONNELLY ROAD SOCIAL HOUSING PROJECT ENVIRONMENTAL CONSULTING SERVICES FOR THE CONSTRUCTION OF SOCIAL HOUSING, IN WENTWORTH, DURBAN, KWAZULU-NATAL, FOR THE DEPARTMENT OF HUMAN SETTLEMENTS & INFRASTRUCTURE: SOCIAL HOUSING UNIT. • VEGETATION ASSESSMENT • ENVIRONMENTAL MANAGEMENT PLAN • ECO MONITORING • ENVIRONMENTAL TRAINING

THE SOUTH AFRICAN COUNCIL FOR NATURAL SCIENTIFIC PROFESSIONS

herewith certifies that

Fatima Peer
Registration number: 400287/11

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice
(Schedule I of the Act)

Chemical Science	**31 August 2011**

31 August 2011
Pretoria

President

Chief Executive Officer

University of Natal

We, the Vice-Chancellor, the Registrar,
and the Dean of the Faculty,
hereby certify
that

Fatima Peer

has this day been admitted to
the degree of

Bachelor of Science Honours (Chemistry)

Vice-Chancellor

Registrar

Dean

20 April 2001

UV PROTECTED – TAMPER EVIDENT UV

IAIAsa Secretariat
Tel +27(0)11 655 7183
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Address:
43 Birchwood Court, Montrose Street, Vorna Valley, Midrand, 1618
Postal address:
PO Box 11666, Vorna Valley, 1686
Email: operations@iaiasa.co.za
Website: www.iaiasa.co.za

IAIAsa Confirmation of Membership: 2017/2018
Fatima Peer Membership Number: 3974

13 September 2017

TO WHOM IT MAY CONCERN

Ms Fatima Peer, 1 World Consultants (IAIAsa membership Number 3974) is a paid-up full member in good standing of the South African Affiliate of the International Association for Impact Assessment and has been a member of IAIAsa since 31 March 2015.
Memebership has been continous from 31 March 2015 to date.

This membership is valid from 1 July 2017 to 30 June 2018.

IAIAsa is a voluntary organisation and is not a statutory body regulating the profession. Its members are however expected to abide by the organisation's code of ethics which is available on our website.

Any enquiries regarding this membership may be directed to the Secretariat at the above contact details.

Yours Sincerely

Robyn Luyt
IAIAsa President 2017/2018

PROJECT ROLE: ENVIRONMENTAL ASSESSMENT PRACTITIONER & WULA OFFICER

Name & Surname:	Adila Sheik Gafoor	
Telephone:	+2782 524 3367	
Email:	adila@1wc.co.za	
Professional Registration:	IAIAsa (membership no.: 5238)	

Nationally at birth	South African				
Present nationality	South African				
Date of birth (day,month,year)	01/10/1990				
Place of birth	Durban				
Sex	Male		Female	x	

WORK EXPERIENCE
(ADD SEPARATE ENTRIES FOR EACH RELEVANT POST OCCUPIED STARTING WITH THE MOST RECENT)

Date (from- to)	October 2014- Present
Name and address of employer	1World Consultants
Type of business sector	Engineering and Environmental Consultants
Occupation or position held	Environmental Assessment Practitioner, WULA Officer & Executive PA
Main activities and responsibilities	Project Manager Environmental Compliance Monitoring/Environmental Inspector/Environmental Officer GIS Water Use License Application Officer Basic Assessment Reports Environmental Impact Assessments Screening Public Participation Specialist Co-ordination Office Administrator Tender administrator Data capturing Report writing Minute taking

Date (from- to)	September 2013- September 2014
Name and address of employer	Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH- South African- German Energy Programme (SAGEN)
Type of business sector	Renewable Energy, Energy Efficiency and Climate Change
Occupation or position held	Intern
Main activities and responsibilities	Data capture GIS Digitizing Training of Staff from various municipalities on energy efficient household surveys Field work Report Writing

Date (from- to)	August 2009 – January 2010
Name and address of employer	Umoya-Nilu Consulting
Type of business sector	Air Quality Consulting
Occupation or position held	Intern
Main activities and responsibilities	Administration Database Registration

EDUCATION AND TRAINING

(ADD SEPARATE ENTRIES FOR EACH RELEVANT COURSE YOU HAVE COMPLETED, STARTING WITH MOST RECENT)

TERTIARY LEVEL EDUCATION	
Date (from – to)	February 2010 – June 2013
Name and type of organization providing education and training	UKZN – University of KwaZulu Natal
Principal subject/ occupational skills covered	Geography and Environmental Management Geographic Information Systems Political Ecology Political Science
Title of qualification awarded	BSc/B.Soc.Sci Geography and Environmental Management Science
Level in national classification (if appropriate)	NQF 6

SECONDARY LEVEL EDUCATION	
Date (from – to)	January 2004 – November 2008
Name and type of organization providing education and training	Dr. A.D Lazarus Secondary School
Principal subject/ occupational skills covered	Maths Accounting History Biology Afrikaans English Life Orientation
Title of qualification awarded	Bachelors Pass/Admission to Bachelor's Degree Distinctions in: History Biology English Life Orientation

PERSONAL SKILLS AND COMPETENCES

(ACQUIRED IN THE COURSE OF LIFE AND CAREER BUT NOT NECESSARILY COVERED BY FORMAL CERTIFICATES AND DIPLOMAS)

MOTHER TONGUE	ENGLISH

OTHER LANGUAGES	AFRIKAANS (BASIC) ZULU (BASIC)

(SPECIFY LANGUAGE)	ENGLISH	AFRIKAANS	ZULU
READING SKILLS	PERFECT	GOOD	POOR
WRITING SKILLS	PERFECT	GOOD	POOR
VERBAL SKILLS	PERFECT	GOOD	FAIR

DRIVING LICENSE(S)	CODE 8

ADDITIONAL INFORMATION	**PROFESSIONAL BUSINESS WRITING** **ENVIRONMENTAL IMPACT ASSESSMENT: THEORY AND PRACTICE** (BY VICKI KING OF METAMORPHOSIS ENVIRONMENTAL CONSULTANTS) **ROLES AND RESPONSIBILITIES OF AN ECO** (BY IAIASA- INTERNATIONAL ASSOCIATION FOR IMPACT ASSESSMENT SOUTH AFRICA) **SPATIAL PLANNING AND LAND USE MANAGEMENT ACT (SPLUMA)** (BY IAIASA- INTERNATIONAL ASSOCIATION FOR IMPACT ASSESSMENT SOUTH AFRICA)

BRIEF PROJECT HISTORY: (SELECTED PROJECTS)	**SEWAGE RETICULATION SYSTEM** ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED SEWAGE RETICULATION SYSTEM, FOR THE MSUNDUZI MUNICIPALITY, DEPARTMENT OF WATER & SANITATION, IN WARD 20 EDENDALE, PIETERMARITZBURG. • BASIC ASSESSMENT • WATER USE LICENSE • PUBLIC PARTICIPATION • HERITAGE IMPACT ASSESSMENT
	FELIX DLAMINI PETROL FILLING STATION AND CONVENIENCE STORE ENVIRONMENTAL CONSULTING SERVICES FOR THE CONSTRUCTION OF A FILLING STATION AND CONVENIENCE STORE LOCATED IN OVERPORT, DURBAN, KWAZULU-NATAL. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • ENVIRONMENTAL AUTHORISATIONS
	ALVERSTONE WATER PIPELINE PROJECT ENVIRONMENTAL CONSULTING SERVICES FOR A PROPOSED WATER PIPELINE FOR THE ETHEKWINI WATER & SANITATION, IN ALVERSTONE, HILLCREST, KWAZULU-NATAL. • BASIC ASSESSMENT • WATER USE LICENSE • PUBLIC PARTICIPATION

	MAPHEPHETHENI WATER TREATMENT WORKS ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED WATER TREATMENT WORKS PROJECT, WHICH WILL INCLUDE THE INSTALLATION OF A WATER PIPELINE AND THE CONSTRUCTION OF RESERVOIRS AND PUMP STATIONS FOR THE DEPARTMENT OF WATER & SANITATION, IN MAPHEPHETHENI, INANDA, KWAZULU-NATAL. • BASIC ASSESSMENT • WATER USE LICENSE • PUBLIC PARTICIPATION
	BURBREEZE WATER PIPELINE AND ASSOCIATED INFRASTRUCTURE ENVIRONMENTAL CONSULTING SERVICES FOR A WATER PIPELINE, RESERVOIR AND PUMP STATION FOR ETHEKWINI WATER & SANITATION, IN TONGAAT, KWAZULU-NATAL. • BASIC ASSESSMENT • WATER USE LICENSE • PUBLIC PARTICIPATION
	BUFFELSDRAAI REFORESTATION HUB ENVIRONMENTAL CONSULTING SERVICES FOR A BUILDING UPGRADE PROJECT AT THE BUFFELSDRAAI LANDFILL SITE, BUFFER ZONE (COMMUNITY REFORESTATION PROJECT), BUFFELSDRAAI, VERULAM, DURBAN, KWAZULU-NATAL. • ECO MONITORING • ENVIRONMENTAL TRAINING
	UMGENI BULK WATER SUPPLY ENVIRONMENTAL CONSULTING SERVICES FOR UMGENI WATER BULK WATER PIPELINE PROJECT, FROM WARTBURG TO BRYUNSHILL AND SOUTH COAST. • ECO MONITORING • ENVIRONMENTAL TRAINING
	DONNELLY ROAD SOCIAL HOUSING PROJECT ENVIRONMENTAL CONSULTING SERVICES FOR THE CONSTRUCTION OF SOCIAL HOUSING, IN WENTWORTH, DURBAN, KWAZULU-NATAL, FOR THE DEPARTMENT OF HUMAN SETTLEMENTS & INFRASTRUCTURE: SOCIAL HOUSING UNIT. • ECO MONITORING • VEGETATION ASSESSMENT • ENVIRONMENTAL MANAGEMENT PLAN

UNIVERSITY OF KWAZULU-NATAL™

INYUVESI YAKWAZULU-NATALI

This is to certify that

Adila Sheik Gafoor

was admitted this day
at a congregation of the University
to the degree of

Bachelor of Social Science

(Geography and Environmental Management)

having satisfied the conditions prescribed for the degree.

M W Makgoba
Vice-Chancellor

MC Baloyi
Registrar

SM Mutula
Acting Dean

7 April 2014

IAIAsa Secretariat
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Fax 086 662 9849
Address:
43 Birchwood Court, Montrose Street, Vorna Valley, Midrand, 1618
Postal address:
PO Box 11666, Vorna Valley, 1686
Email: operations@iaiasa.co.za
Website: www.iaiasa.co.za

IAIAsa Confirmation of Membership: 2017/2018
Adila Gafoor Membership Number: 5238

13 September 2017

TO WHOM IT MAY CONCERN

Ms Adila Gafoor, 1 World Consultants (IAIAsa membership Number 5238) is a paid-up full member in good standing of the South African Affiliate of the International Association for Impact Assessment and has been a member of IAIAsa since 1 July 2016.

This membership is valid from 1 July 2017 to 30 June 2018.

IAIAsa is a voluntary organisation and is not a statutory body regulating the profession. Its members are however expected to abide by the organisation's code of ethics which is available on our website.

Any enquiries regarding this membership may be directed to the Secretariat at the above contact details.

Yours Sincerely

Robyn Luyt
IAIAsa President 2017/2018

CURRICULUM VITAE OF BRYAN WALTER PAUL

Name:	Bryan Walter Paul	
Telephone:	031 262 8327	
Fax:	086 726 3619	
Email:	bryan@1wc.co.za	
Professional Registration:	IAIAsa - Membership No.: 5239	

Nationally at birth	South African					
Present nationality	South African					
Date of birth (day, month, year)	23/04/1991					
Place of birth	Durban					
sex	Male	x	Female			

WORK EXPERIENCE
(ADD SEPARATE ENTRIES FOR EACH RELEVANT POST OCCUPIED STARTING WITH THE MOST RECENT)

Date (from- to)	December 2015- Present
Name and address of employer	1World Consultants 181 Winchester Drive, Reservoir Hills, Durban, 4091
Type of business sector	Engineering and Environmental Consultants
Occupation or position held	Field Services Officer
Main activities and responsibilities	Environmental Compliance Monitoring Biodiversity Surveying and Reporting Vegetation Surveying and Reporting Basic Assessments (BA) Public Participation Process (PPP) and Stakeholder Liaison Officer

Date (from- to)	January 2012 – November 2015
Name and address of employer	Umgeni River Bird Park
Type of business sector	Zoological Conservation and Research
Occupation or position held	Department Manager
Main activities and responsibilities	Design and Implementation of Health and Safety Protocols Waste Management – Recycling green waste, hazardous waste management, design and implementation of waste management programs and protocols. Internal Compliance Monitoring of policy and protocols Performing Avi-faunal Medicals/Sampling – Faucal assessments Human Resource Management Environmental Training and Education Basic Invoicing and Accounting Alien Invasive Plant Removal and Management Indigenous Landscaping

Date (from- to)	January 2011 – December 2011
Name and address of employer	Babanango Valley Environmental Adventures
Type of business sector	Environmental Education/Hospitality
Occupation or position held	Camp Leader/Facilitator
Main activities and responsibilities	Environmental education and training Logistical Planning Basic Invoicing and account Resource Management
Working Experience to Date	7 Years

EDUCATION AND TRAINING
(ADD SEPARATE ENTRIES FOR EACH RELEVANT COURSE YOU HAVE COMPLETED, STARTING WITH MOST RECENT)

Date (from – to)	January 2010 – December 2014
Name and type of organization providing education and training	UNISA – University of South Africa
Principal subject/ occupational skills covered	Environmental Science
Title of qualification awarded	BSc Botany and Zoology with a Geography stream
Level in national classification (if appropriate)	NQF Level 7

Date (from – to)	January 2015 – June 2017
Name and type of organization providing education and training	UNISA – University of South Africa
Principal subject/ occupational skills covered	Environmental Management
Title of qualification awarded	BSc Honors Environmental Management
Level in national classification (if appropriate)	NQF Level 8

PERSONAL SKILLS AND COMPETENCES
(ACQUIRED IN THE COURSE OF LIFE AND CAREER BUT NOT NECESSARILY COVERED BY FORMAL CERTIFICATES AND DIPLOMAS)

MOTHER TONGUE	ENGLISH

OTHER LANGUAGES	AFRIKAANS (BASIC) ZULU (BASIC)

(SPECIFY LANGUAGE)	**ENGLISH**	**AFRIKAANS**	**ZULU**
READING SKILLS	PERFECT	FAIR	POOR
WRITING SKILLS	PERFECT	FAIR	POOR
VERBAL SKILLS	PERFECT	FAIR	FAIR

DRIVING LICENSE(S)	CODE 8

ADDITIONAL INFORMATION	SPATIAL PLANNING AND LAND USE MANAGEMENT ACT (SPLUMA) (BY IAIASA- INTERNATIONAL ASSOCIATION FOR IMPACT ASSESSMENT SOUTH AFRICA)

BRIEF PROJECT HISTORY: (SELECTED PROJECTS)	
	ALVERSTONE WATER PIPELINE PROJECT ENVIRONMENTAL CONSULTING SERVICES FOR A PROPOSED WATER PIPELINE FOR THE ETHEKWINI WATER & SANITATION, IN ALVERSTONE, HILLCREST, KWAZULU-NATAL. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • VEGETATION ASSESSMENT
	MAPHEPHETHENI WATER TREATMENT WORKS ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED WATER TREATMENT WORKS PROJECT, WHICH WILL INCLUDE THE INSTALLATION OF A WATER PIPELINE AND THE CONSTRUCTION OF RESERVOIRS AND PUMP STATIONS FOR THE DEPARTMENT OF WATER & SANITATION, IN MAPHEPHETHENI, INANDA, KWAZULU-NATAL. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • BIODIVERSITY ASSESSMENT
	BURBREEZE WATER PIPELINE AND ASSOCIATED INFRASTRUCTURE ENVIRONMENTAL CONSULTING SERVICES FOR A WATER PIPELINE, RESERVOIR AND PUMP STATION FOR ETHEKWINI WATER & SANITATION, IN TONGAAT, KWAZULU-NATAL. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • VEGETATION ASSESSMENT
	UMGENI BULK WATER SUPPLY ENVIRONMENTAL CONSULTING SERVICES FOR UMGENI WATER BULK WATER PIPELINE PROJECT, FROM WARTBURG TO BRUYNSHILL AND SOUTH COAST. • ECO MONITORING AND VEGETATION ASSESSMENT • ENVIRONMENTAL TRAINING
	BUFFELSDRAAI REFORESTATION HUB ENVIRONMENTAL CONSULTING SERVICES FOR A BUILDING UPGRADE PROJECT AT THE BUFFELSDRAAI LANDFILL SITE, BUFFER ZONE (COMMUNITY REFORESTATION PROJECT), BUFFELSDRAAI, VERULAM, DURBAN, KWAZULU-NATAL. ECO MONITORING • ENVIRONMENTAL TRAINING
	DONNELLY ROAD SOCIAL HOUSING PROJECT ENVIRONMENTAL CONSULTING SERVICES FOR THE CONSTRUCTION OF SOCIAL HOUSING, IN WENTWORTH, DURBAN, KWAZULU-NATAL, FOR THE DEPARTMENT OF HUMAN SETTLEMENTS & INFRASTRUCTURE: SOCIAL HOUSING UNIT. • ECO MONITORING • VEGETATION ASSESSMENT • ENVIRONMENTAL MANAGEMENT PLAN
	MADRASSA AN-NOOR FOR THE BLIND FACILITY ENVIRONMENTAL CONSULTING SERVICES FOR THE CONSTRUCTION PHASE OF A MADRASSA FOR THE VISUALLY IMPAIRED IN CEDARA, PIETERMARITZBURG. • BASIC ASSESSMENT • ECO MONITORING • VEGETATION ASSESSMENT
	REFURBISHMENT AND EXPANSION OF A MULTISTORY RESIDENTIAL BLOCK SITUATED AT 50 LAGOON DRIVE ENVIRONMENTAL CONSULTING SERVICES FOR THE REFURBISHMENT AND EXPANSION OF FLEETSIDE-ON-SEA, UMHLANGA ROCKS, DURBAN. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • VEGETATION ASSESSMENT

UNISA

UNIVERSITY OF SOUTH AFRICA

We certify that

BRYAN WALTER PAUL

having complied with the requirements of the Higher Education Act and the Institutional Statute, was admitted to the degree of

BACHELOR OF SCIENCE HONOURS

in Environmental Management

at a congregation of the University on 2 June 2017

Vice Chancellor

University Registrar

Executive Dean

19810246320202G05481

UN5752581SA

IAIAsa Secretariat
Tel +27(0)11 655 7183
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Postal address:
PO Box 11666, Vorna Valley, 1686
Email: operations@iaiasa.co.za
Website: www.iaiasa.co.za

IAIAsa Confirmation of Membership: 2017/2018
Bryan Paul Membership Number: 5239

13 September 2017

TO WHOM IT MAY CONCERN

Mr Bryan Paul, 1 World Consultants (IAIAsa membership Number 5239) is a paid-up full member in good standing of the South African Affiliate of the International Association for Impact Assessment and has been a member of IAIAsa since 1 July 2016.

This membership is valid from 1 July 2017 to 30 June 2018.

IAIAsa is a voluntary organisation and is not a statutory body regulating the profession. Its members are however expected to abide by the organisation's code of ethics which is available on our website.

Any enquiries regarding this membership may be directed to the Secretariat at the above contact details.

Yours Sincerely

Robyn Luyt
IAIAsa President 2017/2018

PROJECT ROLE: ENVIRONMENTAL ASSESSMENT PRACTITIONER & ECO

Name & Surname:	Roschel Maharaj	
Telephone:	+2763 062 7725	
Email:	roschel@1wc.co.za	
Professional Registration:	IAIAsa (membership no.: 5390)	

Nationally at birth	South African				
Present nationality	South African				
Date of birth (day,month,year)	04/06/1992				
Place of birth	Durban				
Sex	Male		Female	x	

EDUCATION AND TRAINING
(ADD SEPARATE ENTRIES FOR EACH RELEVANT COURSE YOU HAVE COMPLETED, STARTING WITH MOST RECENT)

TERTIARY LEVEL EDUCATION	
Date (from – to)	February 2011– November 2014
Name and type of organization providing education and training	UKZN – University of KwaZulu Natal
Principal subject/ occupational skills covered	Geography Environmental Science Geographic Information Systems
Title of qualification awarded	BSc Geography and Environmental Science
Level in national classification (if appropriate)	NQF 7

WORK EXPERIENCE
(ADD SEPARATE ENTRIES FOR EACH RELEVANT POST OCCUPIED STARTING WITH THE MOST RECENT)

Date (from- to)	01 November 2016 - Current
Name of employer	1World Consultants (Pty) Ltd
Type of business sector	Environmental and Engineering Consultants
Occupation or position held	Environmental Consultant
Main activities and responsibilities	- Drafting Basic Assessment Reports, Scoping and EIA'S - Drafting Water Use License Applications and Technical Reports - Compliance & Monitoring (ECO Duties) - Environmental Audits - Drafting EMP'S - Lodging Applications with Government Authorities - Public Participation Facilitator
Date (from- to)	16 March 2015 – 30 October 2016
Name of employer	HANSLAB (Pty) Ltd
Type of business sector	Environmental and Ground Engineering Specialist
Occupation or position held	Environmental Consultant

Main activities and responsibilities	Drafting Basic Assessment Reports, Scoping and EIA'S - Drafting Water Use License Applications and Technical Reports - Compliance & Monitoring (ECO Duties) - Environmental Audits - Drafting EMP'S - Lodging Applications with Government Authorities - Public Participation Facilitator

Date (from- to)	13 June 2013 – 27 June 2013
Name of employer	Royal Haskoning DHV
Type of business sector	Consulting
Occupation or position held	Intern
Main activities and responsibilities	Assist mentor in all aspects of work

PERSONAL SKILLS AND COMPETENCES

(ACQUIRED IN THE COURSE OF LIFE AND CAREER BUT NOT NECESSARILY COVERED BY FORMAL CERTIFICATES AND DIPLOMAS)

MOTHER TONGUE	ENGLISH

OTHER LANGUAGES	AFRIKAANS (BASIC) ZULU (BASIC)

(SPECIFY LANGUAGE)	ENGLISH	AFRIKAANS	ZULU
READING SKILLS	PERFECT	GOOD	POOR
WRITING SKILLS	PERFECT	GOOD	POOR
VERBAL SKILLS	PERFECT	GOOD	FAIR

DRIVING LICENSE(S)	CODE 8

BRIEF PROJECT HISTORY: (SELECTED PROJECTS)	**EXTENSION AND REFURBISHMENT OF A MULTI-STORY RESIDENTIAL BLOCK** ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED REFURBISHMENT AND EXPANSION OF A MULTI-STORY RESIDENTIAL BLOCK SITUATED AT 50 LAGOON DRIVE, LOCATED WITHIN THE ETHEKWINI MUNICIPALITY. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • EVIRONMENTAL AUTHORISATIONS
	DEMOLISHING AND REBUILD OF A RESIDENTIAL DWELLING ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED DEMOLISHING AND RE-BUILD OF A RESIDENTIAL DWELLING SITUATED AT 18 EASTMOOR CRESCENT, LA LUCIA WITHIN THE ETHEKWINI MUNICIPALITY. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • ENVIRONMENTAL AUTHORISATIONS
	MADRASSA AN-NOOR FOR THE BLIND ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED EXPANSIONS TO THE MADRASSA AN-NOOR FOR THE BLIND ON ERF2 AND 3, CEDARA ROAD, UMNGENI MUNICIPALITY. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • ENVIRONMENTAL AUTHORISATIONS
	SEWER RETICULATION PROJECT ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED CONSTRUCTION OF THE INANDA GLEBE SEWER RETICULATION WITHIN THE ETHEKWINI MUNICIPALITY. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • ENVIRONMENTAL AUTHORISATIONS
	KWA JUSTICE FOODS AGRI-PROJECT ENVIRONMENTAL CONSULTING SERVICES FOR THE PROPOSED CONSTRUCTION OF THE NONOTI ABATTOIR WITHIN THE ILEMBE DISTRICT. • BASIC ASSESSMENT • PUBLIC PARTICIPATION • ENVIRONMENTAL AUTHORISATIONS

UNIVERSITY OF KWAZULU-NATAL™

INYUVESI YAKWAZULU-NATALI

This is to certify that

Roschel Maharaj

was admitted this day
at a congregation of the University
to the degree of

Bachelor of Science

having satisfied the conditions prescribed for the degree.

A S van Jaarsveld
Vice-Chancellor

B Poo
Acting Registrar

A Modi
Dean

15 April 2015

UV PROTECTED

IAIAsa Secretariat
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Postal address:
PO Box 11666, Vorna Valley, 1686
Email: operations@iaiasa.co.za
Website: www.iaiasa.co.za

IAIAsa Confirmation of Membership: 2017/2018
Roschel Maharaj Membership Number: 5390

13 September 2017

TO WHOM IT MAY CONCERN

Miss Roschel Maharaj, 1World Consultants (Pty) Ltd (IAIAsa membership Number 5390) is a paid-up full member in good standing of the South African Affiliate of the International Association for Impact Assessment and has been a member of IAIAsa from 29 November 2016.

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Any enquiries regarding this membership may be directed to the Secretariat at the above contact details.

Yours Sincerely

Robyn Luyt
IAIAsa President 2017/2018

Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 3619

Specialist Declaration

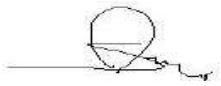
Project Assessment Details & Declaration of Independence

This report has been prepared as per the requirements stipulated in Appendix 6 (1) of the National Environmental Management Act, 1998 (Act 107 of 1998) Environmental Impact Assessment Regulations, 2014.

We the undersigned hereby declare that we act as independent specialist consultants in the field of wetland and riparian ecology.

Report prepared by:	Suheil Hoosen Malek (BSc. Hons) & Dr S. Pillay *(Pr. Sci. Nat.)*
Internal reviewer:	Dr S. Pillay *(Pr. Sci. Nat.)*
Approved by:	Dr S. Pillay *(Pr. Sci. Nat.)*
Date:	12 June 2017
Client:	1World Consultants (Pty) Ltd

I, the undersigned hereby declare that we act as independent specialist consultants in the field of wetland and riparian ecology.



Dr Srinivasan Pillay *(Pr.Sci.Nat.)*

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Inanda Glebe Sewer Reticulation Project, eThekwini Municipality, KwaZulu-Natal – Heritage Impact Assessment.

Specialist:	JLB Consulting		
Contact person:	Jean Beater		
Postal address:	P.O. Box 653, Umhlanga Rocks		
Postal code:	4320	Cell:	084 404 1118
Telephone:		Fax:	
E-mail:	Jean.beater@gmail.com		
Professional affiliation(s) (if any)	ASAPA; IAIAsa		

Project Consultant:	1World Consultants (Pty) Ltd		
Contact person:	Roschel Maharaj		
Postal address:	P.O Box 2311, Westville		
Postal code:	3630	Cell:	063 062 7725
Telephone:	031 262 8327	Fax:	086 726 3619
E-mail:	roschel@1wc.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Jean Lois Beater , declare that --

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

JLB Consulting

Name of company (if applicable):

02-06-2017

Date:

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Biodiversity Assessment and Report - The Proposed Inanda Glebe Sewer Reticulation Project, Inanda, KwaZulu-Natal

Specialist:	1World Consultants (Pty) Ltd		
Contact person:	Bryan Walter Paul		
Postal address:	P.O. Box 2311, Westville		
Postal code:	3630	Cell:	072 528 5956
Telephone:	031 262 8327	Fax:	086 726 3619
E-mail:	Bryan@1wc.co.za		
Professional affiliation(s) (if any)	IAIAsa		

Project Consultant:	1World Consultants (Pty) Ltd		
Contact person:	Roschel Maharaj		
Postal address:	P.O Box 2311, Westville		
Postal code:	3630	Cell:	063 062 7725
Telephone:	031 262 8327	Fax:	086 726 3619
E-mail:	roschel@1wc.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, **Bryan W. Paul**, declare that

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

1World Consultants (Pty) Ltd

Name of company (if applicable):

06 June 2017

Date:

Document Control

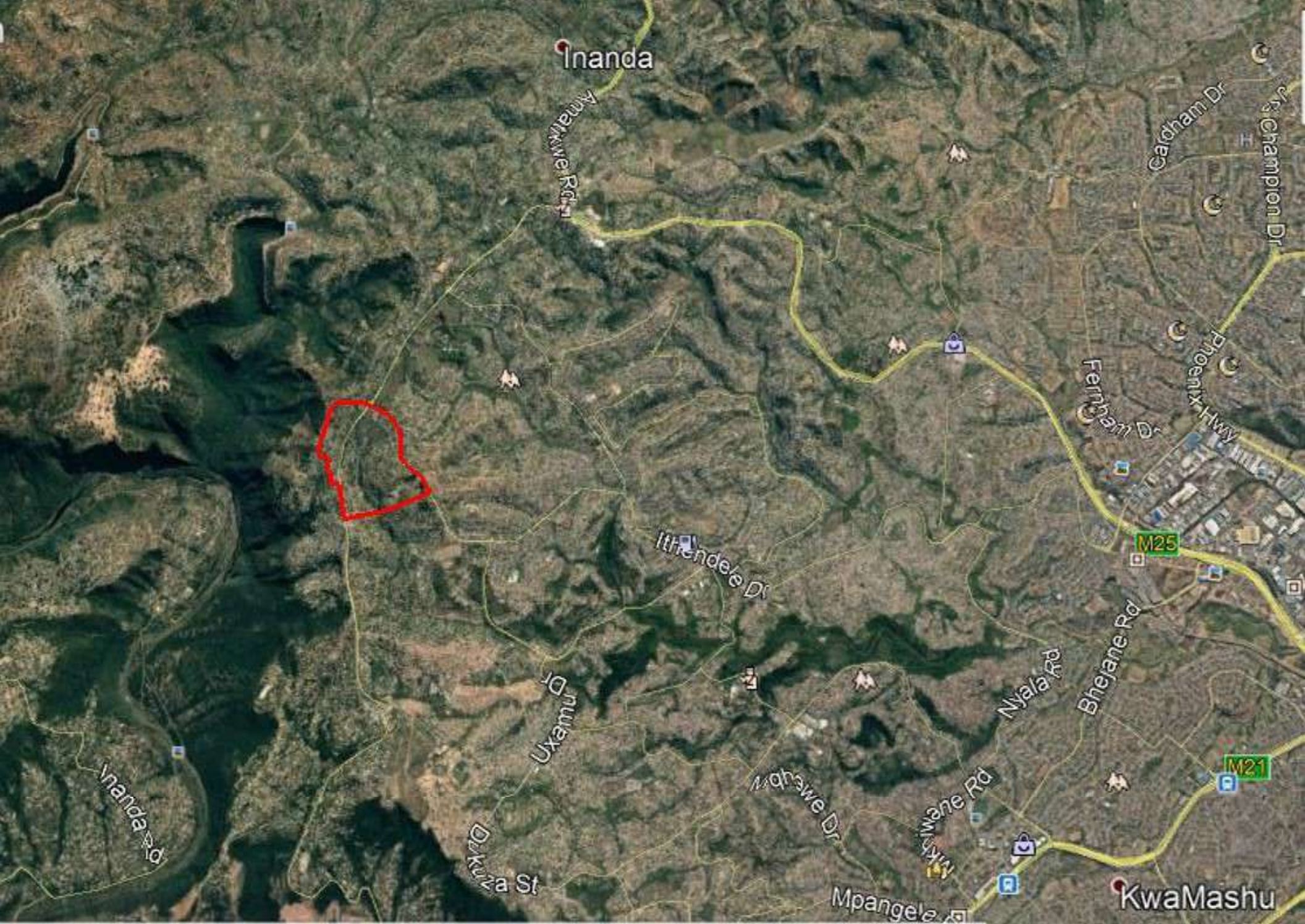
Report Title		Geotechnical investigation for the construction of a Sewer Reticulation at Inanda Glebe		
Report Reference		32010	**Responsible Person**	M. Hadlow
Client Name		Ethekwini Municipality Water and Sanitation	**Client Contact Details**	3 Prior Road, Durban, 4001
Revision	**Date**		**Current Revision**	
Approval				
Author's Signature			**Reviewer's Signature**	
Name		K. Ridgeway	**Name**	M. Hadlow
Title		Eng. Geol.	**Title**	Director (Pr.Sci.Nat.)
Author's Signature				
Name		A. Joubert		
Title		Eng. Geol (Pr.Sci.Nat)		

The ground conditions described in this report refer specifically to those encountered in the hand dug inspection pits (extended by hand drilled auger where possible) and penetrometer tests carried out across the various portions of the proposed development site. It is therefore quite possible that conditions at variance with those at the above mentioned testing positions could be encountered elsewhere on site during construction.

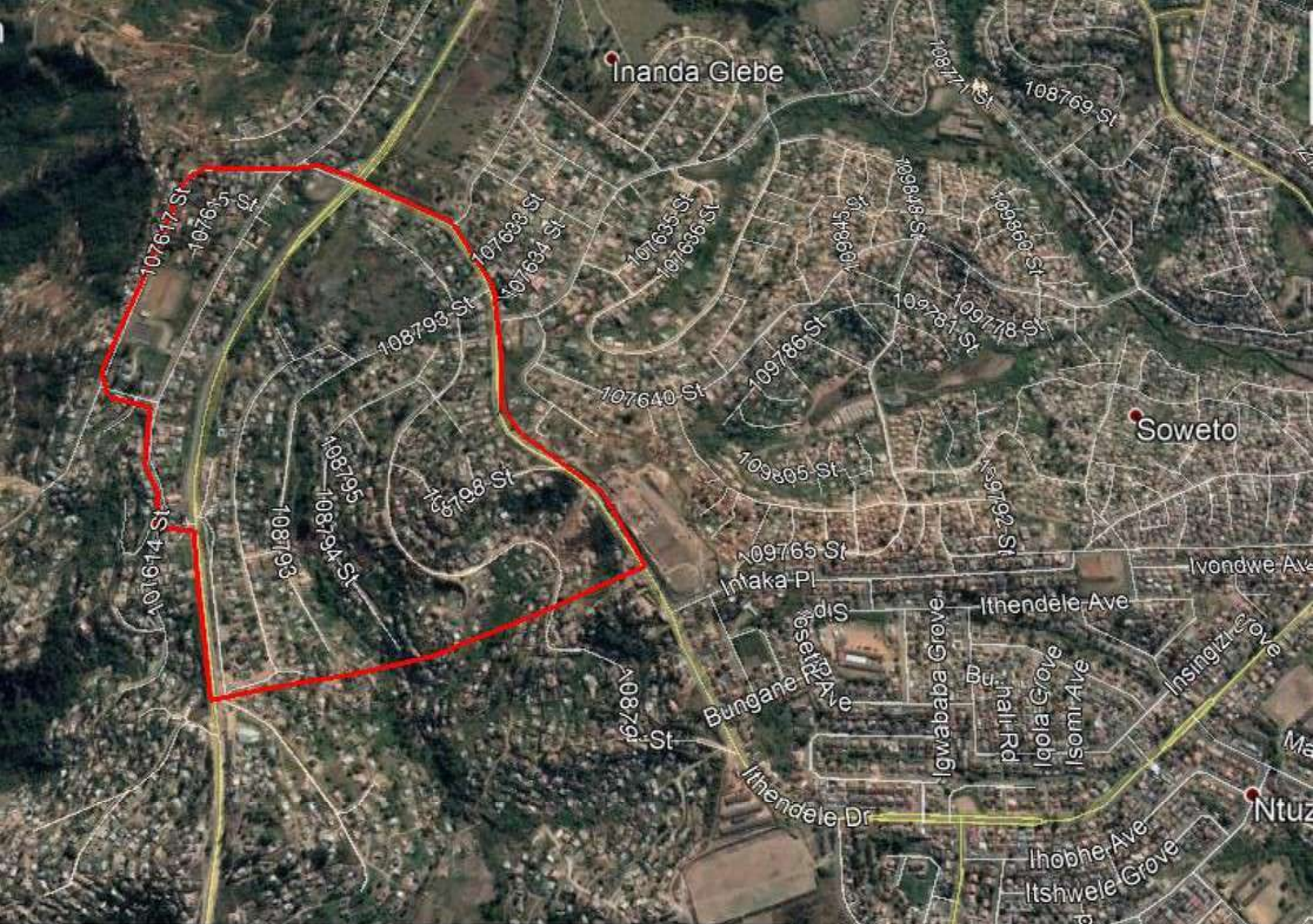
This information in this report is given in good faith, as an indication of the materials and conditions likely to be encountered during construction. There is no warranty that the information is totally representative of the whole area and no responsibility will be accepted for any consequences from actual conditions being different from those indicated in this document.

1world consultants
Environmental & Engineering Consultants
Postal Address: P.O Box 2311, Westville, 3630
Tel: 031 262 8327
Fax: 086 726 3619

Appendix C



eral Locality Map of Inanda and Surrounding Areas.



ality Map of the Study Area, Glebe, Inanda.

Map 3: Environmental Sensitivities within the Study Area and Surrounding Area.

March 5, 2018

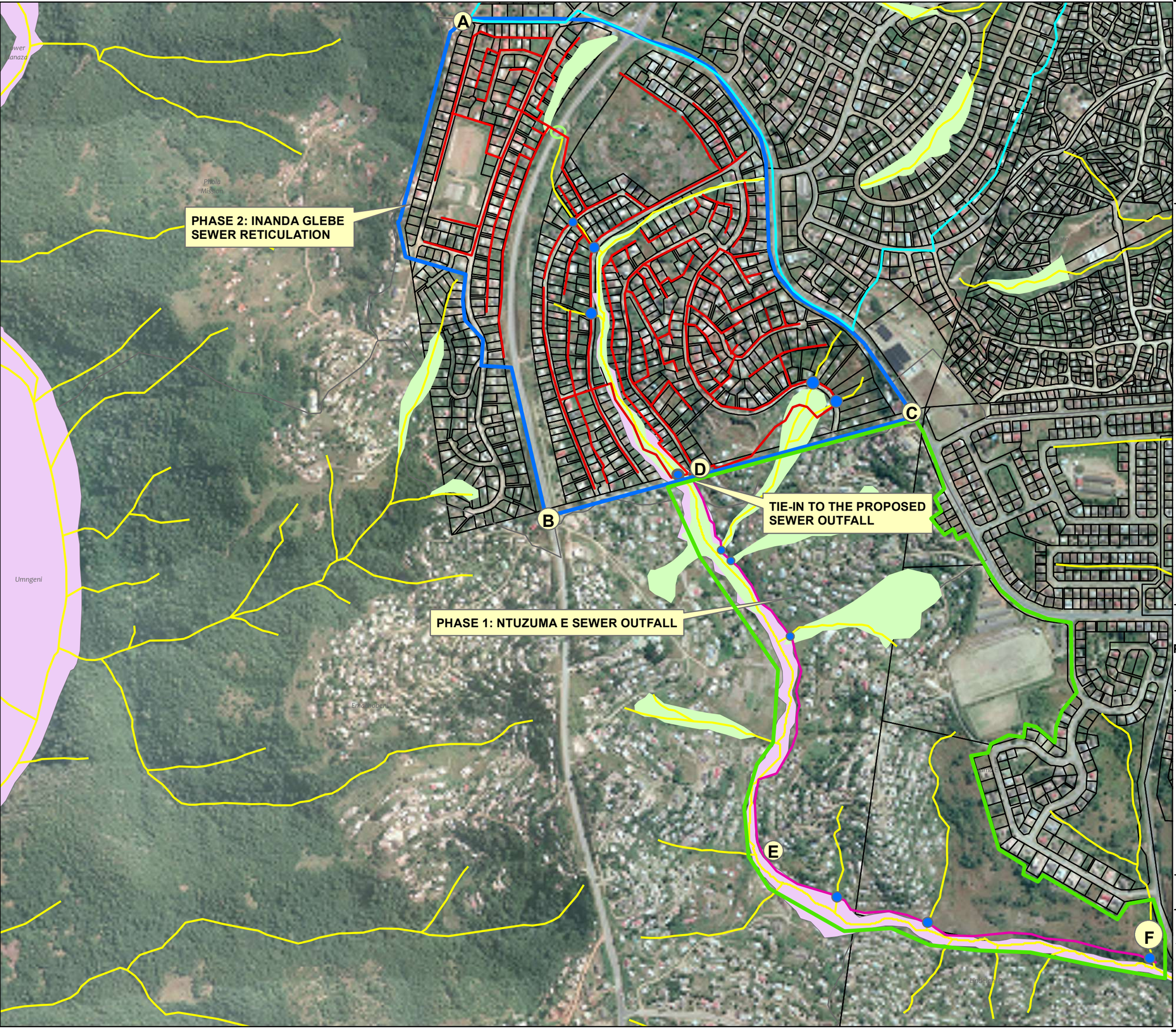
drawGraphics_poly
- User drawn polygons
- Flood Plains
- 100 Year Flood Plain
- DMOSS Proposed Removed
- DMOSS Proposed Addition
- Metro Open Space
- Archeological Sites
- Roads
- Suburbs
- Red: Band_1
- Green: Band_2
- Blue: Band_3

1:10 096

0 650 1 300 2 600 ft

0 205 410 820 m

eThekwini Map Viewer
Copyright



ETHEKWINI MUNICIPALITY

LENGENDS

- Proposed Sewer Reticulation(160mmØHDuPVC)
- Proposed Sewer Outfall 200mmØ HDuPVC
- Wetland Area
- Streams
- Floodplain
- Stream crossing
- Boundary line for phase 2 iNanda Glebe Reticulation
- Boundary line for phase 1 of the Proposed development for the Sewer outfall at Ntuzuma E
- NORTH POINT

Project No: 6459

Project Title :Phase 1: Ntuzuma E Sewer Outfall : Phase 2: iNanda Glebe Sewer Reticulation.

Ward No: 43 & 44

Reason Required : Insitu upgrade for the purpose of eliminating pit latries by constructing new waterborne sewage system.

Scale: 1:7000

Designed by: S.G & A. M

Area Engineer: P. M

Manager: D.L

Deputy Head: B. S

Drawing No: 1	Sheet No: 1 of 1

Inanda Glebe Sewer Reticula
Phase 2

N

Legend

- Road
- Pipeline
- Drainage_Line
- Wetland_Area
- Project_Site
- Buffer_500M
- HGM's 2 and 3 crossings

Meters

0 90 180 360 540

Aeon Nexus
(Pty) Ltd

1world consultants
Environmental & Engineering Consultants
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Tel: 031 262 8327
Fax: 086 726 3619

Method Statement

ETHEKWINI WATER AND SANITATION
WASTEWATER DESIGN BRANCH

SEWER RETICULATION IN INANDA GLEBE

Alex Mahlambi

METHOD STATEMENT

Contents

1. Background

The Inanda Glebe is located in the north of Durban. These area is currently occupied by middle/low income residential without waterborne sewerage. Residents in these area have constructed pit latrines for sanitation purposes. These latrines are, in some instances, constructed on rocky terrain in close proximity (<10m) to the Igobhogobho river and its tributaries which poses a serious pollution risk. Watercourses in the area are utilised for both agriculture purposes and washing of clothes by the community. The eThekwini Water and Sanitation wastewater, Design Branch is proposing to construct waterborne sewer reticulation for the existing houses in Inanda Glebe.

2 Project description

The project will consist approximately 13 kilometres of 160mmØ HDuPVC sewer reticulation and numerous 1000mmØ precast concrete ring manholes.

3 Proposed solution

The proposed sewer reticulation is shown in Appendix A. The critical positions for the reticulation are indicated with the co-ordinates below:

.

Point of Interest	East	South
A	30°54’47.85”	29°42’48.64”
B	30°54’55.06”	29°43’20.20”
C	30°55’19.64”	29°43’14.30”

This project shall not commence until both an Environmental Authorisation (EIA 2017 from DEDTEA and a water use license in terms of the National Water Act, Act 36 of 1998 from the Department of Water and Sanitation (DWS) is complied with.

The eThekwini Municipality Environmental Planning and Climate Protection Department (EPCPD) in conjunction with the DWS have advised that a National Water Act, Act 36 of 1998 Section 19 motivation is the appropriate report to submit to obtain a water use licence for the proposed project. It is for this reason that this motivation has been compiled.

4 Pipeline construction methodology

4.1 Materials

The proposed project consists of pipelines under one flow condition – low pressure for gravity flow. The reticulation will consist of HDuPVC 160mmØ pipes which will be utilised for gravity flows. There are two stream crossings which will be undertaken by encasing the pipe with concrete.

4.2 Construction corridor and servitude

The construction corridor where construction vehicles are permitted and outside of sensitive areas is to be 10m in total, 5m on either side of the proposed pipeline route. The final pipeline servitude width required for maintenance purposes is 3m.

4.3 Pipes laid below ground

Pipelines are to be laid below ground by conventional open trench excavation except in the sensitive areas.

The depth of the various trenches varies according to location and topography of the existing ground level but generally an average depth of 1m above the top of the pipe is adhered to. The trench widths are to be in accordance with SANS 1200 - 300mm wider on either side of the pipeline. This allows for compaction with a motorised rammer.

Before laying, pipes will be visually checked for scratches, puncture, ovality, correct marking.

HDuPVC is to be laid on flexible bedding as shown on Figure 1. The selected cradle and blanket is to be river sand.

More river sand is then placed on the sides of the pipe to 100mm above the crown of pipe (bedding cradle). This is then hand stamped to secure the position of the pipe. Suitable material from the trench excavation or river sand, if the sand taken from the trench has too many large particles, it is then placed a further 200mm on top of the pipe (bedding blanket) and then compacted. The trench will then be backfilled with normal backfill material or the material excavated from the trench till the existing ground level. This backfill is compacted in 300mm layers until the ground profile is reached.

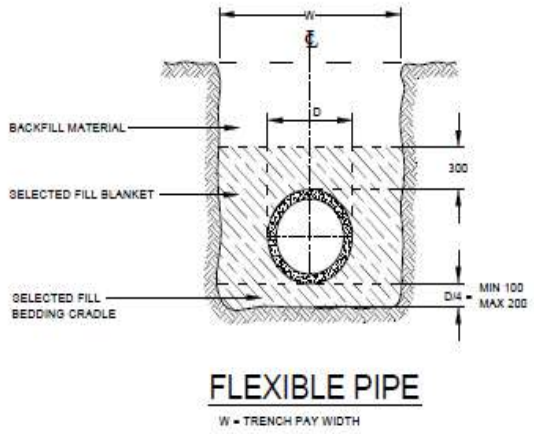


Figure 1: Proposed HDuPVC pipeline bedding

It is acknowledged that construction activities may have impacts on water quality, habitats of animals, and flow regime. This Department has identified a number of potential pollution sources that may arise as a result of construction activity in the area - construction vehicles; construction workers and construction activities. These, along with prevention and mitigation measures is presented in Table 1 below.

Table 1. Potential sources of pollution and mitigation measures

Potential source of pollution	Potential pollution	Mitigation measure
1.Construction Vehicles	a)Oil leaks	(i) Routine checking of machinery/plant and vehicles for oil leaks each day before construction activity begins shall be conducted. Areas in which oil is kept will be bunded.
	b)Access control	(i) No vehicle will be permitted to cross drainage lines, wetlands and floodplain areas during construction. (ii) Access routes shall be designed to limit the potential impact on the environment, bearing in mind steep banks and areas prone soil erosion. (iii) Existing access roads/tracks shall be used where possible.
2.Construction Workers	a)Washing and cleaning of construction equipment	(i) Washing and cleaning of construction shall not be undertaken within the drainage lines, watercourses and wetland areas.
	b)Littering	(i) Waste disposal facilities (bins) shall be provided and workers encouraged not to litter or dispose solid waste in the natural environment but to use available facilities.
	c)Sanitation	(i) Portable toilets shall be provided where construction is occurring. Workers shall be encouraged to use these facilities and not the natural environment.
3.Construction Activity	a) Hazardous substances	(i) Proper storage and handling of hazardous substances (e.g. chemicals) shall be administered. (ii) All employees handling fuels and other hazardous materials shall be trained properly. (iii) Spillage of hazardous substances shall be cleaned up immediately and contaminants properly drained and disposed to a suitable dump site. (iv) Any contaminated soil in the construction site shall be removed and rehabilitated timeously and appropriately.
	b)Stockpile material	(i) No stockpiling of any materials shall take place within any water course, including wetlands and rivers/drainage lines.
	c)Cement	(i) No cement batching activities shall take place near the water course and wetland areas. (ii) Cement batching boards shall be used and cement-based products/wash not be disposed into the natural environment.
	d) Managing the use of sand and water from the watercourse.	(i) Soil/sand required for construction purpose shall not be derived from watercourse. (ii) Water for use in construction or as a drinking supply shall not be taken directly from any wetlands or streams. Where there is an abstraction of water from wetlands or rivers for construction will be approved by the Department of Water and Sanitation. (iii) Excavated material/sediments/spoil from the construction (including any unsuitable materials) shall not be placed or stockpiled within any watercourse (drainage line).

4.4 Stream Crossings

Stream crossings will be constructed mainly via the dam and flume method. In this method the stream is temporarily dammed to prevent water flow in the area to be trenched. The trench is excavated as quickly as possible whilst a pipe or flume is placed over the trench, conveying water downstream. The pipe is encased in concrete (only where the concrete is founded on

rock) and then backfilled up to streambed level. Silt and sediment accumulation is removed from the streambed and the bed and banks of the stream are restored to preconstruction conditions before removal of the dams.

4.5 Road Crossings

There is one pipe jacking which will be undertaken in the main road (P138) to avoid deep excavation of 6m. In other areas where the pipeline crosses the road, conventional open cut trenching with traffic controls will be utilised followed by temporary reinstatement. Once completed formal reinstatement will proceed. The pipeline is to be laid at a depth of 1200mm above the crown of pipe.

4.6 Wetland Crossings

The route of the pipeline crosses two wetlands and will be laid alongside a third wetland unit. All pipes which are laid in these areas will be excavated by hand. Any machines used will cause damage to these causeways and also for the most part they are inaccessible.

All pipes which will cross the wetland will be laid at a minimum depth of 800mm below the river bed.

4.7 Rehabilitation Non-Sensitive Areas

There are three rehabilitation options.

The options are:

- For gentle slopes (>1:10) and not in the path of high flows.

A product produced by Macafferri called Biomac will be installed, Biomac is a bio-degradable product used after reinstating banks and promotes vegetation growth. After the backfilling of the trench is complete the surrounding bank is then shaped and trimmed. A sheet of Biomac is then placed on this area and is anchored down by either steel or wooden pegs. Topsoil of about 20mm thick is then raked over and this area is then hydo-seeded.

- For steeper slopes (between 1:2 and 1:10) and where there is medium velocity flows

A product produced by Macafferri called Mac-mat will be installed. Mac-mat is a woven mesh application which can take a tensile force of up to 30kN (kilonewtons) and is used after reinstating banks and promotes vegetation growth. After the backfilling of the sewer trench is complete the surrounding bank is then shaped and trimmed. A sheet of Mac-mat is then placed on this area and is anchored down by either steel or wooden pegs. Topsoil of about 20mm thick is then raked over and this area is then hydro seeded.

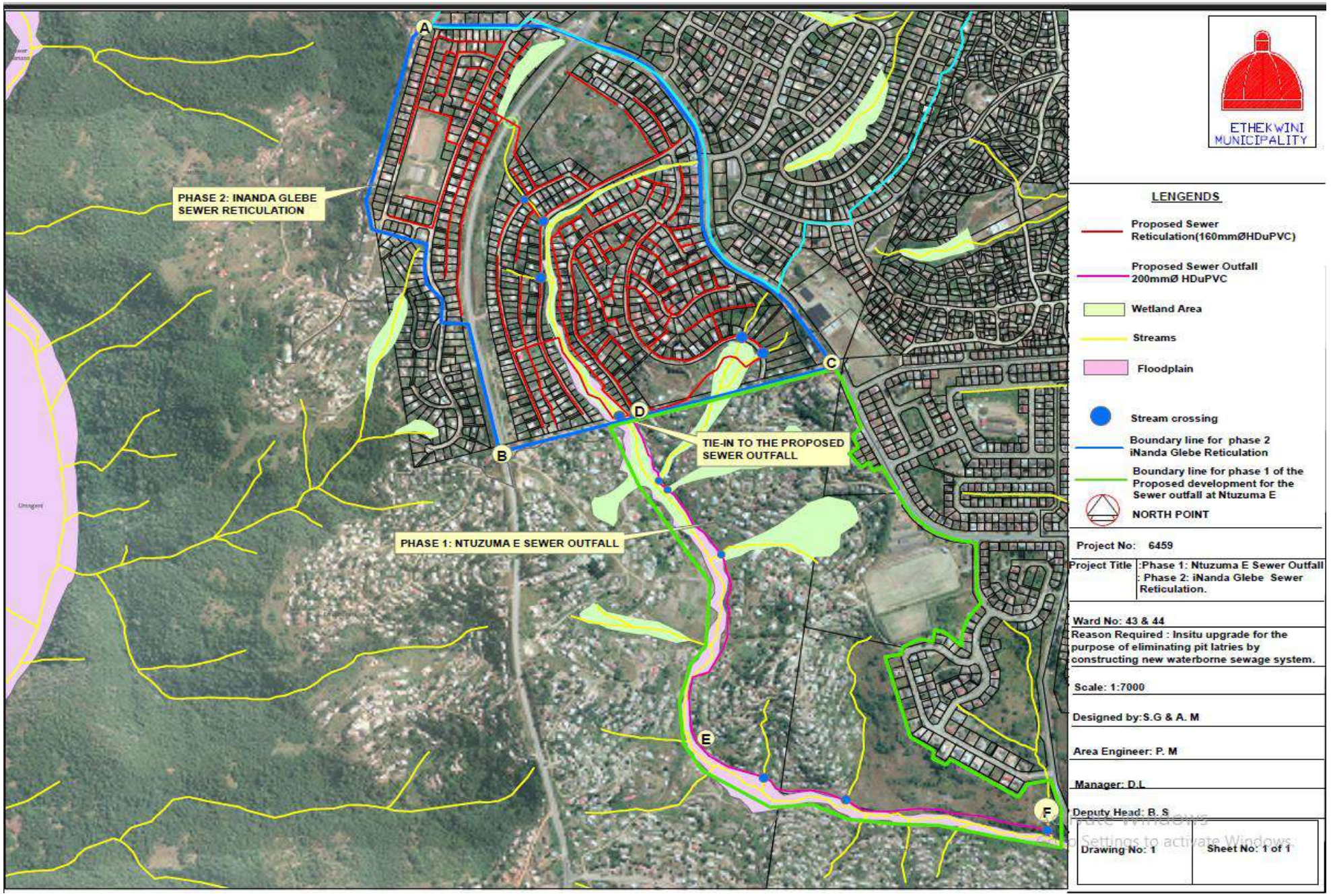
- For steeps banks ($> \mathbf{1}:\mathbf{2}$) and in areas of high flows

A stepped terrace of gabion baskets will be installed along the banks width, if required, Reno mattress will be constructed on the river bed at its existing level. This is specially for areas which run through private property were not much care or inadequate river protection was placed and as a result of flooding has washed away some of the banks.

4.8 Rehabilitation-Sensitive Areas

Rehabilitation for these areas will be in accordance with the EMPr and Plant Rescue and rehabilitation.

ANNEXURE A- The Proposed Sewer Reticulation in Inanda Glebe.


A
B
C
D
E
F
PHASE 2: INANDA GLEBE SEWER RETICULATION
PHASE 1: NTUZUMA E SEWER OUTFALL
TIE-IN TO THE PROPOSED SEWER OUTFALL
ETHEKWINI MUNICIPALITY
LENGENDS
Proposed Sewer Reticulation(160mmØHDuPVC)
Proposed Sewer Outfall 200mmØ HDuPVC
Wetland Area
Streams
Floodplain
Stream crossing
Boundary line for phase 2 iNanda Glebe Reticulation
Boundary line for phase 1 of the Proposed development for the Sewer outfall at Ntuzuma E
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Scale: 1:7000
Designed by:S.G & A. M
Area Engineer: P. M
Manager: D.L
Deputy Head: B. S
Drawing No: 1
Sheet No: 1 of 1

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Service Level Agreement

ETHEKWINI MUNICIPALITY

WATER & SANITATION UNIT
ENGINEERING DEPARTMENT
WASTEWATER DESIGN BRANCH

3 Prior Road, 4001
P.O. Box 1038, Durban, 4000
Tel: 031 311 1111, Fax: 031 311 8549
www.durban.gov.za

Our Ref : 813756-1
Enquiries : P. Mbhele
Telephone : 031 311 8579
Fax : 031 311 8549

25 January 2018

1 World Consultants
P.O Box 2311
Westville
3630

ATTENTION: Roschel Maharaj

Dear Madam

CONFIRMATION OF BULK SEWER INFRASTRUCTURE AT INANDA GLEBE AREA

This confirms that bulk sewer capacity is currently available within the KwaMashu Wastewater Treatment catchment to cater for the sewage flow from 600 residential units.
It should be noted that this approval letter is only valid for 3 years and will become invalid as of 25/01/2021, after which a new confirmation letter will be required.

Yours Faithfully

25/01/2018

E. MSWELI
HEAD : WATER AND SANITATION

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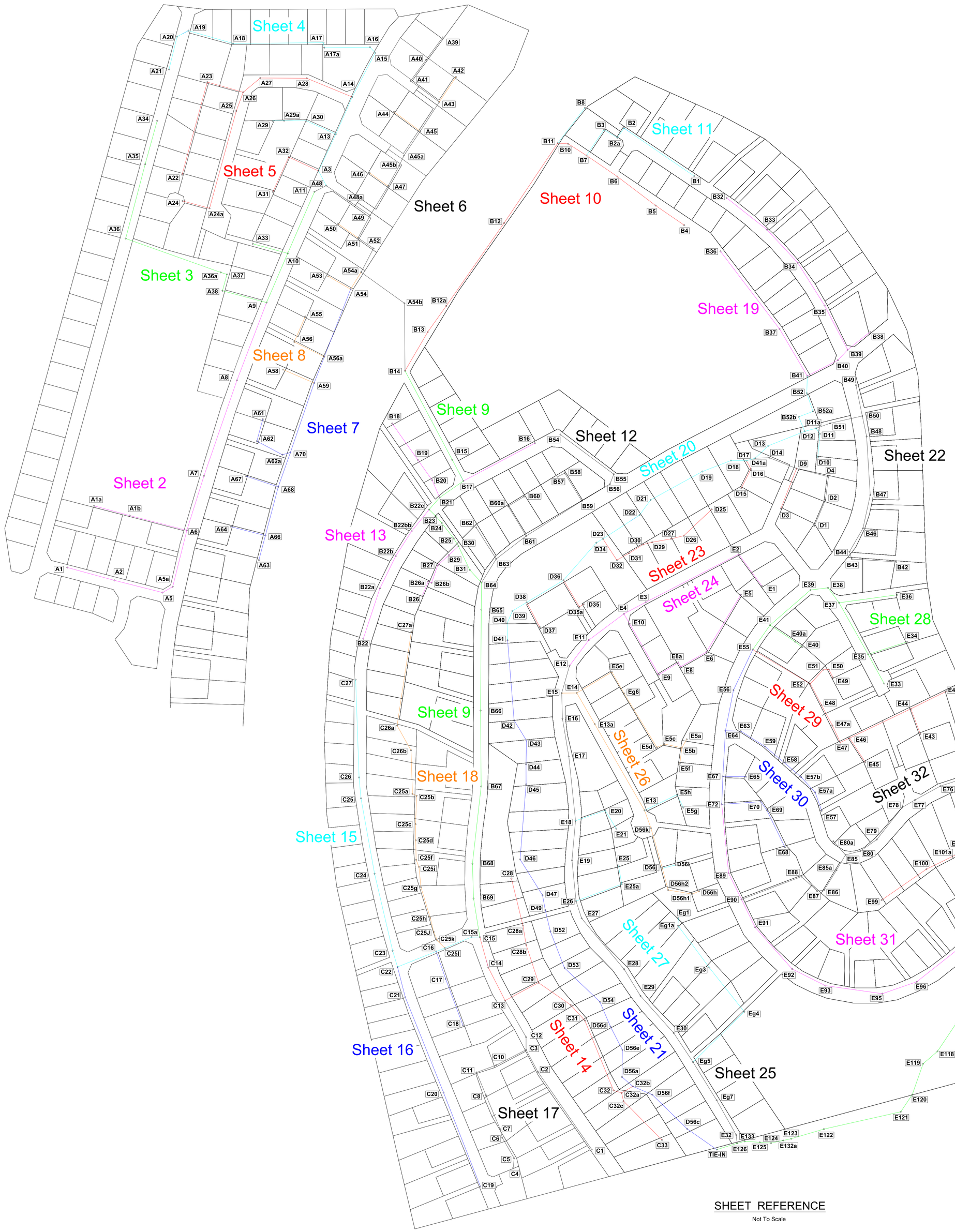
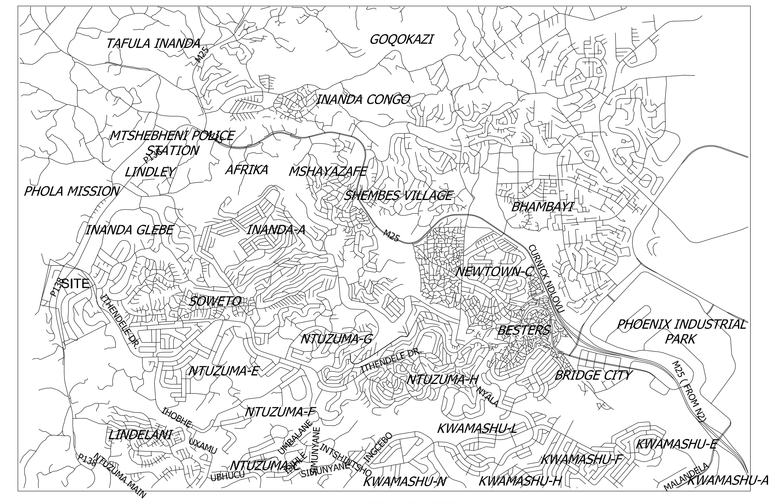
Preferred Layout Alternatives



SHEET REFERENCE

Not To Scale



LOCALITY SKETCH

Not To Scale

NOTES:

1. Manholes to be in accordance with DWG No. 38570 and 38574 .
2. Pipe bedding to be in accordance with departmental specification DB 5.5 .
3. All dimensions are to be checked on site prior to any fabrication and commencement to work .
4. Positions and levels of all services in the vicinity of the new sewer to be checked and proved prior to commencement of construction .
5. Sewer pipe shall be heavy duty uPVC 160mmØ on flexible bedding unless otherwise stated .
6. All Invert levels to be confirmed by contractor on site.
7. All manholes within road carriageway to have H.D. cast iron cover and frame unless otherwise indicated .
8. All existing services to be proven by contractor on site prior to works proceeding .
9. For engineering services layout refer to DRG. No. 10266/5000
10. The minimum cover to all pipes shall be :
    A) Midblock - 800mm
    B) Sidewalk - 1000mm
    C) Roadway - 1200mm
11. Sewer manholes shall be 1000mmØ precast ring manholes with light duty cover and frame unless otherwise indicated .

    N.G.L. - Natural Ground Level
    F.G.L. - Finish Ground level

    Any discrepancies are to be confirmed with the engineer on site prior to work proceeding
12. Actual manhole depth is inclusive of the 150 mm ground clearance. Refer to manhole setting out details table.

REVISIONS

Revision	Date	Description

AS BUILT

DATE : .....SIGN : .....

REDUCED PLAN USE SCALE BELOW

0 10 20 30 40 50 60 70

70mm ON ORIGINAL PLAN

LEGEND OF EXISTING UNDERGROUND SERVICES

- PROPOSED SEWERS AND M.H.'S
- SEWERS AND M.H.'S
- STORM WATER DRAIN AND M.H.'S
- WATER MAINS AND VALVES
- ELECTRICITY CABLES
- TELKOM CABLES
- SPOORNET LINE
- OIL PIPELINE

UNDERGROUND SERVICES CHECKED

SERVICE	DATE	SIGNATURE
S.W DRAINS		
SEWERS		
WATER MAINS		
TELKOM CABLES		
ELECTRIC CABLES		
SPOORNET CABLES		
E.S.C. CABLES		
OIL PIPE LINE		

NOTE: Only underground services affected by new construction work are shown.
Care must be taken during excavations for road foundations, trenches etc. to avoid damage to underground services such as sewers, drains, cables, water mains and connections. Wherever possible these must be located before work proceeds.

NOTE: No construction work to commence until land and servitude acquisitions have been completed
Acquisitions completed:
Date Engineer

NORTH POINT

ENGINEERING

WASTEWATER DESIGN

ETHEKWINI MUNICIPALITY

ETHEKWINI WATER & SANITATION

WS6935

Contract No.

Project Title

INANDA GLEBE : SEWER RETICULATION

Project No. (Y 6459)

Drawing Title

LOCALITY SKETCH AND SHEET REFERENCE

Reference Drgs.			
Scales	: AS SHOWN		
Surveyed	: ,	Date	:
Drawn	: L. COVELE'	Date	: July 2017
Designed	: A. MAHLAMBI	Date	: July 2017
Checked	:		
Area Engineer : P. MBHELE			
Manager : D. LARKIN (Design)			
Deputy Head: B. SONI (Engineering)			
Head : (Water & Sanitation)		E. MSWELI	

Drawing No.	Sheet	Rev.
57 231	1	A

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Appendix D

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I&AP Database

I&AP REGISTER/DATABASE - DISTRIBUTION LIST					
ORGANISATION	**CONTACT PERSON**	**PHONE NUMBER**	**CONTACT DETAILS**	**COPY OF THE BID SENT**	**COPY OF THE DBAR SENT**
KZN Department of Transport	Michele Schmid	033 355 8600	KwaZulu-Natal Department of Transport Private Bag X9043 Pietermaritzburg 3200 **michele.schmid@kzntransport.gov.za**	Yes	Yes
Ezemvelo KZN Wildlife	Dominic Wieners	033 845 1346	Ezemvelo KZN Wildlife P.O.Box 13053 Cascades 3202 **data@kznwildlife.com** **Dominic.Wieners@kznwildlife.com**	Yes	Yes
Department of Water and Sanitation	Siyabonga Buthelezi	031 336 2700	Department of Water and Sanitation 88 Joe Slovo Street Durban 4001 **ButheleziS2@dws.gov.za**	Yes	Yes
AMAFA	Bernadet Pawandiwa	033 394 6543	**bernadetp@amafapmb.co.za**	Yes	Yes
KZN Corporate Governance and Traditional Affairs	Vishnu Govender	031 204 1711	KwaZulu-Natal: Corporate Governance and Traditional Affairs 7 Buro Crescent Mayville Durban 4091 **vishnu.govender@kzncogta.gov.za**	Yes	Yes
Ward Councillor, Ward 44	Councellor B.W. Phewa	0793285935	**bhekokwakhe.phewa@durban.gov.za**	Yes	Yes
Commission on Restitution of Land Rights	Lynn Boucher	033 341 2600	Commission on Restitution of Land Rights Private Bag X9120 Pietermaritzburg 3200 **lynn.boucher@drdlr.gov.za**	Yes	Yes
eThekwini Municipality Environmental Planning & Climate Protection Department	Crystal Naidoo	031 322 4303	eThekwini Municipality: Environmental Planning & Climate Protection Department City Engineers Building Room 200, 2nd Floor, 166 KE Masinga Road Durban 4001 **crystal.naidoo@durban.gov.za**	Yes	Yes

Eskom	Neil Purdon	031 711 5483 082 862 6555	Eskom 2 Valley View Road New Germany Durban 3610 **PurdonNW@eskom.co.za**	Yes	Yes
KZN Department of Economic Development, Tourism and Environmental Affairs	Kacy Rengasamy	031 366 7346	KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs 40 Dr A. B. Xuma Street Durban 4001 **Kacy.Rengasamy@kznedtea.gov.za**	Yes	Yes
eThekwini Electricty MV/LV Voltage Department	James Reynolds	031 311 9048 083 631 7376	5th Floor 1 Jelf Taylor Crescent Durban 4001 **reynoldsja@elec.durban/gov.za**	Yes	Yes
eThekwini Water and Sanitation	Precious Mbhele	031 311 8756	eThekwini Water and Sanitation Design Branch 03 Prior Road, Durban, 4001 **Precious.Mbhele@durban.gov.za**	Yes	Yes

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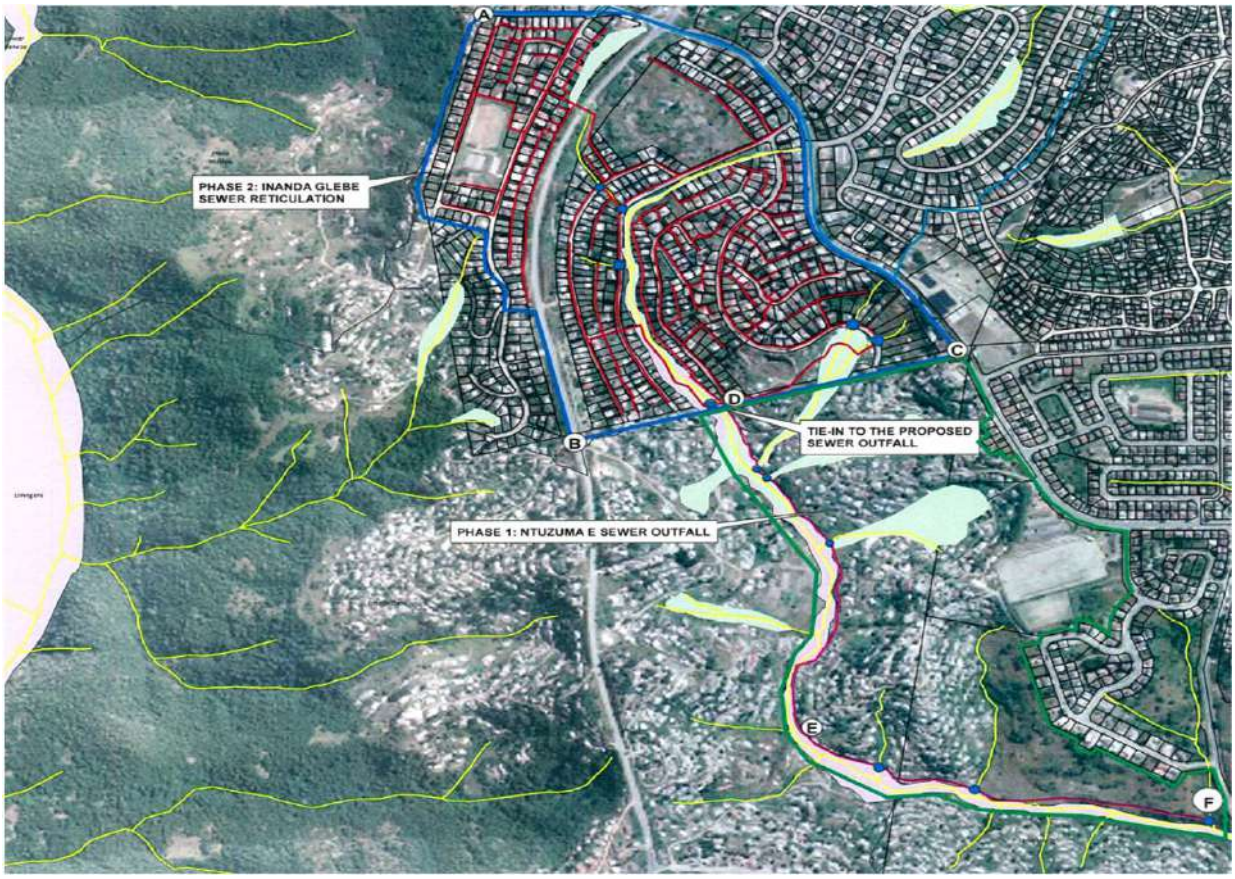
Site Notice Board

INQUBO YOKUHLONZWA UMTHELELA KWEZEMVELO

Isaziso Ngocwaningo Oluyisisekelo Loku-thuthwa Kwendle, eNanda Glebe, Ngaphansi ka-Masipala weTheku, KwaZulu-Natali

Isaziso sikhishwe ngokulandela imogomo yesenzo Sokuphatha KweZemvelo kaZwelonke (National Environmental Act) (Act no 107 ka 1998), eshicilelwe kwi GN 326 (17 kuMbasa 2017), ngenhlososo yokwenza umbiko wocwaningo oluyisekelo lokufakwa Kwamapayipi amasha okuthutha indle ku-Ward 44, eNanda Glebe, ukuze kuqedwe ukusetshenziswa kwamathangi nemigodi.

Reference Namba Yohlonzo: DM/0004/2018



Imininingwane Yephrojekthi: Umnyango wezamanzi noKuhlanhleka ngaphansi kaMasipala weTheku (eThekwini Water and Sanitation) uphakamisa ukufakwa kwamapayipi ayibanga elu-13km ubude nobubanzi obungango-160mm azothutha indle ukuba aqanjwe ngokuthi iGlebe Sewage Reticulation System, eNanda ngaphansi kwaMasipala weTheku.

I-1World Consultants inkampani ezimele yokucwaninga kweMvelo ikhethwe Umnyango wezamanzi nokuhlanzeka kuMasipala weTheku ukuba yenze uhlonzo lwezemvelo ngokubambisana noMphakathi kule phrojekthi ephakanyiswayo. Abafuna ukubamba iqaza noma abathintekayo kumele babhalise ngokuthumela i-email, babhale amagama, nemininingwane yabo yokuxhumana basho nokuthi bathinteka kanjani kule phrojekthi ngokusebenzisa lemininingwane engezansi.

Roschel Maharaj (B.Sc. Environmental Science)
Postal: PO Box 2311, Westville, 3630
Email: roschel@1wc.co.za
Tel: 031 262 8327
Fax: 086 726 3619

Date of this Notice: March 2018

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Photos of Notice Boards on Site

Image 2: Notice Board Located at the Start Point of the Reticulation

Image 2: Notice Board Located Near Wetland

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Image 4: Notice Board on the Gate of Inanda Service Office

Image 4: Close up of Notice Board at Inanda Service Office

Image 6: Notice Board located Near Proposed Road Pipe Jacking

Image 6: Close Up of Notice Board at Proposed Pipe Jacking

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Image 8: Notice Board Near Tie-In Point

Image 8: Close Up of Notice Board Near Tie-In Point

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Newspaper Advert

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NOTICE

ISIMEMO SOMPHAKATHI

ISAZISO SENQUBO YOKUHLOLWA NOKUVUMELEKA UKUQHUBEKA NOHLELO OLUHLONGOZWAYO LWE-PROJEKTHI YENGQALASIZINDA EHLONGOZWAYO ENANDA GLEBE, WARD 44, KUMASIPALA WASETHEKWINI, KWAZULU-NATAL

EIA REFERENCE NUMBER: DM/0004/2018

Isaziso sikhishwe ngaphansi komthetho wokuhlola ukuthinteka kwemvelo ngokwesigaba sika-107 somthetho ka-1998 njengokuchibiyelwa kwawo kuGNR 326 (07 Ephreli 2017) wokwenza lomsebenzi ohlonzwe uMasipala waseThekwini ophikweni lwezaManzi nokuThuthwa kweNdle (EWS):

Umsebenzi Ohlongozwayo: UMnyango wezaManzi nokuThuthwa kweNdle ngaphansi kukaMasipala waseThekwini (eThekwini Water and Sanitation -EWS) uhlongoza uhlelo lomsebenzi ozokwenziwa yikontileka webanga lika-13km ubude, 160 mm ububanzi lokufakwa kwamapayipi oluzokwaziwa ngokuthi yi'Glebe Sewage Reticulation System' , eNanda Glebe, kuMasipala waseThekwini. Lolu hlelo luzoba wusizo ekuchitheni emathangini ukugcola okusuke kuqhamuka emathoyilethi omgodi asetshenziswa umphakathi. Lolu hlelo luzothinta izingxenye ezahlukene ngokomzila, ngaleyondlela kubalulekile ukubheka ukuthinteka kwemvelo okudinga imvume yoMnyango wezokuThuthukiswa koMnotho, ezokuVakasha nezeMvelo, KwaZulu-Natal. Umkhombandlela sowutholakele eMnyangweni wezaManzi nokuThuthwa kweNdle wokuthi umsebenzi ungaqalisa. I-1World Consultants (Pty) Ltd inikezwe lomsebenzi wokuthi uhlole ukuthinteka kwemvelo nokuvumeleka ukuqhubeka kohlelo. Uhlaka lomsebenzi ohlongozwayo luyatholakala ngokwesicelo kwi-1World Consultants (Pty) Ltd.

ISIMEMO SOMPHAKATHI SOKUBA YINGXENYE YALOLUHLELO

I-1World Consultants (Pty) Ltd, iyinhlangano ezimele ebhekele ukuthinteka kwemvelo (Environmental Assessment Practitioner-EAP), eqokwe uphiko lwezaManzi nokuThuthwa kweNdle lukaMasipala waseThekwini ukubheka izinto ezidingakalayo ukuze kuqhutshekwe nalomsebenzi ohlongozwayo.

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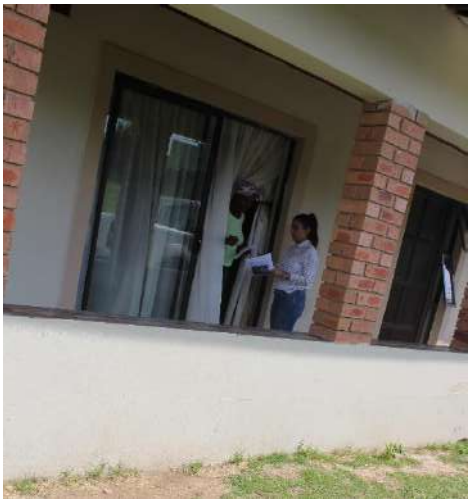

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Appendix E

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Wetland Delineation and Functional Assessment

June 2017

Proposed new Inanda Glebe Sewer Reticulation:

WETLAND DELINEATION AND FUNCTIONAL ASSESSMENT

Aeon Nexus (Pty) LTD

Report prepared for: 1World Consultants (Pty) Ltd

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Report Reference No: WDFA12/06/2017-T

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The project deliverables, including reported results, comments, recommendations and conclusions, are based on the author's professional knowledge and available information. The client acknowledges that the study is based on assessment techniques and investigations that are limited by time and budgetary constraints applicable to the type and level of survey undertaken.

Project Assessment Details & Declaration of Independence

This report has been prepared as per the requirements stipulated in Appendix 6 (1) of the National Environmental Management Act, 1998 (Act 107 of 1998) Environmental Impact Assessment Regulations, 2014.

We the undersigned hereby declare that we act as independent specialist consultants in the field of wetland and riparian ecology.

Report prepared by:	Suheil Hoosen Malek (BSc. Hons) & Dr S. Pillay *(Pr. Sci. Nat.)*
Internal reviewer:	Dr S. Pillay *(Pr. Sci. Nat.)*
Approved by:	Dr S. Pillay *(Pr. Sci. Nat.)*
Date:	12 June 2017
Client:	1World Consultants (Pty) Ltd

I, the undersigned hereby declare that we act as independent specialist consultants in the field of wetland and riparian ecology.

Dr Srinivasan Pillay *(Pr.Sci.Nat.)*

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List of Abbreviations

CARA	- Conservation of Agricultural Resource Act
DAEA	- Department of Agriculture and Environmental Affairs
D'MOSS	- Durban Metropolitan Open Space System
DWA	- Department of Water Affairs
DWAF	- Department of Water Affairs & Forestry
DWS	- Department of Water and Sanitation
EA	- Environmental Authorization
EIS	- Ecological Importance and Sensitivity
GA	- General Authorisation
GIS	- Geographic Information Systems
GPS	- Global Positioning System
HGM	- Hydrogeomorphic
IAP	- Invasive Alien Plant
IHIA	- Intermediate Habitat Integrity Assessment
MAP	- Mean Annual Precipitation
msl	- Mean Sea Level
NEMA	- National Environmental Management Act
NEPAD	- New Partnership for Africa's Development
NFEPA	- National Freshwater Ecosystem Priority Areas
PES	- Present Ecological State
SANBI	- South Africa National Biodiversity Institute
WMA	- Water Management Area
WSSD	- The World Summit on Sustainable Development
WUL	- Water Use License
WULA	- Water Use License Application

Glossary of Terms

Buffer zone	- A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Delineation	- To determine the boundary of a water resource (wetland or riparian area) based on soil and vegetation (wetland) or geomorphological and vegetation (riparian zone) indicators.
Facultative plant species	- Species usually found in wetlands (67% – 99% of occurrences) but occasionally found in non-wetland areas.
Gleying	- A soil process resulting from prolonged soil saturation, which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Mottles	- Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate plant species	- Species almost always found in wetlands (> 99% of occurrences).
Permanent zone of wetness	- The inner zone of a wetland that is permanently saturated.
Seasonal zone of wetness	- The zone of a wetland that lies between the Temporary and Permanent zones and is characterized by saturation for three to ten months of the year, within 50cm of the surface.
Temporary zone of wetness	- The outer zone of a wetland characterized by saturation within 50cm of the soil surface for less than three months of the year.
Terrain unit morphological classes	- Areas of the land surface with homogenous form and slope. Terrain may be seen as being made up of all or some of the following units: (1) crest, (2) scarp, (3) midslope, (4) footslope, and (5) valley bottom.
Wetland *(As defined by the National Water Act)*	- Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

Executive Summary

Aeon Nexus (Pty) Ltd was appointed by 1World Consultants (Pty) Ltd. to undertake a wetland assessment for the Inanda Glebe sewer reticulation, situated in Inanda, Ethekwini Municipality, KwaZulu-Natal. The reason for the sewer reticulation in this area is to provide better sanitation facilities to the community in Inanda Glebe. The proposed sewer pipeline reticulation area is approximately 970m and 1.2km away from suburbs Soweto and Ntuzuma in an easterly and south-easterly direction respectively. The area of the study site is approximately 61.8Ha and is surrounded by several unauthorised residential dwellings. Furthermore, as a result of some of these unauthorised housing being present in wetland environments, in terms of the 2017 Environmental Regulations promulgated under the National Environmental Management Act (107 of 1998), activities which fall within a Listed Activity must not be commenced without the necessary Environmental Authorisation. Hence, those activities that occurred prior and presently to the 2014 Regulations would require (ex post facto) Environmental Authorisation such as a Section 24G.

This specialist wetland assessment was undertaken to identify the location and extents of wetlands and river riparian zones on and within 500m of the study site; determine the functionality and health status of the wetlands and identify the impacts of the proposed activity on the surrounding wetlands.

Specific outcomes required from this wetland assessment include the following:

- Identify Hydrogeomorphic units (HGM) within the study area at a desktop level following the guidelines in the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland System (Ollis *et al*., 2013).
- Delineate all wetland and river riparian areas within the study area and the surrounding 500m buffer according to the guidelines as defined by DWA (2005).
- Determine function and service provision of wetland systems according to the method proposed by Kotze *et al.* (2009).
- Define the health status of wetlands within the study area according to the guideline measures described by Macfarlane *et al.* (2008) and thereby define the PES of the wetlands to be affected by the proposed sewer reticulation.
- Define the IHIA for the river instream and riparian environments within the study area according to the guideline measure described by Kleynhans (1996).
- Define the EIS for the wetland and river riparian system(s) assessed to be at risk (DWS, 1999).

- ❖ Consider potential impacts on the wetland environment and biota likely to arise as a direct result of the proposed sewer reticulation.
- ❖ Present mitigation and recommendation measures that are project relevant in order to minimise the impacts that the proposed activity will have on the wetland environment(s).

The following general conclusions were drawn upon completion of the wetland field assessment:

Wetland systems within the study area were categorised with the use of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013). Eleven wetland systems were identified within the 500m surrounding buffer area. Three of the eleven were present within the proposed study site which was also inclusive of a river riparian environment identified as the Gobhogobho River. Most of the HGM units were identified to be Hill-slope seepages with or without a channel, besides, HGM 10 and 11 which were identified to be channelled valley bottom wetlands. HGM's 1, 2 and 3 were identified to be 'at risk' which summarises the PES, EIS and buffer zone analysis in the tables below:

HGM 2						
WET-Health		WET-EcoServices		EIS		Buffer zone analysis
Overall PES	Trajectory of Change	Average Physical Ecosystem Services	Average Sociocultural Ecosystem Services	Average Score	Median Score	Recommended buffer
D	(↓)	2.26	1.42	1.09	1	25m

HGM 2						
WET-Health		WET-EcoServices		EIS		Buffer zone analysis
Overall PES	Trajectory of Change	Average Physical Ecosystem Services	Average Sociocultural Ecosystem Services	Average Score	Median Score	Recommended buffer
D	(↓)	2.2	1.34	1.27	1	25m

HGM 2						
WET-Health		WET-EcoServices		EIS		Buffer zone analysis
Overall PES	Trajectory of Change	Average Physical Ecosystem Services	Average Sociocultural Ecosystem Services	Average Score	Median Score	Recommended buffer
D	(↓)	2.13	1.32	2.09	2	32m

The above table displays the functionality, importance and buffer zone analysis of HGM's 1, 2and 3:

- HGM's 1, 2 and 3 scored an overall PES of D with a slight deterioration over the next five years.
- EcoServices results for HGM's 1, 2 and 3 showed that the unit provided a moderate sociocultural ecosystem services but did offer many physical ecosystem services such as serving as an efficient trap for toxicants, sediment and nitrates in addition to erosion control.
- The EIS scoring indicated low ecological importance and sensitivity for HGM's 1 and 2, and moderate ecological importance and sensitivity for HGM 3 as this wetland had portions of NFEPA wetlands within it. Furthermore, it is recommended that a full ecological assessment will verify the veracity of HGM's 1, 2 and 3.
- Buffer zone analysis concluded that a buffer of at least 25m is required for HGM's 1 and 2 and a buffer of 32m for HGM 3.

River riparian 1 was identified to be 'at risk' from the proposed sewer reticulation; hence an IHIA, EIS and buffer assessment was conducted for this river system.

HGM 2				
WET-Health		EIS		Buffer zone analysis
Overall PES	Trajectory of Change	Average Score	Median Score	Recommended buffer
D	(↓)	1.18	1	25m

The above table display IHIA, EIS and Buffer zone assessments for RR 1:

- The IHIA's scored an overall PES of category D for the instream and riparian habitat environments. Therefore, these environments will be Largely modified. A loss and change of natural habitat and biota have occurred.
- The EIS scoring indicated a low ecological importance and sensitivity.
- Buffer zone analysis concluded that a buffer of at least 25m is required.

<u>The following general conclusions were drawn upon completion of the risk assessment:</u>

The risk assessment was conducted to determine which of the wetland units, if any, would incur detrimental impacts as a consequence of the activity. The table below summarizes the risk assessment results obtained:

HGM 1				
Activity	Sewer reticulation			
Aspect	Maintenance and repair of existing access roads	Vegetation maintenance within wetlands	Introduction of foreign material	Excavation, trenching and infilling
Risk Rating	L	L	M	M

HGM 2				
Activity	Sewer reticulation			
Aspect	Maintenance and repair of existing access roads	Vegetation maintenance within wetlands	Introduction of foreign material	Excavation, trenching and infilling
Risk Rating	L	L	M	M

HGM 3				
Activity	Sewer reticulation			
Aspect	Maintenance and repair of existing access roads	Vegetation maintenance within wetlands	Introduction of foreign material	Excavation, trenching and infilling
Risk Rating	L	L	M	H

The results revealed that aspects such as use, maintenance and repair of existing access roads were a low risk for all HGMs, as well as, vegetation maintenance within wetlands were a low risk for HGM's 1 and 2 but a moderate risk for HGM 3. All the above HGM units revealed a moderate risk for introduction of foreign material and; excavation, trenching and infilling, besides HGM 3 which revealed a high risk for excavation, trenching and infilling as a direct result of the possible pipe installation through HGM 3.

The sewer reticulation presents various impacts and is discussed in this report. Mitigation and recommendations of the impacts need to be taken into consideration and is discussed in this report.

After presenting the possible alternatives for the sewer reticulation, a possible environmentally acceptable manner of the installation of pipes in the wetland environments is presented, together with the creation of a suitable wetland offset, subject to the approval of the DWS.

Given the above, the proposed sewer reticulation in the Inanda Glebe area will require, *inter alia*, a Water Use License Application.

One problem related to this study is the issue of unauthorized development in the buffer and wetland areas. The fact that people have constructed homes in this zone presents particular difficulties and these unauthorized housing should be addressed and a Section 24G application is required for these dwellings.

An important aspect of this study is the issue of excavating, trenching and infilling within wetland area for the installation of pipes. This activity should not commence in wetland areas as it will have drastic impacts on the hydrological, geomorphological and vegetation in the wetland. However, if pipe installation cannot be avoided in the wetland environment, different methods are mentioned in this report, with special mitigation and recommendations of the aforementioned impacts are thoroughly discussed.

Furthermore, as a result of the impacts of pipe installation within wetland environment, wetland offsets in terms of creating sufficient functional wetland hectare equivalents are discussed as another cost-effective method.

Calculations for the suggested offset are presented in this report.

This will further lead to more stringent management of wetland environments and enhance the aesthetic appeal of the surrounding landscape.

1. INTRODUCTION

1.1 Background

Aeon Nexus (Pty) Ltd was appointed by 1World Consultants (Pty) Ltd to conduct a wetland delineation and functional assessment for the proposed 160mmØHDuPVC sewer pipeline reticulation situated in Inanda Glebe, Ethekwini Municipality, KwaZulu-Natal. The reason for the sewer pipeline reticulation project was to facilities in the area for the purpose of eliminate latrines by constructing new waterborne sewage systems.

The proposed sewer pipeline reticulation area is approximately 970m and 1.2km away from suburbs Soweto and Ntuzuma in an easterly and south-easterly direction respectively. The area of the study site is approximately 61.8Ha which is surrounded by several unauthorised residential dwellings. Furthermore, as a result of some of these unauthorised housing being present in wetland environments, in terms of the 2017 Environmental Regulations promulgated under the National Environmental Management Act (107 of 1998), activities which fall within a Listed Activity must not be commenced without the necessary Environmental Authorisation. Hence, those activities that occurred prior and presently to the 2014 Regulations would require (ex post facto) Environmental Authorisation such as a Section 24G.

The proposed alteration to the beds, banks and characteristics of the watercourses resulting from the construction of the proposed sewer pipeline are considered listed activities under the National Environmental Act (Act No. 107 of 1998) and water uses under the National Water Act (Act No. 36 of 1998).

The specialist wetland assessment report was prepared to identify the location of wetlands and river riparian on and within 500m of the study site; determine the functionality and health status of the wetlands and identify the impacts of the proposed activity on the surrounding wetlands and riparian habitats.

After the wetland and riparian environments within the proposed development site and the surrounding 500m buffer were identified, delineated and assessed for ‘at risk’ status as a consequence of the activity, a functional assessment was undertaken to rapidly assess the health status and ecosystem goods and services provided by these wetlands. The latter was achieved via a Level 2 WET-EcoServices and Level 1 WET-Health assessments. This report presents the findings of the assessment and proposes appropriate recommendations and mitigation measures with regards to the wetland environments.

1.2. What constitutes a wetland?

Wetlands can be described as areas of land flooded or saturated for long periods of time. Certain plants have adapted to wetland conditions such as growing in anaerobic soil (Ramachandra and Kumar, 2008). The space that exist between soils particles usually become filled with water due to the soil becoming increasingly wet. A typical characteristic of wetlands is their ability to drain water extremely slowly therefore becoming waterlogged. Anaerobic conditions usually occur in waterlogged wetland soils due to the rapid usage of oxygen by organisms and plant roots.

Wetlands are therefore characterized by:

- *Soil saturation together with redoximorphic features*
- *high clay and organic matter content in soils and,*
- *a suite of characteristic wetland vegetation types and topographic settings in which they occur.*

The Department of Water and Sanitation (DWS) requirement is that more than one distinguishing characteristic must be present before positive identification of wetlands is accomplished.

1.3. Scope of Work

The aim of this wetland delineation and functional assessment was to identify and demarcate wetland and riparian environments at risk within 500m of the proposed sewer reticulation, as well as to assess the ecological health and functionality of these wetlands. The details pertaining to the scope of work include the following:

Wetland Delineation and Functional Assessment, incorporating the following:

- To identify and delineate potential wetland and riparian environments within 500m of the proposed development site based on aerial photography and available wetland/river coverages *via* a desktop survey;
- To conduct a comprehensive field survey to identify and delineate wetlands using the Department of Water Affairs & Forestry guideline manual (DWAF, 2005);
- To classify and describe the wetlands/riparian areas affected by the proposed sewer reticulation using the *National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa* (Ollis *et al.,* 2013);
- To undertake a rapid desktop aquatic screening and risk assessment to determine which of the desktop delineated wetlands are likely to be affected by the proposed sewer reticulation;

- To establish Present Ecological State (PES) of the instream and riparian habits using an Intermediate Habitat Integrity Assessment (IHIA) (Kleynhans, 1996);
- To establish the present Ecological State (PES) of the affected wetlands using a Level 1 WET-Health assessment tool (Macfarlane *et al.,* 2008);
- To assess the importance of the affected wetland areas in providing ecosystem goods and services using a Level 2 WET-EcoServices assessment tool (Kotze *et al.,* 2009);
- To assess the Ecological Importance and Sensitivity (EIS) of the affected wetland areas (Kleynhans, 1999);
- To identify and describe the potential aquatic ecological impacts associated with the proposed development; using the risk assessment tool (DWS, 2015);
- To provide wetland buffer zone recommendations based on best-practice guidelines and available buffer zone guidelines;
- To provide suitable recommendation and mitigation measures for the wetland environments to maintain and ideally improve the wetland ecological health status and provision of eco-services;
- To recommend the best route and method for the sewer reticulation pipeline that will be best suited for the surrounding environments.

1.4. Assumptions and Limitations

- The hydrogeomorphic units were assessed in their entirety, even if it included sections of artificial wetland or extended beyond the boundary of the study area; the latter assessed from aerial imagery with limited infield verification and assumed to be accurate within specialist expertise.
- Monitoring and management of any wetland impacts/remediation/rehabilitation will be advised in accordance with best practice.
- Due to the scale of the imagery (1:10 000 orthophotos and Google Earth® Imagery), as well as the accuracy of the handheld Global Positioning System (GPS) Unit, the delineated wetland boundaries have a marginal error of approximately 5m.

1.5. Legislative Framework

Table 1.1 below outlines the national and international legislation, together with a short description of the relevant portions application to wetlands:

TABLE 1.1: A review of the applicable guidelines under international and national legislation.

Name	Short Description and relevant section/s
International Legislation	
RAMSAR Convention	Importance is placed on the ecological, economic and social feasibility of wetland restoration programmes in order to protect wetlands by implementing initiatives to maintain or improve the state of wetland resources.
Convention on Biological Diversity	An important tool for the *in situ* conservation of biodiversity is wetland rehabilitation. Countries are to rehabilitate and restore degraded ecosystems and promote the recovery of threatened species through the formulation and implementation of appropriate plans and strategies.
United Nations Convention to Combat Desertification	Countries are to respond to land degradation and the effects of drought which includes the rehabilitation, conservation and sustainable management of land and water resources. South Africa has responded by developing a National Action Plan which aims to implement current and future policies that affect the natural resource management and rural development as well as to establish partnerships between all sectors this includes government departments, overseas development agencies, the private sector and non-governmental organizations.
New Partnership for Africa's Development (NEPAD)	One of the eight themes under the environmental initiative is wetland conservation.
The World Summit on Sustainable Development (WSSD)	The implementation plan places emphasis on the actions that reduce the risk of flooding in drought-vulnerable countries through promoting the restoration and protection of wetlands and watersheds.

National Legislation	
South African Constitution No 108 of 1996	The constitution is the overarching framework of South African law. It provides a legal foundation for the existence of the republic, outlines the rights and responsibilities of South African citizens and it defines the structure of government. Chapter 2- Bill of rights (Section 24) Everyone has a right to **an environment that is not harmful** to their health or wellbeing and is protected through reasonable legislative or other measures. (Section 27) National government is the custodian of all the country's water resources.
National Environmental Management Act (NEMA) No. 107 of 1998	This is an overarching statute regulating various aspects of natural resource use, integrating environmental management and pollution control. It provides principles and guidelines for sensitive, dynamic or stressed ecosystems i.e. wetlands. NEMA effectively promotes sustainable development into all planning and decision-making processes and adopts principles such as the 'precautionary approach,' 'polluter pays approach,' and requires that environmental responsibility be taken throughout the lifecycle of a project. Chapter 5 – Integrated Environmental Management (Section 24) provides for the prohibition, restriction and control of activities which are likely to have detrimental effects on the environment. The activities listed in the environmental impact assessment regulations that require assessment and environmental assessment have been promulgated in 2010 under NEMA. A number of activities listed in the regulations have relevance to wetland environments including a range of activities within 32m of a water course (including wetlands).
National Water Act No. 36 of 1998	This act provides a framework to protect the country's water resources this includes rivers, streams, estuaries, dams, wetlands and groundwater as well as the sustainable management thereof. The act provides guidelines and procedures on the protection, management and use of water resources in a controlled and integrated manner. Chapter 4 – Use of water - Deals with setting the basis for regulating water usage as well as details of various types of licensed and unlicensed

	entitlements to the use of water. Water use has a broad definition in the Water Act and requires that any activities with a potential impact on wetlands (within a parameter of 500m upstream or downstream of a wetland) be authorized. Chapter 19 (1) - *"An owner of land, a person in control of land or a person who occupies or uses the land on which a) any activity or process is or was performed or undertaken; which caused or likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring."* General Authorisations (GAs) – have been promulgated under the National water Act and were published under GNR 398 of 2004. Any uses of water which do not meet the requirements of Schedule 1 or Gas, require a license which should be obtained from the Department of Water Affairs and Forestry.
National Environmental Management Act: Biodiversity Act No. 10 of 2004	This act provides the management and conservation of the country's biodiversity within the framework of NEMA 1998. The sustainable use of indigenous biological resources and the protection of species and ecosystems that warrant natural protection as well as to ensure the fair and equitable sharing of the benefits arising from the use of biological resources. It addresses aspects such as protection of threatened ecosystems and requires a duty of care relating to listed invasive alien plants.
Conservation of Agricultural Resource Act (CARA) No. 43 of 1983	This act deals with control of the over-utilization of South Africa's natural agricultural resources, and to promote the conservation of soil and water resources and natural vegetation. This includes wetland systems and requires authorizations to be obtained for a range of impacts associated with cultivation of wetland areas.

2. STUDY AREA

2.1 Project and study area description

The proposed sewer reticulation project is situated within the Inanda Glebe area, at geographical co-ordinates 29°43'7.63"S and 30°55'2.56"E, Ethekwini Municipality, KwaZulu-Natal. The study area is bordered and surrounded by unauthorised residential housing in all cardinal directions. Additionally, towns surrounding the study area include Inanda Namibia, approximately 470m away in a north-easterly direction and Ntuzuma E, approximately 1.1 km in a south-easterly direction. The study area can be accessed via the M25 in Kwa-Mashu through the settlement of Ntuzuma and along Somiso Road.

The proposed sewer reticulation site is approximately 14.5 km away from the Indian Ocean, results in the elevation profile of the study area that ranges between 340 m above mean annual sea level (amsl) to 380 m amsl. The study area is encompassed by built up residential areas and other privately owned settlements. Taking into consideration the copious amounts of development such as residential housing, tar roads and laying of pipelines that have commenced around the study area, the terrain within the study area has been transformed drastically, which gives rise to the diverse array of alien vegetation with the study site. Furthermore, to the west of the study site, within the 500m surrounding buffer is a Durban Metropolitan Open Space System (D'MOSS) area, which is inclusive of drainage lines and the Mgeni River which is approximately 1km away from the study site.

The area consists of several wetlands in and within the 500m surrounding buffer which were identified to be Hill-slope seepage and channel valley bottom wetlands, in which the Hill-slope seepage wetlands within the proposed study site drain into one river riparian habitat identified as the Gobhogobho River.

2.2. Climate

The proposed Inanda Glebe sewer reticulation project is located on the KZN seaboard, approximately 14.5 km from the Indian Ocean resulting in the high humidity experienced in the area. The area is situated in the sub-tropical rainfall region of South Africa which experiences most of its rainfall during the summer season that extends from November to February. The lowest rainfall received is during winter months June and July. The average midday temperature at the study area ranges from 22.4°C during the winter months and 27.6°C during the summer months. The Mean Annual Precipitation (MAP), the Mean Annual Evapotranspiration (MAE) and Mean Annual Runoff of the study area are 921mm, 1214mm and 152mm respectively.

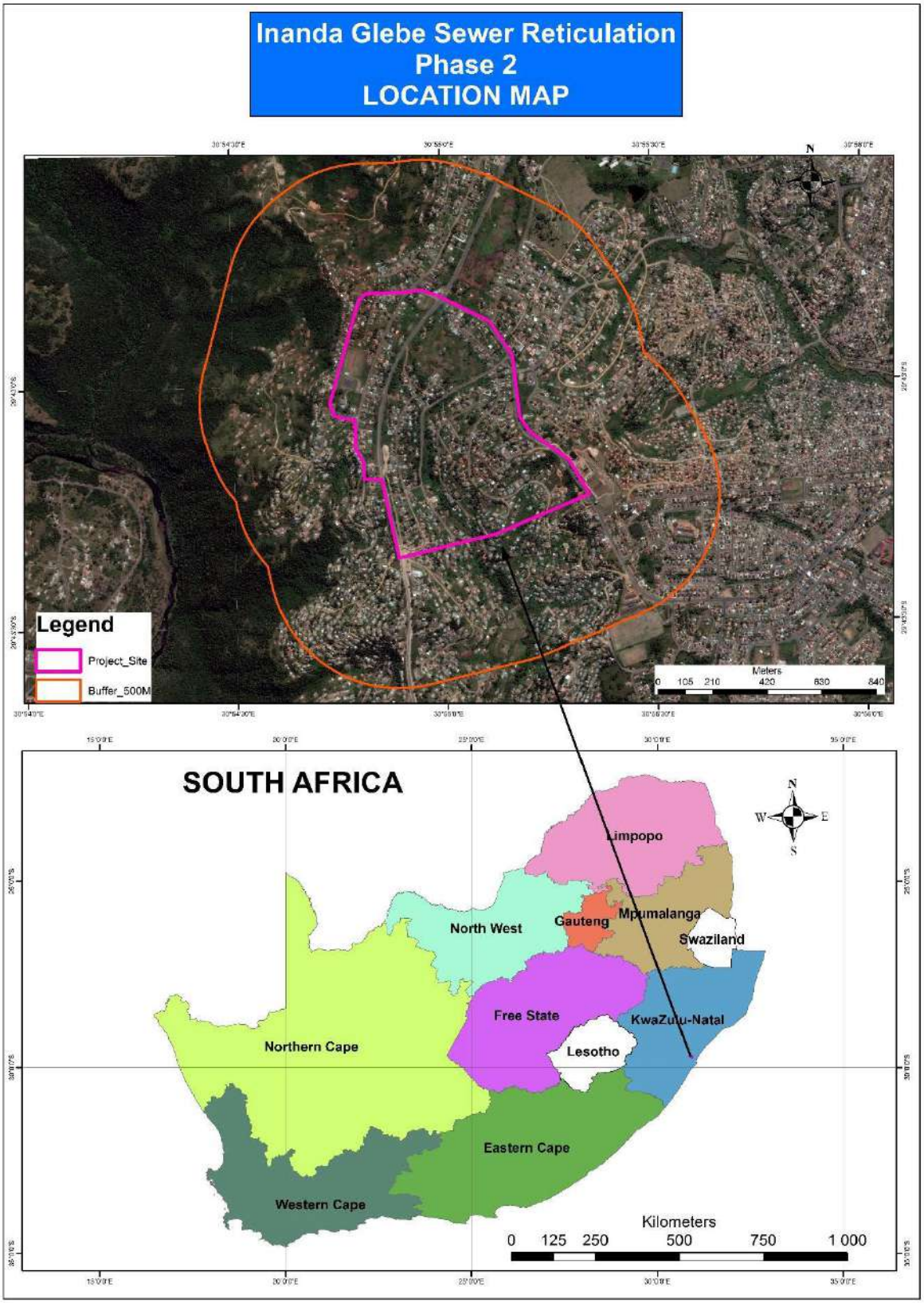

Inanda Glebe Sewer Reticulation
Phase 2
LOCATION MAP
N
Legend
Project_Site
Buffer_500M
Meters
0 105 210 420 630 840
SOUTH AFRICA
N
W
E
S
Limpopo
North West
Gauteng
Mpumalanga
Swaziland
Free State
KwaZulu-Natal
Lesotho
Northern Cape
Eastern Cape
Western Cape
Kilometers
0 125 250 500 750 1 000

FIGURE 2.1: Location of the Inanda Glebe sewer reticulation with the proposed plan superimposed on the site.

2.3. Slope and Topography

The general topography of the study site is characterized by undulating hills with gentle and steep sloping landscape cut by drainage lines. The study site situated on several major and minor ridges, and a single valley in which the Gobhogobho River flow within it. The terrain around the study site has been altered drastically by residential housing found major and minor ridge ridges and, even in close proximity to the Gobhogobho River. Additionally, vegetation is present in dense amounts within the river riparian habitat and in areas where the land has not been altered.

2.4. Hydrology and impacts to the hydrological regime

According to the Department of Water Affairs (DWA) Water Management Areas (WMAs), the proposed pipeline development is situated in the Mvoti to UMzimkhulu WMA and falls within the quaternary catchment U20 M. Historically, the study area was largely natural with a few residential settlements that used the land for subsistence farming. Consequently, the rapid increase in residential settlements and infrastructural development surrounding the study area, such as the presence of gravel roads and manmade paths, have transformed the landscape which in turn altered flow regime and the quality of water in certain areas within the 500m buffer zone. Additionally, the common water-uses of the quaternary catchment U20 M includes domestic use and for small scale subsistence farming.

The Inanda Glebe proposed sewer reticulation site occurs within the KwaZulu-Natal Foreland Groundwater Region and is characterised by predominantly arenaceous rocks consisting of Sandstone and Dwyka Tillite.

2.5. Site geology

The geology of the study site as previously mentioned in (Section 2.3 Hydrology) above is mostly characterised by arenaceous rocks. The hydrologically relevant geology recognized in the study area comprise of exposed sandstone bedrock which was identified within the valleidentified within the valley in close proximity to the river riparian environment and exposed Dwyka Tillite identified on a major ridge of the study site. Furthermore, the exposed sandstone bedrock contained intrusions of dolerite (dykes).

2.6. National Freshwater Ecosystems Protected Areas (NFEPA)

National Freshwater Ecosystem Priority Areas (NFEPA) are considered to be highly important yet vulnerable to any alterations in water quantity and quality in South Africa (Nel *et al.,* 2011). Their importance stems from the fact that NFEPAs are responsible for encouraging the sustainable use of water resources and protecting freshwater ecosystems. Additionally, the NFEPA project also strives to conserve a sample of freshwater ecosystems and diversity of species as well as the ecosystem processes which generate and maintain diversity. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development. According to the NFEPA wetland coverage of the study area, there are four NFEPA wetlands in and within the 500 surrounding buffer. The two NFEPA wetlands located within the study site are located to the south of the site and identified as natural bench wetlands. The two NFEPA wetlands located within the 500m surrounding buffer are located to the south-east and east of the study site, approximately 335m and 390m away respectively. These NFEPA wetlands were also identified to be natural bench.

2.7. DWA Ecoregions and Vegetation

TABLE 2.1: DWA Ecoregions and Vegetation descriptions.

DWA Ecoregions	Vegetation
Ecoregions are used to categorise the regional setting for national and regional water resource management applications. The ecosystem approach identifies main attributes which include physiography, climate, rainfall, geology and potential natural vegetation (Kleynhans *et al*., 2005). The proposed mixed use development activity site is situated within the North Eastern Coastal Belt Ecoregion (Level 1, Ecoregion 17). This ecoregion is characterized by diverse terrain morphology (closed hills, mountains, plains, table lands) and the primary vegetation types consist of Valley Thicket and a variety of Grassland and Bushveld types (Kleynhans *et al.,* 2005).	The proposed development site is located within the Indian Ocean Coastal Belt biome in Kwa-Zulu Natal. This biome primarily occurs on the East Coast of South Africa across the Eastern Cape and KwaZulu-Natal. The coastline is extensively developed with very limited portions of the land retaining its native vegetation. Approximately 7% of the belt is protected in terms of its natural vegetation while 39% of the area has been highly transformed (Wakenshaw Trust, Environmental Scoping Report, 2008). The study area was inclusive of a combination of alien invasive plants and indigenous vegetation. Some of the alien invasive plants

	that were noted on site included *Canna sp.*, *Carica papaya* (Papaya), *Psidium guajava* (guava), Cyprus sp., *Gomphocarpus physocarpus*, *Chromolaena odorata* and *Lantana camara*.

2.8. D'MOSS

The D'MOSS (Durban Metropolitan Open Space System) is a system of open spaces; the aim of the D'MOSS is to maintain as many functional ecosystems as possible and to provide corridors between open spaces to allow for the flow of genetic material, water, nutrients and energy as well as to prevent local species extinctions in the eThekwini Municipal Area. In addition, D'MOSS plays a significant role in climate change mitigation due to its carbon sinks, therefore, wetlands and forests ecosystems. The developer needs to ensure that the proposed site does not fall within or affects a D'MOSS corridor. This is important since the study site is in close proximity to a D'MOSS conservancy.

2.9. National Biodiversity Assessment (NBA, 2011)

The NBA (2011) provides a vast array of assessment of South Africa's biodiversity and ecosystems, which is inclusive of national maps for the estuarine, freshwater, marine and terrestrial environments. The South African National Biodiversity Institute (SANBI) in collaboration with the Department of Environmental Affairs and a range of organisations led the NBA (2011) such as a range of organisations, involving wide participation from stakeholders, scientists and biodiversity management experts throughout the country over a three-year period. The NBA (2011) is a follow on from the National Spatial Biodiversity Assessment 2004, which broadened the scope of the assessment to include thematic issues and spatial assessment. Furthermore, the NBA (2011) is inclusive of a summary of the spatial biodiversity priority areas that have been identified through systematic biodiversity plans at a local, provincial and national level (SANBI BGIS).

As a result of this information provided by the NBA (2011), it can be determined if the study area is a protected area or not. The study area was determined not to be located within an informally or formally protected area.

3. METHODOLOGY

3.1. Desktop study

A desktop study was initially undertaken to acquire an understanding of the general study area, details of which are presented in Section 2: Study Area. Desktop data included sourcing information on vegetation characteristics, hydrology, Ecoregion classification; NFEPA's, D'MOSS designated areas, NBA (2011) areas and land uses occurring in the region. Thereafter, a desktop survey was conducted to identify potential wetland and fluvial areas of interest within the site and the 500m buffer of the development site *via* satellite imagery as well as shapefiles obtained from the South African National Biodiversity Institute (SANBI) (Ollis *et al.,* 2013). Wetland boundaries assessed were delineated at a desktop level and were later verified *via* a comprehensive field survey.

3.2. Field assessment of wetland delineation

A comprehensive wetland delineation field survey was undertaken on the 24th April 2017 to accurately delineate boundaries of wetland and river riparian environments in the Inanda Glebe study site and surrounding 500m buffer area. The field survey included identifying wetland areas, delineating the outer boundaries of temporary zone of wetland and classifying the type of wetland.

3.2.1. Wetland delineation

Four specific wetland indicators were used to identify/verify wetland areas:

- terrain unit,
- vegetation (Table 3.1),
- soil: texture (sand & clay); colour (chroma, hue & value); organic matter and;
- degree of saturation.

Once wetland areas were identified, wetland delineation was undertaken. The wetland delineation procedure identifies the outer edge of the temporary wetland zone, marking the boundary between the aquatic and adjacent terrestrial areas. The wetland delineation field verification began at the lowest lying point of the wetland and proceeded outwards into the permanent, seasonal and ultimately the outermost temporary zone (Figure 3.1). To identify the outer edge of the temporary wetland zone, a Dutch soil auger was used to extract sediment cores. The sediment samples were evaluated on-site for redoxymorphic soil features such as mottling, soil wetness and gleying after which the samples were discarded.

The GPS coordinates of all soil sampling locations were captured and mapped using Geographic Information Systems (GIS) (ArcView 10.2) for further processing and analysis. Aerial photography, field notes and coordinates of the sampling sites were then used in combination to identify and delineate the extent of wetlands/riparian areas.

TABLE 3.1: Classification of plants per occurrence in wetlands (DWAF, 2008).

Type	Description
Obligate Wetland Species	Almost always grow in wetlands (> 99% of occurrences)
Facultative Wetland Species	Usually grow in wetlands (67-99% of occurrences) but occasionally are found in non-wetland areas
Facultative Species	Are equally likely to grow in wetlands and non-wetland areas (34-66% of occurrences)
Facultative Dry-land Species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% of occurrences)

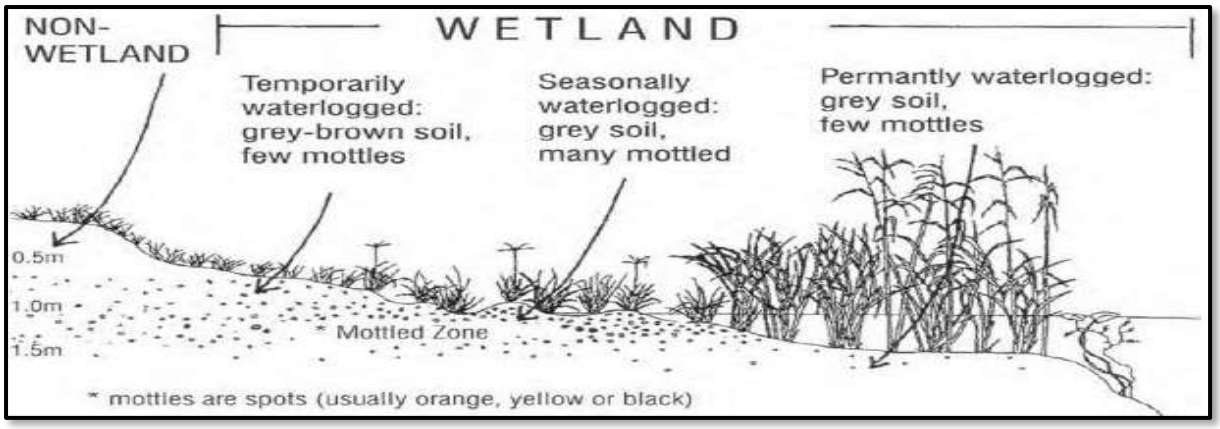


FIGURE 3.1: Non-wetland and wetland zones (DWAF, 2005).

3.3. Wetland/Riparian classification

Wetlands may comprise of one or more HGM units. In this report, the method of identifying a wetland followed by its sub-classification into HGM units is utilized where necessary. The wetland areas identified were classified into HGM units according to the National Wetland Classification System developed by the SANBI (Ollis *et al.,* 2013). The HGM classification system uses the geomorphological and hydrological features of the delineated wetland unit to determine its classification. The features that are assessed relate to the way in which water behaves in the wetland system. River Riparian (RR) systems were divided in RR units based on topographic location, landform, hydrological characteristics and potential risk of degradation.

3.4. Wetland screening

A wetland screening was conducted to determine if the delineated wetlands were likely to be affected by the proposed Inanda Glebe sewer reticulation and likely to trigger aspects of a National Water Act, Section 21 (c and i). Any wetlands that fell within the impact zone, within the minor catchment of the Inanda Glebe pipeline development site and were potentially at risk, were screened further.

The first phase of the risk assessment was conducted at desktop level and verified in-field. This aided the determinations of which of the desktop delineated wetlands were likely to be affected by the proposed sewer reticulation. Wetlands not in the sphere of influence of the proposed activity, but within the 500m buffer were excluded from further risk quantification.

3.5. Risk Assessment

Those wetlands identified to be within the sphere of influence of the proposed Inanda Glebe sewer reticulation were further assessed using an adapted version of the risk assessment developed by the DWS (2015): "*Aspects and impact register/risk assessment for watercourses including rivers, pans, wetlands, springs, drainage lines.*" The risk assessment involves scoring parameters with a rating between 1 and 5. A risk category class is derived for each activity/aspect (Table 3.2). A low risk category should be subjected to duty of care. A wetland that scores a moderate/high risk rating for any of the impacts should be subjected to a full wetland functional assessment. The tool used to determine the functionality of a wetland is described below.

TABLE 3.2: Risk categorization.

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Impact to watercourses and resource quality small and easily mitigated.
56 – 169	(M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale

3.6. Wetland/Riparian functional assessment

Following the above, functional assessments were conducted on all wetlands/river riparians assessed to be at risk of being compromised as a consequence of the activity. The functional assessment techniques used were: the WET-Health Level 1 assessment, WET-EcoServices Level 2 assessment; and the Ecological Importance and Sensitivity assessment and, Intermediate Habitat Integrity Assessment (IHIA).

3.6.1. WET-Health (Present Ecological State)

The WET-Health Level 1 assessment was undertaken to ascertain the Present Ecological State (PES) of the wetland environment affected by the proposed sewer reticulation. The state of the three main functional aspects of the wetland is considered for the WET-Health index. These include: (1) hydrology, (2) geomorphology and (3) vegetation.

Each of these functional aspects follows a broadly similar approach and is used to determine which anthropogenic impacts have affected the health status of the wetland. The overall score is integrated and expressed as a PES category. In addition, the trajectory of change of the wetland health is also assessed and is expressed as a change symbol (Tables 3.3 and 3.4).

TABLE 3.3: Present ecological score categories for describing the integrity of wetlands.

Impact Category	Health Category	Description	Range
None	A	Unmodified/natural	0 – 0.9
Small	B	Mostly Natural with a few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1 – 1.9
Moderate	C	Moderately modified. A moderate change in the ecosystem processes and the loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9
Large	D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4 – 5.9
Serious	E	A very large change in ecosystem processes and loss of natural habitat and biota but some of the remaining natural habitat features are still recognizable.	6 – 7.9
Critical	F	The modification has reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota	8 – 10

TABLE 3.4: Present ecological score categories for describing the integrity of wetlands.

Change Class	Description	HGM change symbol	Change Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain Stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is likely to deteriorate substantially over the next 5 years	-2	↓↓

3.6.2. WET-EcoServices (Ecological Goods and Services)

A WET-EcoServices Level 2 assessment evaluates the "ecological goods and services" provided by HGM units potentially affected by the proposed development. The tool provides information on the importance of wetlands in delivering different ecosystem services under a number of different categories (Kotze *et al.*, 2009). These categories are illustrated in Table 3.5.

Table 3.5: Wetland ecological goods and services assessed by the WET-EcoServices tools.

WET-EcoServices	
Physical ecosystem services	**Socio-cultural ecosystem services**
Flood attenuation	Biodiversity maintenance
Stream flow regulation	Provision of water for human use
Sediment trapping	Provision of cultural floods
Phosphate assimilation	Cultural significance
Nitrate assimilation	Tourism and recreation
Toxicant assimilation	Education and research
Erosion control	
Carbon storage	

The WET-EcoServices assessment technique focuses on assessing the extent to which a benefit is being supplied by the wetland habitat, based on both:

- The opportunity for the wetland to provide the benefits; and
- The effectiveness of the particular wetland in providing the benefit.

Ecosystem services, which include direct and indirect benefits to society and the surrounding landscape, were assessed by rating various characteristics of each wetland and their surrounding catchments, based on a scale of:

- Low (0)
- Moderately Low (1);
- Intermediate (2);
- Moderately High (3); and
- High (4).

The scores obtained from these ratings for the wetland HGM unit were then incorporated into WET-EcoServices scores for the ecosystem services (Figure 3.2).

3.6.3. Ecological Importance and Sensitivity (EIS)

The EIS scores are calculated using the methods outlined by the "*Resource Directed Measures for Protection of Water Resources*" (Kleynhans, 1999). This approach provides information on the ecological importance of the HGM units and River riparian habitat in terms of unique biodiversity and sensitivity which refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Table 3.6).

TABLE 3.6: Ecological Importance and Sensitivity Scores.

EIS Category	Ecological Management Class[1]	Description	Range of Median
Very High	A	Ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4
High	B	Ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate	C	Ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2
Low/marginal	D	Ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>0 and <=1

3.6.4. Intermediate Habitat Integrity Assessment (IHIA)

The general habitat integrity of the RR unit was determined based on the application of the IHIA for use in rapid and intermediate habitat assessments (Kleynhans, 1999). This method describes the PES of both the instream and riparian habitats at each site according to a weighting system ranging from 0 to 25, with 0 representing no impact and 25 an extremely critical impact. The system then makes use of an average of the weighted rating of each aspect to determine the integrity of both the instream environment and the riparian zone. The IHIA score is then defined as the average score for the instream and riparian habitat integrity scores. The method classifies Habitat Integrity into one of six classes (Table 3.7), ranging from unmodified/natural (Class A), to critically modified (Class F).

TABLE 3.7: Habitat integtrity score classes (Kleynhans, 1996).

Class	Description	Score
A	Unmodified/natural	100
B	Largely natural with few modification. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged	80-99
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions have occurred	40-59
E	The loss of natural habitat, biota and basic ecosystem functions are extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

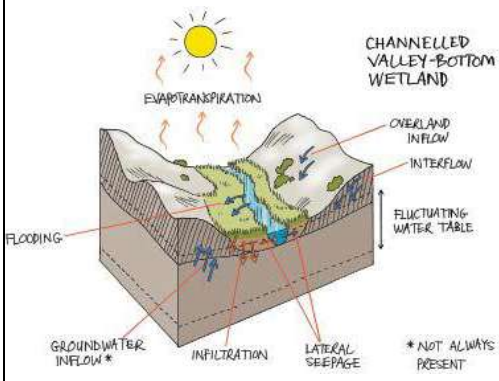
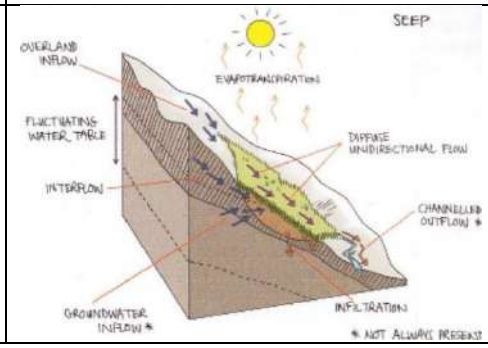
4. RESULTS OF THE WETLAND ASSESSMENT

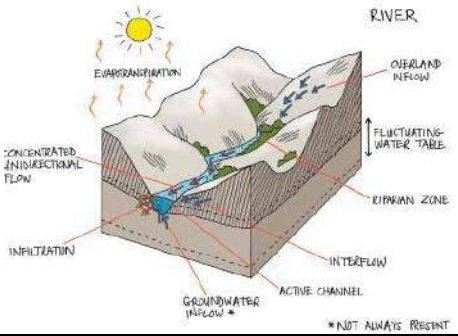
4.1. Desktop study and field survey

The desktop and field surveys incorporated the identification of the wetland and river riparian environments in and within the 500m buffer surrounding the site. Eleven wetland systems were identified and delineated and one river riparian system was mapped in the site and within the surrounding buffer area.

For further understanding of the description of the HGM units and river riparian system occurring in the Inanda Glebe study site, DWAF (2008) and Ollis et al (2013) created a generic description which is shown in Table 4.1 below.

TABLE 4.1: HGM units present on the proposed development site and surrounding 500m buffer (DWAF, 2008; Ollis et al., 2013).

Classification	Illustration	Description
Channelled valley bottom		Linear fluvial, net depositional valley bottom surfaces with a straight channel and permanent or seasonal flow. Episodic flow is thought to be unlikely in this wetland setting. The straight channel tends to flow parallel with the direction of the valley The valley floor is a depositional environment such that the channel flows through fluvially-deposited sediment. Tend to be found in the upper catchment areas.
Hillslope Seep (isolated or linked to a stream channel)		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflows either very limited, through diffuse sub-surface and/or surface flow, or with a direct surface water connection to a stream channel.

River		Linear fluvial, eroded landforms which carry channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone.

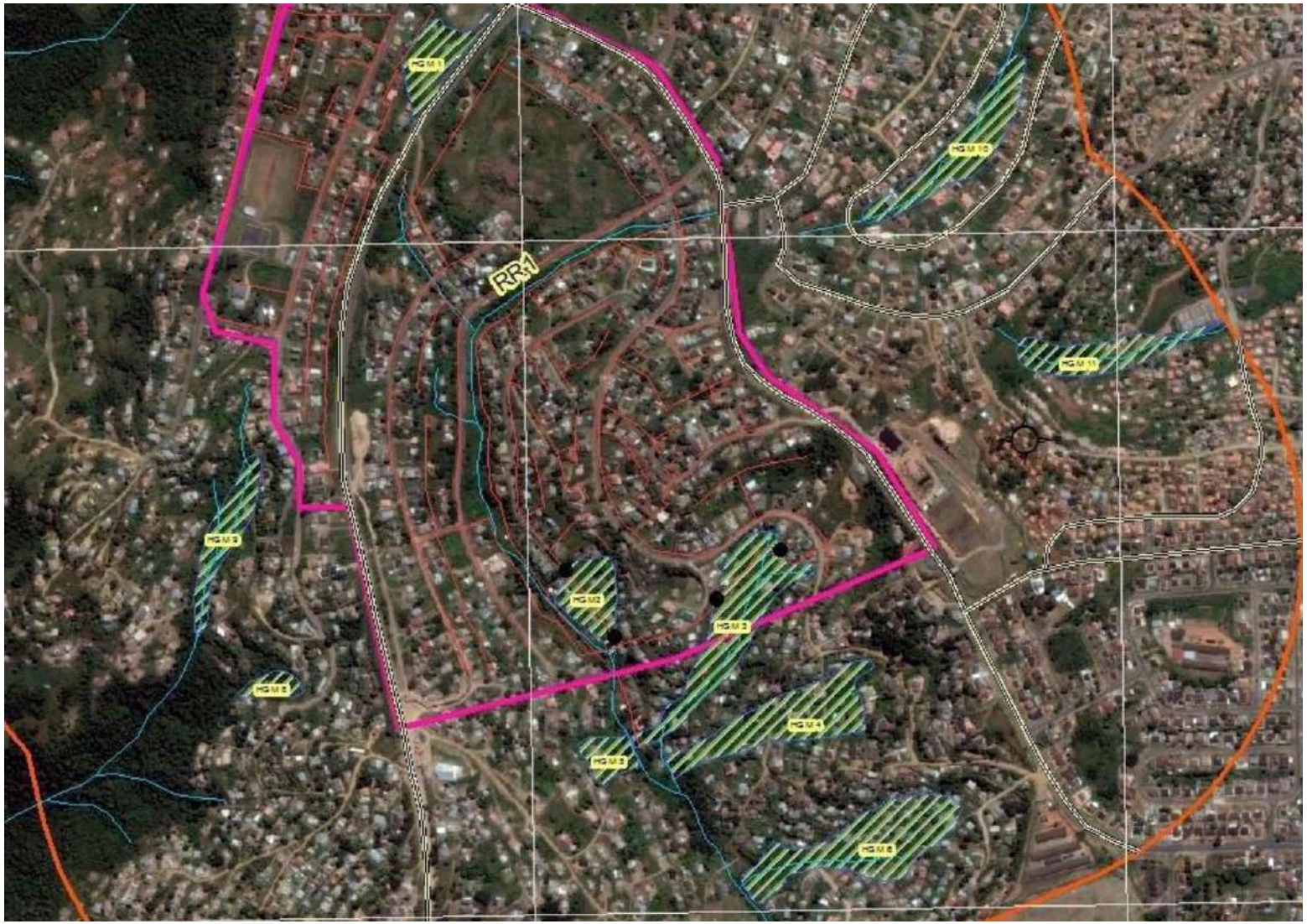


FIGURE 4.1: The HGM units and river riparian habitat found within the surrounding 500m buffer of the Inanda Glebe sewer reticulation project

4.2. Hydrogeomorphic units

A summary table of the wetlands and HGM units together with their characteristics is provided below (Table 4.2)

TABLE 4.2: Summary of wetland and river riparian characteristics

Wetland/RR No.	HGM/RR No.	Wetland Type/River Riparian	Extent (Ha)	Slope (%)	Length of HGM (m)	Pipeline	Crossing width (m)	Start	End
1	1	HS	0.67	0.01	354	-	-	-	-
2	2	HS	0.74	1.3	465	160mmHDuPVC	84	29°43'13.91"S 30°55'12.95"E	29°43'15.67"S 30°55'10.27"E
3	3	HS	1.45	13.1	875	160mmHDuPVC	90	29°43'14.85"S 30°55'36"E	29°43'17.88"S 30°55'4.63"E
4	4	HS	1.59	10.2	704	-	-	-	-
5	5	HS	0.23	0.03	172	-	-	-	-
6	6	HS	1.51	11.2	690	-	-	-	-
7	7	HS	0.90	10.8	631	-	-	-	-
8	8	HS	0.13	0.03	136	-	-	-	-
9	9	HS	0.45	9.8	426	-	-	-	-
10	10	CVB	1.32	5.6	704	-	-	-	-
11	11	CVB	0.82	8.6	590	-	-	-	-
1	1	RR	N/A	N/A	833	-	-	-	-

CVB – channeled valley bottom wetland; UVB – un-channeled valley bottom wetland; HS – hillslope seepage wetland; D/P – Depression/Pans. * Note: HGM units and streams at risk are shaded in red.

Wetland 1, 2 and 3: HGM 1, 2 and 3

- HGM 1, 2 and 3 are all located within the proposed sewer reticulation study site. HGM 1 is an isolated Hill-slope seepage wetland to the north boarder of the proposed study site and HGM 2 and 3 are also Hill-slope seepage wetlands but connected to a channel and located to the south boarder of the proposed study site. HGM 1, 2 and 3 contain appreciable alien vegetation and patches of areas with wetland vegetation such as *Phragmites australis* and *Typha capensis*. Furthermore, HGM 2 and 3 is partly utilized for subsistence farming.

  HGM 1 will be impacted by the proposed sewer reticulation as the planned pipe laying boarders the HGM unit. Furthermore, a Section 24G application will be required as unauthorised housing exists within the area of the wetland environment. HGM 2 and 3 will be significantly impacted by the proposed sewer reticulation as pipe laying will occur within wetland environment. Therefore, special mitigation measures will be required for these HGM units which will be discussed further (in Section 6 of this report). Additionally, since unauthorised housing exist within the bounds of these HGM units, a Section 24G application will be required.

FIGURE 4.2: HGM's 2 and 3 associated impacts.

Wetland 4, 5, 6 and 7: HGM 4, 5, 6 and 7

- HGM 4, 5, 6 and 7 are all located within the 500m surrounding buffer area. All of these HGM's are positioned to the south of the 500m surrounding buffer area. All of these wetland systems were identified as Hill-slope seepage HGM units with a channel that drain towards the Gobhogobho River. As HGM 1, 2 and 3, all of the above HGM units contain an appreciable amount of alien vegetation within them and a host of unauthorised housing within the wetland area.

  HGM 4, 5, 6 and 7 are not impacted by the proposed sewer reticulation as the locations of these HGM units fall out of the study sites jurisdiction. However, as a result of the unauthorised housing within the HGM units, a Section 24G application will be required for those specific housing.

Wetland 8 and 9: HGM 8 and 9

- HGM 8 and 9 are located to the south-west area within the 500m surrounding buffer. HGM 8 was identified as an isolated Hill-slope seepage, whereas HGM 9 is a Hill-slope seepage with a channel. These HGM units contain a fair amount of alien vegetation in and surrounding the wetland. Furthermore, HGM 8 and a small portion of HGM 9 are inclusive of a D'MOSS area. Although these HGM 8 and 9 are not located within the proposed sewer reticulation and are identified not to be at risk from this, no construction work should impact this area currently and in the future.

Wetland 10 and 11: HGM 10 and 11

- HGM 10 and 11 are located to the north-east area within the 500m surrounding buffer. These HGM units are located a fair distance away from the proposed sewer reticulation area and were identified as channelled valley bottom wetlands. The surrounding land around these wetland systems have been modified drastically by tar and dirt roads, and several residential dwellings in close proximity to these wetland systems.

River Riparian 1: RR 1

- One river riparian habitat is located within the valley of the proposed sewer reticulation. This river riparian habitat was identified to be the Gobhogobho River. The river systems flow begins from the north-east boundary of the proposed site in which several tributaries feeds into the main river channel that changes flow into a southerly direction. The tributaries that feed the main river channel present with or without Hill-slope seepage wetlands.

FIGURE 4.3: River riparian 1 and its associated impacts

4.3. Screening of 'at risk' wetlands/river riparian environments

A river riparian habitat and eleven wetland systems were identified within the 500m buffer zone *via* desktop survey and subsequent field surveys/verification (as shown in Figure 4.1).

Wetlands not at risk

HGM's 4, 5, 6, 7, 8, 9, 10, and 11 were assessed not to incur impacts (direct or indirect) from the proposed sewer reticulation:

- All the above-mentioned wetlands are not within the boundary of the proposed sewer reticulation. HGM's 4, 5, 6 and 7 are all located to the south of the proposed sewer reticulation all within the surrounding 500m buffer area. The above mentioned HGM units are a fair distance away from the proposed study site, hence, no impacts will incur on these wetlands. HGM's 8 and 9 are located to the west, HGM's 10 and 11 are located to the east of the proposed sewer reticulation. These HGM units are topographically separated and a fair distance away from the site as a result of HGM's 8 and 9 location on a west-facing ridge and, HGM's 10 and 11 are a distance away from east boundary of the proposed sewer reticulation.

Wetland and River riparian systems at risk

- HGM's 1, 2 and 3; and river riparian 1 were assessed to be at risk of being impacted directly by the proposed sewer reticulation. These systems were therefore functionally assessed (WET-Health Level 1; WET-EcoServices Level 2, EIS and IHIA

4.4. Functional Assessment for HGM unit 2

4.4.1. WET-Health and Present Ecological assessment

Wetland health measures the status of a given wetland relative to the natural or reference condition or specifically, is a measure of the extent to which anthropogenic impacts have caused the wetland to differ from the natural reference condition. In this study, the WET-Health procedure (Macfarlane *et al.,* 2009) was used to examine the deviation from the natural reference condition for three components of wetland health, *viz*., hydrology, geomorphology and vegetation.

TABLE 4.3: Composite PES scores for HGM 2

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	1	25	4.0	-1	1.9	-1	7.5	-1
2	1	20	7.5	-1	1.8	-1	5.9	-1
3	1	55	7.0	-1	2.0	-1	7.0	-1
Area weighted impact scores			7.4	-1	1.9	0	6.9	-1
PES Category			E	↓	B	↓	E	↓

The PES determination for the 'at risk' wetlands provide some useful insight of the health status of the wetlands.

Hydrology

The hydrology of all systems has been compromised. HGM's 2 and 3 have been seriously impacted, both by housing development, subsistence farming, trenching for pipe laying and creation of dirt roads within these wetland systems which all compromise the sub-surface water quantity. Furthermore, a reduction in flood peak patterns will occur diffuse flow within the wetland environments are drastically impacted.

The hydrology score for HGM 1 reflects a PES category D as compared to HGM's 2 and 3 which are a category E respectively. This is a direct result of housing and subsistence farming occurring within the HGM unit, however, at not the same severe degree as compared to HGM's 2 and 3. The overall hydrology PES for all HGM units is a category E within slight deterioration over the next five years.

Geomorphology

The geomorphology of all HGM units revealed overall category B PES. Hence, the overall geomorphology within these wetland systems remained largely natural with a few changes

to the natural habitat and biota as a result of the land-use changes that have occurred within the wetland system. However, the geomorphology is expected to slightly deteriorate over the next five years as a direct result of possible trenching and excavating to lay pipes for sewer reticulation within wetland areas.

Vegetation

The vegetation overall vegetation module for all HGM units revealed a PES category of E and the vegetation health is expected to decrease slightly over the next 5 years. This indicated that the wetlands would experience a serious impact with regards to changes in vegetation composition. Several factors influenced the change in vegetation; these include the removal of indigenous vegetation within the wetland, subsistence farming in the seasonal and temporary zones of the wetland, the proliferated dense alien vegetation in the wetland and areas of sediment deposition. Furthermore, the housing found in certain portions in the wetland further resulted in impacts to vegetation due to clearing of vegetation and establishment of foreign vegetation in several areas.

HGM 2 scored a category D PES for vegetation as a result of slightly less removal of indigenous vegetation and less housing within the wetland environment.

4.4.2. WET-EcoServices assessment and the provision for Ecological goods and services

A WET-EcoServices Level 2 assessment was conducted and assessed the indirect "ecological goods and services" provided by HGM's 1, 2 and 3 which are potentially affected by the proposed sewer reticulation and the maintenance of this new reticulation in the future. The tool provided information on the importance of a HGM unit which delivered different ecosystem services in relation to a number of different categories (Kotze *et al.,* 2009). Figure 4.2 illustrates the ecosystem services scores:

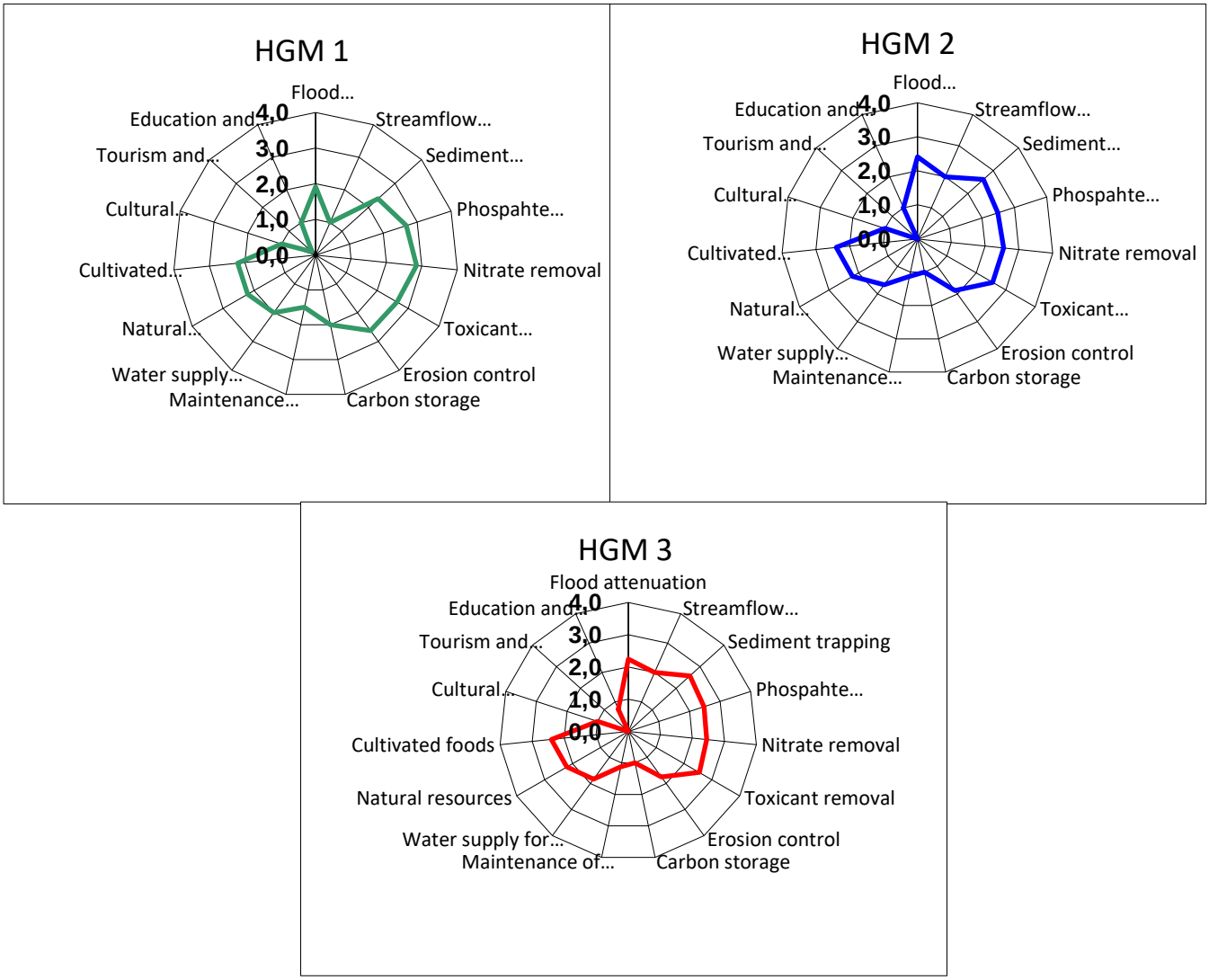


FIGURE 4.4: WET-EcoServices for HGM's 1, 2 and 3.

The ecosystem services provided by HGM's 1, 2 and 3 were evaluated and the aforementioned diagrams. The wetlands hydro-geomorphological type influenced the type and extent of ecosystem services provided by the wetlands. The contribution to socio-cultural benefits were limited, as a result of the location of the wetlands in a rural community that provided certain households with cultivated food and natural resources. However, from an education and cultural standpoint, all of the HGM units did not provide much insight.

The wetlands contributed moderately to high to physical ecosystem services which included phosphate, nitrate, toxicant removal and; sediment trapping and erosion control. Although the terrain within the HGM units have been drastically altered, the HGM units still aids in the natural filtration of nutrients and toxicants and allows for sediment trapping to occur before

entering the river riparian habitat. Furthermore, carbon storage for HGM 2 and 3 are limited as a result of possible rapid mineralization of organic matter in this environment and due to a lack of indigenous vegetation. HGM 1 on the other hand is well vegetated and offers some carbon storage attributes, however, streamflow regulation is poor as a direct result of this HGM unit not being linked to any stream network.

4.4.3. Intermediate habitat integrity assessment

This method describes the PES of both the instream and riparian habitats for RR 1 according to a weighting system ranging from 0 to 25, with 0 representing no impact and 25 an extremely critical impact. The system then makes use of an average weighting rating of each aspect to determine the integrity of both the instream environment and riparian zone. The IHIA score is then defined as the average score for the instream and riparian habitat integrity scores. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F). The IHIA scores for the RR unit are discussed below.

TABLE 4.4: Instream Habitat Integrity

Weights	14	13	13	13	14	10	9	8	6		
Criteria	Water abstraction	Flow Modification	Bed Modification	Channel modification	Water quality	Inundation	Exotic macrophytes	Exotic fauna	Solid waste disposal	Total score (%)	Classification
RR1	6	16	12	12	13	11	0	0	14	84	
Score	3.36	8.32	6.24	6.24	7.28	4.4	0	0	3.36	60.8	C – Moderately modified

TABLE 4.5: Riparian Zone Habitat Integrity

Weights	13	12	14	12	13	11	12	13		
Criteria	Vegetation removal	IAP encroachment	Bank erosion	Channel modification	Water abstraction	Inundation	Flow modification	Water quality	Total score (%)	Classification
RR1	13	17	10	10	3	11	11	14	89	
Score	6.76	8.16	5.6	4.8	1.56	4.84	5.28	7.28	55.72	D – Largely modified

TABLE 4.6: Final Intermediate Habitat Integrity Assessment scores

RR unit	Instream Habitat	Riparian Zone	IHI Score	Class
RR1	60.8	55.72	58.26	D

River riparian 1:

- The instream environment and riparian habitat were assessed to be moderately modified and largely modified respectively. Many activities/impacts within the instream environment for RR1 were largely severe including bed and channel modification, and water quality. This was a direct result of excavation currently occurring in the instream environment and wetlands in the catchments inability to trap sediment as a result of changes in its environment. The solid waste pollution was considered to be large impact on the instream environment. The riparian habitat zone was moderately impacted by bank erosion and seriously impacted by IAP encroachment. A large loss and change of natural habitat, biota and ecosystem functions have occurred. Overall the habitat of the system can be considered to be largely modified, PES Class D.

4.4.4. Ecological importance and sensitivity

The ecological importance of a wetland/river riparian environment is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has been impacted (Kleynhans *et al.*, 1998).

The EIS considers biodiversity, rarity, uniqueness and fragility of the resource. The intrinsic ecological value of the resource and its importance to the functioning of neighbouring ecosystems are the main concerns.

TABLE 4.7: EIS assessment scores, confidence levels and descriptions for HGM's 1, 2, 3 and RR1

Determinant	HGM 1	HGM 2	HGM 3	RR 1	Conf.	Reason
1. Rare and endangered species	0	0	0	0	4	None observed, The surrounding areas are highly transformed, due to anthropogenic activities in particular unauthorised housing in wetland areas and in close proximity to river riparian environments.
2. Populations of unique species	0	0	0	0	3	None observed during the site visit and it is unlikely that any exist however; a detailed ecological assessment may reveal the presence of unique species.
3. Species / taxon richness	1	1	1	1	3	Poor indigenous species richness was observed throughout the wetland and river riparian environments, many invasive alien plants were found throughout the HGM units and river riparian environments.
4. Diversity of habitat types or features	1	1	3	1	3	Generally low *natural* habitats within wetland and river riparian environments.
5. Migration/breeding and feeding site for wetland/river riparian species	1	1	2	1	2	No bird species were observed at the HGM and river riparian environments during the field survey. However, an extensive ecological assessment is required for discerning the migrating/breeding wetland and river riparian species.
6. Sensitivity to changes in natural hydrological regime	1	2	3	3	3	HGM 1 is not susceptible to hydrological change as it is not linked to a channel and is predominantly fed by sub-surface flow. HGM's 2 and 3 and; RR 1 are more susceptible to hydrological change as these environments rely on sub-surface and surface water inputs. A distinct channel also runs through these environments which can be detrimental to these environments if the channels are altered.
7. Sensitivity to water quality changes	2	2	3	2	3	The wetland and river riparian environments are susceptible to changes in water quality due to the catchment activities that promote introduction of point and non-point sources of pollution.
8. Flood storage, energy dissipation and particulate/element removal	2	3	3	2	3	In the HGM units the flood waters may be dissipated by reed and other vegetation types. The river riparian environment can regulate the flow and energy of water downstream.
9. Base flow augmentation; dilution	2	2	2	0	3	The main contributor to flow in the HGM units are sub-surface input with little to none from lateral input. This is not applicable to the river riparian environment

Determinant	HGM 1	HGM 2	HGM 3	RR 1	Conf.	Reason
10. Protected Status Area	1	1	4	1	4	HGM's 1 and 2; and RR 1 are not protected areas. However, portions of HGM 3 were identified to be NFEPA natural bench wetlands.
11. Ecological importance (rarity of size/type/condition) – local, regional or national context	1	1	2	2	3	HGM 1 and 2 was of low ecological importance, HGM 3 and RR 1 were of moderate importance as a result of their size.
TOTAL	**12**	**14**	**23**	**13**	**35**	
Average	**1.09**	**1.27**	**2.09**	**1.18**	**3.18**	
MEDIAN	**1**	**1**	**2**	**1**	**3**	

The EIS assessment for HGM's 1, 2 and RR 1 shows that the biodiversity within the area was not of significant importance and sensitivity. HGM's 1, 2 and RR 1 yielded a median score of 1 indicating low importance and sensitivity, therefore a Category D for ecological importance and sensitivity. The biodiversity of ecology of these areas are adaptable and probably have a low sensitivity to flow and habitat modifications. The EIS assessment for HGM 3 was conducted and determined that this system yielded a median score of 2 which is of moderate importance, therefore a Category C for ecological importance and sensitivity. Portions of HGM 3 was identified to be NFEPA natural bench wetlands, therefore, HGM 3 will be sensitive to hydrological changes, water quality changes and changes to natural habitat. This area should be well protected as it serves several functions and acts a corridor for migratory fauna.

4.5. Buffer zone assessment for HGM's 1, 2, 3 and RR 1

Buffer zones are areas of vegetation around the wetland boundaries, which are requested to protect the wetland from developmental or land use changes. Protection may also extend to peak runoff/flood flows and the buffer zone may also provide feeding/breeding areas for wetland or river fauna and accordingly enhance the corridor function of drainage lines. In terms of the guidelines presented by DWAF, an appropriate buffer strip surrounding the wetland/riparian habitat is required to protect the habitat and the water resource. The buffer strip is dependent on the following (Kotze, *et al*., 2009):

- The type of adjacent land use;
- The sensitivity of the wetland; and
- The scarcity and quality of the water resource.

The following criteria table was used to derive an appropriate environmental setback from the wetland habitat for the current activity on site (Table 4.7).

TABLE 4.8: Buffer zone determination for HGM's 1, 2, 3 and RR 1

Factors to be considered	Less important Buffer (15 –20m)	Of value Buffer (20 – 30m)	Important Buffer (>= 30m)
1 Downstream and upstream sensitivities	Minimal e.g. surrounded by industry-residential-agriculture.	Moderate e.g. an important water catchment area.	Significant e.g. upstream of important nesting sites, spawning areas.
HGM's and RR affected by Factor 1		HGM's 1, 2 and RR 1	HGM 3
2 Soil permeability	High	Medium	Low
HGM's and RR affected by Factor 2		HGM's 1, 2, 3 and RR 1	
3 Topography, in particular steepness of the slope	Flat	Moderate	Steep
HGM's andRR affected by Factor 3		HGM's 1, 2 and RR 1	HGM 3
Factors to be considered	Less important Buffer (15 –20m)	Of value Buffer (20 – 30m)	Important Buffer (>= 30m)

4 **Biodiversity value in terms of conservation targets**	Low e.g. area completely transformed.	Moderate e.g. area has limited biodiversity value.	High e.g. area has significant biodiversity value.
HGM's and RR affected by Factor 4		HGM's 1, 2 and RR 1	HGM 3
5 **Degree of transformation proposed (coverage)**	0% - 20%	20% - 50%	50% - 100%
HGM's and RR affected by Factor 5			HGM's 1, 2, 3 and RR 1
6 **Volume of water flowing into the HGM's and RR**	Low e.g. low rainfall area	Medium e.g. medium rainfall area.	High e.g. high rainfall area.
HGM's and RR affected by Factor 6		HGM's 1, 2, 3 and RR 1	
7 **Potential environmental risks associated with the particular activity**	Low e.g. no pollutants.	Medium e.g. some Pollutants from anthropogenic activities.	High e.g. hazardous materials.
HGM's and RR affected by Factor 7		HGM 1	HGM's 2, 3 and RR 1

In this study, a 25m buffer around HGM's 1, 2 and RR 1 is required, and a 32m buffer is required for HGM 3. The buffer recommended around all HGM units and RR environments will help maintain the integrity of these environments in its current state. Although, the proposed sewer reticulation plan requires some pipe laying to occur through wetland environments, this will be discussed further in Section 6 of this report which provides specific recommendations and mitigations measures. Furthermore, all other recommendations and mitigation measures outlined in this report and the environmental management plan should be adhered to ensure the best environmental practices are conducted.

5. RISK ASSESSMENT

The impacts that may result from the proposed sewer reticulation can be direct impacts, indirect impacts or cumulative impacts. The main causes of impacts are insufficient planning prior to development. All construction activities should be conducted outside sensitive HGM units and their recommended buffer zone to prevent direct impacts to these environments. A risk assessment was conducted for HGM's 1, 2, and 3 as seen in the tables below.

5.1. Risk assessment key

TABLE 5.1: Risk assessment results for HGM 1

HGM 1				
Activity	Inanda Glebe sewer reticulation			
Aspects	Maintenance and repair of existing access roads	Vegetation maintenance within wetland	Introduction of foreign material	Excavating, trenching and infilling
Impacts	Erosion, sedimentation, change in geochemical regimes and loss of biodiversity			
Flow regime	1	2	3	3
Physio & Chemical (Water Quality)	2	2	3	3
Habitat (Geomorphology + Vegetation)	1	2	3	3
Biota	3	2	3	3
Severity	1.75	2	3	3
Spatial scale	2	2	3	2
Duration	2	3	2	2
Consequence	5.75	7	8	7
Frequency of activity	1	1	1	1
Frequency of impact	2	2	3	3
Legal issues	1	1	1	5
Detection	2	2	3	1
Likelihood	6	6	8	1
Significance	34.5	42	64	70
Risk Rating	L	L	M	M

The risk assessment revealed that the HGM 1 will have a 'low risk' for aspects maintenance and repair of existing roads and, vegetation maintenance within wetland. A 'moderate risk' was assigned for aspects introduction of foreign material and; excavating, trenching and infilling. This is due to these aspects ability to inhibit a more severe direct and indirect impact on the wetland as a result of the close proximity of excavating, trenching and infilling and; the ability of foreign material to easily transport and deposit into the wetland environment. Therefore, implementation of mitigation measures is a necessity to prevent and reduce the impacts from occurring.

TABLE 5.2: Risk assessment results for HGM 2

HGM 2				
Activity	Inanda Glebe sewer reticulation			
Aspects	Maintenance and repair of existing access roads	Vegetation maintenance within wetland	Introduction of foreign material	Excavating, trenching and infilling
Impacts	Erosion, sedimentation, change in geochemical regimes and loss of biodiversity			
Flow regime	2	3	4	4
Physio & Chemical (Water Quality)	2	3	4	4
Habitat (Geomorphology + Vegetation)	1	2	3	4
Biota	2	3	4	5
Severity	1.75	2.75	3.75	4.25
Spatial scale	2	2	3	3
Duration	2	2	3	3
Consequence	5.75	6.75	9.75	10.25
Frequency of activity	2	2	1	3
Frequency of impact	2	2	4	4
Legal issues	1	1	5	5
Detection	2	3	2	1
Likelihood	7	8	12	13
Significance	40.25	54	117	133.25
Risk Rating	L	L	M	M

The risk assessment revealed that the HGM 2 will have a 'low risk' for aspects maintenance and repair of existing roads and, vegetation maintenance within wetland. A 'moderate risk' was assigned for aspects introduction of foreign material and; excavating, trenching and infilling. Similarly to HGM 1, this is due to these aspects ability to inhibit a more severe direct and indirect impact on the wetland as a result of the close proximity of excavating, trenching and infilling and; the ability of foreign material to easily transport and deposit into the wetland environment. However, the risk rating score for this HGM unit will be of a higher intensity as excavating, trenching and infilling could occur in a small portion within the wetland. Therefore, special implementation of mitigation measures is a necessity to prevent and reduce the impacts from occurring (Discussed further in Section 6 of report).

TABLE 5.3: Risk assessment results for HGM 3

HGM 3				
Activity	Inanda Glebe sewer reticulation			
Aspects	Maintenance and repair of existing access roads	Vegetation maintenance within wetland	Introduction of foreign material	Excavating, trenching and infilling
Impacts	Erosion, sedimentation, change in geochemical regimes and loss of biodiversity			
Flow regime	2	3	4	5
Physio & Chemical (Water Quality)	2	3	4	5
Habitat (Geomorphology + Vegetation)	2	3	4	4
Biota	2	4	5	5
Severity	2	3.25	4.25	4.75
Spatial scale	1	2	3	3
Duration	2	2	3	4
Consequence	5	7.25	10.25	11.75
Frequency of activity	1	2	1	5
Frequency of impact	2	3	3	4
Legal issues	1	1	5	5
Detection	3	3	1	1
Likelihood	7	9	10	15
Significance	35	62.25	102.5	176.25
Risk Rating	L	M	M	H

The risk assessment revealed that the HGM 3 will have a 'low risk' for aspects maintenance and repair of existing roads. A 'moderate risk' was assigned for aspects vegetation maintenance within wetland and introduction of foreign material. A 'high risk' rating was assigned for excavating, trenching and infilling as a direct result of the proposed sewer reticulation pipe laying cutting through the wetland environment. This aspect will have severe impacts on the wetland environment as a result of changes in the hydrological and geomorphological regimes. Therefore, special implementation of mitigation measures is a necessity to prevent and reduce the impacts from occurring (Discussed further in Section 6 of report).

5.1. Direct/Indirect Impacts

The construction activities associated with the proposed development, in particular the pipeline, are listed below:

- Clearing of wetland crossing (vegetation and soil stripping);
- Flow diversion around the trench;
- Excavation of the trench;
- Top soil and subsoil stockpiling;
- Pipeline construction;
- Back-filling and compaction of wetland sub-soils and top-soils;
- Hazardous substances, handling mixture and disposal; and
- Waste generation and disposal.

Generally, all construction activities should be conducted outside the wetland/river riparian areas and their recommended buffer zone to prevent direct impacts to these environments. However, in the case of HGM 2 and 3 the proposed sewer reticulation pipeline will intersect these HGM units. In addition, HGM 1 and RR1 will be indirectly affected by the proposed pipeline.

TABLE 5.4: Construction phase impacts and their associated environmental significance

Environmental Significance Impacts (HGM's 1, 2, 3 and RR1)
❖ Habitat alteration -The removal if existing vegetation during construction by machinery or workers altering the ecological condition of the area and available habitat.
❖ Vegetation removal -The removal of vegetation will result in the exposure of the top-soil and bare surfaces processes (eg. Water flow, wind action). In addition, the removal of vegetation can destabilise embankments leaving them prone to collapse. Deposited sediment from bank collapse poses a high risk owing to its instability and susceptibility to transportation.
❖ Alteration of sediment dynamics i.e. sediment transportation -Physical alteration of the cross-sectional profile of the HGM unit will lead to altered sediment dynamics/sediment transport within the wetland affecting habitats downstream.
❖ Alteration of the hydrological regime i.e. natural flow -Physical alteration of the cross-sectional profile of the HGM unit will lead to altered, i.e. a decrease in natural flow within the wetland affecting habitats downstream. -Infilling and compaction of the wetland soils can lead to reduced soil permeability and increased surface runoff which may lead to increased erosion and the formation of concentrated flow paths. -Concentrated flows during high runoff events can cause enhanced erosion within the wetland altering the geomorphology of the system.
❖ Increased erosion and sedimentation -Bulk earthworks (excavation, trenching, re-profiling) within the HGM unit, decompression of wetland soils coupled with surface processes (e.g. wind, water, flow), can stimulate erosion and increase sedimentation of habitats downstream. -HGM's 2 and 3 are confined within a steep slope. The proposed pipeline trenches will be located in specific areas on either side within the wetland. Infilling and compaction of terrestrial soils can lead to reduced soil permeability and increased surface runoff downslope along the length of the trench. This may lead the formation of concentrated flow paths, increased erosion and sedimentation within HGM's 2 and 3; and further downslope. -Bulk earthworks (excavation, trenching, re-profiling) along the pipeline route coupled with surface processes (eg. wind, water, flow), can stimulate erosion and increase sedimentation of HGM's 1, 2 and 3.
❖ Soil disturbance, infilling and compaction -Infilling and compaction of soils within the wetland can lead to increased surface runoff which may lead to increased erosion through the formation of concentrated flow paths.
❖ Introduction of foreign material -Construction activities produce solid waste in the form of building material amongst others. These pollutants maybe unintentionally dumped into the wetland consequently reducing surface water quality.
❖ Reduction in aquatic species richness and abundance -Once areas have been cleared of vegetation, it is likely that invasive alien plants will colonise certain areas posing a threat to indigenous vegetation. IAP species have the ability to propagate and proliferate rapidly. Once established, IAP species generally outcompete indigenous plant species for natural resources, therefore, altering the structure and functioning of the ecosystem.
❖ Noise related disturbances -Construction activities undertaken within the wetland will produce noise pollution resulting in the disturbance and in some cases the dispersal of faunal species (eg. small mammals, birds and reptiles) from the habitat.

TABLE 5.5: Operation phase impacts and their associated environmental significance

Environmental significance
Impacts (HGM's 1, 2, 3 and RR 1)
❖ Proliferation of invasive alien plant species -Once construction activities have been completed, many areas in particular, the wetland crossings and surrounding construction sites will be bare ground. It is likely that IAP will colonise these areas. IAP species have the ability to propagate and proliferate rapidly posing a threat to indigenous vegetation. Once established, IAP species generally outcompete indigenous plant species for natural resources, therefore, altering the structure and functioning of the ecosystems.
❖ Wetland hydration -If the pipeline were to burst at the crossing it is most likely that the input of water into the HGM units will hydrate the wetland further. This is turn will increase nitrate and nitrate levels within the wetland as sewer water will be introduced directly into the wetland.

It is therefore proposed that all phases of construction and post construction be controlled and monitored to ensure that the above-mentioned impacts are prevented. Given sufficient care during the construction phase, this possibility can be eliminated almost completely.

6. MITIGATION AND RECCOMENDATION MEASURES

6.1. General recommendations and mitigation measures to be instituted into the EMP for the sewer reticulation.

The following general mitigation measures should be applied to the area of the sewer reticulation project to limit impacts on HGM 2 and 3 which are crossed by the pipeline:

Access control

- Schedule laying of pipes should be conducted in the dry season to prevent increased surface runoff, erosion and sedimentation as well as to avoid disturbance to resources during critical periods i.e. periods of courtship, breeding, nesting etc.
- part of the induction process, all staff should be educated about the importance and sensitivity of environmental areas near or within the sewer reticulation zones. Frequent inspection of the site must be done to ensure that the integrity of sensitive areas is maintained at all times.
- The construction zone should be restricted to a 15m construction servitude or to the engineer's specification
- The construction zone along the pipeline, where the pipeline crosses the wetland, should be fenced off and be clearly demarcated to prevent access to other areas of the wetland. Access in and out of the wetland area should be limited as far as possible

Vegetation

- All NEMBA category 1a and 1b invasive alien plant species should be removed and disposed of appropriately prior to the sewer reticulation. The sewer reticulation sites should be inspected regularly to identify and remove emerging IAP species.
- Where possible the existing vegetation along the pipeline route should be carefully removed and stored for replacement after the pipeline has been laid and backfill process completed.
- Care should be taken not to remove indigenous vegetation unnecessarily from the sensitive wetland areas and their associated buffers during all phases of construction.
- The removal of alien vegetation should be undertaken manually by hand near sensitive areas. The use of heavy machinery should be kept to minimum near sensitive environments.
- Fauna found within the sewer reticulation zones should be moved to the closest natural or semi-natural habitat zone away from any human induced anthropogenic activities.

Erosion and sedimentation control

- Sandbags should be utilized as a temporary diverting barrier downslope of excavation areas. The sandbags should be placed in order to minimize surface runoff ensuring the sensitive areas situated downslope does not incur any impacts as a result of sedimentation and erosion. Sandbags used to temporarily divert water should always be in good condition and inspected regularly.
- The use of heavy machinery within the wetland should be prevented. Excavation, trenching and re-profiling should always be conducted by hand in order to limit disturbance in the wetland and must take cognizance of maintaining hydrological flow regime of the HGM unit. All banks or slopes be profiled to maintain to the geomorphological integrity of the HGM unit.
- Soil excavated during construction should not be piled onto from top to bottom within a stipulated area away from any sensitive environment. The soil should be kept in stock piles and must be situated upslope or conveniently placed to prevent sedimentation of the sensitive environments.
- Soil stockpiles should be conveniently placed in a position that minimises erosion. The central wetland should be kept clear of imported and excavated material to reduce the risk of downstream sedimentation.
- Soil stockpiles must be protected from erosion, surrounded by suitable earthen buns and covered by erosion control blanket.
- HGM's 2 and 3 are noted to be Hill-slope seepage wetlands. The proposed pipeline trenches will be located on either side of the unit. Infilling and compaction of terrestrial soils can lead to reduced soil permeability and increased surface run-off downslope along the length of the trench. This may lead to the formation of concentrated flow paths, increased erosion and sedimentation of HGM's 2 and 3 downslope. Earthen buns should be installed across the trench 2m apart from the top of the ridges to HGM's 2 and 3. This will reduce the velocity of flowing water preventing erosion and sedimentation of HGM's 2 and 3. Flow paths created during high rainfall events should be filled immediately and monitored.
- Site engineers should regularly inspect the erosion control measures to confirm their appropriateness and integrity.
- The EO/ECO should perform regular visual inspection of surface water in order to identify any rapid increase in erosion and erosional features in the area and remedy where essential.

Pollution control

- No dumping of any materials or storage of any equipment should be allowed within the sensitive areas.
- During all phases of the construction, all waste should be removed to an appropriate waste facility and under no circumstance should waste materials or contaminants be discharged into the environment or buried.
- Washing and cleaning of equipment should also be done within berms or bunds, in order to trap any cement/sediment and prevent excessive soil erosion. These sites must be re-vegetated after construction has been completed.

Surface water quality

- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms/bunds to avoid the spread of any contamination into sensitive areas.
- Proactive measures should be enforced to ensure that work vehicles are up to standard regarding maintenance and function. These measures should include routine leak checks prior to construction and decommissioning of vehicles and machinery not up to par.
- Dripping during the aforementioned leak checks and maintenance must be accommodated for by the provision of drip trays.
- Handling of hazardous substances should be kept to a minimum within the construction site. Additionally, thorough training should be administered to site personnel regarding handling of the aforementioned substances.
- Regarding sanitation – portable chemical toilets should be made available to site personal and should be located +- 30m away from sensitive environments. Waste from the toilets should be collected and disposed of appropriately by a waste contractor.
- An emergency "clean up kit" containing spillage clean up materials should be readily available on site to be used in event of a spill.
- Fuels, chemicals and other hazardous substances should be stored in the appropriate, marked containers with closed lids.
- All spillages or contaminations are to be immediately reported to the Site Manager and Environmental Officer so that appropriate clean up measures may be enacted.
- Temporary noise should be kept to a minimum with equipment, machinery and vehicles, especially in sensitive areas.
- The site must be inspected frequently (daily during the sewer reticulation and monthly thereafter) to ensure that the integrity sensitive areas is maintained at all times.

- Additionally, readiness and professional execution of the clean-up contingency plan as well as the mitigation and rehabilitation is essential to ensure that the integrity of the sensitive areas is not compromised

The following recommendations and mitigation measures should be applied to limit impacts to HGM 1 and RR 1 where the unit will be indirectly impacted by the installation of sewer reticulation pipelines:

- Soil stockpiles must be protected from erosion, surrounded by suitable earthen buns and covered by erosion control blanket to prevent the transfer of sediment into HGM 1 and RR 1.
- It is recommended sewer reticulation pipeline route to be adjusted slightly away from HGM 1 and RR 1 which will in turn eliminate impacts on these systems.
- Trenching, refill and backfill must take cognizance of maintaining the hydrological flow regime of the HGM 1 and RR 1.
- All banks or slopes should be profiled to maintain to the geomorphological integrity of the HGM unit (HGM 1).
- Disturbed wetland areas should be re-vegetated immediately after construction has been undertaken with wetland vegetation indigenous to the area.

6.2. Recommendations regarding the health status of the "at risk" wetland (HGM 2)

Given that the health status of HGM's 1, 2 and 3 will be impacted by certain activities by the sewer reticulation– such as:

- Excavating, trenching and infilling within or in close proximity to wetland environments will cause geomorphological, hydrological and gradual vegetation changes;
- The possibility of contamination from the entry of foreign materials into the wetland environments, in spite of control measures, would exist;
- Inability of wetland environments to re-establish previous PES conditions as a result of drastic alterations within and around the wetland environment.

NB: It is recommended that a specialist study be commissioned to develop rehabilitative strategies for the affected wetlands and those recommendations and calculations for wetland offsets be made for the anticipated loss of current wetland area as a consequence of the activity. These can be presented in a Wetland Rehabilitation and Wetland Offset Plan for the Inanda Glebe sewer reticulation plan.

6.3. Methods of pipe installation, mitigation measures and rehabilitation

There are several methods in which pipe laying can occur within wetland environments. The common installation methods are:

- Horizontal direction drilling (pipe-jacking);
- Elevation over wetland;
- Trench method;
- Overhead poles;
- Attachment to bridge or other structures

However, planning and design stages are vital to identify techniques to protect wetland functionality and ecosystem services. These techniques can be implemented before, during, or after construction.

South Africa is currently experiencing a protracted period of drought. Furthermore, the rapid water demands of a growing population and industry is a strain to South Africa's freshwater supply. Hence it is imperative to follow the basic Avoidance and Minimisation techniques to protect valuable freshwater ecosystems:

- Avoidance of both above and below-ground wetland crossing is imperative unless absolutely necessary;
- If crossing a wetland is unavoidable, already disturbed areas within or in close proximity to wetland such as easements, roads, roadway shoulders, bridges, or old railroad beds should be utilised for possible pipe laying areas;
- Try to avoid disturbing stream beds, if they must be disturbed, utilise a straight and narrow section with low banks;
- The temporary zones should be considered to be disturbed first before any seasonal or permanent zones are disturbed;
- If underground piping cannot be avoided, consider installing it in a crack-proof casing so that the area above the piping can be replanted with wetland vegetation;
- Avoid diversions of surface water and groundwater sources, which could affect nearby wetlands;
- Sub-draining effects from trenching installation must be especially guarded against.

Furthermore, the following necessary steps before, during and after pipe installation occurs should be implemented.

Before pipe installation

- Ensure that soil erosion and sediment controls are properly installed and maintained;
- Avoid disturbing soils especially on steep slopes;
- Use erosion control blankets, such as jute or other types of non-plastic matting to prevent erosion on steep slopes;
- Have all necessary materials on hand before beginning work;
- Especially for house lots, try to plan for driveway and utility installation to occur with close time proximity to limit the length of disturbance to nearby wetlands.

During pipe installation

- Limit pipe installation to outside the breeding and migratory seasons of wetland wildlife;
- Limit pipe installation activities to the low flow periods (i.e. winter);
- Preserve existing tree canopies and natural areas in and around wetlands as much as possible;
- Use structures or devices to prevent sub-draining or groundwater movement along pipelines such as anti-seepage collars, intermittent clay barriers, trench plugs, or clay saddles;
- If cutting of wetland vegetation cannot be avoided, complete the work by hand (chain or hand saw) instead of using large equipment;
- Use wide-tired vehicles when working in or near wetlands to cause less rutting and soil disturbance;
- Use timber mats when working in or near wetlands;
- If dewatering of trenches is necessary, water must be pumped to an acceptable, properly designed dewatering basin.

After pipe installation

- Plan for restoration to be completed before the end of the growing season and as soon as possible after laying the pipelines;
- Utilise a wildlife conservation seed mix on all disturbed surfaces within wetlands;
- Stabilise all disturbed areas outside of the cleared maintenance zone with grasses, and restore them with trees, shrubs or other vegetation;
- Restore wetland soils and hydrology to existing conditions or better conditions if possible;
- Restore disturbed stream channels to original width and substrate;
- Maintain the area by hand cutting or moving;

- Avoid the use of fertilizers, pesticides, herbicides, or pollutants – chemical or organic within wetlands;
- A detailed maintenance schedule and a responsible entity for cutting, trimming, mowing and removal of IAP within wetland should be drawn up and followed.

6.4. Recommendation: to be assessed and ratified by DWS:

Possible pipe installation within wetland environments and wetland offset creation

It is recognised that the installation of the sewer reticulation pipes within the wetland environment is generally not acceptable. However, where viable alternatives are not available, sustainable solutions to the developmental-environmental protection should be explored fully to obtain the best possible outcomes from a socio-environmental perspective.

The outcome of the possible pipe installation within wetland environments can be severely detrimental to the hydrological, geomorphological and biota within the system, but mitigation and rehabilitation methods have been mentioned previously in this section.

Another method that could be used to potentially increase the functionality and ecosystem services of all wetlands within the area is a Wetland Offset.

Wetland Offset

In order to redress the potential loss of healthy, functioning wetland as a consequence of the proposed sewer reticulation pipe installation in specifically HGM 3, it is proposed that a wetland offset be undertaken to regenerate healthy wetland that is not impacted by the proposed activity such as HGM 4.

Table 6.1 below shows the PES and hectare equivalent calculations for HGM 3 under two scenarios-

- The current situation without the proposed sewer reticulation;
- The projected situation with the proposed sewer reticulation.

An approximate 87.75% decrease in functionality is projected with the possibility of further loss without mitigation and rehabilitation.

TABLE 6.1: PES for HGM 3 with Hectare Equivalence calculated for the current situation (without the proposed sewer reticulation) and projected (with sewer reticulation) situations.

HGM 3	Hydrology Impact Score	Geomorphology Impact Score	Vegetation Impact Score	Overall Health Category	Ha[1] EQUIV Healthy	Ha[2] EQUIV Losses
Current situation without mitigation (PES-WOM)	7.0 (Class E)	2.0 (Class B)	7.0 (Class E)	5.5 (Class D)	0.6525	0.7975
Projected with mitigation and sewer reticulation (PES WM)	8.2 (Class F)	3.2 (Class C)	8.1 (Class F)	6.7 (Class E)	0.4785	0.9715
Increase/decrease in wetland functionality =(PES CUR-PES WM(1.45*100)					-82.75	

For HGM 4, a similar exercise was performed in which the current PES is shown without rehabilitation and restoration of the wetland. Following mitigation and rehabilitation, the PES of HGM 4 improves markedly with a significant gain in wetland functionality. The area of gain is also relatively larger than that lost in HGM 3 as a consequence of the sewer reticulation.

TABLE 6.2: PES for HGM 4 with Hectare Equivalence calculated for the current situation (without the proposed sewer reticulation) and projected (with sewer reticulation) situations.

HGM 4	Hydrology Impact Score	Geomorphology Impact Score	Vegetation Impact Score	Overall Health Category	Ha[1] EQUIV Healthy	Ha[2] EQUIV Losses
Current situation without mitigation (PES-WOM)	6.5 (Class E)	1.5 (Class B)	5.8 (Class D)	4.9 (Class D)	0.8109	0.7791
Projected with mitigation (PES WM)	6.0 (Class E)	1.5 (Class B)	3.9 (Class C)	4.1 (Class C)	0.9381	0.6519
Increase/decrease in wetland functionality =(PES CUR-PES WM(1.59*100)					50.31	

Therefore, the rehabilitation of HGM 4 could serve as adequate offset for the loss of functional hectare equivalents from HGM 3 as a consequence of the sewer reticulation plan.

The restored wetland could serve as an aesthetically pleasing landscape feature and may help increase biodiversity once it is properly established.

Given the various options available, this presents a cost-effective solution with minimal further environmental degradation that will increase functionality of other wetlands as HGM 3 re-establishes prior PES after the sewer reticulation has decommissioned.

However, it must be noted in order to excavate, trench or infill with a wetland environment, the relevant authorization from DWS is required prior to this activity being undertaken and non-compliance will result in penalties as per requirement from DWS.

7. CONSTRUCTION AND WETLAND REHABILITATION GUIDELINES

7.1. Excavation

- The alignment of the trench and adjacent areas should be clearly marked off before excavation and related construction activities are undertaken. All activities should be restricted to a 15m construction servitude. This will limit rehabilitation efforts primarily to the construction zone.
- Where possible the existing vegetation should be carefully removed during construction and stored for replacement during wetland rehabilitation.
- The topsoil and subsoil should be excavated and stored separately in order to re-construct the soil profile during back-filling.
- The excavated material should be protected from erosion if it is going to be exposed for a long period of time. Stockpiled material should be covered with erosion control blankets and surrounded by earthen berms to prevent material from eroding down slope or downstream.
- The trench should be backfilled immediately after the pipe has been laid and the backfilled material should be replaced in the order in which it was removed. The sub-soil should be replaced first followed by the top-soils in-order to re-construct the soil profile.
- The backfill material should be moistened and compacted every 100mm to the density of the surrounding area. Once filled, the backfill material should be compacted to the same height as the natural ground profile.
- Reno-mattresses should be installed (downstream and upstream of the trench) to stabilize banks that are unstable at the wetland crossing point.
- Sediment that has dispersed upslope of the wetland should be removed by hand. In addition, all waste material should be collected and disposed of appropriately.

7.2. Re-vegetation

- All NEMBA category 1a and 1b invasive alien plant species should be removed and disposed of appropriately prior to rehabilitation. Alien vegetation should be removed through manual clearing. The material should be cut and stored outside the wetland and the recommended wetland buffer zone. Thereafter, all cuttings should be removed and legally disposed of at a landfill site. Cut stumps should then be treated with an appropriate herbicide to prevent further growth. Appropriate herbicides should be prescribed by the contractor.
- The vegetation removed during the clearing phase should be replanted to rehabilitate the wetland.

- Preferably vegetation should be planted at the start of the wet season.
- Prior to re-vegetation the soil should be prepared accordingly. Where there is significant compaction, the soils in these areas should be loosened to encourage the establishment of planted vegetation. Where there is good topsoil, these areas should remain un-disturbed.
- It is important that vegetation is planted immediately after backfilling of the trench is complete to limit sedimentation impacts on the wetland.
- The wetland should be re-seeded with wetland plants to fill any remaining gaps with the wetland plants. The wetland plants sourced should be indigenous as well as suited to the conditions of the temporary and seasonal zones.
- Diversion structures should be placed along the trench to reduce sediment runoff opportunities and ensure vegetation growth.
- The diversion structures utilized should preferably consist of berms of biodegradable sacks filled with soil.
- The berms should be placed 2m apart along the disturbed area. The number of berms utilized should be reviewed by the onsite environmental control officer. The number of berms utilized can be increased or decreased as per the recommendations of the onsite environmental control officer.
- Biodegradable erosion control blankets should be used to stabilise the disturbed banks on either side of the central wetland channel.

7.3. Monitoring

Quarterly inspections of the wetland crossings should be carried out for one year after construction to monitor vegetation cover and wetland condition.

Given that the mitigation measures prescribed here are adhered to and the rehabilitation methods prescribed are implemented it is most likely that the PES score of HGM's 2 and 3 will improve

8. CONCLUSION

This report presents the wetland delineation and functional assessment of the Inanda Glebe sewer reticulation plan.

An intensive field survey was conducted during which aided in the delineation process. Eleven wetland systems and one river riparian habitat were identified and delineated within the site footprint and the surrounding buffer. The HGM units identified were predominantly Hill-slope seepages with or without a channel and two channelled valley bottom wetlands. It was determined that HGM's 1, 2, and RR 1 would be impacted on as a consequence of the proposed sewer reticulation plan.

The functional assessments confirmed that degradation of HGM 1, 2 and 3 has occurred, but solely to the vegetation and hydrological modules. HGM 1, 2 and 3 returned a category B score for PES for the geomorphology component indicating that the morphological integrity was slightly impacted but remained mainly intact. An overall category score of E for PES for the vegetation and hydrological component was concluded for HGM's 1, 2 and 3. This confirmed severe impacts to ecosystem processes which may result in the loss of native habitat and biota. Furthermore, HGM's 1, 2 and 3 would experience a slight deterioration over the next 5 years.

The EcoServices assessment revealed that HGM's 1, 2 and 3 was an efficient provider of physical ecosystem services such as sediment and phosphate trapping, nitrate and toxicant removal and erosion control. This is a direct result of catchment activities and some of the houses being built within the wetland environment. Socio-cultural ecosystem services by HGM's 1, 2 and 3 provided moderate services such as resources and subsistence farming in certain households.

The IHIA assessment for RR 1 which was identified as the Gobhogobho river revealed a PES score of C and D for the instream habitat and river riparian habitat respectively. The PES scores obtained was a direct result of impacts such as solid waste disposal and channel modification of the instream and river riparian habitats

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The Ecological Importance and Sensitivity (EIS) scores demonstrate a median score of 1 for HGM's 1, 2 and RR 1 indicating little variation in these environments comparative ecological importance. However, HGM 3 EIS score demonstrates a median score of 2 indicating moderate EIS. Hence, HGM 3 was sensitive to hydrological change which was a direct result of portions of this HGM unit being identified as NFEPA natural bench wetlands.

Buffer zone analysis results indicate a buffer of 25m around HGM 1, 2 and RR 1 is adequate enough to protect the wetlands integrity and a buffer of 32m around HGM 3 as a result of this wetland being more sensitive to hydrological changes.

Risk assessment results confirmed that HGM's 1, 2 and 3 are likely to suffer direct and indirect impacts as a consequence of the proposed sewer reticulation. The results indicated that excavating, trenching and infilling and; introduction of foreign material will be a moderate risk in HGM's 1 and 2 but a high risk in HGM 3. Maintenance and repair of access roads proved to be a low risk.

Given the above, the proposed sewer reticulation in the Inanda Glebe area will require, *inter alia*, a Water Use License Application.

One problem area of this study is the issue of unauthorized development in the buffer and wetland areas of Inanda Glebe. Hence, a Section 24G application is required for these dwellings.
The issue of excavating, trenching and infilling within wetland area for the installation of pipes should not commence within a wetland environment, however, if this cannot be avoided, special mitigation and recommendations are discussed in Section 6 of this report.

Furthermore, wetland offsets are discussed in Section 6 as another cost-effective method in order to create sufficient functional wetland hectare equivalence.

This will further lead to more stringent management of wetland environments and enhance the aesthetic appeal of the surrounding landscape.

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Heritage Impact Assessment

INANDA-GLEBE RETICULATION PROJECT, ETHEKWINI MUNICIPALITY KWAZULU-NATAL

HERITAGE IMPACT ASSESSMENT

April 2017

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Executive Summary

The Water and Sanitation Unit of the eThekwini Municipality proposes the construction of 13 kilometres of 160mmØ HDuPVC sewer reticulation and numerous 1000mmØ precast concrete ring manholes in Inanda Glebe, Ward 44, eThekwini Municipality. The reason for the in situ upgrade is for the purpose of eliminating pit latrines by constructing a new waterborne sewage system.

As the proposed sewer reticulation is longer than 300m – (there will be 13 kilometres of sewer reticulation) - it triggers section 38 (1) (a) which refers to the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length that could potentially require an HIA. In addition, the proposed project could impact on graves, structures, archaeological and palaeontological resources that are protected in terms of sections 33, 34, 35, and 36 of the KwaZulu-Natal Heritage Act (No. 4 of 2008) as well as sections 34, 35, and 36 of the NHRA.

The area of the proposed development is situated in Ward 44, Inanda in the eThekwini Municipality and the approximate middle point of the area to receive the proposed sewer reticulation is at: S29º43'08.10"; E30º55'01.78".

A site inspection of the proposed project area was undertaken on 10 April 2017. The project area is located in an urban township with existing houses, other structures (such as spaza shops) and roads. It is therefore highly disturbed. Sections of the proposed reticulation works will run close to a stream and associated wetland. This area is heavily infested with invasive vegetation which limited visibility on the ground.

A large vacant area situated immediately east of the M25 was inspected. It was found to be a fallow field which had been cultivated several years back. The current vegetation cover is very thick reducing visibility but no heritage sites were found. Some subsistence farming was found on the southern edge of this vacant area abutting 108793 Street. The disturbed nature of the area indicates that the possibility of finding intact heritage sites is low.

The housing throughout the project area is largely made up of formal structures that are interspersed with some informal / backyard structures. The project area is highly disturbed due to this as well as other developments including the laying of a new water pipeline through a section of the project area.

An area where Shembe followers worship was found in the project area. The site is situated at: S 29º42'53.0"; E 30º55'06.1". This area should be avoided by the proposed reticulation works as

the site is of importance to those who use it. No other heritage resources were found during the site inspection.

The South African Heritage Resources Agency's Fossil Sensitivity Map indicates that the project area falls within an area of moderate sensitivity which requires that a desktop study is undertaken. However, due to the highly disturbed nature of the project area it is unlikely that intact fossils deposits (if any) will be found and it is therefore recommended that no desktop study is required.

It is recommended that the installation of the sewer reticulation proceed with the proviso that the recommendations regarding the Shembe site are adhered to as well as the implementation of the mitigation measures provided in Chapter 9 of this report.

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AUTHOR DETAILS

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1. INTRODUCTION

The Water and Sanitation Unit of the eThekwini Municipality proposes the construction of 13 kilometres of 160mmØ HDuPVC sewer reticulation and numerous 1000mmØ precast concrete ring manholes in Inanda Glebe, Ward 44, eThekwini Municipality. The reason for the *in situ* upgrade is for the purpose of eliminating pit latrines by constructing a new waterborne sewage system.

An Environmental Authorisation DM/0002/2014 in terms of GNR543 of the EIA Regulations 2010 was granted for the Ntuzuma sewer reticulation project, the outfall sewer to which the proposed Inanda Glebe reticulation drains. Due to the additional sewer reticulation in Inanda Glebe, eThekwini Water and Sanitation is seeking Environmental Authorisation for this project.

The proposed Inanda Glebe reticulation project is situated immediately north of and alongside the Ntuzuma project.

2. LEGISLATIVE CONTEXT OF PROJECT

As the proposed sewer reticulation is longer than 300m – (13 kilometres of sewer reticulation is proposed) - it triggers section 38 (1) (a) which refers to the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length that could potentially require an HIA.

In addition, the proposed project may impact on graves, structures, archaeological and palaeontological resources that are protected in terms of sections 33, 34, 35, and 36 of the KwaZulu-Natal Heritage Act (No. 4 of 2008) as well as sections 34, 35, and 36 of the NHRA.

In terms of Section 3 of the NHRA, heritage resources are described as follows:
(a) places, buildings, structures and equipment of cultural significance;
(b) places to which oral traditions are attached or which are associated with living heritage;
(c) historical settlements and townscapes;
(d) landscapes and natural features of cultural significance;
(e) geological sites of scientific or cultural importance;
(f) archaeological and paleontological sites;
(g) graves and burial grounds, including—

(i) ancestral graves;

(ii) royal graves and graves of traditional leaders;

(iii) graves of victims of conflict;

(iv) graves of individuals designated by the Minister by notice in the *Gazette*;

(v) historical graves and cemeteries; and

(vi) other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);

(h) sites of significance relating to the history of slavery in South Africa;

(i) movable objects, including:

(i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;

(ii) objects to which oral traditions are attached or which are associated with living heritage;

(iii) ethnographic art and objects;

(iv) military objects;

(v) objects of decorative or fine art;

(vi) objects of scientific or technological interest; and

(vii) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

A Phase I HIA was undertaken to assess whether any heritage resources will be impacted by the proposed sewer reticulation project.

3. LOCATION OF THE SITE

The area of the proposed development is situated in Ward 44, Inanda and the approximate middle point of the area to receive the proposed reticulation is at: S29º43’08.10”; E30º55’01.78”. See **Figures 1 and 2** below.

It is the understanding of the specialist that no houses will be affected by the proposed reticulation works and that it will be installed along road reserves and between houses.

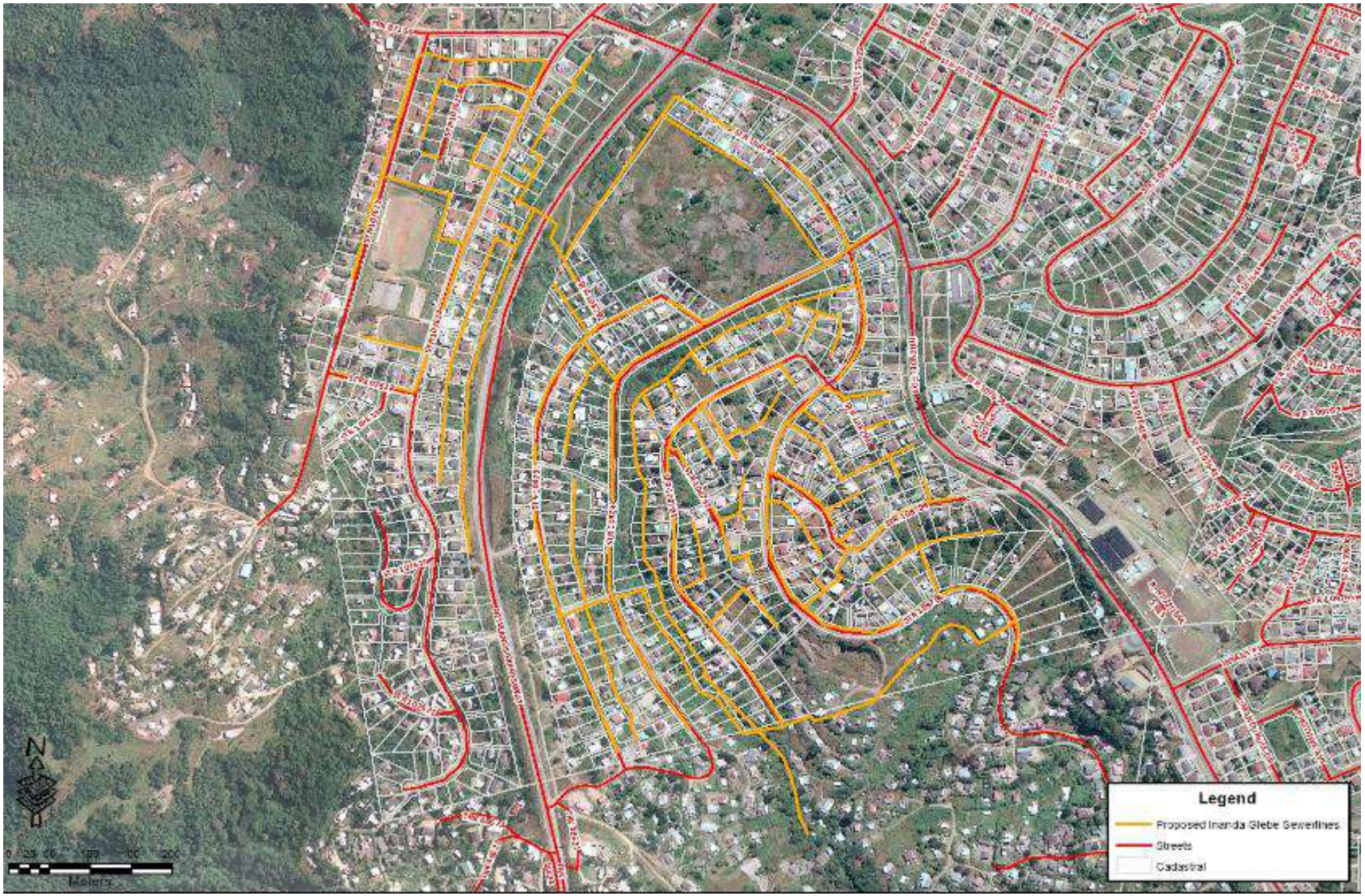


Figure 1: Location of proposed Inanda Glebe reticulation project

Figure 2: Reticulation project (indicated in blue) in wider geographic environment

4. TERMS OF REFERENCE

To undertake a Phase 1 Heritage Impact Assessment in order to determine the possible existence of archaeological, historical sites and resources in and/or close to the sewer reticulation project that could be impacted by the proposed activity

Provide mitigation measures to limit or avoid the impacts (if any) of the construction of the project on heritage resources.

5. METHODOLOGY

A survey of literature, including other heritage/archaeological impact assessment reports completed in the wider geographical area, was undertaken in order to place the development area in an archaeological and historical context.

A site inspection of the proposed reticulation project was undertaken on 10 April 2017. The project site is located in an urban township with existing houses, other structures (such as spaza shops) and roads. It is therefore highly disturbed by such developments. Sections of the proposed reticulation works will run close to a stream and associated wetland. This area is heavily infested with invasive vegetation which limited visibility.

6. HISTORICAL BACKGROUND OF THE STUDY AREA

The earliest agricultural sites in KwaZulu-Natal date to between AD 400 and 550. All of these sites were situated close to sources of iron ore, and within 15 km of the coast. Current evidence suggests it may have been too dry further inland at this time for successful cultivation. From AD 650 onwards, however, climatic conditions improved and agriculturists expanded into the valleys of KwaZulu-Natal, where they settled close to rivers in savanna or bushveld environments (eThembeni Cultural Heritage 2013:20).

Twelve archaeological sites have been previously recorded within a 10km radius of the study area. These sites consists of Early Iron sites near valley bottoms, Late Iron Age sites near the tops of hills, and a few Late Stone Age sites in various localities (Anderson 2009:10) some distance from the project area.

According to Harber and Associates (2010:3), one of many sites in the valley now inundated to form the Inanda Dam, was named Kwagandaganda because tractors were utilized to speed up archaeological excavations during construction of the dam. The small Early Iron Age agricultural settlement with byres, evidence of built platforms, granaries, a forging area and a men's assembly area dating back to the sixth century prove that the Inanda area has been occupied by Bantu people for at least 1 500 years. Clay vessels, grindstones, clay cattle and figurines and remnants of dung reinforce this evidence.

In Inanda, under Mqhawe, the Qadi clan granted land to the Christians of the American Board so that schools would be built, access to farming equipment could be made available, and to assist when dealing with the colonial authorities could be offered. James Dube, the uncle of the chief becoming a devout Christian and one of the first black pastors. His son John Dube was born on the Inanda Mission. John Dube made an enormous social impact on Inanda and South Africa. He travelled to the USA to continue his education for the priesthood where he met the influential Booker T. Washington and returned to Inanda to establish the Ohlange Institute. He also founded the first Black newspaper in South Africa, and later was elected the first President of the ANC in 1912 (Harber and Associates 2010:4).

Etherington (1989:282) explains that the first Black Christian converts in the Colony of Natal were referred to as kholwa or Amakhlowa who were economically successful and that this success owed in part to the educational facilities of the mission schools (Etherington 1989:289). The kholwa were pioneers in many branches of commercial agriculture, experimenting in the 1850s with cotton, coffee, arrowroot and sesame, and sugar. The success of the education venture encouraged similar enterprises including the Inanda Seminary (Etherington 1989:289) which is situated approximately one kilometre north of the project area. The seminary was established in 1869 and is an Independent School for girls that falls under the auspices of the United Congregational Church of Southern Africa (UCCSA) (eNanda Online n.d:1).

7. RESULTS OF SITE INSPECTION

The community liaison officer (CLO), Mr Muziwenhlanhla Goodman Ndlovu accompanied the specialists during the site inspection. He indicated that to his knowledge the area started to develop around 20 years ago.

A large vacant area situated immediately east of the M25 was inspected. It was found to be a fallow field which had been cultivated several years back. The current vegetation cover is very thick reducing visibility and no heritage sites were found during the inspection. Some subsistence farming was found on the southern edge of the vacant area abutting 108793 Street. The disturbed nature of the area indicates that the possibility of finding intact heritage sites would be low. The CLO stated that it is proposed that a school be built on the vacant area as there is a shortage of schools in the immediate area.

Figure 3: Thick vegetation covering vacant area

Figure 4: Cultivation of maize on southern edge of vacant land

The proposed reticulation works will also be located in the residential immediately west of the M25. This area includes a large sports field and netball court and the area is highly disturbed.

Figure 5: Sports field

The housing throughout the project area is largely made up of formal structures that are interspersed with some informal / backyard structures. The project area is highly disturbed due to this as well as other developments including the laying of a new water pipeline through a section of the project area (see **Figure 7** below).

Figure 6: Formal housing with clearing for garden in foreground

Figure 7: Excavations for water pipeline

Figure 8: View of section of project area

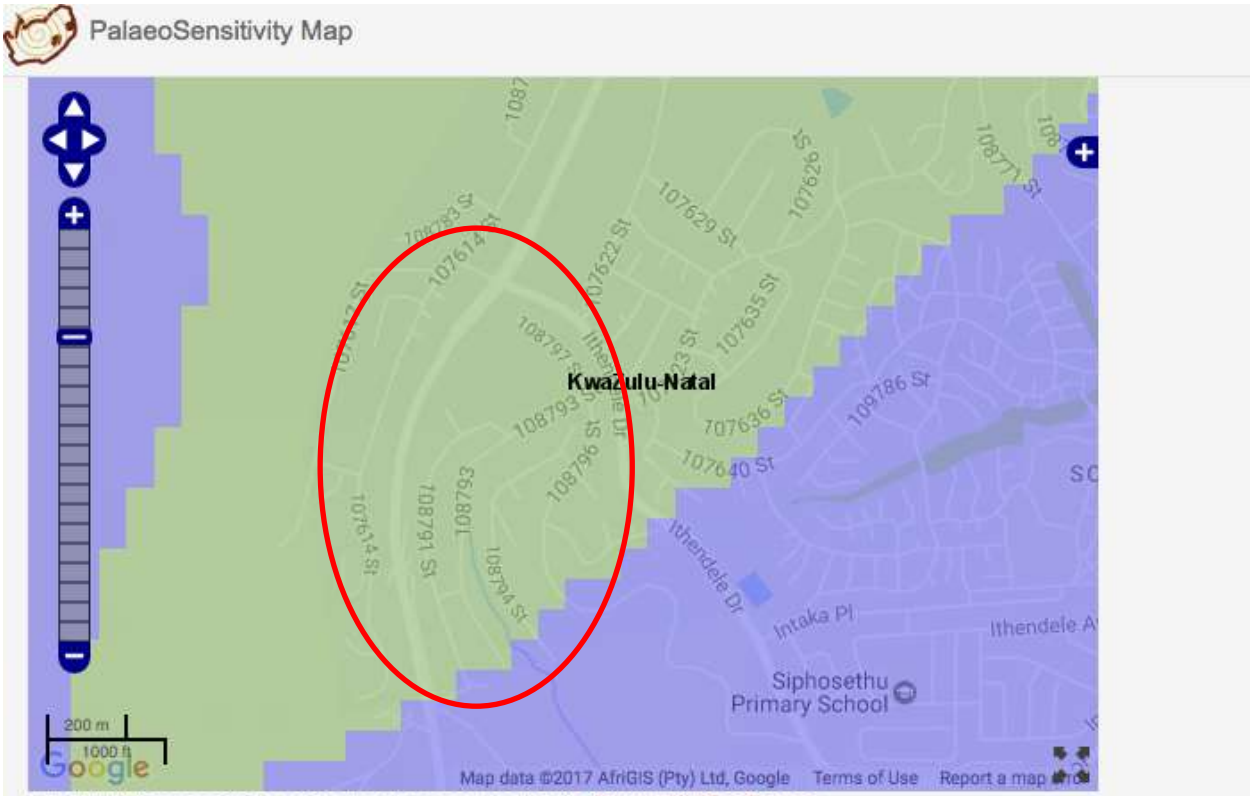
An area where Shembe followers worship was found in the project area. The site is situated at: S 29º42'53.0"; E 30º55'06.1". This area should be avoided by the proposed reticulation works as the site is of importance to those who use it. Mr Ndlovu mentioned that the municipality had

provided the land to the Shembe and had planted the trees visible in **Figures 9 and 10** below. The area is fenced and the grass was being cut during the site inspection.

Figure 9: Section of Shembe worship area

Figure 10: Shembe worship area

No other heritage resources were found during the site inspection. Mr Ndlovu said that the residents use cemeteries in Inanda and KwaMashu to bury their dead hence there were no graves in the project area.



1 in 250 000 geological formation layers are courtesy of the Council for GeoScience

For more information, go to How to Use the Palaeontological (fossil) Sensitivity Map

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 11: Fossil sensitivity of project area (indicated with red circle)

The South African Heritage Resources Agency's (SAHRA) Fossil Sensitivity Map indicates that the project area falls within an area of moderate sensitivity which requires that a desktop study is undertaken. However, due to the highly disturbed nature of the project area it is unlikely that intact fossils deposits (if any) will be found and it is therefore recommended that no desktop study is required. The proposed development is unlikely to affect any fossil bearing deposits unless the excavations go much deeper than 1.5m to 2m. A protocol for chance finds of fossils is included in Chapter 9 of this report.

8. RECOMMENDATIONS AND CONCLUSION

No heritage sites of significance were found during the site apart from the Shembe worship site which is significant in terms of its importance for the Shembe community. It is recommended that the sewer reticulation works avoid this site completely. If this cannot be done, then discussions must be held with the Shembe community to address the issue.

The CLO indicated that the community used cemeteries in Inanda and KwaMashu to bury their dead so there were no graves to his knowledge amongst the residential dwellings. None were found during the site inspection.

It is therefore recommended that the installation of the sewer reticulation proceed with the proviso that the recommendations regarding the Shembe site are adhered to as well as the implementation of the mitigation measures listed below.

9. MITIGATION MEASURES

- For any chance finds, all work will cease in the area affected and the Contractor will immediately inform the Project Manager. A registered heritage specialist must be called to site for inspection. The relevant heritage resource agency (Amafa) must also be informed about the finding/s.
- The heritage specialist will assess the significance of the resource and provide guidance on the way forward.
- Permits must be obtained from Amafa if heritage resources are to be removed, destroyed or altered.
- All heritage resources found in close proximity to the construction area are to be protected by a 5m buffer in which no construction can take place. The buffer material (danger tape, fencing, etc.) must be highly visible to construction crews.
- Under no circumstances may any heritage material be destroyed or removed from site unless under direction of a heritage specialist.
- Should any remains be found on site that is potentially human remains, the South African Police Service should also be contacted.
- If there are chance finds of fossil deposits during construction, a palaeontologist must be called to the site in order to assess the fossils and rescue them if necessary (with an Amafa permit). The fossils must then be housed in a suitable, recognized institute.

10. REFERENCES

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Biodiversity Assessment and Report

BIODIVERSITY ASSESSMENT AND REPORT

THE PROPOSED INANDA GLEBE SEWER RETICULATION PROJECT, INANDA, KWA-ZULU NATAL

JUNE 2017

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ETHEKWINI MUNICIPALITY

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INANDA GLEBE SEWAGE RETICULATION PROJECT, ETHEKWINI MUNICIPALITY, KWA-ZULU NATAL

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Verification	**Capacity**	**Name**	**Signature**	**Date**
Author	**Field Services Practitioner**	**Bryan Walter Paul**		**05 June 2017**
Reviewed by	**Project Manager**	**Fatima Peer**		**06 June 2017**

EXECUTIVE SUMMARY

1World Consultants was appointed to conduct a Biodiversity Assessment on the sewage reticulation route for the Proposed Glebe Sewage Reticulation Project. The Purpose and Scope of Work of the assessment is to identify and record any protected fauna and flora that may be on the site and report on the current biodiversity's susceptibility to possible impacts of the development. This report will be used primarily to identify and mitigate the developmental impact on site and to identify ecological enhancements by:

- *alien invasive plant removal,*
- *retaining certain areas of vegetation and/or possible habitats and*
- *rehabilitation to its original state but devoid of exotic competitors*

The proposed site environment has undergone 100% transformation and most of the natural vegetation expected to be in this area have been removed and replaced by exotic non-indigenous plants, especially in the form of alien invasive plant species. Heavy anthropological pressures have stripped the study area of suitable habitat and resulted in both the Gobhogobho River and three wetlands found on site being highly degrade and in a poor state. The poor water quality would be owed to the lack of infrastructure in the area, such as running water and adequate sewage facilities. In addition to this pollution and heavy vegetation clearing for residential expansion has played its part over the years in reducing the present ecological state of this area, which is evident by the short indigenous species list found in this report.

The proposed site of this development does not fall within a Critical Biodiversity Area, yet there are areas within 500m of the development boundary that show irreplaceable biodiversity. It is therefore, imperative that the Contractor/Applicant ensures that impacts associated with construction are kept within the anticipated construction servitudes and areas of anticipated impact.

According to the literature review there are currently no faunal species of conservation importance that would be anticipated and found within this study area. Furthermore, no species on conservation importance were recorded whilst surveying all possible habitats. The overall lack of abundance and diversity of fauna would be owed to the overall lack of undisturbed habitat and anthropological pressures (hunting, trapping and pollution) which would be is common in unprotected environments. The proposed development should then not have a significant impact on any fauna that may exist in this study area. This is reinforced by the nature of the project, where species will have the opportunity to move from the construction site to other more suitable locations nearby.

At the time of the study there was a small quantity of indigenous flora recorded on site, of which only two were protected by the Natal Nature Conservation Ordinance, Aloe ferox and Aloidendron barberae. No species were recorded that are protected by the National Forest Act 1998. This is due to the ever-increasing need for space to development houses and general human induced impacts that have encouraged the introduction of exotic (including invasive plant species). Furthermore, the development of buildings within rivers/wetlands and other habitats have also played a negative role in reducing what habitat may have been previously in existence. However, as there are three wetlands and one river found in the proposed development area, there is a small possibility that species from the Liliaceae family, such as fire lilies, gladioli and Arum lilies will be encountered during construction but only as remnant populations that have survived the surrounding pressures. The appointed ECO must be notified of any such species and advice on their protection or removal and relocation nearby.

With regard to the fauna component, there was no fauna recorded during the ground study and the literature study revealed that no species of great conservation importance should occur on site, mainly due to the local disturbances and lack of suitable and pristine habitat found in the study area. However, it would be advised that the developer limits the construction work in the wetland and riparian areas as must as possible to further prevent degradation of this area. The development could however owe itself to improve the PES, especially in the riparian zones, where the eradication of alien invasive plants could encourage the re-occupation of indigenous hydrophytes and fauna after the construction phase is completed. Although no real species of great conservation importance are expected to be found in this area, both amphibians (frogs) and reptiles (snakes) would be encountered during excavation and the Contractor and all construction staff must be educated on the importance of preservation of the species found in this study area.

Developmental impact is anticipated to be low, given that all mitigation techniques are followed. This is owing to the fact that there is already a limited amount of biodiversity present on site and in addition to the clearing of vegetation the operational activities should not be substantially higher given that the sewage pipeline is well maintained and that maintenance is limited to site specific zones and staff do not damage recuperating vegetation.

It is therefore of the authors opinion that there is no reason why the development should not go ahead and supports the improvement of the infrastructure in this area, which will not only drastically improve the lives of the community but also reduce the pollution of locally occurring rivers, wetlands and ecosystems found on site.

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1 INTRODUCTION

1.1 THE PROPOSED ACTIVITY

The proposed development forms part of Phase 2, with Phase 1 incorporating the installation of a Sewer Outfall in the Ntuzuma E location, situated South of Inanda Glebe. The reticulation will feed into the Ntuzuma E Sewer Outfall located at approximately 29°43' 19.36" S; 30° 55' 04.93" E. The reticulation itself triggers the need for a Basic Assessment since it will traverse identified wetlands. The route for the proposed reticulation has been assessed based on a working servitude of 5m during construction activities for the 13km length.

The preferred route alternative runs along a combination of roads within a semi-rural residential area. The area is encompassed by built up residential areas and other privately-owned settlements. The route is in areas of disturbance and transformation by human impacts. In addition to this, the area is highly polluted and environmentally degraded. The sewage infrastructure project involves the construction of an approximately 13km long, 160mm diameter HDuPVC reticulation that will transfer sewage from the Inanda, Glebe area to the Ntuzuma E sewer outfall. Sections of the reticulation will pass through individual properties as well as intersect two wetlands and run parallel to a third.

This Biodiversity Assessment will form part of the Basic Assessment Report in order to comply with the South African environmental legislation. The report will use a holistic approach to identify the constraints that the environment has on the proposed development and aims to identify the effects that the development will have on the environment.

1.2 OBJECTIVES OF THE BIODIVERSITY ASSESSMENT

1World Consultants has been appointed to assess the probable impacts that may be caused by the proposed development on the flora and fauna within the area. The Biodiversity Report has been compiled by Bryan Paul and reviewed by Fatima Peer. The objectives of the study are as follows:

- To identify all threatened and/or Red List Data species that currently exist or are likely to inhabit the area in and around the proposed pipeline route;
- To give a basic depiction of the flora and fauna present along the proposed sewage reticulation route;
- To identify and describe the current habitats present within the area, especially for areas that are noted have particular conservation value and promote probable habitat for threatened flora and fauna in the area;
- To identify and assess significant impacts of the proposed development that are likely to affect the environment and its biological components; and
- To assess the net habitat loss or gain caused by this development.

1.3 SCOPE OF THE ASSESSMENT

- A rapid Ecological Survey to assess and identify the main vegetation types in the developmental area and identify and record the presence of fauna within the area.
- The assessment will aid in identifying all significant ecological habitats within the area with special emphasis on the conservation of Red Data plants and animals within the area and their populations.

- Identify all impacts that have potential to disrupt the ecology of the area and where possible project the impact significance.
- Conduct a literature review to support field data or where there are data gaps.
- Suggest or recommend mitigation techniques and methods of impact avoidance or reduction when necessary.
- Generate a report that consolidates all the findings and recommendations.

1.4 STUDY CONSTRAINTS

- Due to nature of the survey and the requirements for the Basic Assessment, it can be said that this survey would be more biased towards more common and dominant fauna and flora within the area. In order for the rarer and less common species to be identified a more intense survey would be required, but not recommended for this study area.
- The season and current conditions of the areas posed a constraint to the survey, a number of species would either not be in flower and/or not be visible within this area. Therefore, the species list for this survey cannot be regarded a report that has listed all species accruing within the area but reflects those accruing predominantly at the time and season.
- Due to the combination of scattered private homesteads and inaccessibility due to harsh terrain not all of the study area could be accessed by foot. However, the specialist attained vantage points along the route to view these specific areas and ensured that all the riparian areas were properly assessed through ground truthing.

1.5 METHODOLOGY

- A survey was conducted to assess the probable impact of the development. The entire route walked and data was recorded.
- Provision of recommendations
- The flora aspect of this report was compiled using a the SANBI BGIS Maps which make use of *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) as well as the *National Red List of Threatened Plants of South Africa* (Raimondo *et al.* 2009). Mammal names are those used by Stuart (2005), bird names Sasol 2015, reptile names by Branch (1998) and amphibian names by Du Preez and Carruthers (2009).

1.6 STUDY AREA

The study area (as seen in **Figure 1**) is located in the Inanda Glebe area which is located north of Durban and in Ward 44. The area is currently occupied by middle/low income residential housing without any waterborne sewerage. Here residents in this have constructed pit latrines for sanitation supposes. The lack of formal sewer infrastructure has lead not only to potential health related risks but also the degradation of surrounding natural environments.

Due to the need for basic housing for the increasing population in this area and the overall lack of available space, houses have not only been built on dryland but can be found illegally placed within wetlands and 1:100-year flood lines. This has further lead to the removal of suitable habitat and the promotion of opportunistic invader species.

Figure 1 – The General Surroundings of the Proposed Site (Google Earth, 2017)

2 MAPPING RESULTS

2.1 GENERAL SOIL TYPES AND GEOLOGY WITHIN THE STUDY AREA

The soils found along the proposed development are characterised the presence of two soil type. The first, referred to as "A" in **Figure 2** is classified as Lithosols, which consist of shallow soils on hard or weathering rock. The second type, referred to as "B" is comprised of soils that are imperfectly drained which are often shallow with plinthic horizon.

Figure 2 – General Soil Types within the Study Area (SANBI, 1996)

2.2 CONSERVATION STATUS OF KZN VEGETATION TYPE WITHIN THE STUDY AREA

As demonstrated in **Figure 3** the proposed development is found to be in an area that is categorised as vulnerable with the presence of endangered vegetation types surrounding the wetland areas. After the ground study was conducted it was immediately evident that although the maps show that this proposed site falls within these listed vegetation types, it has already been greatly transformed. Species that should be found within this area no longer exist and have been replaced by exotic species. The development will then have little or no effect on the conservation efforts applied to these two vegetation types that will be directly affected by the development.

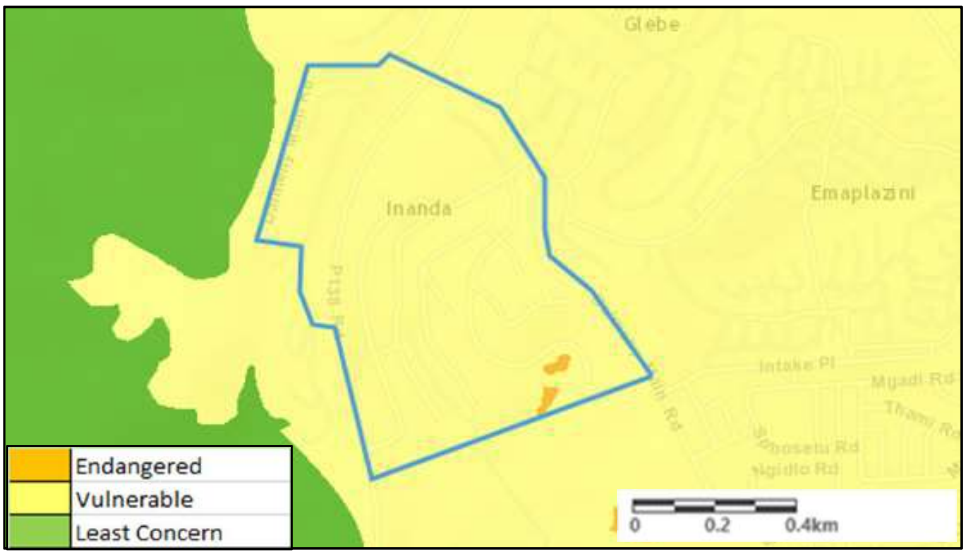

Figure 3 – Conservation Status of KZN Vegetation Type within the Study Area (SANBI, 2011)

2.3 VEGETATION MAP OF THE AREA

According to **Figure 4** the naturally occurring vegetation of the area is KwaZulu-Natal Coastal Belt Thornveld, with the occurrence of subtropical alluvial vegetation found within the wetland area. Nearby This vegetation type is listed as endangered and is said to be the dominant vegetation of the entire area. In a broader geographical context, there is also a substantial amount of Southern Coastal Scarp Forest, which has not extended into the study area.

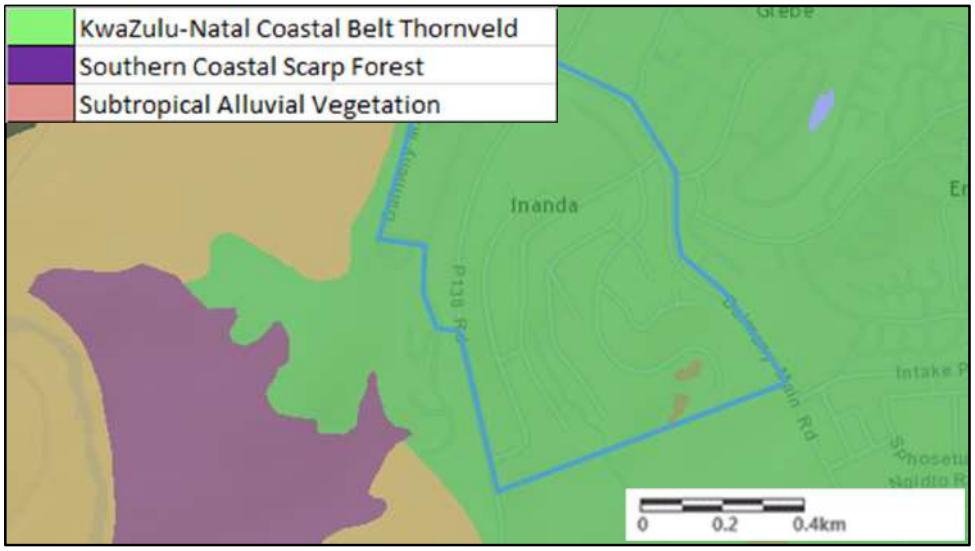

Figure 4 - Vegetation Map of the Area (SANBI, 2014)

2.4 EKZNW CRITICAL BIODIVERSITY AREAS (CBA'S) OF THE STUDY AREA

Figure 5 below demonstrates the Critical Biodiversity Areas (CBA's) within close proximity of the proposed site. As it is apparent in figure 5, no CBA mapped areas are found to be directly affected by the project. However, it must be noted that there are CBA's within close proximity, especially within the northern most portion of the study area. It is therefore important that the BAR includes mitigation techniques to address construction staff from entering these areas (collecting plants and illegally harvesting wood).

In general terms, CBA units demonstrate features confined to specific niche habitats such as forest (Eastern Scarp Forest), which does not extend into this study area. Furthermore, it is apparent that no ecological support areas or corridors are found within, or nearby the development area.

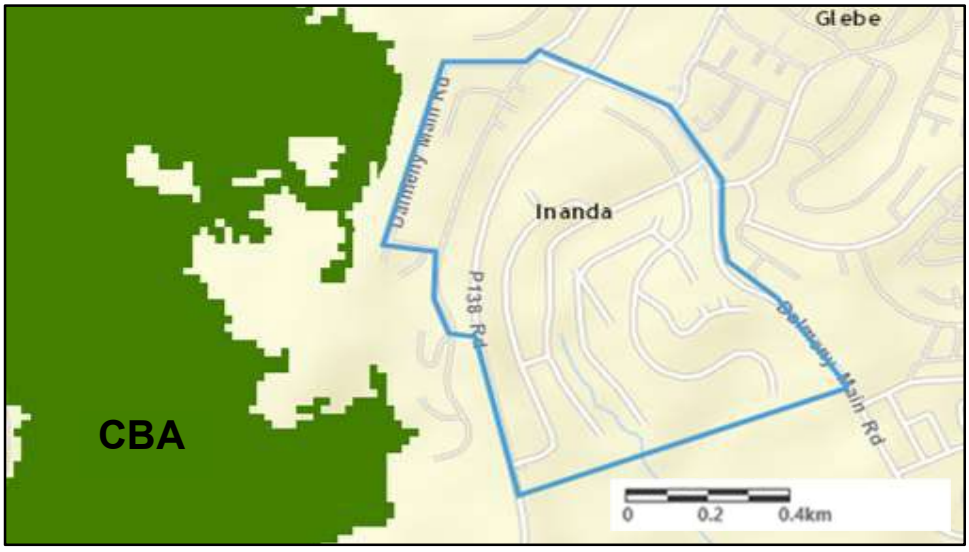

Figure 5 – Critical Biodiversity Areas (Irreplaceable) in the Study Area (eKZNW 2016)

2.5 PROTECTED AREAS, WETLANDS AND D'MOSS AREAS

According to **Figure 6** below, no formally protected areas are found within the study area or will be impacted upon by the development at hand. However, there are three wetlands and one river that will be directly affected by the development. A wetland delineation study will ensure that the extent these habitats are determined and anticipate impacts are assessed.

As it is apparent in **Figure 7** below the proposed development will not directly impact upon any D'MOSS zoned areas. It must be noted that there is D'MOSS within 500m of the Western boundary of the developmental area and therefore the Applicant must ensure that no illegal construction activities will caused any unanticipated impacts to these regions. Impacts such illegal harvesting of wood, trapping or killing of animal must be prevent and the biodiversity noted in these regions must not be affected in any way.

Figure 6 – Protect Areas and Wetlands in the Study Area SANBI, 2016)

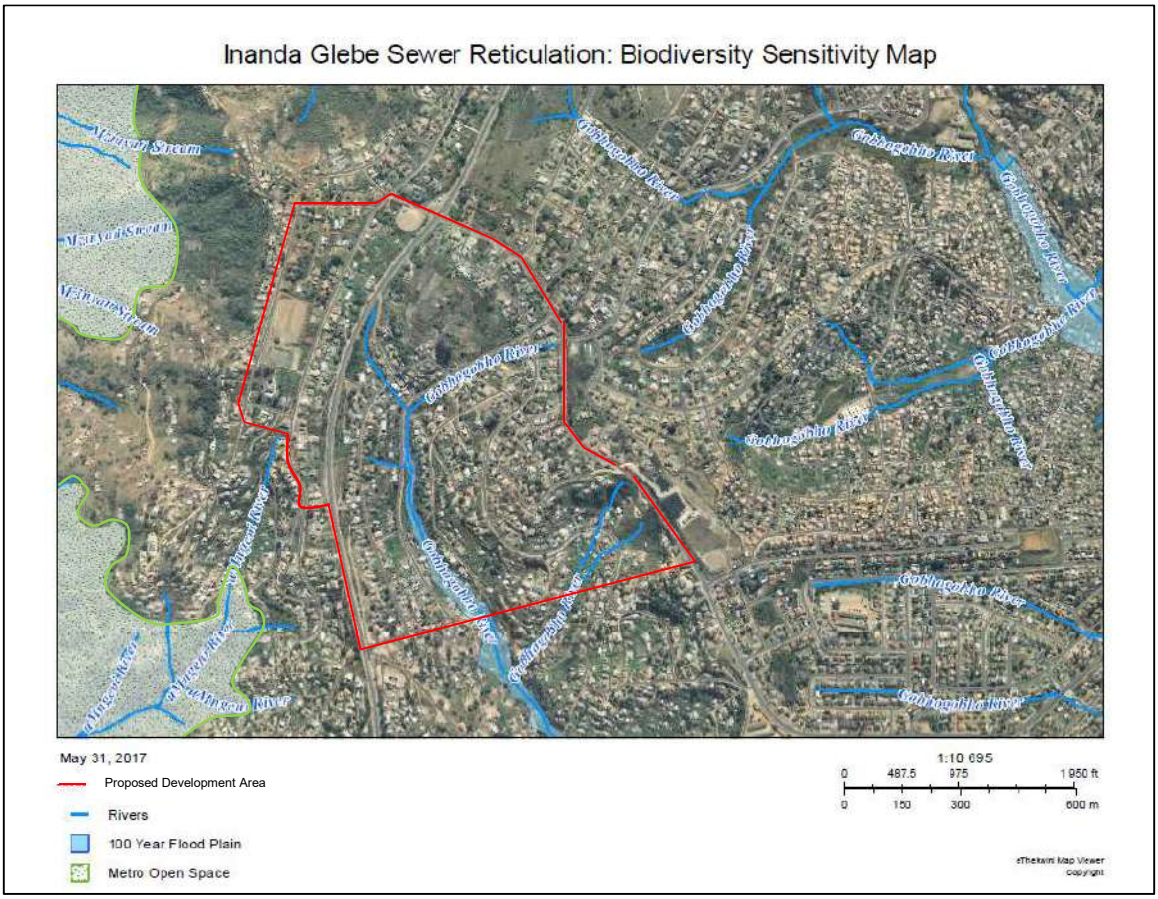

Figure 7 – D'MOSS in the Study Area (eThekwini, 2017)

3 GENERAL FINDINGS

3.1 FLORA

The proposed development site can be regarded as greatly transformed, with very little remaining indigenous vegetation that occurs within the area and have been replaced by crop species (*Zea mays, Colocasia esculenta*) and common invasive species usually associated with disturbed KZN areas. The Following are a snapshot of the vegetation scene that unfolds in the area.

Table 1: Different Vegetation Types Present on Site

General Photo	Description
(1) 	This photo shows the general scene that unfold along the study area. Here most naturally occurring dryland species have been removed and replaced by grass verges, subsistence crops (*Zea Mays* and *Musa).*
(2) 	In this snapshot, the current state of the habitat near one of the drainage lines that feeds into the Gobhogobho River is demonstrated. All natural vegetation appears to be cleared and replaced by cultivated crops (*Musa hybrid)* and exotics such as *Melia azedarach* and *Solanum mauritianum.*

(3) 	This photo gives an example of vegetation that can be found along the riparian area (Gobhogobho River) that cuts through the middle of the proposed develop area. In this particular photo, there was one indigenous species (*Typha capensis*) found which is seen to be a very common species to the river environment. Other vegetation is of an exotic nature, majority of which are alien invasive plant species (*Lantana camara, Canna Indica* and *Melia azedarach*).
(4) 	In photograph 4, the first wetland affected by the proposed development can be seen. Here, unlike the other two wetlands, some natural vegetation still remains. However, the dominant natural vegetation is *Typha capensis* and sedges, which are very common and often dominate these environments and can become weeds. This wetland lacked evidence of lilies or other natural hydrophilic species which otherwise would be expected in a wetland. What can also be seen in this snapshot is a single Acacia sieberana and an large expanse young Chromolaena odorata.
(5) 	In this snapshot the second wetland can be seen. In the background, residential houses can be seen encroaching on this already disturbed area. In the middle of the photo, a single Syzigium *cordatum* can be seen on the boundary of this wetland. Alongside this species, *Canna indica, Morus nigra, Solanum mauritianum and Schinus terebinthifolius* can be found in high numbers.

(6) 	Although densely populated by exotic species, there was specific area inhabited by more than six mature species of *Syzygium cordatum*. A tree found commonly in forest margins and riverine thickets and should be conserved as far as possible during development.

- **Indigenous Vegetation**

Throughout the development area there is a low diversity of indigenous vegetation, which is evident in the species list shown in this report. The general lack of naturally occurring vegetation is due to the human activity subjected to this local habitat in the form of mass clearing for informal residential areas and subsistence farming found throughout this area. With specific reference to the wetlands and riverine areas, much of the indigenous vegetation that would otherwise thrive in these habitats has been replaced by alien invaders and exotic plant species. The reason behind this transformation is due years of polluted and unmanaged water systems within this study area. Where indigenous vegetation could not sustain life, the heavy competition from alien invaders have taken over and established themselves. However, throughout the study area there are still ruminants of indigenous vegetation, which must be preserved as much as possible during construction to further prevent degradation of this area.

Table 2: Species that are Expected to be within this Region (Animal Demography Unit, 2016)

Species	Common Name	Red Listing
Ehretia rigida	Puzzle Bush	Not Listed
Xylotheca kraussiana	African Dog-rose	Not Listed
Syzigium cordatum	Waterberry, Umdoni	Not Listed

Ground Study Results:

- *Acacia Karoo Hayne* - Sweet Thorn Acacia
- *Agapanthus praecox* – Common agapanthus
- *Albizia adianthifolia* – Flat-crown albizia
- ***Aloe ferox – Bitter Aloe (Protected)***
- ***Aloidendron barberae* – Tree Aloe (Protected)**
- *Carissa edulis* - Pinned numnum
- *Ceratotheca triloba* - White Foxglove
- Cymbopogon caesius – Common Turpentine Grass
- *Cynodon dactylon* – Bermuda Grass
- Cyperaceae – Sedges
- *Erythrina lysistemon* – Common coral tree
- Hyparrhenia hirta – Common thatching grass
- *Indigofera spicata – Creepinig Indigo*
- *Panicum maximum* - Guinea grass
- *Paperbark Acacia* - Acacia sieberana
- *Plumbago auriculata Lam.* -Plumbago
- *Setaria megaphylla* – Ribbon Grass
- *Sida rhombifolia* – Broom Weed
- *Syzigium cordatum* – Umdoni
- *Typha capensis* – Bulrush

Protected Species of Vegetation

In terms of the Plants protected under the provincial conservation ordinance, there were two species recorded during the survey. Both will require tree removal permits to be applied for in order to destroy/remove and transplant these specimens. If during the clearing stage of the proposed development more species that are protected are found, an application for the removal to destroy or move must be lodged with Ezemvelo KwaZulu-Natal Wildlife (it must be note that permits are required for both destroying, cutting or moving).

Table 3: Species Protected by the Provincial Conservation Ordinance

Species	Location	Found in Watercourse	Occurrence
Aloe ferox	29°43'0.87"S and 30°54'46.04"E 29°42'51.94"S and 30°54'53.27"E	No	2
Aloidendron barberae	29°42'53.41"S and 30°54'58.15"E	No	1

There were no species found at the time of the survey. Plant species protected by the National Forest Act will require that the developer applies for a permit from the relevant authority to either transplant or destroy. If the

contractor finds any species protected by this Act, it will be in the best interest of the developer to inform the ECO and for the appropriate permits to be applied for.

- *Exotic Plant Species*

Due to the long-term pressures that this study area has been exposed to, most plant species occurring are weed/ruderal species many of which are alien invasive. The current anthropological activities such as clearing plots for housing, uncontrolled excavation within a river/wetland and subsistence farming has resulted in a highly transformed habitat and environment. In many instances, invasive plant populations have been controlled on properties through regular maintenance of gardens, but in open spaces that have either been cleared and left un-developed or along the banks of rivers/streams invasive plant populations have been left to expand drastically over the years. The following exotics can been found in varying amounts throughout the study area. The species below offer limited availability of habitat in their own capacity and will need to be removed to increase the overall PES status of this region.

- *Achyranthes aspera* – Burweed
- *Agave sisalana variegate* - Verigated Agave
- Ageratina adenophora - Crofton Weed
- *Ageratum conyzoides* - Invading Ageratum
- *Bambusoideae* - Bamboo
- *Bidens pilosa* - Blackjack
- *Canna indica* - Wild Canna or Indian Shot (potential invasive)
- *Chromolaena odorata* - Triffid weed
- *Conyza spp*. - Horse Weed
- *Eucalyptus grandis* – Saligna Gum
- *Lantana camara* – Lantana *
- *Mangifera indica* – Mango Tree
- *Melia azedarach* (Syringa Berry Tree)
- *Mirabilis jalapa* - Four O'clock (potential invasive)
- *Montanoa hibiscifolia* – Tree Daisy
- *Morus nigra*– Mulberry Tree
- *Musa hybrid* – Commercial Banana
- *Persea Americana* – Avo
- Prunus avium - Cherry Tree
- *Psidium guajava* – Common Guava
- *Rhoeo Discolor* – Boat Lily
- *Ricinus communis* - Castor-oil Bush
- *Schinus terebinthifolius* – Brazilian Pepper Tree
- *Senna didymobotrya* – Peanut butter cassia
- *Solanum mauritianum* – Bugweed
- *Tagetes minuta* - Southern Cone Marigold (Karkie Bos)
- *Triumfetta rhomboidea* – Burr Bush
- *Verbena brasiliensis* - Brazilian Verbina
- *Yucca filamentosa* – Yucca

3.2 FAUNA (*Coverage Map* 2940_3055 (GDGC: 2930DB) Inanda

- **Birds**

The South African Bird Atlas Project (SABAP1) lists a total of 198 species (14 breeding) from the QDGS in which the study site is situated and of these 6 are Red Listed as indicated in **Table 4**.

Table 4: Birds within the QDGS (Animal Demography Unit, 2016).

Species	Red Listing	Sighting
Martial Eagle	VU	10
African Crowned (Crowned) Eagle	NT	195
Lanner Falcon	NT	31
Grey Crowned Crane	VU	4
Southern Ground Horn-bill	VU	1
Broad-tailed Warbler	NT	2

In Table 4 above, the bird species that have been recorded in this location are listed. Five out of the six species that are listed would not be expected to breed or regularly frequent the development area and would only be found closer to the D'MOSS section. The Broad-tailed Warbler (Not Threatened) would occasion be seen in this location but not affected by the development.

No Coordinated Waterbird Count (CWAC) sites are associated with the study area. At the time of the study there were no recorded Coordinated Avifaunal Roadcount (CAR) routes associated with or within close proximity of the study. In terms of the nearest Important Bird Area (IBA) there are no registered areas in close proximity to the study area.

- **Mammals**

No mammals were observed during the site visit and the Animal Demography Unit's Mammal Map atlas project indicates 21 records for the area, including three Red Listed species as seen in Table 5 below. Of the species below no species of conservation importance would be expected within close proximity of the development area. However, when clearing any Banana (*Musa)* species, special caution should be taken to prevent potential impacts to bat species along the route.

Table 5: Mammals within the QDGS (Friedmann & Daly, 2004)

Family	Genus, Species, Subspecies	Common Name	Red Listing
Molossidae	*Otomops martiensseni*	Large-eared Giant Mastiff Bat	Vulnerable
Muridae	*Lemniscomys rosalia*	Single-Striped Lemniscomys	Data Deficient
Rhinolophidae	*Rhinolophus clivosus*	Geoffroy's Horseshoe Bat	Near Threatened
Soricidae	*Suncus Lixus*	Greater Dwarf Shrew	Data Deficient
Vespertilionidae	*Myotis bocagei*	Rufous Hairy Bat	Data Deficient
Vespertilionidae	*Myotis tricolor*	Temminck's Myotis	Near Threatened

- **Reptiles**

In generating a fully inclusive list of reptiles requires intensive surveys over several seasons as a result of the secretive and cryptic nature of these organisms. The majority of reptiles are sensitive to severe habitat alteration and fragmentation and disturbances such as clearing and burning. The human presence in the area has further impacted on the likelihood of encountering a diverse reptile fauna, as has the agricultural activities. No reptiles were found during the site visits and the Animal Demography Unit Town Reptile Atlas Project returns 34 records for the QDGC with seven being Atlas Region endemics and seven being Red Listed.
(as in **Table 6)**.

Table 6: Reptiles within the QDGS (Michael *et al*. 2014)

Family	Genus, Species, Subspecies	Common Name	Red Listing
*Chamaeleonidae	*Bradypodion melanocephalum*	KwaZulu Dwarf Chameleon	Vulnerable
*Colubridae	*Dasypeltis inornata*	Southern Brown Egg-eater	Least Concern
*Colubridae	*Philothamnus natalensis occidentalis*	Western Natal Green Snake	Least Concern
Elapidae	*Dendroaspis angusticeps*	Green Mamba	Vulnerable
*Lamprophiidae	*Lamprophis aurora*	Aurora House Snake	Least Concern
*Lamprophiidae	*Lycodonomorphus laevissimus*	Dusky-bellied Water Snake	Least Concern
Lamprophiidae	*Macrelaps microlepidotus*	Natal Black Snake	Near Threatened

- **Amphibians**

After conducting an in-depth literature review there was only one species recorded of conservation importance. Although there is three wetland recorded on site, that will be directly affected by development itself, chance finds of this species will be low to very low. However, to avoid and/or minimise possible impacts, mitigation techniques mentioned in this report are to be followed.

Table 7: Amphibians within the QDGS (Minter, Burger, Braack, Bishop & Kloepfer, 2004)

Family	Genus, Species, Subspecies	Common Name	Red Listing
*Hemisotidae	*Hemisus guttatus*	Spotted Shovel-nosed Frog	Vulnerable
*Ptychadenidae	*Amietia quecketti*	Queckett's River Frog	Least Concern

- **Invertebrates**

The Animal Demography Unit's invertebrate atlases record the following from the QDGS:

- Thirty-three Odonata, neither are Red Listed nor Atlas Region endemic (Animal Demography Unit, 2016).
- Neuroptera or Megaloptera, none of which are Red Listed or an Atlas Region endemic (Animal Demography Unit, 2016).
- No Species of scorpion are found within this GDGS (Animal Demography, 2016)
- Within this GDGS there were two hundred and twenty-six species of Lepidoptera, of which one is Red Listed and ten are Atlas Region endemic as listed below:

Table 8 - Lepidoptera within the QDGS (Animal Demography Unit (2016)

Family	Genus, Species, Subspecies	Common Name	Red Listing
*HESPERIIDAE	*Celaenorrhinus mokeezi mokeezi*	Christmas forester	Least Concern
*HESPERIIDAE	*Coeliades keithloa*	Red-tab policeman	Least Concern
*HESPERIIDAE	*Eretis umbra umbra*	Small marbled elf	Least Concern
*LYCAENIDAE	*Alaena amazoula amazoula*	Yellow zulu	Least Concern
LYCAENIDAE	*Durbania amakosa flavida*	Amakoza rocksitter	Endangered
*LYCAENIDAE	*Durbania amakosa natalensis*	Amakoza rocksitter	Least Concern
*LYCAENIDAE	*Leptomyrina Gorgias gorgias*	Common black-eye	Least Concern
*LYCAENIDAE	*Pentila tropicalis tropicalis*	Spotted pentila	Least Concern
*NYMPHALIDAE	*Paralethe dendrophilus albina*	Forest beauty	Least Concern
*PIERIDAE	*Colotis erone*	Coast purple tip	Least Concern

4 DEVELOPMENTAL IMPACTS CAUSED

With the current nature of the proposed site being in a highly transformed state, it will allow for overall low impact to be caused on the proposed sewage reticulation site, given that the mitigation techniques are adequately implemented during the construction phase of the project.

In terms of dryland habitats, the current land use of this area is predominantly used for housing and in such an extent that most of the expect vegetation has been removed. Therefore, development impacts caused to dryland areas will be low. In order to further reduce impacts to these areas, preservation of indigenous trees and scrubs that are so infrequently scattered through the study area must be preserved or otherwise removed and transplanted where possible or advised by the ECO.

In terms of the single river and its associated habitat that dissects the study area, much of the encroachment from houses and perimeter fences have been maintain just outside of the 1:100-year flood zones. Which would be owed to the amount of flooding that would take place along this river during times of heavy rain. However, the current status of this river can be regarded as poor. This owes to the intense pollution through solid waste, the overall lack of sewage infrastructure and invasion of IAP which has led to very low indigenous species diversity in this area. The development is anticipated to have an overall low impact on the river environment and many of the existing fauna, if any would be evading the proposed development.

In terms of the wetland habitats found in the study area there is an overall low impact that is anticipated to occur. Although all three of the wetland that were noted during survey were in a poor state, a small portion of the habitat remaining, was indigenous vegetation. There was no rare or endangered species were found, but the remaining vegetation would offer a limited habitat for fauna in the area, especially in terms of amphibians and avi-fauna. Therefore, it is important that construction staff and management follow the mitigation techniques mentioned in this report and are adequately educated on environmental topics when working within these areas.

During times of vegetation clearing and trench work, it is can be assumed that species that prefer disturbed environments, such typical IAP (especially *Bidens pilosa* and *Tagetes minuta*) will rapidly occupy newly cleared areas and topsoil stockpiles. It is ttherefore crucially important that the Applicant/Contractor ensures regular Alien Invasive Control on site and does not allow for populations to establish on site. In doing so an opportunity for the ecological integrity of the area to be improved by the development is possible and the development should focus on preventing a further damage to more sensitive areas of the site and the enhancement of the PES through rehabilitation and indigenous landscaping which will encourage a greater faunal component to occupy site.

If there is a need to remove indigenous species (whether it be grasses or shrubs found on site) the contractor must do so systematically to prevent an overabundance of exposed soils at any point in time. In all instances the removal of vegetation must only be done if necessary and the use of a nursery could be considered to aid in the vegetation of the area post construction. Although no faunal species were found on site at the time of the ground study, it can be assumed that any organisms that are present on site will be able to vacate the point of construction and return once competed and the rehabilitation is completed. The impacts caused by this development must be mitigated to minimise the effects.

4.1 IMPACT MITIGATION

Table 9 – Impact Mitigation Table

IMPACT	IMPACT INTENSITY	
	Unmitigated	Mitigated
1. Soil erosion	High	Low
2. Destruction of indigenous vegetation	Low	Very low
3. Harvesting of flora/poaching	Medium	Very Low
4. Noise disturbance	Medium	Low
5. Loss of protected species	Low	Very Low
6. Contamination of soil and habitat	Medium	Low

4.2 SUGGESTED MITIGATION MEASURES

- Disturbance and habitat loss must be kept to a minimum.
- All trenches must be clearly demarcated and barricaded on site at all times.
- Care must be taken to keep soils stabilized when removing vegetation during construction and as part of alien plant eradication and strict on-site soil erosion measure must be implemented.
- Topsoil must be stockpiled for eventual return during top soil back-filling and rehabilitation. These must be weed free and must not stand for a prolonged period of time.
- Sub-soil and topsoil must be stored separately onsite.
- Care must be taken to prevent the contamination of ground water with accidental fuel and oil spills from earth-moving and construction equipment and vehicles. Adequate usage of drip trays and bunded storage zone must be implemented on site.
- Trenched must have one sloped side to allow animals which fall in to get out.
- Trenches must be checked daily while open for animals which may be unable to get out.
- Any animals found must be returned uninjured to suitable safe habitat.
- Hunting and trapping of any animals by staff must be prevented. This includes reptiles which must be handled by a professional.
- A pre-construction walk-through must be implemented by the ECO at the crossing points in the wetland and river areas before excavation takes place on site. This will be used to identify any species of conservation importance that may have occupied the site after the compilation of this report.
- Should any species be found that are protected, either provincially or Nationally, the correct permit should be applied for in advance and the conditions of those permits should be followed to prevent or offset impacts during construction.
- Alien invasive plant eradication plan must be implemented on an ongoing basis to limit the establishment of exotic species during the rehabilitation of the disturbed areas.
- The ECO must supply the Contractor with list a list of problematic alien invasive plant species that are likely to occupy the site during construction.
- Regular Environmental Toolbox Talks must be implemented by the Contractor on site
- Noise levels including vibrations caused by drilling must be kept to a minimum to prevent animals abandoning nearby habitats.

5 CONCLUSION

In conclusion of the results acquired from both the literature study and the ground study there should be no reason why this development should not go ahead. There are currently limited impacts anticipated to be caused by the development, mainly owing to the fact that this study area has been subjected to the high anthropological pressures such as vegetation clearing, subsistence farming, introduction of exotic species and intense habitat alterations for housing over a long period of time.

The proposed site of this development does not fall within a Critical Biodiversity Area, yet there are areas within 500m of the development boundary that show irreplaceable biodiversity. Therefore, is imperative that the Contractor/Applicant ensures that impacts associated with construction are kept within the anticipated construction servitudes and areas of anticipated impact.

According to the literature review there are currently no faunal species of conservation importance that would be anticipated and found within this study area. Furthermore, no species on conservation importance were recorded whilst surveying all possible habitats. The overall lack of abundance and diversity of fauna would be owed to the overall lack of undisturbed habitat and anthropological pressures (hunting, trapping and pollution) which would be is common in unprotected environments. The proposed development should then not have a significant impact on any fauna that may exist in this study area. This is reinforced by the nature of the project, where species will have the opportunity to move from the construction site to other more suitable locations nearby. However, there are four main faunal “hot-spots” that should be treated differently to general dryland areas. These will be the three wetlands and the single river that flows through the proposed site. Here the contractor should carefully ensure that all mitigation techniques are implemented and care is taken not to destroy or injure any animals that may be found during construction, as unlikely as their presence will be in this degraded habitat.

At the time of the study there was a small quantity of indigenous flora recorded on site, of which only two were protected by the Natal Nature Conservation Ordinance, but none protected by the National Forest Act 1998. This is due to the ever-increasing need for space to development houses and general anthropological pressures such a vegetation clearing, introduction of exotic (including invasive plant species) and development of buildings within rivers/wetlands and other habitats that may have been previously in existence. However, as there are three wetlands and one river found in the proposed development area, there is a small possibility that species from the Liliaceae family, such as fire lilies, gladioli and Arum lilies will be encountered during construction but only as remnant populations that have survived the surrounding pressures. The appointed ECO must be notified of any such species and advice on their protection or removal and relocation nearby.

This development should have a minimal operational impacts, given that there is regular maintenance on the pipeline and that any works conducted are done so without disturbing the surrounding environment. The installation of adequate sewage infrastructure should increase the water quality of the surrounding habitat and thus increase the total PES of this area.

If there are any queries relating to the report, please do not hesitate to contact the author on the details on the cover page.

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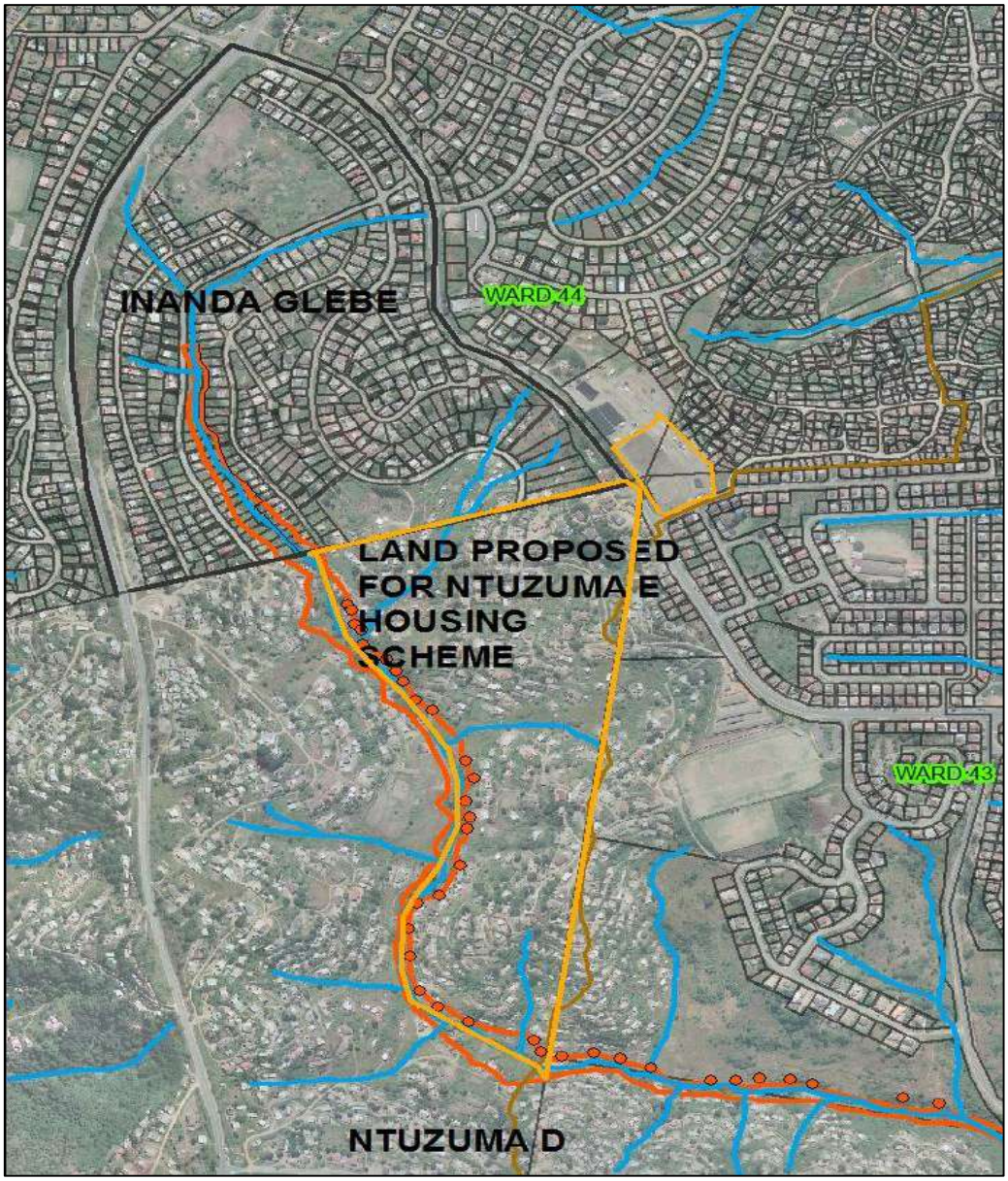
Stormwater Management Plan

INANDA GLEBE SEWER RETICULATION: STORMWATER MANAGEMENT PLAN



Contents

1. Introduction

This storm water Management Plan outlines the methodologies that will be employed to manage storm water before, during and after construction for the iNanda Glebe sewer reticulation. The objectives are to minimise the threat of flooding, protect watercourses which are potential receiving bodies and to ensure proper disposal of storm water.

2. Background

The Human Settlements Department has earmarked Ntuzuma E for the construction of low cost housing with waterborne sewerage. This area is bordered by Inanda Glebe and Ntuzuma D as indicated in Appendix 1. Inanda Glebe is to be upgraded to waterborne sewerage from the current pit latrine system used by residents. The outfall sewer will cater for Inanda Glebe, the existing low cost houses in Ntuzuma E as well as the proposed development once constructed. The EThekwini Water and Sanitation Design Branch proses to construct a 200mm Ø HDuPVC sewer in the valley to service these areas.

3. Location

The site of the works is in the iNanda Glebe area, north of Durban. Access to the site is the M25. The extent of the site is shown on the locality sketch in Annexure 1.

4. Existing storm water Infrastructure

There is an existing storm water infrastructure in the area. The extent of the storm water infrastructure is shown on the sketch in Annexure 2.

5. Proposed new Infrastructure

There is no proposed stormwater infrastructure that will be constructed under this project.

6. Storm water Control measures Before Construction

The following measures will be implemented before construction

- Environmental awareness training of the contractor and his workers will take place wherein acceptable construction methods and stormwater management practices will be discussed.

7. Storm water Control measures During Construction

The following measures will be implemented during the construction phase to mitigate the impact of storm water run-off on the environment and the works:

- The length of open trench excavations will be limited to a maximum of 100m.
- Cut-off catch water berms will be constructed on the high side of the trench. This will be particularly relevant for areas with steep slopes. For the steep areas, berms will be positioned so that the velocity of the storm water run-off will be reduced.
- Where material is highly erodible, sand bags will be used channel the flows.

- storm water run-off will be directed on to vegetated buffer zones and not directly into water courses
- Trench barricading will have openings to prevent the build-up of storm water run-off behind them.
- In areas with a high water table, there will be adequate battering and shoring to prevent trench collapses.
- Pumps will be available at all times on site for dewatering of trenches after storm events.
- The open ends of the pipe will be blocked with end caps or geo-textile fabric (Bidim) to prevent debris from entering the pipe.
- Sediment traps and fencing will be utilised to prevent excess levels of sediments entering watercourses from work areas and afterwards disposed of in a lawful manner The contractor will check weather forecasts to mitigate potential storm damage.
- During rehabilitation process, in steep areas, sand bags will be placed perpendicular to the trench.

Design Standards

The design standards and criteria used are based on the eThekwini specifications from the following:

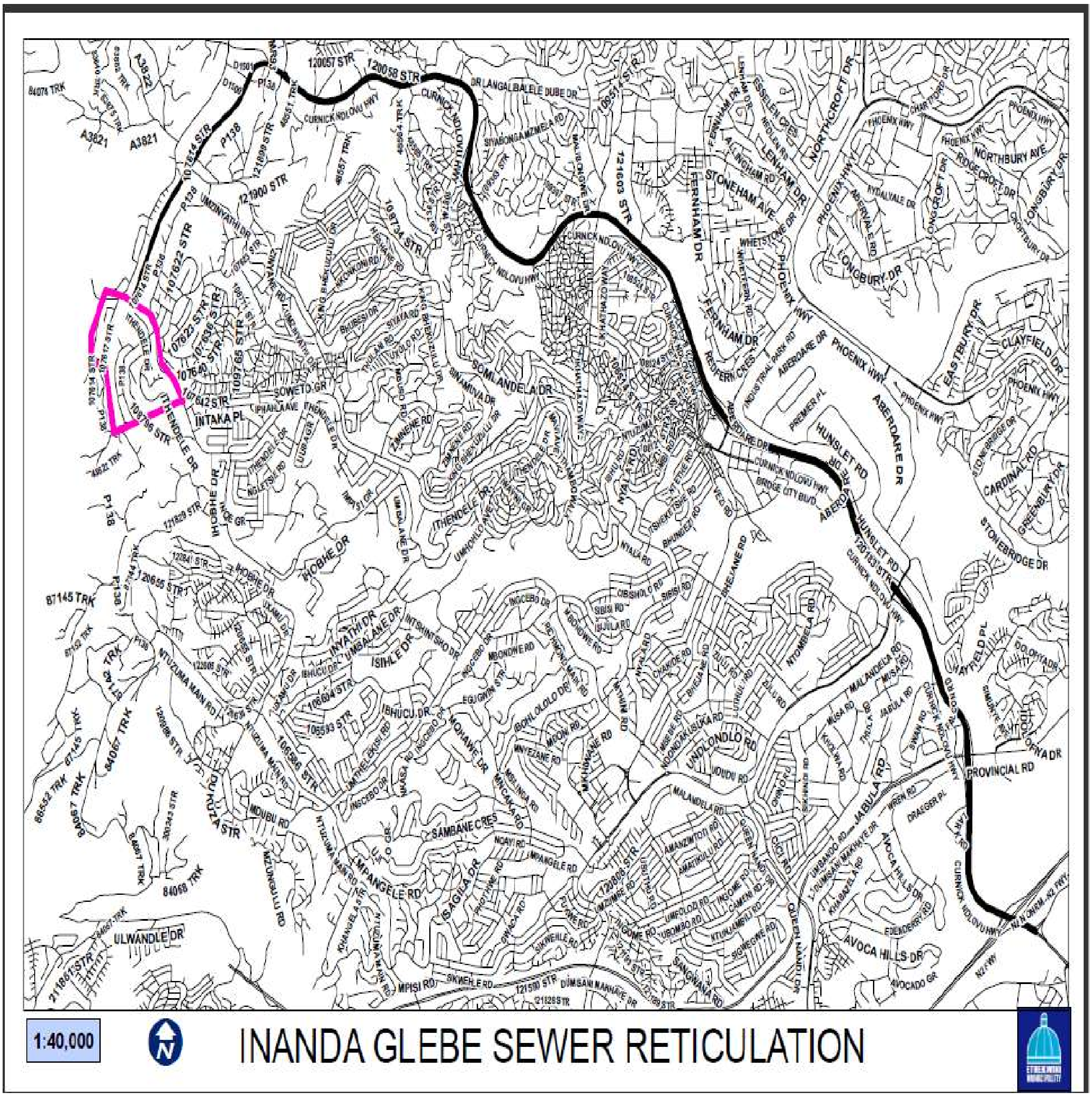
PART DB	:	EARTHWORKS FOR PIPE TRENCHES
PART L	:	MEDIUM-PRESSURE PIPELINES
PART LB	:	BEDDING (PIPES)

Annexures

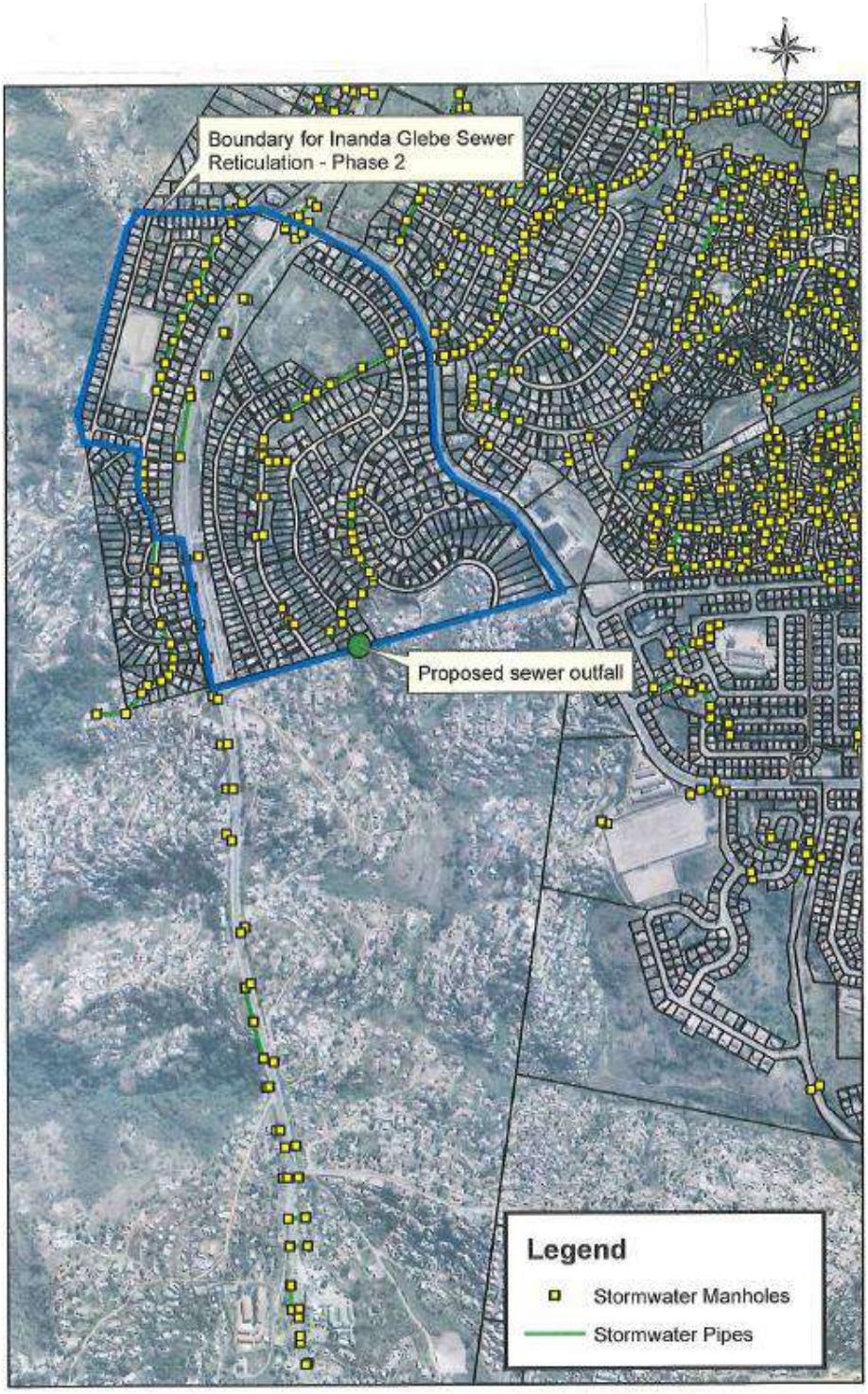
Annexure 1: Locality Sketch

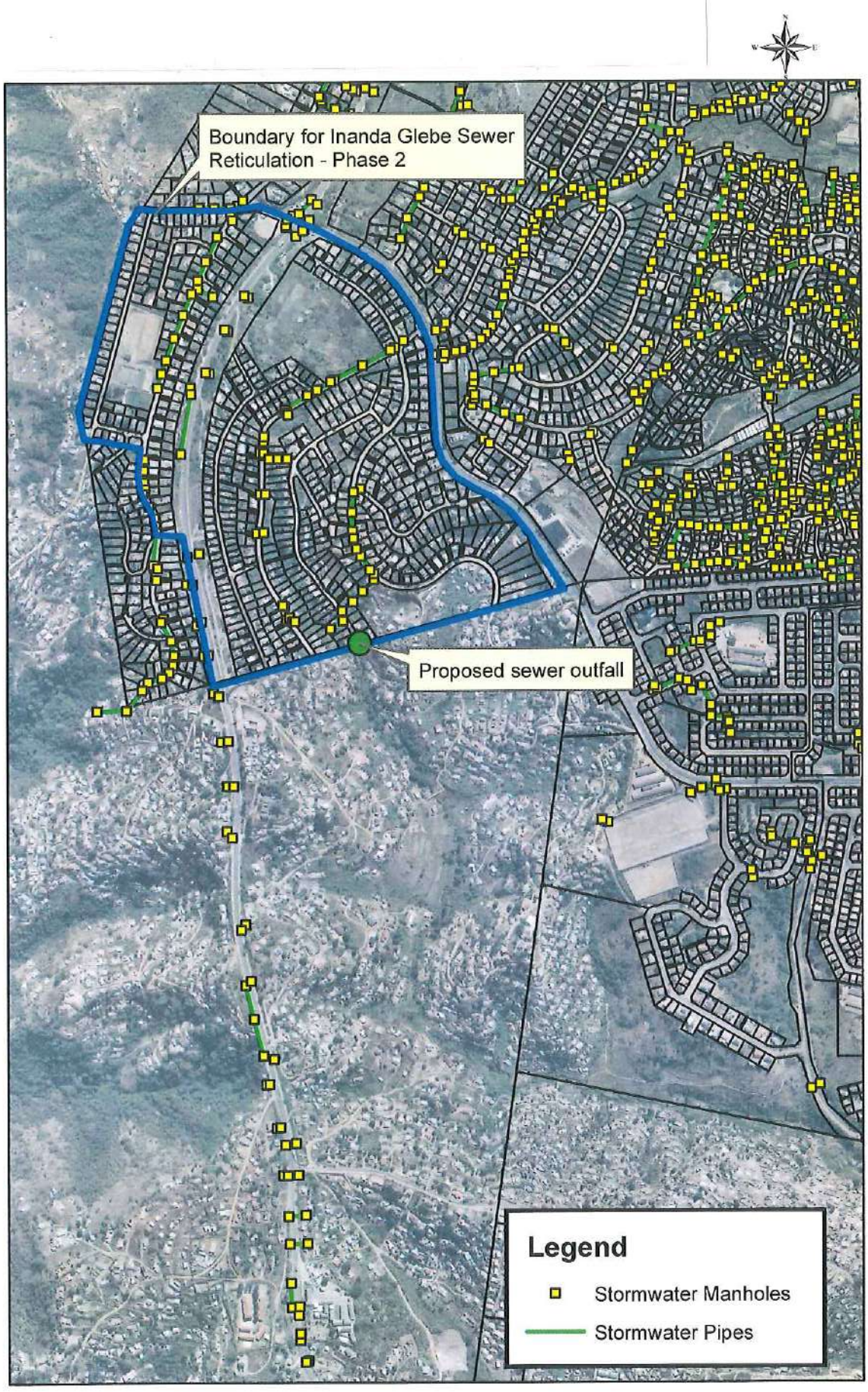
Annexure 2: Existing Stormwater

Annexure 1: Locality Sketch



Annexure 2: Existing Stormwater




Boundary for Inanda Glebe Sewer Reticulation - Phase 2
Proposed sewer outfall
Legend
Stormwater Manholes
Stormwater Pipes

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Geotechnical Investigation

REPORT TO

ETHEKWINI MUNICIPALITY

WATER AND SANITATION UNIT

ENGINEERING DEPARTMENT

WASTE WATER DESIGN BRANCH

ON A

GEOTECHNICAL INVESTIGATION

FOR THE PROPOSED

SEWER RETICULATION

AT INANDA GLEBE

(WQ 65/9220)

Ref Nº **32010**

DECEMBER 2017

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Document Control

Report Title		Geotechnical investigation for the construction of a Sewer Reticulation at Inanda Glebe		
Report Reference		32010	**Responsible Person**	M. Hadlow
Client Name		Ethekwini Municipality Water and Sanitation	**Client Contact Details**	3 Prior Road, Durban, 4001
Revision	**Date**		**Current Revision**	
Approval				
Author's Signature			**Reviewer's Signature**	
Name		K. Ridgeway	**Name**	M. Hadlow
Title		Eng. Geol.	**Title**	Director (Pr.Sci.Nat.)
Author's Signature				
Name		A. Joubert		
Title		Eng. Geol (Pr.Sci.Nat)		

The ground conditions described in this report refer specifically to those encountered in the hand dug inspection pits (extended by hand drilled auger where possible) and penetrometer tests carried out across the various portions of the proposed development site. It is therefore quite possible that conditions at variance with those at the above mentioned testing positions could be encountered elsewhere on site during construction.

This information in this report is given in good faith, as an indication of the materials and conditions likely to be encountered during construction. There is no warranty that the information is totally representative of the whole area and no responsibility will be accepted for any consequences from actual conditions being different from those indicated in this document.

CONTENTS

CONTENTS

REPORT TO ETHEKWINI MUNICIPALITY WATER AND SANITATION ENGINEERING DEPARTMENT ON A GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF SEWER RETICULATION AT INANDA GLEBE (WQ 65/9220)

1. INTRODUCTION AND TERMS OF REFERENCE

Drennan Maud (Pty) Ltd was appointed by Ethekwini Municipality to carry out a geotechnical investigation for the construction of the proposed Inanda Glebe Sewer Reticulation project. The geotechnical investigation was undertaken during the month of October 2017 and comprised an assessment of the prevailing geological and geotechnical conditions through out the project area.

Drennan Maud's scope of works as stipulated in the quotation document (Part C3), comprised the following;

- Determining the site geology through the excavation of hand dug inspection pits and hand augers along existing streets and building platforms as well as at proposed stream crossings and pipe jack locations.
- DCP testing at various locations across the project area as well as at the stream crossing and pipe-jack locations.
- Collection of materials sampled from the inspection pits for laboratory testing.
- Broad geotechnical assessment of the site and immediate surroundings with a view to provide information pertaining to the subsoil profiles, geological structures, excavatability, trench sidewall stability, ground water seepage, material suitability as well as recommendations for earthworks, site drainage and pipe-jacking.

The findings of the geotechnical investigation and subsequent recommendations for the proposed pipeline development in terms of the above scope of works are set down below in this geotechnical report.

2. INFORMATION SUPPLIED

Information supplied to Drennan Maud (Pty) Ltd included the "The Provision of Consulting Services For a Geotechnical Investigation For The Construction of Sewer Reticulation at Inanda Glebe" (Quotation Number: WQ 65/9220) which included a drawing showing the locality and layout of the proposed sewer reticulation route.

Upon Drennan Maud's appointment for the Inanda Glebe geotechnical investigation, Drennan Maud (Pty) Ltd was supplied with the following information for the purpose of the assessment:

- A service plan, Drawing № 'CAD INANDA GLEBE11A (002)', showing the existing services and partial contours of the existing topography. This has been used as the site plan DWG 32010-02 of this report.
- Aerial photo of Inanda Glebe and proposed pipeline routes.
- GPS coordinates of a pipe jack crossing (IP PJ1 - PJ2) and two stream crossings (IP S1 - S2 and IP S3 - S4)
- "Report to WAC JV on a Geotechnical Investigation on Sector 5 (Wyebank Reservoir to Ntuzuma Reservoir) of the proposed Western Aqueduct Pipeline: Phase 2" compiled by Moore Spence Jones Reference № 08-249, dated September 2009.

In addition to the above information supplied, Drennan Maud (Pty) Ltd, formerly Drennan Maud and Partners carried out a number of geotechnical investigations in the Inanda and immediate surrounding areas, the most applicable to the current site area being a report to Innova Ikhaya Division on an Engineering Geological Investigation of the Inanda Glebe Area for residential development purposes, reference № 6479, dated 1988.

The information supplied and available to Drennan Maud from previous investigations was reviewed and consulted during the course of the current investigation.

3. PROPOSED DEVELOPMENT

The proposed Inanda Glebe Sewer Reticulation development will comprise the installation of approximately 13km of 160mm diameter sewer pipeline through out the residential area of Inanda Glebe situated north west of the Durban city centre.

Due to developed nature of the area the proposed pipeline network will be aligned along existing tarred/gravel roads and between existing properties/dwelling platforms. In addition the pipeline is to traverse a stream at two separate location as well as pass below the Curnick Ndlovu highway via pipe-jack. At this preliminary stage pipe invert levels are unknown but, as described in the initial tender document, will likely range between 1.2 - 3.8m below existing ground level with an average depth of 2.5m assumed for the purpose of the assessment.

4. SITE DESCRIPTION

The project area is situated within the area of Inanda Glebe located some 18.5km as the crow flies north west of the Durban city centre. The site is primarily located between Ithendele Drive and 107617 Street to the east and west respectively whilst 108791 Street demarcates the southern most limit of the site. The GPS co-ordinates for the approximate centroid position of the site are 29°43'03.00" S; 30°54'58.00" E. The approximate extent of the Inanda Glebe project area is depicted in Figure 1 below.

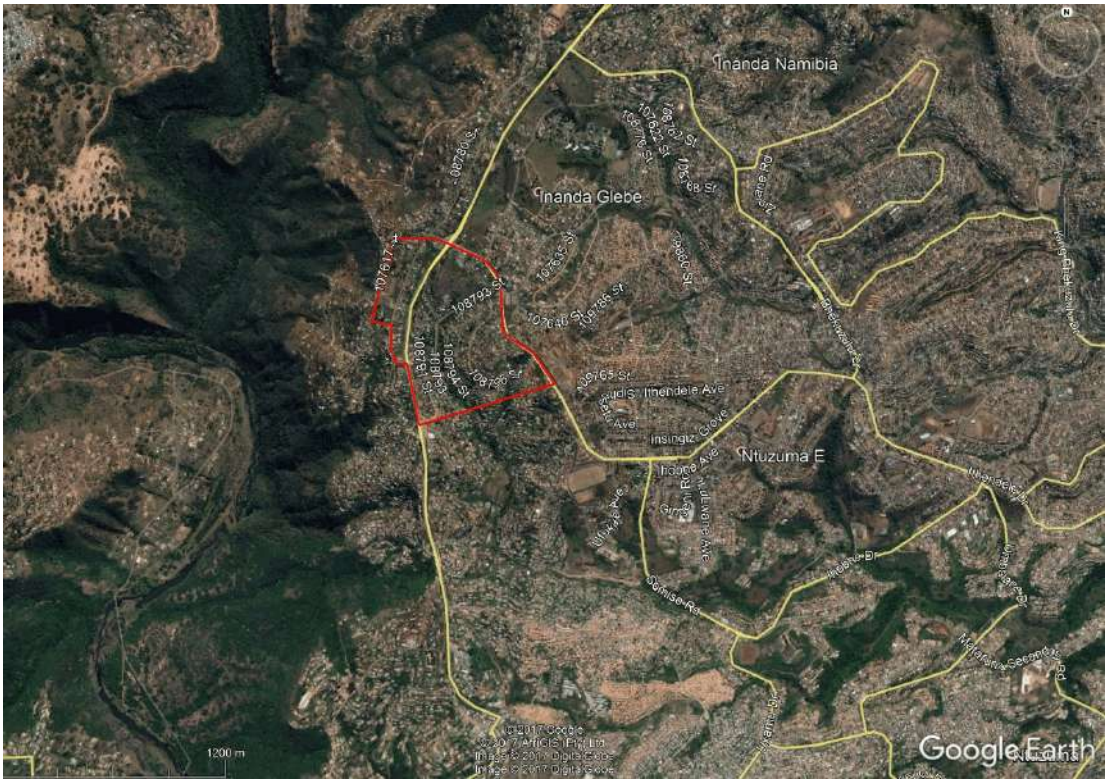


Figure 1: Approximate extent and locality of the Inanda Glebe assessment area.

The layout of the project area can be appreciated from the1:1250 scale site plan (Drawing 32010-02) accompanying this report.

The site comprises a well elevated, moderately shallow incised plataeu which falls away steeply into the deeply incised Umgeni River valley located to the immediate west of the site.

The project area is characterised by moderate sloping sideslopes (8 - 12°) and gently sloping valley bottom and hilltops (3 - 8°) with relatively well elevated hilltops and sideslopes intersected by a shallow stream valley and associated tributaries. The natural ground generally slopes in a south easterly to easterly direction across the western, northern and south eastern portions of the site whilst south west to westerly facing slopes prevail across the central and south central cordon of the site. The

sideslopes generally reflect a planar to convex conformation across the western and eastern portions but give way to a distinctive concave conformation towards the central northern portion of the site and at the heads of localised smaller tributaries.

The area is drained by a centrally positioned, approximately north-south trending stream. The gently sloping areas directly adjacent the stream at the base of the shallow incised drainage valley are generally poorly drained and thus characterised by typical marshy / wetland conditions.

The area is relatively densely populated with the residential homesteads cut into the sideslope and hilltops areas, whilst the network of interconnecting roads cut into the slope generally traverse the undulating topography along similar contour levels.

The general site conditions encountered on site are broadly represented in Figure 2 below.

Figure 2 : Photograph of the southeastern portion of the site, taken from DCP32 facing east, showing gently to moderate steep slopes above gently sloping natural drainage line and typical local housing present throughout the developed site area.

5. FIELD WORK

The field work was carried out between the 17th October 2017 and 20th October 2017 and comprised the excavation of hand dug inspection pits (IP) extended by hand bored augers, Dynamic Cone Penetrometer (DCP) testing, geological mapping and sampling of materials for laboratory testing.

The positions of the inspection pits and exposures profiles from the current assessment, as well as relevant profiles from previous investigations are indicated on the site plan, DWG 32010-02 of this report.

5.1 Inspection Pits and Auger Holes

A total of eighteen inspection pits, designated TP 1 - 12, IP S1-S4 and IPJ1 - J2, were excavated at various positions across the site to investigate the nature of the underlying subsoils, depths to bedrock and its inferred excavatability as well as to obtain samples for laboratory testing. IP S1 to IP S4 and IP J1 and IP J2 were excavated at the predetermined positions (provided by the client) of the stream crossings and pipe jack road crossing respectively. The pits were excavated to a maximum depth of 1.5m and extended by hand augers to 4m or until refusal was met at shallower depths.

The subsoils exposed in the inspection pits and removed from the hand bored auger holes were examined and logged by an Engineering Geologist, under the supervision of a SACNSP registered Engineering Geologist, familiar with the procedures of soil logging in terms of the guidelines for Soil And Rock Logging in South Africa, 2nd Impression 2002, edited by A.B.A Brink and R.M.H Bruin. This included recording the following parameters.

- For soil : Moisture conditions, colour, consistency, structure (where applicable), soil texture and origin.
- For rock : Colour, weathering, fabric discontinuities, hardness, rock name.

The resultant soil profiles logs, as well as relevent profile logs compiled from a previous assessment of the site are recorded in Appendix A of this report.

5.2 Geological Mapping

The excavation of inspection pits was supplimented with geological mapping of the project area which comprised the examination and logging of man-made and natural exposures throughout the Inanda Glebe area.

A total of six exposure profiles, designated Exp 1 - 6, were logged in accordance with the standards mentioned in Section 5.1 above, with the exposure profiles also included in Appendix A of this report.

5.3 Dynamic Cone Penetrometer Testing

A total of forty one Dynamic Cone Penetrometer (DCP) tests, designated DCP 1 to DCP 35, DCP S1 to S4 and DCP J1 to J2 were conducted across the site.

The aim of the DCP testing was to obtain an indication of the consistency of the subsoil underlying the site at shallow to moderate depths and the inferred depth to weathered bedrock at probe refusal.

The DCP tests achieved depths ranging between 0.6 - 4.5m below existing ground level and were taken to refusal in either very stiff clays, gravel rich horizons or extremely soft to very soft bedrock.

The results of the probes are presented graphically within Appendix B.

Table 1 overleaf is provided in order to facilitate in the interpretation of the DCP results with regard to the consistency of the non-cohesive and cohesive materials underlying the proposed sewer reticulation route. However, it must be understood that this table is only provided as a guide and is specific to Drennan Maud (Pty) Ltd equipment.

Table 1 : Subsoil Consistency Inferred from the DCP Test Results

Non Cohesive Soils		Cohesive Soils	
№ of blows/300 mm Penetration	Subsoil Consistency	№ Of blows/300 mm Penetration	Subsoil Consistency
<8	Very loose	<4	Very soft
8 - 18	Loose	4 - 8	Soft
19 - 54	Medium dense	8 - 16	Firm
55 - 90	Dense	16 - 24	Stiff
>90	Very dense	25 - 54	Very stiff
		>54	Hard

5.4 Material Sampling

A total of 16 representative samples of the prevailing geological units encountered across the study area were obtained from the inspection pits and returned to Thekwini Soils Laboratory, a SANAS accredited laboratory in Durban for analysis.

Testing on the retrieved samples, in accordance with the Bill of Quantities provided in the Tender document, included full grading analyses, Atterberg Limit determinations, Mod AASHTO density and California Bearing Ration (CBR) testing. In addition, compactability testing was carried out on selected samples.

A schedule of the samples retrieved and the testing conducted thereon is included as Table 2 below;

Table 2 : Laboratory Testing Schedule

IP	Description	Depth (m)	Test			
			Full Indicator	Mod AASHTO	CBR	Compact
1	Residual Dolerite	0.00 - 1.60	x	x	x	
2	Hillwash / Colluvium	0.00 - 0.45	x	x	x	
3	Residual tillite	0.55 - 1.40	x	x	x	
4	Weathered Sandstone	0.15 - 0.45	x	x	x	
5	Hillwash / Colluvium	0.00 - 0.85	x	x	x	x
7	Hillwash / Colluvium	0.50 - 0.85	x	x	x	
8	Fill	0.00 - 2.00	x	x	x	
10	Weathered Sandstone	1.00 - 1.90	x	x	x	x
11	Hillwash / Colluvium	0.50 - 1.40	x	x	x	
12	Fill	0.00 - 1.60	x	x	x	
PJ1	Alluvium	0.30 - 1.10	x	x	x	
PJ2	Alluvium	0.00 - 0.50	x	x	x	
S2	Alluvium	0.50 - 1.00	x	x	x	
S2	Residual Natal Group	1.00 - 1.90	x	x	x	
S3	Alluvium	0.00 - 0.85	x	x	x	
S4	Alluvium	0.00 - 1.40	x	x	x	

The results of the laboratory testing are included in the Laboratory Test Summary table and graphically presented in the grading analysis, both of which are included in Appendix C of this report. Furthermore, the results are summarised and further discussed in Sections 7 and 8 below.

6. GEOLOGY AND SOILS

6.1 General Overview

The 1:250 000 geological series Durban (2930) map indicates the area is underlain by tillite bedrock of the Dwyka Group and Natal Group sandstone. Inspection pitting and geological mapping of the area revealed that the parent rock material has been intruded in places by small sheets of Karoo dolerite. The respective parent rock material is overlain by variable amounts of colluvial and residual soils derived therefrom.

The northwestern and mid to lower western portions of the site, west of the centralised wetland /drainage line area, are underlain by Dwyka Formation tillite, whilst the mid and lower southeastern and upper northeastern portions of the site are underlain by Natal Group sandstone bedrock.

Karoo dolerite has intruded the Dwyka Group tillite and Natal Group sandstone bedrock in the form of large sills and dykes being present across the upper northeastern hilltop portion, and the central lower southern portions of the site.

It is evident that the lower lying drainage lines are characterised by a typical thickening of the colluvial/hillwash soils and underlying residual silty clayey sands attaining a combined thickness in the order of 1.8 - 4.5m. Conversely, the moderately sloping and gently sloping upper hilltop portions are characterised by generally thinner colluvial/hillwash/residual horizons attaining a combined thickness in the order of 0.9 to 3.3m.

Alluvial material is present along the valley bottoms and the lower lying flanks of valley lines.

Given the developed nature of the site fill material associated with various phases of the residential development underlie portions of road and building platforms.

The inferred site geology is depicted on the site plan (DWG 32010-02) whilst the generalised description of the various bedrock materials and soil horizons encountered are provided below;

6.2 Bedrock Material

6.2.1 Weathered Natal Group Sandstone

Sandstone bedrock where underlying lower lying portions of the site was generally encountered at depths in the order of 2.0m below natural ground level, whilst across the relatively elevated hilltops and moderately sloping sideslopes was intersected at depths ranging between approximately 0.5 - 1.5m below existing ground level. However, this in places is due to augmentation of the slope through cutting.

The weathered sandstone material generally occurs as highly weathered, pinkish brown to orange brown, very close to medium jointed, medium bedded, very soft rock which in places is mantled by an approximately 1m thick horizon of completely weathered, extremely soft rock.

Where exposed in natural or man-made cuttings in the order of 1.0 - 3.0m high the weathered bedrock is generally uniformly weathered with no indication of a significant increase in rock hardness with depth.

That being said the localised occurrence of harder, more quartzitic rich and thus less weathered sandstone lenses cannot be completely excluded. If encountered, these sandstone horizons will likely be removed as hard blocky boulders. However, the converse is also true where relatively softer 'pockets' of deeply weathered sandstone bedrock, recovered as clayey sand may also occur locally.

6.2.2 Dwyka Group Tillite

Dwyka tillite bedrock where underlying the development area is generally deeply weathered comprising yellow and orange brown, completely to highly weathered, very close to closely jointed, extremely soft to very soft rock likely grading into less weathered, soft rock tillite with depth.

Although not encountered within inspection pits, due to its typical erratic weathering pattern the presence of potentially large, slightly weathered boulders within the tillite bedrock or overlying residual material may be encountered locally along the pipeline route.

The dwyka tillite bedrock generally occurs at depths ranging between approximately 1.0 - 3.4m below natural ground level, however, as alluded to above may be exposed at shallower depths within cut road/building platforms.

6.2.3 Karoo Dolerite

No dolerite bedrock was encountered within any of the inspection pits excavated during the current assessment. However, from the previous assessment of the area dolerite bedrock, where present across the upper slope towards the north western portion of the site, generally occurs as yellowish brown to reddish brown, dark grey and yellow, completely to highly weathered, closely jointed, extremely soft to very soft rock. The bedrock is generally intersected at depths ranging between 1.5 - 2.0m and extends to depths ranging between 2.5 - 4.0m below existing ground level.

Thereunder the bedrock generally becomes less weathered with depth and comprises highly weathered, very soft to soft rock.

The upper completely to highly weathered bedrock is overlain by a generally deeply weathered and thick residual clay profile. Although not encountered on site, rounded, hard rock dolerite corestones in the residual/completely weathered material may be present.

6.3 Soils

6.3.1 Residual Sandstone

The residual soils derived from the sandstone bedrock generally occur as slightly moist to moist, purple brown to brown and orange brown stained yellow, firm to very stiff or loose to medium dense, slightly sandy silty clay to fine to medium grained sand.

Where intersected the residual sandstone material is encountered at depths ranging between 0.5 - 1.5m and ranges from nominally thick (0.1m) to 1.4m thick in places.

6.3.2 Residual Tillite

Residual tillite encountered across the site generally occurs as moist to wet, yellow brown mottled orange, red and dark grey, firm to very stiff, slightly gravelly, slightly sandy clay to gravelly silty clay, the gravel material generally comprising rounded ferricrete nodules.

The residual material occurs at depths ranging between 0.7 - 1.1m below existing ground level, where not removed through cutting, and extended to depths in excess of 1.25 - 3.4m below existing ground level given the generally deeply weathered nature of the underlying tillite bedrock, especially towards drainage lines and lower slopes.

6.3.3 Residual Dolerite

Residual dolerite encountered on site as well as during previous assessments generally occurs as slightly moist to moist, red orange and yellow brown, slightly fissured, firm to stiff, slightly sandy silty clay.

The residual dolerite where intersected in inspection pits (both previous and current) occurs from approximate ground level or shallow depths of 0.5m and ranges from approximately 0.5m thick to in excess of 4m thick in places but generally attains a thickness of at least 1.5 - 2.5m.

6.3.4 Colluvium

The mantle of colluvial/hillwash material present through out the assessment area across the upper and mid sideslopes generally occur as slightly moist to moist, dark brown grey, loose to medium dense, gravely clayey sand to sandy clay and locally clayey sandy gravel, this gravel material comprising rounded ferricrete nodules.

Colluvial material, where not overlain by fill material, generally occurs from surface level to depths ranging between approximately 0.5 - 1.5m depth and directly overlies the residual or completely weathered bedrock thereunder.

6.3.5 Alluvium

The alluvial materials generally occur as moist to wet, dark brown becoming mottled and blotched orange brown and very dark grey, very soft to firm and very loose to loose, fine grained slightly sandy clay to slightly clayey fine to medium grained sand occasionally becoming more gravelly in places.

Alluvial material was found along valley bottom areas from surface level to depths ranging between approximately 1.0 - 2.0m below existing ground level thereunder typically underlain by residual clay.

6.3.6 Fill

Fill material encountered generally comprises brown, slightly clayey, gravelly, sand often containing foreign material such as wire, brick, plastic or rubble material. The material was likely derived from colluvial or weathered bedrock material and placed during initial formal/informal development stages of the area. Where encountered along road/building platforms the fill material obtains maximum thickness ranging between 0.2 - 1.2m.

6.4 Groundwater Seepage

Ground water seepage was encountered in areas underlain by sandstone, tillite and dolerite bedrock.

Seepage was primarily intersected within pits excavated towards the heads of valleys, which are typically known to harbour ground water or along lower slopes in the vicinity of existing drainage features or marshy areas. The groundwater table was intersected at shallow depths ranging between 0.2 and 1.5m in these areas where likely perched in the alluvial and/or residual soils.

Seepage was also intersected locally across the mid to upper slopes at depths ranging between 1.7 and 1.8m where ground water is perched on less permeable clayey residuum or at the soil rock interface. Furthermore, the presence of ferricrete nodules in the residual and colluvial subsoils in places suggest a seasonally perched ground water table therein.

A summary of the inspection pits in which groundwater seepage was encountered as well the depth thereof is provided in Table 3 below.

Table 3 : List of Inspection Pits With Groundwater Seepage

Inspection Pit №	Groundwater Seepage Depth (m)
PJ1	0.4
PJ2	0.5
S1	0.2
S2	0.8
S3	1.5
S4	0.85
IP3	1.7
IP8	1.8

6.5 Structural Faulting

Based upon the 1:50 000 scale geological series map of Durban (2930) and information available from previous assessments carried out in the area, a prominent south west - north east striking fault occurs across the southern portion of the investigated area along the inferred alignment indicated within Drawing No. 32010-02 of this report.

The fault represents a tilted block, step fault with associated horst and graben structures which is typical along the Kwa-Zulu Natal coastline. The movement along the fault sometime in the geological past, coupled with subsequent weathering and erosion has lead to, in some places, the juxtaposition of younger overlying Dwyka Formation tillite adjacent to older Natal Group sandstone.

Furthermore, it is evident that the fault has acted as a conduit for the intrusion of dolerite into the southern regions of the site alongportions of its length.

7. LABORATORY ANALYSES

The results of the laboratory testing are included in the Laboratory Test Summary Table and graphical representation of the grading analysis included in Appendix C of this report. However, for ease of reference the results have been summarised in Table 4 - 6 below.

7.1 Grading Analyses

Grading analyses and Atterberg determinations were carried out on selected materials occurring across the proposed development area for classification purposes and to determine the suitability of the materials for use as pipe-bedding, selected cover material or general backfill to the pipe trench.

Table 4 : Summary of Full Indicator Testing

IP №	Depth (m)	LL %	PI	LS %	GM	% Silt/Clay	AASHTO Classification
HILLWASH / COLLUVIUM							
2	0.0-0.45	33	9	7	0.29	31	A - 4 (6)
5	0.0-0.85	21	5	3	2	10	A - 1 - b (0)
7	0.5-0.85	49	18	10	0.82	26	A - 7 - 5 (11)
11	0.5- 1.4	21	5	2	1.34	13	A - 2 - 4 (0)
ALLUVIUM							
PJ1	0.3- 1.6	28	8	6	0.96	20	A - 4 (1)
PJ2	0.0- 0.5	27	6	5	0.59	24	A - 4 (2)
S2	0.5- 1.0	15	0	0	0. 8	11	A - 2 - 4 (0)
S3	0.0- 0.85	23	8	3	0.55	23	A - 4 (2)
S4	0.55-1.40	26	9	7	0.42	26	A - 4 (4)

IP №	Depth (m)	LL %	PI	LS %	GM	% Silt/Clay	AASHTO Classification
RESIDUAL DOLERITE							
1	0.0- 1.6	54	27	12	0. 1	37	A - 7 - 6 (29)
RESIDUAL NATAL GROUP							
3	0.55- 1.4	32	9	6	1.54	15	A - 4 (0)
S2	1.0- 1.9	20	8	2	0.67	16	A - 4 (0)
WEATHERED NATAL GROUP BEDROCK							
4	0.85-1.05	30	10	7	1.66	12	A - 4 (0)
10	1.0- 1.9	67	9	3	1.81	11	A - 2 - 4 (0)
FILL							
8	0.0- 2.0	21	0	0	1.26	8	A - 2 - 4 (0)
12	0.0- 16.	26	8	3	1.63	9	A - 2 - 4 (0)

7.2 Density Testing

Table 5 : Summary of Mod AASHTO and CBR Testing

IP №	Depth (m)	Mod AASHTO		CBR Results			TRH 14
		MDD (kg/m^3)	OMC %	90 %	98 %	Swell %	
HILLWASH / COLLUVIUM							
2	0.0-0.45	1643	20.8	4.1	8.3	1.16	G10
5	0.0-0.85	2022	11.2	7	16	0	G9
7	0.5-0.85	1655	20.3	1	3.8	3.21	G10+
11	0.5-1.4	1850	10.7	3	16	0.57	G9
ALLUVIUM							
PJ1	0.3-1.1	1743	14.9	3.4	3.5	0.51	G10
PJ2	0.0-0.5	1761	12.1	2.2	3.8	2.94	G10+
S2	0.5-1.0	1979	9.2	5	18	0.82	G9
S3	0.0-0.85	1860	11.1	1.6	2.8	1.18	G10+
S4	0.55-1.40	1826	12.3	1.4	5.4	1.86	G10+
RESIDUAL DOLERITE							
1	0.0-1.6	1419	30.4	1.3	8.4	9.4	G10+

IP №	Depth (m)	Mod AASHTO		CBR Results			TRH 14
		MDD (kg/m^3)	OMC %	90 %	98 %	Swell %	
RESIDUAL NATAL GROUP							
3	0.55-1.4	1863	13.9	4.6	9.6	1.73	G10+
S2	1.0-1.9	1865	12.8	1.3	1.4	1.64	G10+
WEATHERED NATAL GROUP BEDROCK							
4	0.85-1.05	1863	13.9	4.6	9.6	1.73	G10+
10	1.0-1.9	1812	13.8	3	13	1.05	G10
FILL							
8	0.0-2.0	1927	9.7	7.5	15	0	G8
12	0.0-1.6	1961	9.2	7	10	0.57	G9

7.3 Compactibility Testing

Compactability factor testing was carried out on two selected representative samples, in accordance with the allotted testing allowed for in the tender document, to determine the suitability of the material for the application of pipe bedding. The results of the testing are summarised in Table 4 below and discussed further in Section

Table 6: Compactibality Factor Test Results

Inspection pit №	LAB №	Material Description	Compactability Factor
IP 5	10081	Dark brown, sandy fine to medium grained Gravel	0.355
IP 10	10083	Yellow brown stained very dark grey extremely soft rock Sandstone	0.391

8. GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

Based on the assessment of the site area and the prevailing subsoil conditions as well as intended pipeline development, geotechnical considerations that should be bourne in mind during the planning and construction phases should included, but are not limited to the following;

8.1 Slope Stability

Sandstone and tillite bedrock is generally considered to be inherently stable given the massive nature of the materials. Furthermore, given the gentle to moderately sloping topography the potential for deep seated instability in the weathered bedrock is considered low across the proposed development area.

However, given the developed nature of the area, localised instability may be encountered where pipe trench excavation is required at the toe of unretained, steep cut slopes excavated into the sideslopes for the construction of road and building platforms. In this regard instability may be encountered in the upper unconsolidated soils and/or overlying fill material especially where poor surface drainage conditions prevail.

Where such conditions are encountered along the proposed pipeline alignment, caution must be taken during excavation of pipe trenches or pipe jack pits and should incorporate the following preventative measures as a minimum;

- Stormwater run-off and any subsoil seepage must be adequately managed
- Vegetation removal should limited to a minimum.
- The subsoil removed from the trench excavation should be stockpiled a minimum distance equal to the height of the trench away from the cuff of the excavation.
- The trench should be excavated and pipe installed in sections along potentially unstable areas with the trench not left open for any extended period of time.
- Suitable shoring/lateral support used where excavation depths require.

8.2 Excavatability along the Proposed Sewer Reticulation Route

As alluded to in Section 3, although the exact pipe invert level has not been confirmed, it is likely to range between 1.2 - 3.8m below existing ground level with an average depth of 2.5m below existing ground level.

In this regard, as described in Section 5 above, as well as indicated on the site plan accompanying this report, depth to weathered bedrock along the pipeline route generally ranges from between 0.5 - 1.5m across the eastern portion of the site underlain by sandstone and slightly greater depths of 1.5 - >2.8m across the western portion of the site underlain by Dwyka tillite bedrock and deeply weathered dolerite.

However, given the developed nature of the site and the location of the proposed pipeline along cut road and building platforms, weathered bedrock will be encountered locally at relatively shallower depths or exposed at surface level.

Manual excavation across the site generally met with refusal either at the soil rock interface or within a depth of <1.0m into the respective weathered bedrock materials.

However, given the generally deeply weathered nature of the sandstone and tillite bedrock where exposed in existing road and platform cuttings, it is inferred that 'soft excavation' as defined by SABS 1200D is anticipated within the highly weathered sandstone and highly weathered tillite bedrock to the inferred average pipe invert level below existing ground level along the majority of the proposed pipeline network route.

In general, areas underlain by dolerite bedrock within the project area are characterised by a deeply weathered residual profile to depths ranging between 1.6 - 2.0m underlain by completely to highly weathered dolerite bedrock extending to depths of at least 3.0 - 4.0m below existing ground level. As such, 'soft excavation' (after SABS 1200D) is also expected to the proposed pipe invert level in areas underlain by dolerite bedrock.

Notwithstanding the above, although not encountered within excavations carried out, the weathered tillite, sandstone and dolerite bedrock prevailing across the project area are prone to erratic weathering and thus relatively harder zone may occur, wherein relatively harder excavation (intermediate to hard) may be encountered to required pipe depth. Although provision should be allowed for these harder zones, they are anticipated to be localised if encountered. Furthermore, should slightly weathered dolerite and/or tillite corestone boulders be encountered locally, these will require greater effort to remove and may require chiselling or in extreme cases blasting to remove.

Excavation in all overlying colluvial, residual, alluvial and fill material where present along the route will classify as 'soft' excavation through out the respective materials entire depths (after SANS 1200D).

Although manual excavation is likely to be achievable within the fill, colluvial, residual and alluvial material, excavation by hand within the weathered bedrock is likely to be highly onerous and time consuming.

It should be noted that where weathered bedrock is removed as relatively large blocks or rounded to semi rounded dolerite and/or tillite boulders are removed, these should be placed carefully adjacent the trench excavation to ensure that boulders are not allowed to roll down slope as this may cause significant damage to property and potential loss of life of residents or livestock.

8.3 Trench Sidewall Stability

The Standard Engineering Specifications for Earthworks for Pipe Trenches, pare DB states that 'trenches must be excavated in narrow sidewall conditions with vertical sides necessitating the use of adequate shoring methods to prevent erosion and consequent slope instability along any section of the proposed route'.

In this regard where weathered bedrock is located at shallow depths below existing ground level (< 0.5m), vertically cut trench side walls in the weathered bedrock to depths in the order of 2.5m are considered to stand with no shoring during pipe installation.

However, in areas where the depth to highly weathered bedrock exceeds 1.0m, trench sidewalls in typically loose to medium dense, sandy fill and colluvium as well as clayey/sandy residual or completely weathered material where present will be prone to collapse if left open for extended periods of time and allowed to either dry out or become saturated. As such sidewalls in the unconsolidated materials should be suitably shored or battered back to a maximum batter of 1:1,5 (33°) for the entire thickness of the unconsolidated material to ensure safe working conditions therein.

8.4 Material Suitability

8.4.1 Pipe-Bedding / Backfill Material

According to SABS 1200 LB standards one class of bedding is provided for flexible pipes (plastic and steel). The bedding cradle must comprise compacted selected granular material with a compacted selected fill blanket. The pipe bedding material requirements should conform to the following;

a) Selected Granular Material: Non-cohesive, singularity graded between 0.6mm - 19mm, having a compactability factor not exceeding 0.4.

b) Selected fill material: Material with a plasticity index not exceeding 6 and free of vegetation and lumps or stones exceeding 30mm.

In terms of the above the suitability of the typical materials encountered on site is as follows;

With regards to the laboratory testing carried out, both the highly weathered sandstone and sandy colluvial material tested returned suitable compactability factors ranging between 0.36 - 0.39 respectively.

Although not tested during the course of the assessment, based on previous testing of highly weathered tillite bedrock as well as sandy alluvial material as is locally present across the site, these materials are also likely to return a suitable compactability factor of less than 0.4, whereas residual dolerite, tillite and clayey/silty sandstone material is unlikely to meet the minimum compactability requirements for pipe bedding material.

However, with regards to the above, although certain materials have suitable compactability factors, none of the materials encountered on site meet the minimum grading requirements for the material to be suitable for use as selected granular material. That being said, if the granular materials are suitably screened such that they fall within the required grading envelope these materials may be considered suitable for use. However, this process may be onerous and expensive and therefore may be more prudent to import a suitable selected granular material to site from a local source.

The samples of weathered sandstone, residual sandstone, colluvium, alluvium and fill material range from being non-plastic to slightly plastic to plastic with plasticity indices ranging from acceptable (PI of 0 or below 6) to marginally unacceptable (PI of 8 - 9) and therefore considered only selectively suitable for use as selected fill blanket material provided all particles greater than 30mm are removed prior to the placement and compaction thereof to marginally unsuitable. Residual tillite and dolerite material will have consistently high plasticity indices and thus considered unsuitable.

In terms of the above, although the selective use of local on-site material for selected fill blanket material is feasible, given it will require a well trained eye to discern suitable material and constant confirmatory laboratory testing, it may be more practical to acquire suitable selected fill blanket material from a local suitable source.

The weathered sandstone and tillite bedrock, colluvium, fill and alluvium as well as sandy varieties of residual material are considered suitable as general backfill provided any potential large rock fragments are removed such that the material can be suitably compacted and the material does not cake or form lumps upon drying out.

8.4.2 General Construction Use

The generally sandy to clayey sandy hillwash/colluvium and alluvial materials encountered on site generally classify according to TRH 14 - 1985 standards as G9 - G10+ materials and thus range from being acceptable to unacceptable for use as subgrade and bulk fill material depending on the materials relative clay content.

Samples of residual sandstone, residual dolerite and likely residual tillite do not meet the minimum requirements of a G10 type material and thus are considered not suitable for use as bulkfill or subgrade material.

Highly to completely weathered sandstone samples classify as G10 to G10+ material depending on the weathered state thereof and clay content and thus range from suitable to not suitable for use as bulk fill and subgrade material. Less weathered material, possibly encountered with depth, will likely classify as G7 to G8 material and thus may be used as construction material if encountered.

Based on previous testing of similar tillite bedrock material the completely weathered to highly weathered tillite bedrock is likely to similarly classify as G8 - G10+ material (after TRH 14 - 1985) and therefore can be used as construction material if required depending on the weathered state thereof.

The generally granular fill material encountered within the site areas classifies as G8 and G9 type material and thus considered suitable as lower selected layer material, subgrade and bulk fill if required, provided all foreign materials that may occur within are removed prior to its use.

8.5 Subsoil Seepage

As discussed previously ground water seepage was only locally encountered on the mid to upper slopes within the project area.

As such, where ground water seepage encountered within the pipe trench excavation it should be dealt with symptomatically if and when it occurs. This may require the installation of temporary cut off drains/berms or sump and pump measures to be adopted locally.

However, along the lower portions of the sideslopes, valley bottoms and heads of drainage valleys, ground water seepage will be encountered and ground water seepage management measures mentioned above will need to be adopted during pipe installation, in addition to dewatering measures, especially at the proposed stream crossing and pipe-jack positions.

8.6 Stream Crossings

The proposed reticulation pipeline network will cross the central main stream within the Inanda Glebe project area at two locations, namely between S1 - S2 and S3 - S4 positions located towards the central southern and north eastern portions of the site respectively where indicated on the site plan accompanying this report.

Profiling at the two stream crossing locations predictably revealed both areas are underlain by sandy to clayey sandy alluvial material to depths of at least 1.2 - 1.9m at S1-S2 and 1.1-1.2m below existing ground level at S3-S4, the latter being underlain by residual clay material to the maximum excavated depths ranging between 1.55m and 2.75m prior to hand auger refusal.

DCP refusal at depths of 1.8m at the S1-S2 crossing and 2.7m at the S3-S4 crossing indicate the inferred depth to underlying weathered tillite/sandstone bedrock.

In terms of the above, 'soft excavation' in terms of SABS 1200D standards is anticipated within the alluvial, residual and completely weathered bedrock material at the stream crossing locations to depths of at least 2.5 - 3.5m below existing ground level, thereunder potentially classifying as 'intermediate' excavation in the inferred weathered bedrock, depending on the degree of weathering. As such excavatability at the stream crossing positions is unlikely to be problematic and the required pipe invert level is likely to be easily achievable by mechanical means.

Ground water seepage was encountered within all of the excavated inspection pits at the proposed stream crossing at shallow depths below existing ground level. As such, significant subsoil seepage should be anticipated at the stream crossing positions and within the marshy/wetland areas along the flanks thereof. Thus, in addition, to carrying out the excavation of this section of the route during the relatively drier winter months, it recommended that stream diversion and dewatering practices be allowed for during the planning and design phases of the project.

Furthermore, the provision of a rock pioneer horizon may be prudent to facilitate ingress and egress of plant from the site as well provide a medium on which anchoring structures can be founded to counteract buoyancy forces on sections of the pipeline.

Given the saturated nature of the near surface clayey sandy to sandy alluvial soils, shoring of the trench sidewalls will be imperative to prevent certain sidewall collapse thereof. For general earthworks operations at the stream crossing areas, cut embankments should be restricted to a maximum temporary batter of 1:2 (26°) in the alluvium, residual and completely weathered materials, but may be temporarily steepened at the engineers discretion to 1:1,5 (33°) in highly weathered bedrock if encountered, provided the cut embankment does not exceed a height of 3m.

8.7 Pipe Jacking

Pipe jacking will be required where the proposed pipeline crosses the Curnick Ndlovu highway towards the northern western portion of the site area, at the PJ1-PJ2 positions indicated on the site plan. Invert level of the pipeline is unknown at this stage.

Assessment of the subsoil conditions at the proposed pipejack position was carried out via two manually excavated inspections pits extended via hand auger and two DCP's carried out on either side of the main road.

IP PJ1 and PJ2 excavated on the western and eastern sides of the road respectively revealed the area is underlain by clayey sand to sandy alluvium to depths ranging between 0.7 - 1.1m, thereunder underlain by stiff to very stiff residual tillite sandy clay to the maximum excavated depths ranging between 2.0 - 2.6m below existing ground level. DCP's PJ1 and PJ2 extended to depths ranging between 2.7 - 4.5m below existing ground level prior to refusal on inferred completely to highly weathered tillite bedrock. The DCP's indicate very loose to loose conditions in the upper alluvium becoming stiff to very stiff in the residual to completely weathered material thereunder.

Ground water seepage was encountered within the inspection pits at depths in the order of 0.5m. Given the pipe jack position toward the head of a prominent drainage valley ground water seepage should be expected year round.

Sufficient space is considered available on either side of the main road for the establishment of the launching and receiving pipe jack excavations.

Excavatability is considered to classify as 'soft excavation' to depths in the order of 3.5 - 4.5m below existing ground level and therefore likely to be non-problematic. However, that being said, although not encountered at the pipe jack position within the inspection pits, the presence of slightly weathered, potentially very large, very hard rock tillite corestone boulders within the residual and/or completely weathered bedrock cannot be excluded. If encountered, such an obstruction could be highly problematic and would require significantly greater effort to remove via chiselling/breaking with pneumatic tools or even blasting if possible and may in extreme cases even require the pipeline alignment to be relocated accordingly.

Ground water seepage at the pipe jack location is of concern and will likely require constant dewatering efforts to sufficiently lower the shallow ground water table and prevent water from entering the pipe jack excavations. In this regard a sump and pump method can be implemented at the discretion of the pipe-jack contractor/design engineer, or alternatively a series of dewatering well points can be installed. To aid in the dewatering efforts it is recommended that as much a practically possible that the pipe-jacking operation is carried out during the relatively drier winter months.

The launching pit should be positioned on the lower eastern side of the road and progress in a slight upwards direction to give the pipejack excavation a slight fall and allow any seepage encountered at the face of the excavation to drain naturally out of the pipe excavation and into a sump in the launching pit where it can be pumped out downslope.

Suitable shoring of the pipe-jack launching and receiving pits should be provided to prevent the sidewall collapse in the upper alluvial, residual and completely weathered bedrock material present to inferred depths in the order of 3.0 - 4.5m below existing ground level. The lateral support should be suitably designed by a Structural Engineer familiar with such projects and subsoil conditions.

8.8 Buoyancy Control

Given the shallow ground water table located at depths in the order of 0.5 - 1.0m below existing ground level along the valley bottom areas, the proposed pipeline will be subject to an upward buoyancy force along the lower slope areas and where it cross the stream valley.

In this regard the pipeline should be suitably anchored in place using a concrete saddle or similar structure to resist the upward force, the design of which must be carried out by a Structural Engineer based on appropriate buoyancy calculations.

9. CONCLUSION

Based on the findings of the geotechnical assessment the proposed 160mm diameter sewer reticulation pipeline network within the Inanda Glebe area is considered feasible provided the geotechnical considerations and recommendations provided in this report are taken into account during the design and construction phases.

It is anticipated that 'soft' excavation (after SABS 1200D) is anticipated along the majority of the pipeline route to anticipated pipe trench depths (ranging between 1.2 - 3.8) within the weathered sandstone, tillite and dolerite bedrock and overlying unconsolidated material. However, it is considered prudent that provision for localised harder zones, as may occur within the prevailing bedrock types, should be allowed for.

The weathered tillite, sandstone and sandy colluvial and alluvial material present on site will need to be passed through a screening process if they are to be used as selected granular fill material. Alternatively suitable material will need to be imported to site from a local source. Selected testing of the prevailing materials indicates that they generally range from suitable to marginally unacceptable for use as selected fill material, with the exception of the generally very clayey residual dolerite and tillite subsoils. All of the materials encountered on site are likely suitable for use as general backfill material provided the material does not form into lumps upon drying and all particles greater than 30mm are removed prior to its use.

Pipe-jacking where required along the route will need to be planned carefully, with all due caution exercised with regard to the excavation of launching and jacking pits and the lateral support thereof as well as necessary dewatering measures to adequately lower the shallow ground water table. The same applies to pipeline stream crossings which will be plagued by shallow ground water seepage and likely trench sidewall collapse if not adequately shored or battered back.

Given the shallow ground water table within the valley bottoms and heads of drainage valleys consideration must be given the upward buoyancy force that will be exerted on the pipeline and must be suitably anchored to counteract the upward force, the design of which must be carried out by an experienced Structural Engineer.

Where the pipe trench is located entirely within loose fill, colluvium or residual material the trench sidewalls should be suitably shored to prevent localised collapse thereof whilst trenches located entirely in weathered sandstone or tillite bedrock will likely stand unsupported during pipe installation provided no excessive seepage therein is encountered.

10. REPORT LIMITATIONS

The ground conditions described in this report refer specifically to those encountered in the subsoil excavations and exposures along the proposed pipeline route. It is therefore quite possible that conditions at variance with those in the excavations could be encountered elsewhere on site during pipeline installation. The information in this report is given in good faith, as an indication of materials and conditions likely to be encountered during construction along the pipeline route. There is no warranty that the information is totally representative of the whole route and no responsibility will be accepted for any consequences arising from actual conditions being different from those indicated in this document.

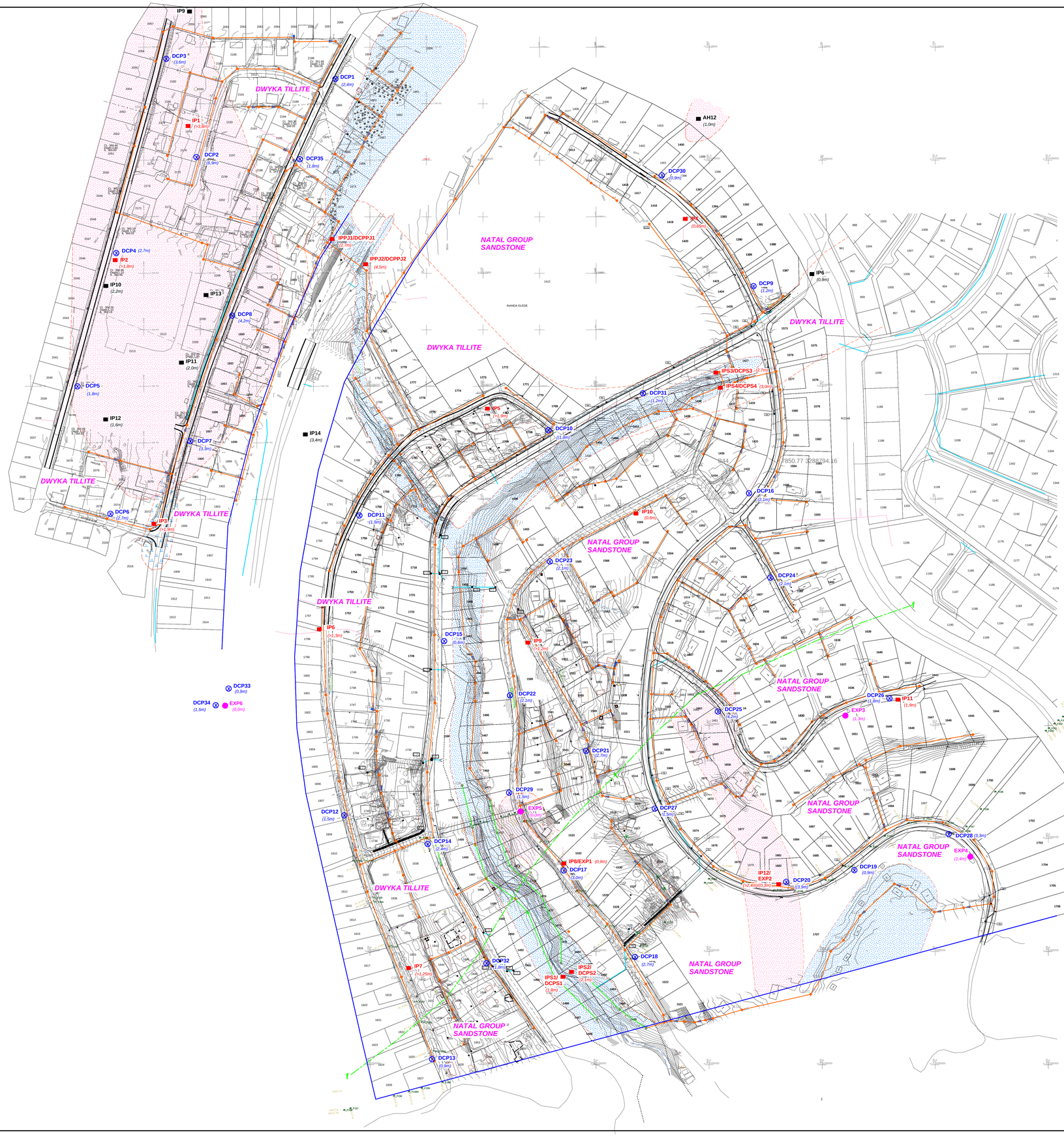
A. JOUBERT Pr.Sci.Nat.

REFERENCE 32010
DECEMBER 2017
/kjr/aj/kc

DRENNAN MAUD (PTY) LTD
68 Peter Mokaba Ridge, Tollgate,
DURBAN, 4001

DRAWING 32010-2

SITE PLAN



KEY

DCP1 (0,9m) — APPROX. POSITION OF DYNAMIC CONE PENETROMETER TESTS (DEPTH TO REFUSAL)

IP1 (0,9m) — APPROX. POSITION OF INSPECTION PITS (DEPTH TO BEDROCK)

EXP1 (0,9m) — APPROX. POSITION OF EXPOSURES (DEPTH TO BEDROCK)

IP1 (0,9m) — APPROX. POSITION OF INSPECTION PITS (PREVIOUS ASSESSMENT - FEB. 1987 - DMP REF. NO. 6479) (DEPTH TO BEDROCK)

DOLERITE

SEEPAGE / ALLUVIUM

SEEPAGE

INFERRED GEOLOGICAL FAULT

INFERRED GEOLOGICAL CONTACT

NO.	AMENDMENT	APPROVED	DATE

REVISIONS

CLIENT

ETHEKWINI MUNICAPILITY

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4058
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E-mail : info@drennanmaud.com

PROJECT

SEWER RETICULATION
INANDA GLEDE

TITLE

GEOTECHNICAL INVESTIGATION

CONSULTING ENGINEER	DESIGNED : K.R
SIGNATURE:.....	DRAWN : S.P.
PR. NO.:.....	CHECKED :
DATE:.....	SCALE : 1:1250 (A0)

REFERENCE NO. 32010-02

REVISION

APPENDIX A

INSPECTION PITS LOGS, EXPOSURE LOGS AND PHOTOGRAPHS

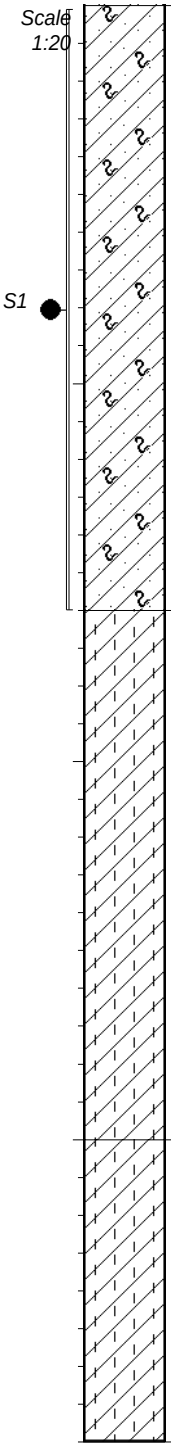
DRENNAN MAUD (PTY) LTD

Geotechnical Engineers & Engineering Geologists

ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP1**
Sheet 1 of 1

JOB NUMBER: **32010**



SAMPLE	DEPTH (m)	
IMC		0.00 Slightly moist to moist, red brown, intact, firm to stiff, fine grained very sandy CLAY containing minor roots at surface – (Residual Dolerite)
		1.60 Moist, orange red occasionally speckled yellow brown and very dark grey, stiff, silty CLAY – (Residual Dolerite)
		3.00 Slightly moist to moist, yellow brown stained orange red mottled very dark grey, stiff, silty CLAY – (Residual Dolerite)
		3.80

NOTES

1) Pit excavated to 1.4m, extended via hand auger to 3.8m

2) Final depth at 3.80m. No refusal encountered but stopped due to slow material recovery.

3) No groundwater seepage encountered.

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.01--1.60m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288491
Y-COORD : 0008333

HOLE No: **IP1**

IP 1

REF : 32010

SEWER RETICULATION INANDA GLEBE

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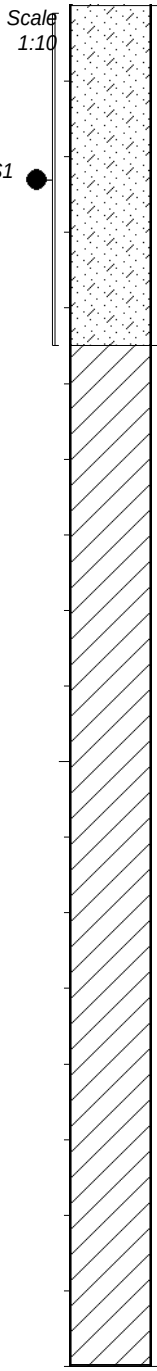
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: IP2
Sheet 1 of 1

JOB NUMBER: 32010



SAMPLE	DEPTH (m)	
IMC		0.00 Slightly moist, dark brown and dark red brown, intact, loose to medium dense, slightly gravelly clayey fine grained SAND – (Colluvium)
	0.45	Moist, red brown mottled and speckled yellow brown, intact, stiff, slightly sandy CLAY containing occasional dolerite corestone encountered with depth – (Residual Dolerite)
	1.80	

NOTES

1) Pit excavated to 1.4m, extended via hand auger to 1.8m

2) Refusal at 1.80m on inferred dolerite corestone

3) No groundwater seepage encountered.

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.01--0.45m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288582
Y-COORD : 0008422

HOLE No: IP2

IP 2

REF : 32010

SEWER RETICULATION INANDA GLEBE

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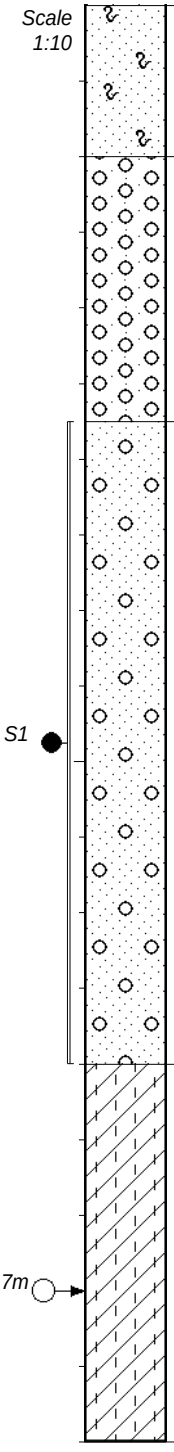
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: IP3
Sheet 1 of 1

JOB NUMBER: 32010



0.00 – Slightly moist to moist, brown to dark brown, intact, loose, fine to medium grained SAND containing roots – (Colluvium)

0.20 – Slightly moist to moist, dark brown, intact, loose to medium dense, slightly clayey sandy GRAVEL – (Colluvium)

0.55 – Slightly moist to moist, very dark brown stained red and orange yellow occasionally speckled very light grey, intact, firm to very stiff, slightly clayey gravelly fine grained SAND – (Residual Tillite)

IMC

1.40 – Very moist to wet, light yellow brown mottled very light grey and occasionally brownish red, intact, firm to very stiff, slightly sandy silty CLAY – (Residual Tillite)

1.90

NOTES

1) Pit excavated to 1.2m, extended via hand auger to 1.9m

2) Final depth at 1.90m. No refusal. Slow material recovery.

3) Groundwater seepage encountered at 1.7m

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.55--1.40m (Indicator / Mod AASHTO / CBR)

SAMPLE	*DEPTH (m)*

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288826
Y-COORD : 0008390

HOLE No: IP3

IP 3

REF : 32010

SEWER RETICULATION INANDA GLEBE

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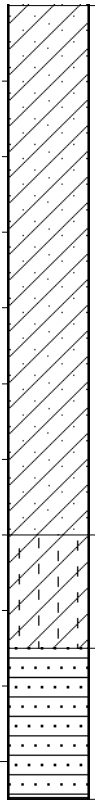
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: IP4
Sheet 1 of 1

JOB NUMBER: 32010

Scale 1:10



SAMPLE	DEPTH (m)	
		0.00 Moist, very dark brown grey, intact, very stiff, slightly gravelly fine grained sandy CLAY – (Colluvium) containing roots
		0.70 Slightly moist, orange stained light yellow brown, intact, stiff, silty CLAY – (Residual Natal Group)
IMC	1	0.85 Light brown yellow stained very dark grey, completely weathered, extremely soft to very soft rock, Sandstone recovered as silty gravelly sand – (Natal Group)
S1		1.05

NOTES

1) Pit excavated to 1.05m

2) Refusal encountered at 1.05m on extremely soft to very soft rock.

3) No groundwater seepage encountered

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.85--1.05m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
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ELEVATION :
X-COORD : 3288550
Y-COORD : 0007922

HOLE No: IP4

IP 4

REF : 32010

SEWER RETICULATION INANDA GLEBE

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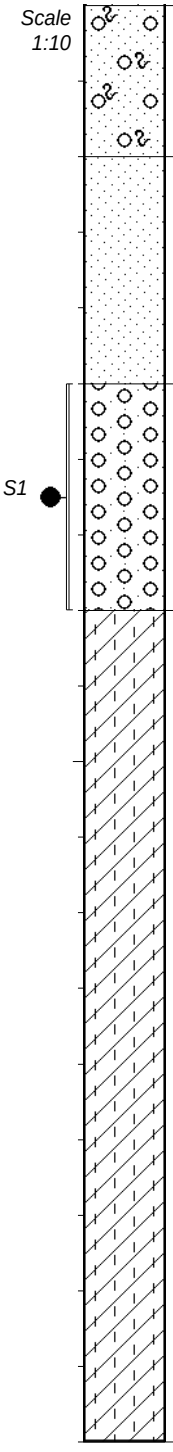
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP5**
Sheet 1 of 1

JOB NUMBER: **32010**



SAMPLE	DEPTH (m)	
	0.00	Slightly moist to moist, brown speckled and mottled yellow and orange, intact, loose, slightly clayey gravelly SAND containing roots and rubble fragments – (Fill)
	0.20	Slightly moist to moist, very dark brown to dark brown, intact, medium dense, slightly clayey SAND – (Colluvium)
	0.50	Slightly moist to moist, dark brown, fissured, medium dense, sandy fine to medium grained pedogenic GRAVEL – (Colluvium)
S1 COMPACT, IMC	0.80	Slightly moist to moist, yellow brown stained orange streaked very dark grey, intact, very stiff to hard, slightly sandy silty CLAY containing occasional completely weathered rock fragments – (Residual Tillite)
	1.90	

NOTES

1) Pit excavated to 1.2m, extended via hand auger to 1.9m

2) Refusal of hand auger encountered at 1.90m on very stiff clay. Slow material recovery at base of hole.

3) No groundwater seepage encountered.

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.50--0.80m (Compactibility / Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288719
Y-COORD : 0008095

HOLE No: **IP5**

IP 5

REF : 32010

SEWER RETICULATION INANDA GLEBE

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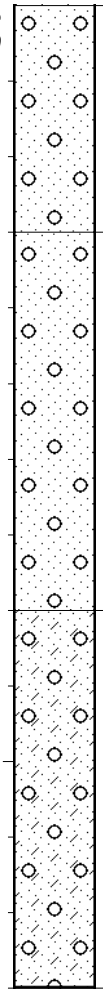
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: IP6
Sheet 1 of 1

JOB NUMBER: 32010

Scale 1:10



0.00

Slightly moist to moist, light brown to brown, intact, loose to medium dense, slightly clayey gravelly SAND containing occasional cobble sized particles of weathered tillite – (Fill)

0.30

Slightly moist to moist, dark brown to brown, intact, medium dense, slightly clayey gravelly SAND containing occasional cobble sized particles of weathered tillite – (Colluvium)

0.80

Slightly moist to moist, very dark brown stained orange and mottled red, intact, medium dense, gravelly very clayey SAND containing occasional cobble sized particles of weathered tillite – (Colluvium)

1

1.30

NOTES

1) Pit excavated to 1.0m, extended via hand auger to 1.3m

2) Refusal at 1.30m on likely cobble obstruction at base of auger hole.

3) No groundwater seepage encountered.

4) No sidewall collapse encountered.

5) No samples taken

6) Pipe encountered on side of pit from 0.3m

SAMPLE	*DEPTH (m)*

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288927
Y-COORD : 0008247

HOLE No: IP6

IP 6

REF : 32010

SEWER RETICULATION INANDA GLEBE

DRENNAN MAUD (PTY) LTD

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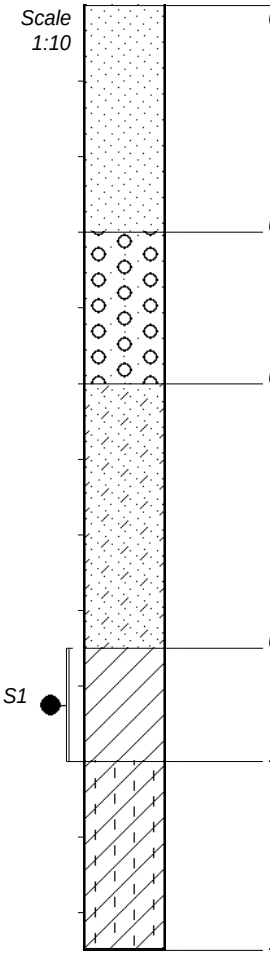
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: IP7
Sheet 1 of 1

JOB NUMBER: 32010



SAMPLE	DEPTH (m)	
		Slightly moist to moist, very dark brown, intact, loose, slightly clayey SAND – (Colluvium)
		Slightly moist to moist, very dark brown, intact, medium dense, slightly clayey sandy GRAVEL containing occasional dolerite cobbles – (Colluvium)
		Moist, dark brown stained red and yellow brown streaked very dark grey, intact, loose to medium dense, slightly gravelly very clayey fine grained SAND containing occasional dolerite cobbles – (Colluvium)
IMC		Moist, dark brown stained red and yellow brown streaked very dark grey, intact, stiff, slightly sandy CLAY containing occasional dolerite cobbles – (Colluvium)
	1	Moist, yellow brown mottled grey and orange red, intact, stiff to very stiff, silty CLAY – (Residual Tillite)

NOTES

1) Pit excavated to 1.0m, extended via hand auger to 1.25m

2) Refusal at 1.25m on very stiff clay. Slow material recovery.

3) No groundwater seepage encountered.

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.85--1.00m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289201
Y-COORD : 0008166

HOLE No: IP7

IP 7

REF : 32010

SEWER RETICULATION INANDA GLEBE

DRENNAN MAUD (PTY) LTD

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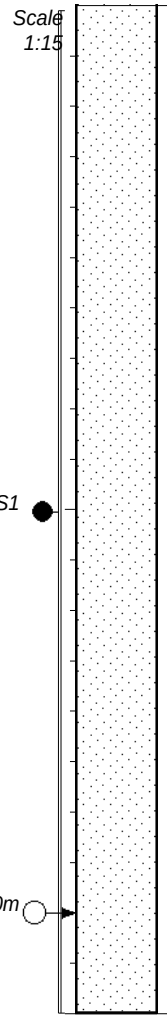
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP8**
Sheet 1 of 1

JOB NUMBER: **32010**



Moist to very moist, brown occasionally mottled light grey brown, orange brown and pinkish purple brown, intact, very loose to loose, slightly clayey slightly gravelly SAND containing cobbles and boulders of sandstone – (Fill)

IMC

NOTES

1) Pit excavated along existing pipe trench alignment through trench backfill.

2) Pit excavated at foot of adjacent EXP1.

3) Pit excavated to 1.4m, extended via hand auger to 2.0m

4) Refusal at 2.0m on weathered sandstone at base of previous trench.

5) Groundwater seepage encountered at 1.80m

6) No sidewall collapse encountered.

7) Samples taken:
S1 0.01--2.00m (Indicator / Mod AASHTO / CBR)

SAMPLE	*DEPTH (m)*

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289143
Y-COORD : 0008023

HOLE No: **IP8**

IP 8

REF : 32010

SEWER RETICULATION INANDA GLEBE

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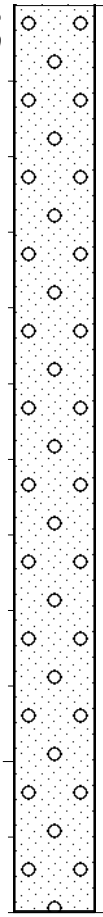
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: IP9
Sheet 1 of 1

JOB NUMBER: 32010

Scale 1:10



0.00

Slightly moist to moist, brown blotched orange brown, intact, loose, gravelly SAND containing tiles and rubble fragments – (Rubble)

1

1.20

NOTES

1) Pit excavated to 1.1m, extended via hand auger to 1.2m

2) Pit excavated on roadside fill embankment.

3) Refusal at 1.20m on rubble.

4) No groundwater seepage encountered.

5) No sidewall collapse encountered.

6) No samples taken.

SAMPLE	DEPTH (m)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288929
Y-COORD : 0008067

HOLE No: IP9

IP 9

REF : 32010

SEWER RETICULATION INANDA GLEBE

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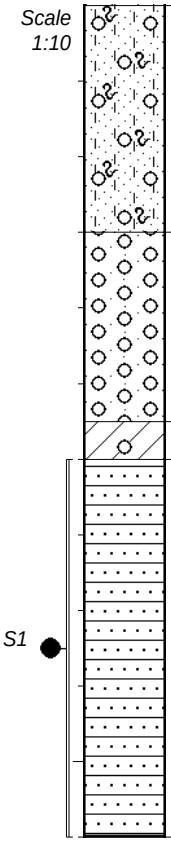
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP10**
Sheet 1 of 1

JOB NUMBER: **32010**



0.00 – Slightly moist, dark brown, intact, loose, gravelly silty SAND containing roots – (Colluvium)

0.30 – Slightly moist to moist, very dark brown, intact, medium dense, sandy GRAVEL – (Colluvium)

0.55 – Slightly moist to moist, orange brown stained yellow, intact, stiff, gravelly CLAY – (Residual Sandstone)

0.60 – Yellow brown stained very dark grey, completely weathered, extremely soft to very soft rock, SANDSTONE recovered as slightly silty sandy gravel – (Natal Group)

1.10

COMPACT, IMC

NOTES

1) Pit excavated to 1.1m.

2) Refusal at 1.10m on very soft rock.

3) No groundwater seepage encountered

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.60--1.10m (Compactibility / Indicator / Mod AASHTO / CBR)

SAMPLE	*DEPTH (m)*

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288810
Y-COORD : 0007959

HOLE No: **IP10**

IP 10

REF : 32010

SEWER RETICULATION INANDA GLEBE

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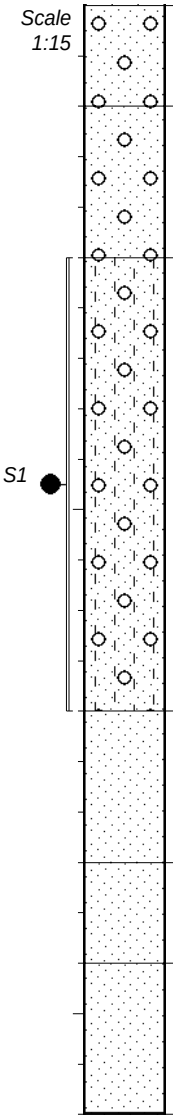
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP11**
Sheet 1 of 1

JOB NUMBER: **32010**



SAMPLE	DEPTH (m)	
	0.00	Slightly moist to moist, orange brown to brown, intact, medium dense, gravelly SAND containing occasional cobble and plastic pieces – (Rubble/Fill)
	0.20	Slightly moist to moist, dark brown speckled orange brown, intact, loose, gravelly SAND containing occasional cobble and plastic pieces – (Rubble/Fill)
	0.50	Moist, dark brown and brown, speckled and mottled yellow orange brown, intact, loose to medium dense, silty gravelly SAND gravels are comprised of completely weathered extremely soft rock sandstone – (Colluvium)
IMC		
	1.40	Moist, dark brown to brown speckled orange brown, loose to medium dense, slightly gravelly fine to medium grained SAND – (Residual Sandstone)
	1.70	Slightly moist to moist, purple brown to brown, loose to medium dense, fine to medium grained SAND – (Residual Sandstone)
	1.90	Slightly moist to moist, purple brown stained orange brown and light grey, medium dense, very dense, fine to medium grained SAND – (Completely weathered to Residual Sandstone)
	2.20	

NOTES

1) Pit excavated to 1.2m, extended via hand auger to 2.2m

2) Refusal at 2.20m on likely gravel layer / completely weathered sandstone.

3) No groundwater seepage encountered.

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.50--1.40m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288976
Y-COORD : 0007736

HOLE No: **IP11**

IP 11

REF : 32010

SEWER RETICULATION INANDA GLEBE

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ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP12**
Sheet 1 of 1

JOB NUMBER: **32010**

Scale 1:15

SAMPLE	DEPTH (m)		
		0.00	Moist, pinkish brown blotched orange and yellow brown, intact, very loose to loose, slightly clayey gravelly SAND containing occasional sandstone cobbles and boulders – (Fill)
IMC			
S1			
	1	1.60	Very moist, dark brown speckled light brown, intact, loose to medium dense, silty gravelly SAND – (Fill)
	2	2.40	

NOTES

1) Pit excavated along existing pipe trench alignment through trench backfill.

2) Pit excavated adjacent to EXP2.

3) Pit excavated to 1.4m, extended via hand auger to 2.4m

4) Refusal at 2.4m on likely cobble.

5) No groundwater seepage encountered.

6) No sidewall collapse encountered.

7) Samples taken:
S1 0.01--1.60m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289149
Y-COORD : 0007836

HOLE No: **IP12**

IP 12

REF : 32010

SEWER RETICULATION INANDA GLEBE

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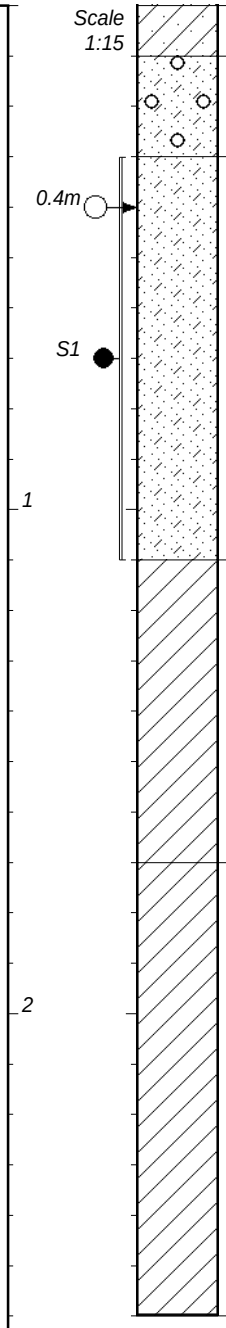
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: IP PJ1
Sheet 1 of 1

JOB NUMBER: 32010



SAMPLE	DEPTH (m)		
		0.00	Very moist to wet, dark brown, intact, very soft, fine grained sandy CLAY containing minor roots – (Topsoil)
		0.10	
			Wet, brown speckled light brown, intact, very loose, clayey gravelly coarse grained SAND containing minor roots – (Alluvium)
		0.30	
IMC			Wet, very dark brown grey speckled light brown, very soft to firm, slightly gravelly clayey fine grained SAND containing minor roots – (Alluvium)
		1.10	
			Wet, very dark grey mottled light brown and orange brown, stiff to very stiff, slightly sandy CLAY – (Residual Tillite)
		1.70	
			Wet, grey streaked and mottled brown and orange brown, intact, very stiff to hard, slightly gravelly slightly sandy CLAY containing occasional fragments of highly weathered soft rock tillite – (Completely weathered / Residual Tillite)
		2.60	

NOTES

1) Pit excavated to 0.8m, extended via hand auger to 2.6m

2) Refusal at 2.60m in completely weathered tillite.

3) Groundwater seepage encountered at 0.4m

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.30--1.10m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION : NA
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288572
Y-COORD : 0008237

HOLE No: IP PJ1

IP PJ1

REF : 32010

SEWER RETICULATION INANDA GLEBE

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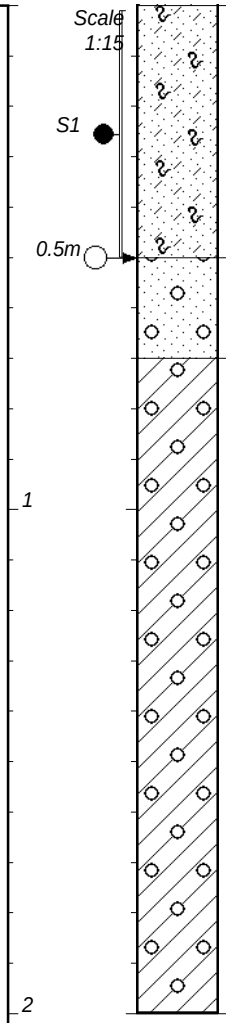
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP PJ 2**
Sheet 1 of 1

JOB NUMBER: **32010**



SAMPLE	DEPTH (m)	
IMC	0.00	Moist, very dark brown, intact, loose, clayey fine grained SAND organic material containing minor roots – (Alluvium)
	0.50	Wet, brown speckled light brown, intact, very loose to loose, slightly clayey gravelly medium to coarse grained SAND – (Alluvium)
	0.70	Moist, yellow brown streaked very dark grey stained orange red, intact, firm to very stiff, slightly sandy slightly gravelly to gravelly with depth CLAY – (Residual Tillite)
	2.00	

NOTES

1) Pit excavated to 0.8m, extended via hand auger to 2.0m

2) Refusal encountered at 2.0m on gravel layer in the residual tillite.

3) Groundwater seepage encountered at 0.5m

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.01--0.50m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288597
Y-COORD : 0008203

HOLE No: **IP PJ 2**

IP PJ2

REF : 32010

SEWER RETICULATION INANDA GLEBE

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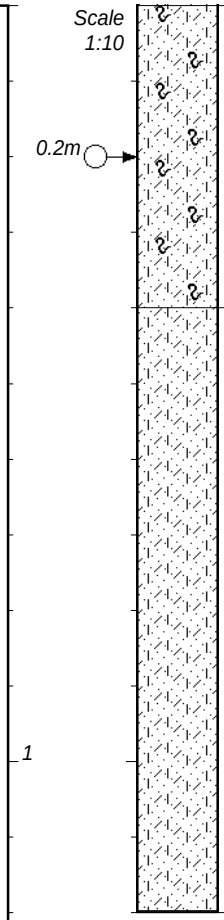
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP S1**
Sheet 1 of 1

JOB NUMBER: **32010**



SAMPLE	DEPTH (m)	
	0.00	Very moist to wet, dark brown blotched orange brown and very dark grey, intact, very loose, silty clayey fine grained SAND organic material containing roots – (Alluvium)
	0.40	Wet, olive grey dark brown, intact, very loose to medium dense, slightly gravelly silty clayey fine to medium grained SAND containing occasional gravels – (Alluvium)
	1.20	

NOTES

1) Pit excavated to 0.6m, extended via hand auger to 1.2m

2) Refusal encountered at 1.2m on inferred gravel horizon in the alluvial material.

3) Groundwater seepage encountered at 0.2m

4) Sidewall collapse encountered at 0.4m

5) No samples taken.

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289222
Y-COORD : 0008031

HOLE No: **IP S1**

IP S1

REF : 32010

SEWER RETICULATION INANDA GLEBE

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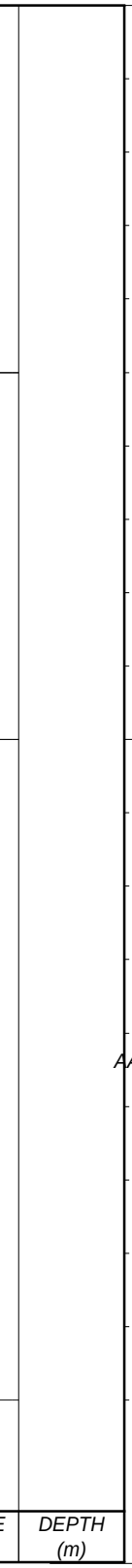
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP S2**
Sheet 1 of 1

JOB NUMBER: **32010**



SAMPLE	DEPTH (m)	
	0.00	Moist, very dark brown mottled light brown, intact, very loose, slightly clayey fine to medium grained SAND – (Alluvium)
IMC	0.50	Very moist to wet, brown to dark brown mottled orange brown, intact, loose, slightly clayey fine to medium grained SAND – (Alluvium)
IMC	1.00	Moist to very moist, dark purple brown and grey stained and blotched orange brown, intact, medium dense, slightly clayey fine to medium grained SAND containing occasional sandstone gravels – (Residual Sandstone)
IMC	1.90	

NOTES

1) Pit excavated to 1.0m, extended via hand auger to 1.9m

2) Refusal encountered at 1.90m on gravel horizon.

3) Groundwater seepage encountered at 0.8m

4) Sidewall collapse encountered at 0.8m.

5) Samples taken:
S1 0.50--1.00m (Indicator / Mod AASHTO / CBR)
S2 1.00--1.90m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 11:13
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289217
Y-COORD : 0008022

HOLE No: **IP S2**

IP S2

REF : 32010

SEWER RETICULATION INANDA GLEBE

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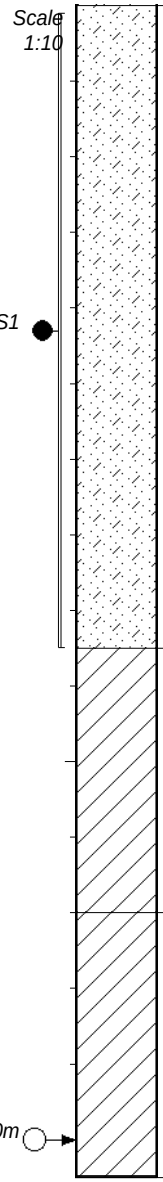
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **IP S3**
Sheet 1 of 1

JOB NUMBER: **32010**



SAMPLE	DEPTH (m)	
		0.00 Moist to very moist, very dark brown, intact, very loose to loose, slightly gravelly clayey fine grained SAND – (Alluvium)
IMC		
		0.85 Moist to very moist, dark brown mottled orange brown and very dark grey, intact, stiff, slightly sandy CLAY – (Alluvium)
		1.20 Very moist to moist becoming wet, yellow brown mottled dark grey and red, firm becoming very stiff, slightly sandy CLAY – (Residual Tillite)
		1.55

NOTES

1) Pit excavated to 1.1m, extended via hand auger to 1.55m

2) Refusal at 1.55m in very stiff residual clay.

3) Groundwater seepage encountered at 1.50m

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.01--0.85m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : *DMPSP.SET*

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288687
Y-COORD : 0007891

HOLE No: **IP S3**

IP S3

REF : 32010

SEWER RETICULATION INANDA GLEBE

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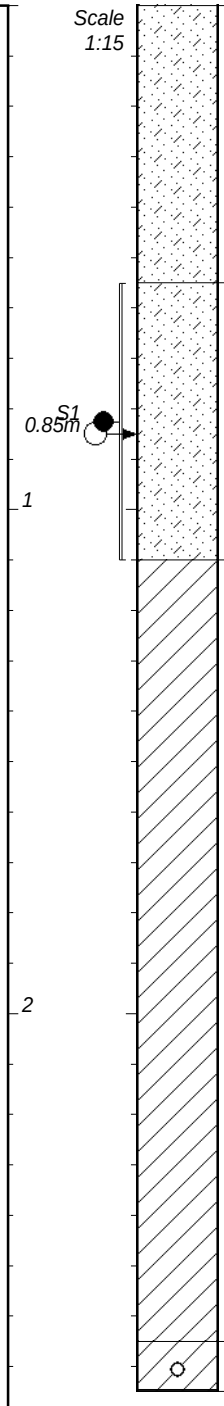
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: IP S4
Sheet 1 of 1

JOB NUMBER: 32010



SAMPLE	DEPTH (m)	
	0.00	Moist to very moist, very dark brown, intact, very loose, very slightly gravelly very clayey fine grained SAND – (Alluvium)
	0.55	Very moist to wet, dark brown mottled yellow brown and red and grey, intact, loose, very clayey fine grained SAND – (Alluvium)
IMC		
	1.10	Wet, grey streaked purple grey and orange light brown, firm to very stiff, slightly sandy slightly gravelly CLAY – (Residual Tillite)
	2.65	Wet, grey streaked purple grey and orange light brown, very stiff, very gravelly CLAY containing soft rock tillite gravel fragments – (Completely weathered tillite / Residual Tillite)
	2.75	

NOTES

1) Pit excavated to 1.1m, extended via hand auger to 2.75m

2) Refusal at 2.75m on weathered tillite.

3) Groundwater seepage encountered at 0.85m

4) No sidewall collapse encountered.

5) Samples taken:
S1 0.55--1.10m (Indicator / Mod AASHTO / CBR)

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288699
Y-COORD : 0007887

HOLE No: IP S4

IP S4

REF : 32010

SEWER RETICULATION INANDA GLEBE

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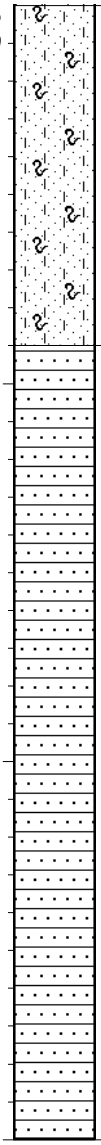
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **EXP 1**
Sheet 1 of 1

JOB NUMBER: **32010**

Scale 1:20



0.00 Slightly moist, brown grey, loose, fissured, slightly gravelly silty SAND containing roots – (Colluvium)

0.90

1

Purple pink weathered orange brown and very light grey, completely to highly weathered, close to medium jointed, medium bedding, extremely soft to very soft rock, SANDSTONE – (Natal Group)

2

3

3.00

NOTES

1) Road cutting.

2) No groundwater seepage encountered.

SAMPLE	*DEPTH (m)*

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 07/12/17 16:41
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289143
Y-COORD : 0008023

HOLE No: **EXP 1**

EXP 1

REF : 32010

SEWER RETICULATION INANDA GLEBE

DRENNAN MAUD (PTY) LTD

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Geotechnical Engineers & Engineering Geologists

ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **EXP 2**
Sheet 1 of 1

JOB NUMBER: **32010**

Scale 1:10

SAMPLE	DEPTH (m)		
		0.00	Slightly moist, very dark grey stained light brown, loose, fissured, clayey SAND – (Colluvium)
		0.30	Blue grey speckled light grey weathered orange brown and yellow brown, highly to medium weathered, very closely jointed, very soft to soft rock, DOLERITE – (Karoo Supergroup)
	1		
		1.90	

NOTES

1) Mechanically excavated pipe trench.

2) No groundwater seepage encountered.

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

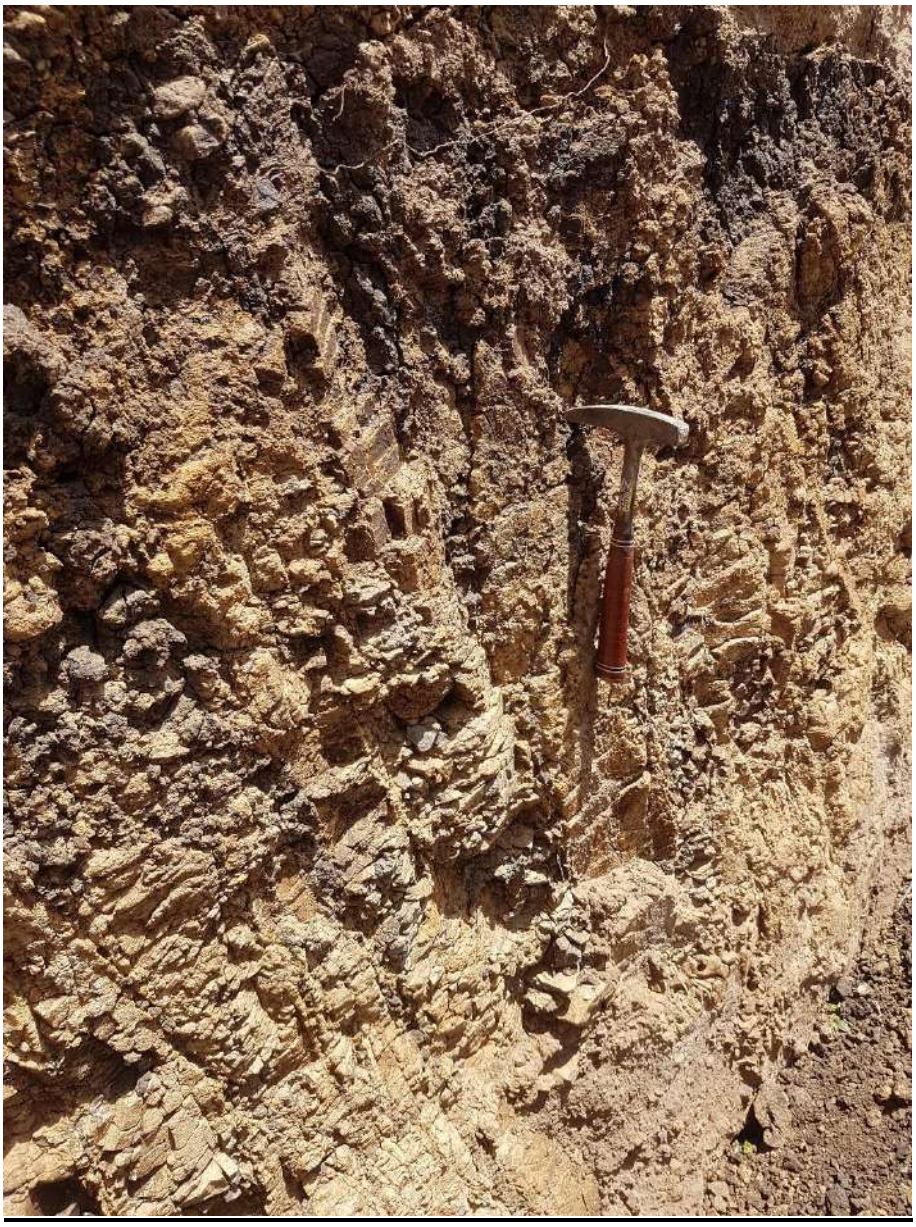
INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 07/12/17 16:41
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289149
Y-COORD : 0007836

HOLE No: **EXP 2**

EXP 2



REF : 32010

SEWER RETICULATION INANDA GLEBE

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ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: EXP 3
Sheet 1 of 1

JOB NUMBER: 32010

Scale 1:25

SAMPLE	DEPTH (m)	
		0.00 Slightly moist to moist, dark brown, loose, intact, gravelly silty SAND – (Colluvium)
	1	
		1.30
		Pinkish purple brown stained and weathered orange brown, highly weathered, close to medium jointed, medium bedded, fine to medium grained, extremely soft to very soft rock, SANDSTONE – (Natal Group)
	2	
	3	
	4	
		4.80

NOTES

1) House cutting.

2) No groundwater seepage encountered.

3) Bedding gently dipping out of slope in a southerly direction.

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288986
Y-COORD : 0007773

HOLE No: EXP 3

EXP 3

REF : 32010

SEWER RETICULATION INANDA GLEBE

DRENNAN MAUD (PTY) LTD

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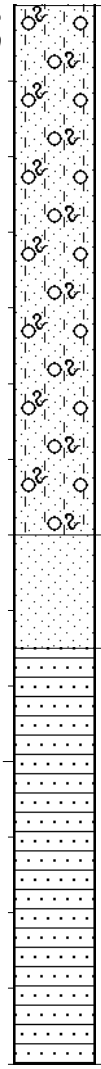
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: EXP 4
Sheet 1 of 1

JOB NUMBER: 32010

Scale 1:10



SAMPLE	DEPTH (m)	
		0.00 Slightly moist to moist, dark grey to dark brown, loose to medium dense, intact, silty gravelly SAND containing minor roots – (Colluvium)
		0.70 Slightly moist to moist, purple and or dark purple grey, intact, medium dense, slightly gravelly SAND – (Colluvium)
		0.85 Purple brown stained orange brown and red streaked dark brown, highly weathered, fine to medium grained, very soft rock SANDSTONE – (Natal Group)
	1	
		1.40

NOTES

1) House cutting.

2) No groundwater seepage encountered.

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289124
Y-COORD : 0007665

HOLE No: EXP 4

EXP 4

REF : 32010

SEWER RETICULATION INANDA GLEBE

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SEWER RETICULATION AT INANDA GLEBE

HOLE No: EXP 5
Sheet 1 of 1

JOB NUMBER: 32010

SAMPLE	DEPTH (m)	Scale 1:10		
			0.00	Yellow orange brown stained light grey, completely to highly weathered, very close to closely jointed, extremely soft to very soft rock, DOLERITE – (Karoo Supergroup)
			0.30	

NOTES

1) Mechanically excavated pipe trench.

2) No groundwater seepage encountered.

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3289093
Y-COORD : 0008049

HOLE No: EXP 5

EXP 5

REF : 32010

SEWER RETICULATION INANDA GLEBE

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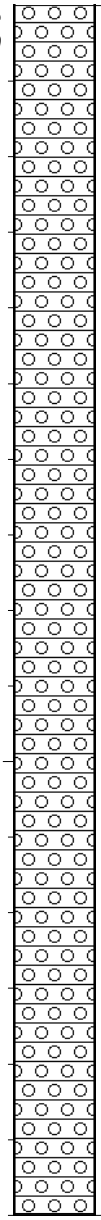
ETHEKWINI MUNICIPALITY WATER AND SANITATION
SEWER RETICULATION AT INANDA GLEBE

HOLE No: **EXP 6**
Sheet 1 of 1

JOB NUMBER: **32010**

Scale 1:10



0.00

Blueish grey speckled light grey and very dark grey, medium to slightly weathered, closely jointed, cobbles in a fine grained matrix, soft rock TILLITE – (Dwyka Formation)

1

1.60

NOTES

1) Road cutting.

2) No groundwater seepage encountered.

SAMPLE	*DEPTH (m)*

CONTRACTOR :
MACHINE : NA
DRILLED BY : NA
PROFILED BY : KJR

TYPE SET BY :
SETUP FILE : DMPSP.SET

INCLINATION :
DIAM : NA
DATE : NA
DATE : 17-20/09/2017

DATE : 08/12/17 09:14
TEXT : ..C:\DOTIN\SPMASTER.DOC

ELEVATION :
X-COORD : 3288981
Y-COORD : 0008317

HOLE No: **EXP 6**

EXP 6

REF : 32010

SEWER RETICULATION INANDA GLEBE

DRENNAN MAUD (PTY) LTD

APPENDIX B

DYNAMIC CONE PENETROMETER TEST

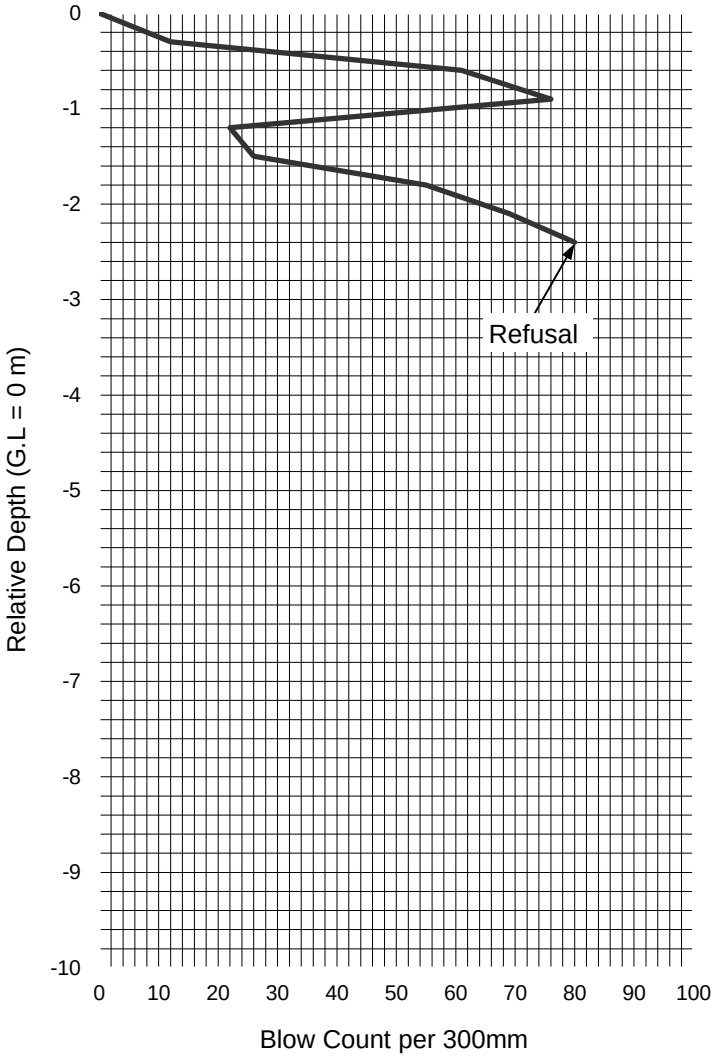
Dynamic Cone Penetrometer

Test No. : 1

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	12
-0.6	61
-0.9	76
-1.2	22
-1.5	26
-1.8	55
-2.1	69
-2.4	80

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

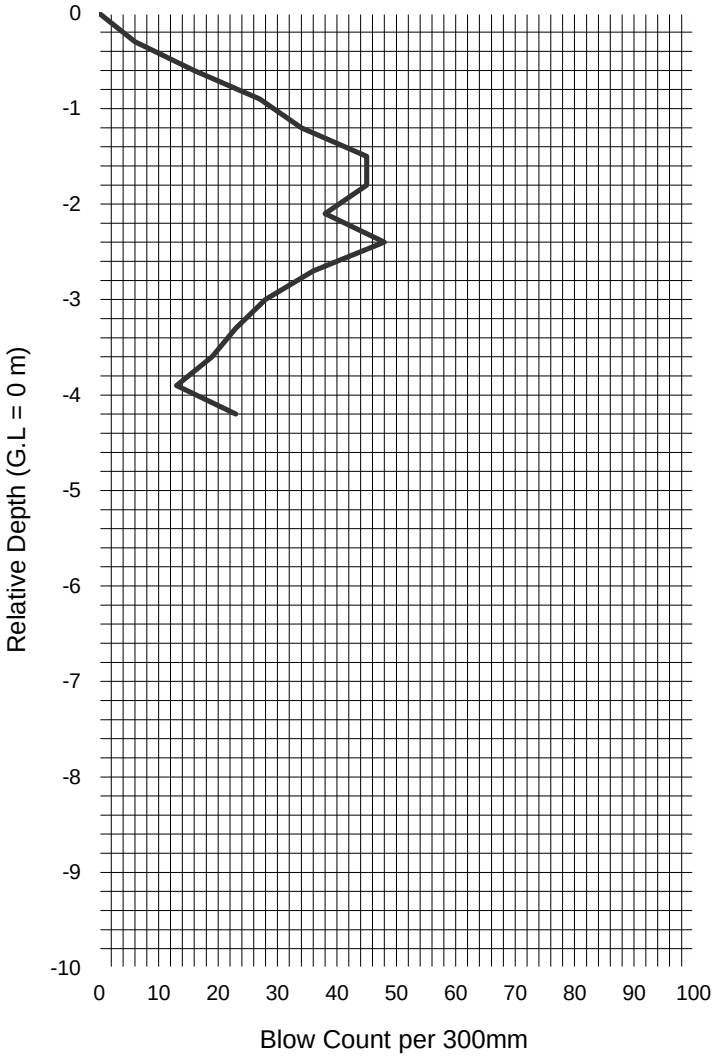
Dynamic Cone Penetrometer

Test No. : 2

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	6
-0.6	16
-0.9	27
-1.2	34
-1.5	45
-1.8	45
-2.1	38
-2.4	48
-2.7	36
-3.0	28
-3.3	23
-3.6	19
-3.9	13
-4.2	23

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

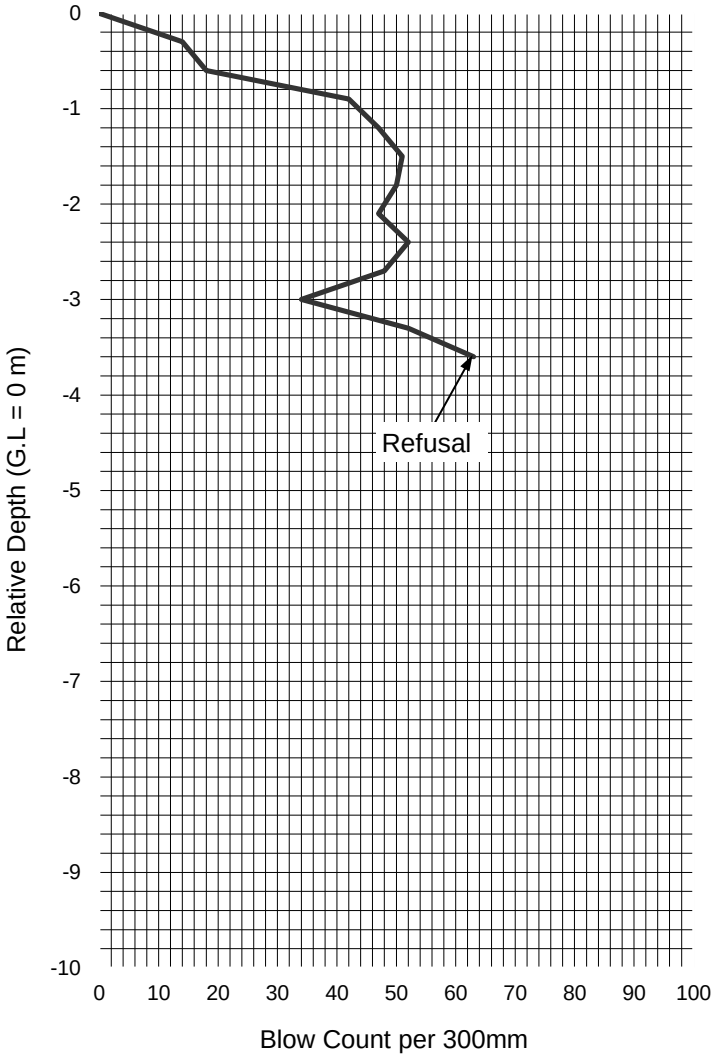
Dynamic Cone Penetrometer

Test No. : 3

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	14
-0.6	18
-0.9	42
-1.2	47
-1.5	51
-1.8	50
-2.1	47
-2.4	52
-2.7	48
-3.0	34
-3.3	52
-3.6	63

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

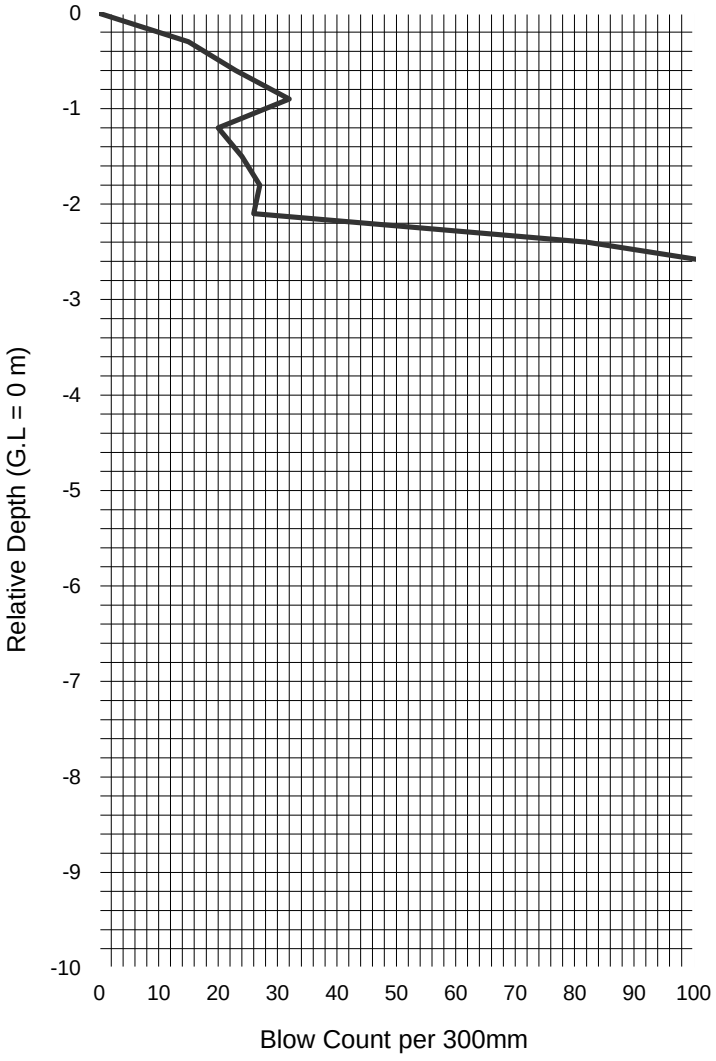
Dynamic Cone Penetrometer

Test No. : 4

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	15
-0.6	23
-0.9	32
-1.2	20
-1.5	24
-1.8	27
-2.1	26
-2.4	82
-2.7	113

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

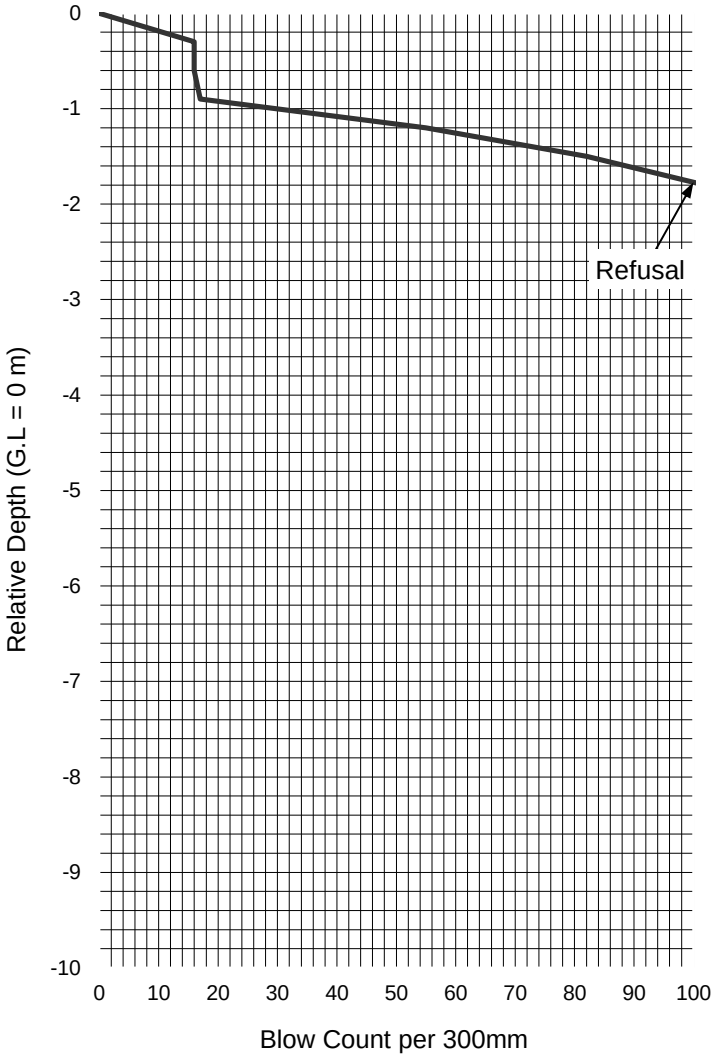
Dynamic Cone Penetrometer

Test No. : 5

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	16
-0.6	16
-0.9	17
-1.2	55
-1.5	82
-1.8	102

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

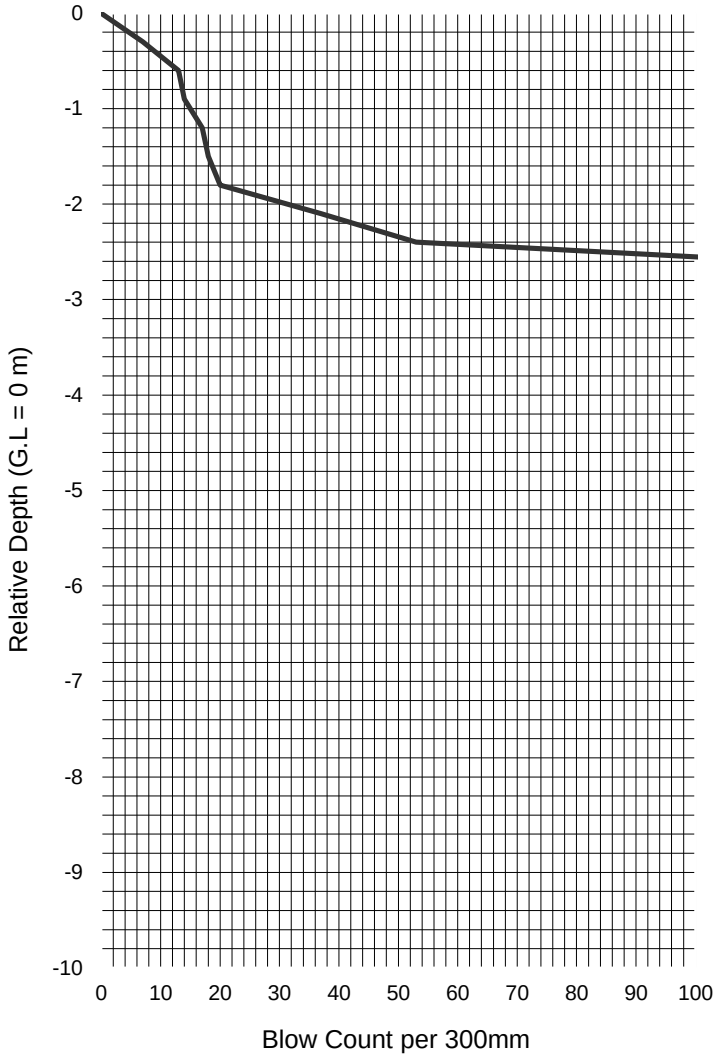
Dynamic Cone Penetrometer

Test No. : 6

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	7
-0.6	13
-0.9	14
-1.2	17
-1.5	18
-1.8	20
-2.1	37
-2.4	53
-2.7	145

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

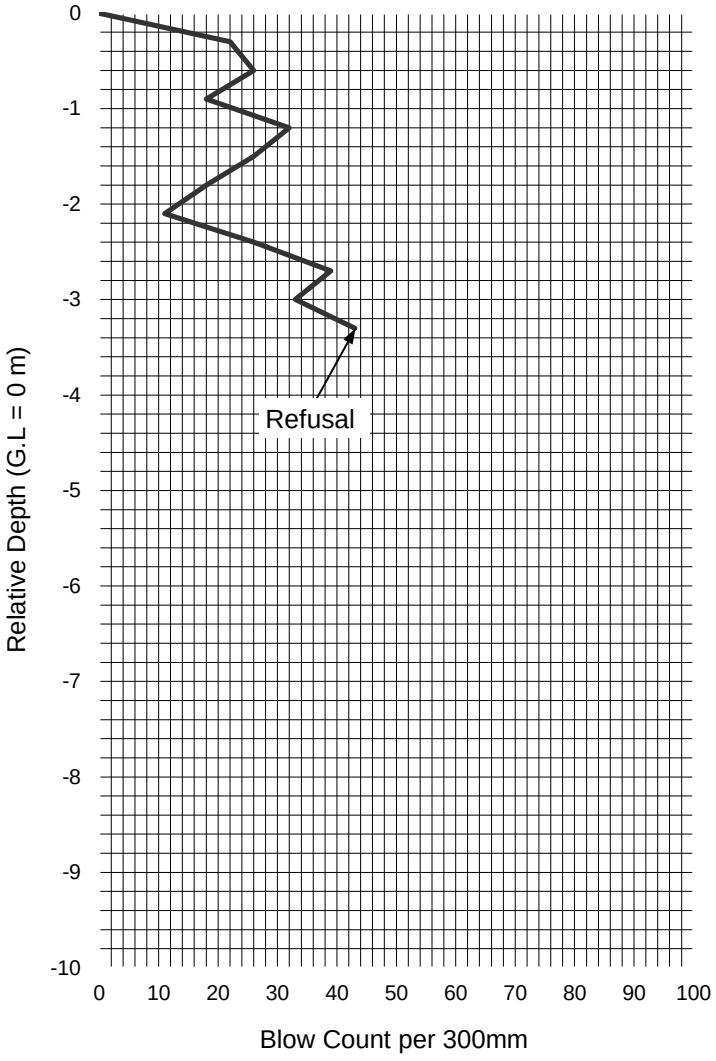
Dynamic Cone Penetrometer

Test No. : 7

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	22
-0.6	26
-0.9	18
-1.2	32
-1.5	26
-1.8	18
-2.1	11
-2.4	26
-2.7	39
-3.0	33
-3.3	43

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

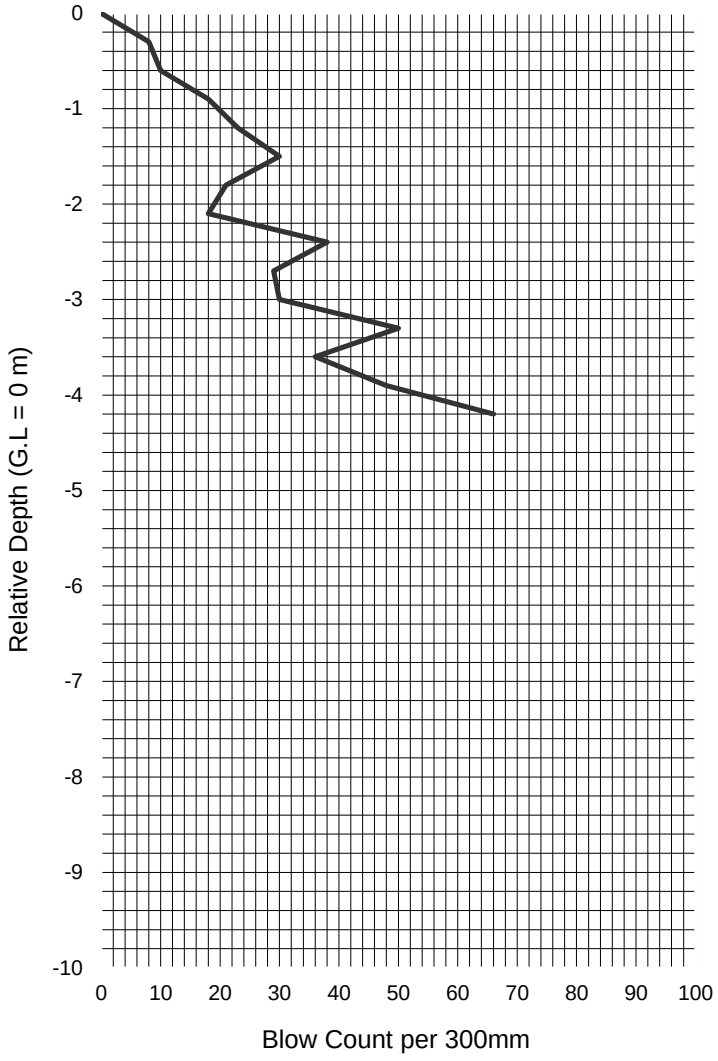
Dynamic Cone Penetrometer

Test No. : 8

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	8
-0.6	10
-0.9	18
-1.2	23
-1.5	30
-1.8	21
-2.1	18
-2.4	38
-2.7	29
-3.0	30
-3.3	50
-3.6	36
-3.9	48
-4.2	66

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

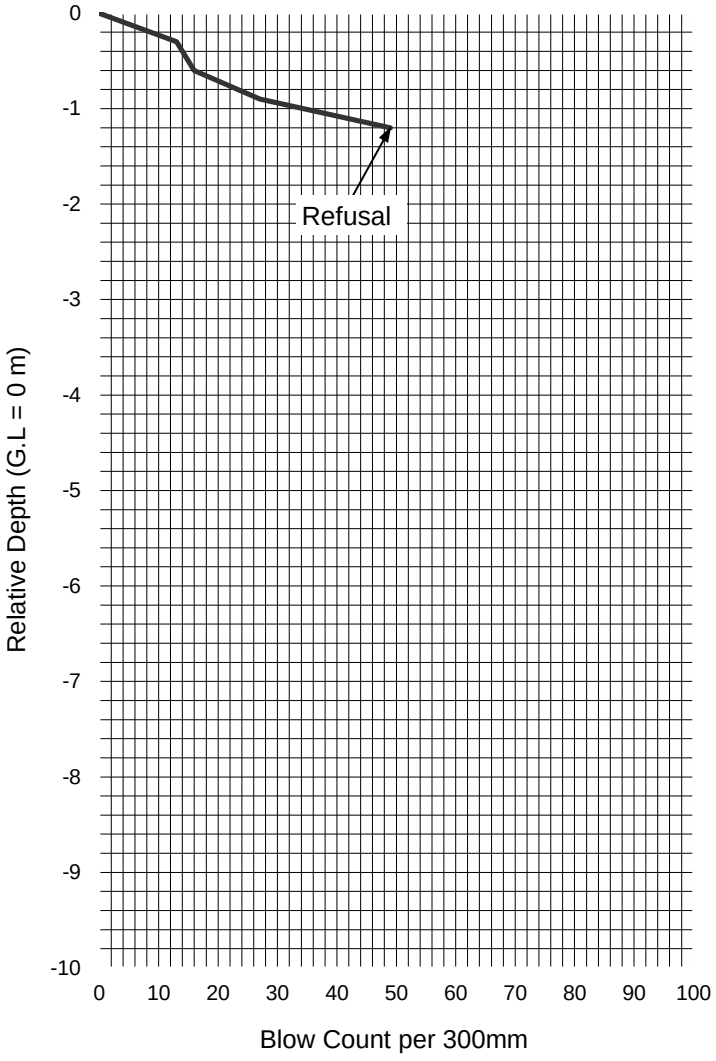
Dynamic Cone Penetrometer

Test No. : 9

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	13
-0.6	16
-0.9	27
-1.2	49

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

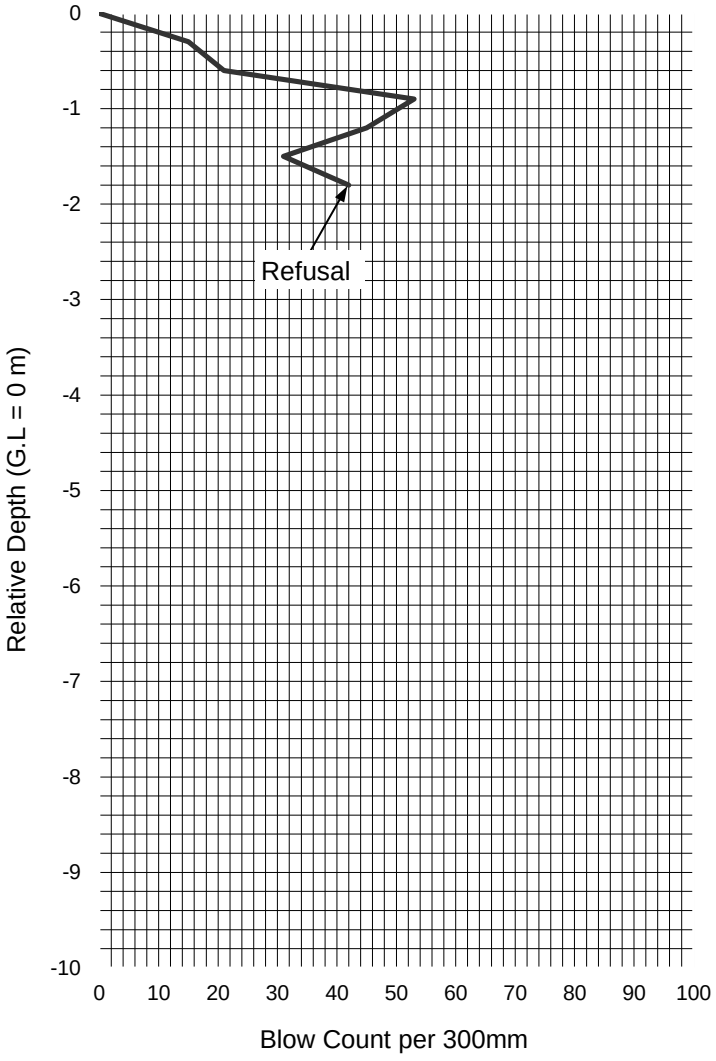
Dynamic Cone Penetrometer

Test No. : 10

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	15
-0.6	21
-0.9	53
-1.2	45
-1.5	31
-1.8	42

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

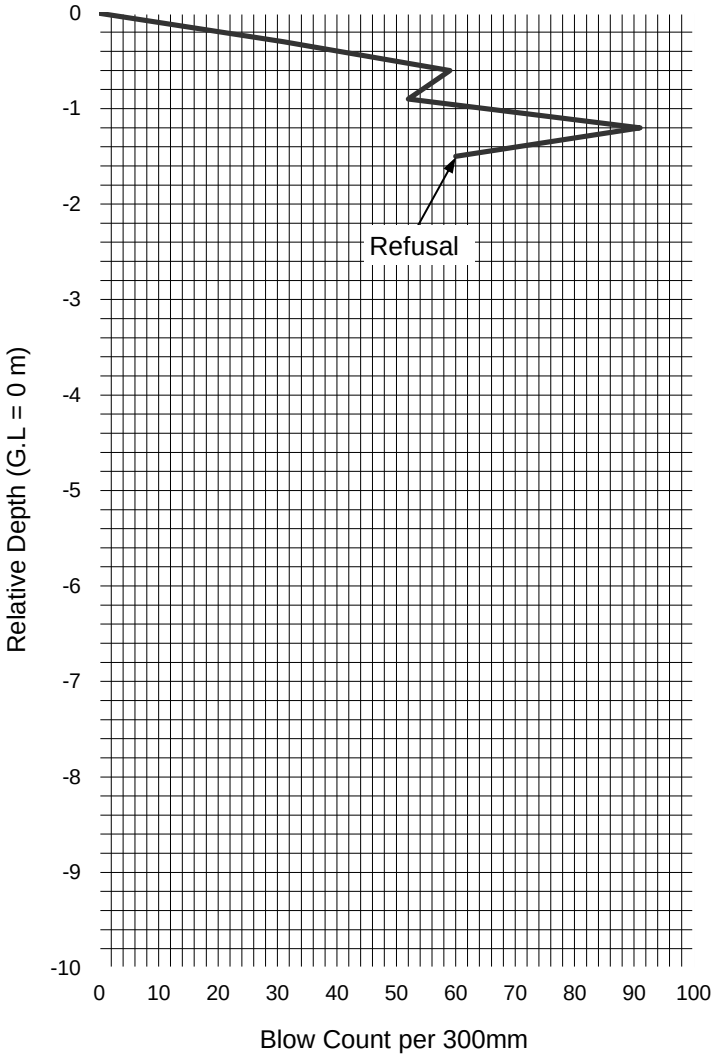
Dynamic Cone Penetrometer

Test No. : 11

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	31
-0.6	59
-0.9	52
-1.2	91
-1.5	60

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

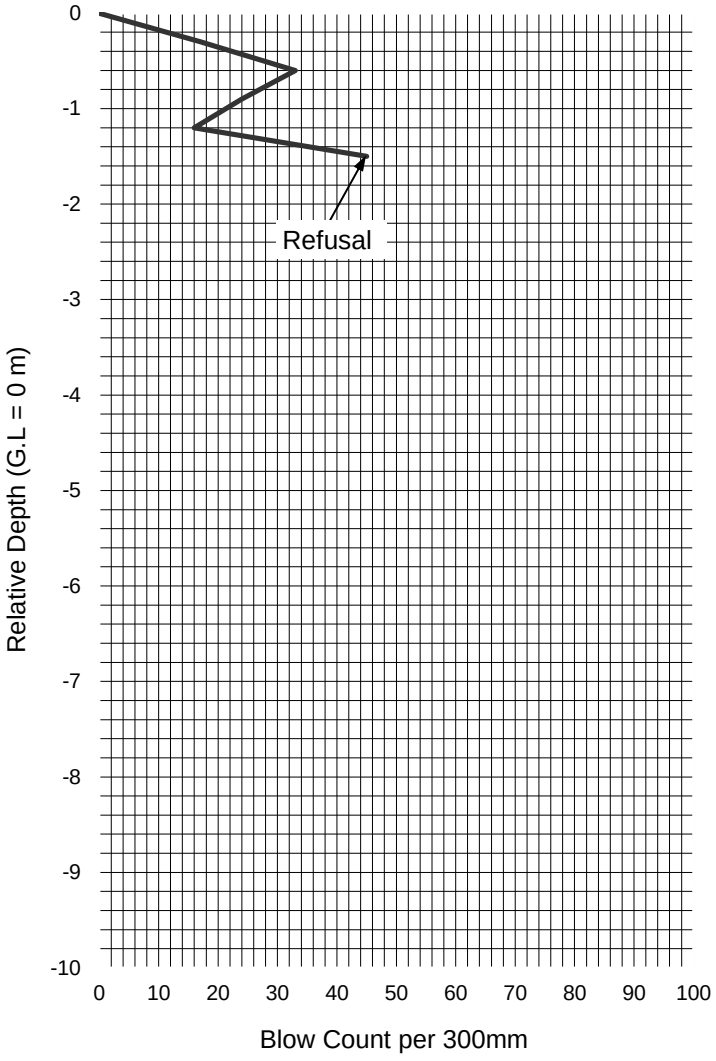
Dynamic Cone Penetrometer

Test No. : 12

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	17
-0.6	33
-0.9	24
-1.2	16
-1.5	45

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

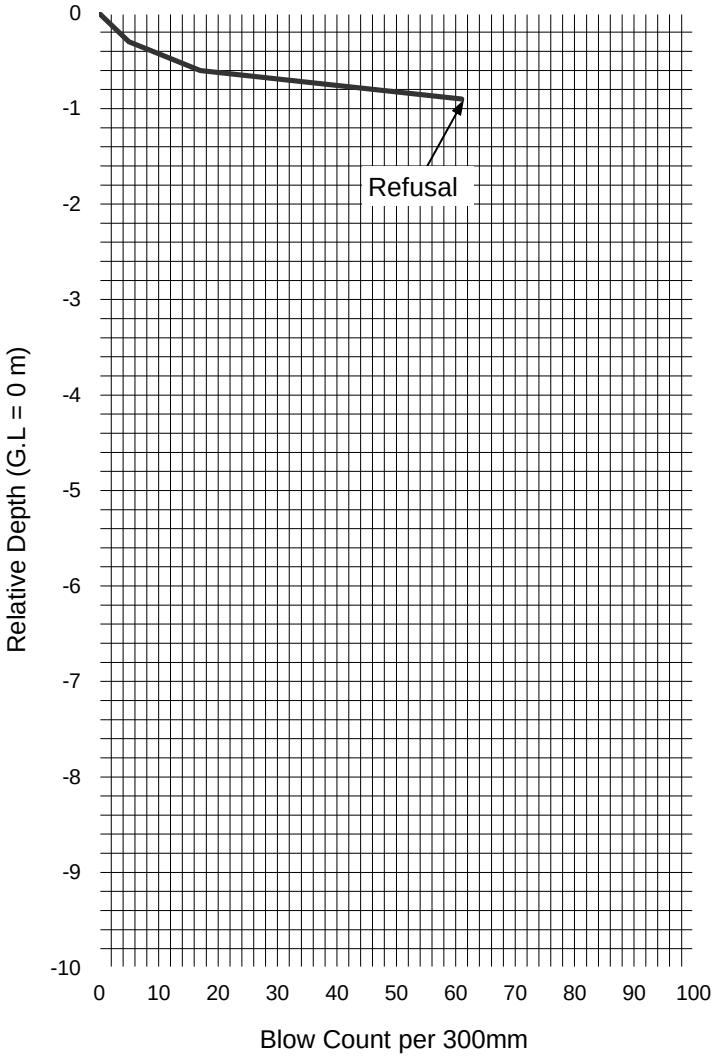
Dynamic Cone Penetrometer

Test No. : 13

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	5
-0.6	17
-0.9	61

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

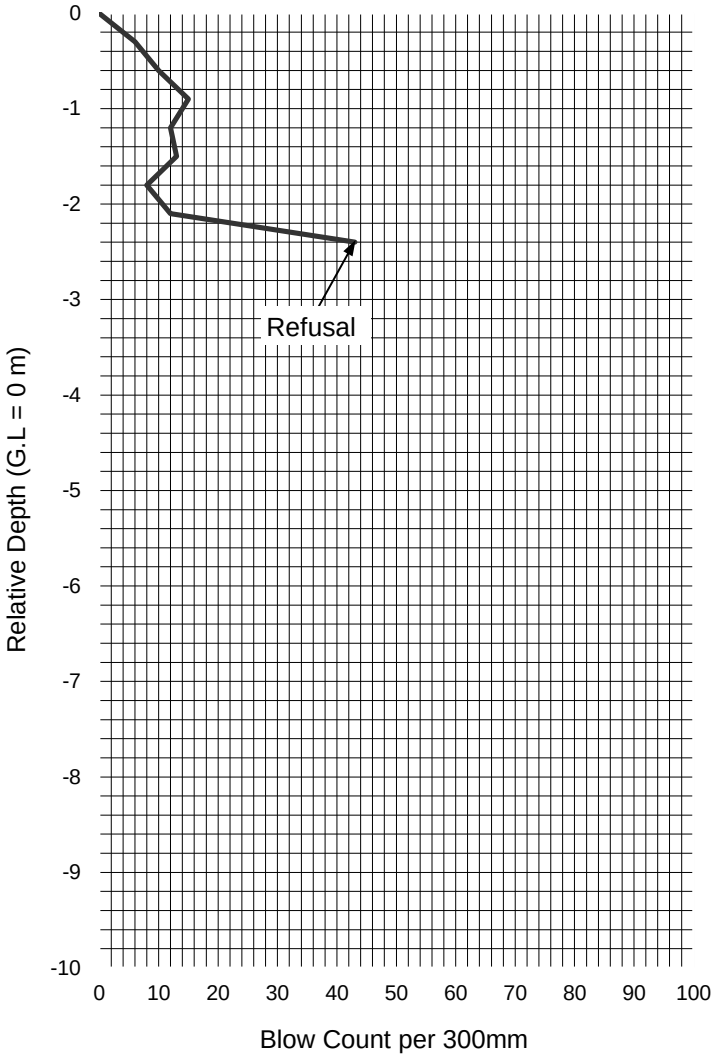
Dynamic Cone Penetrometer

Test No. : 14

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	6
-0.6	10
-0.9	15
-1.2	12
-1.5	13
-1.8	8
-2.1	12
-2.4	43

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

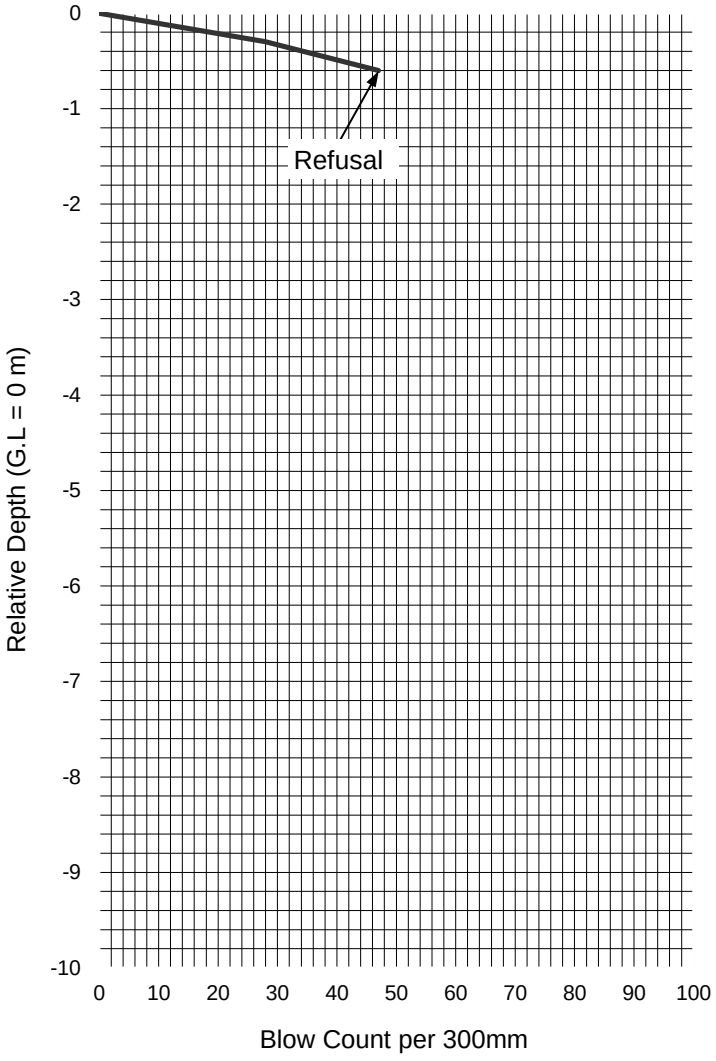
Dynamic Cone Penetrometer

Test No. : 15

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	28
-0.6	47

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

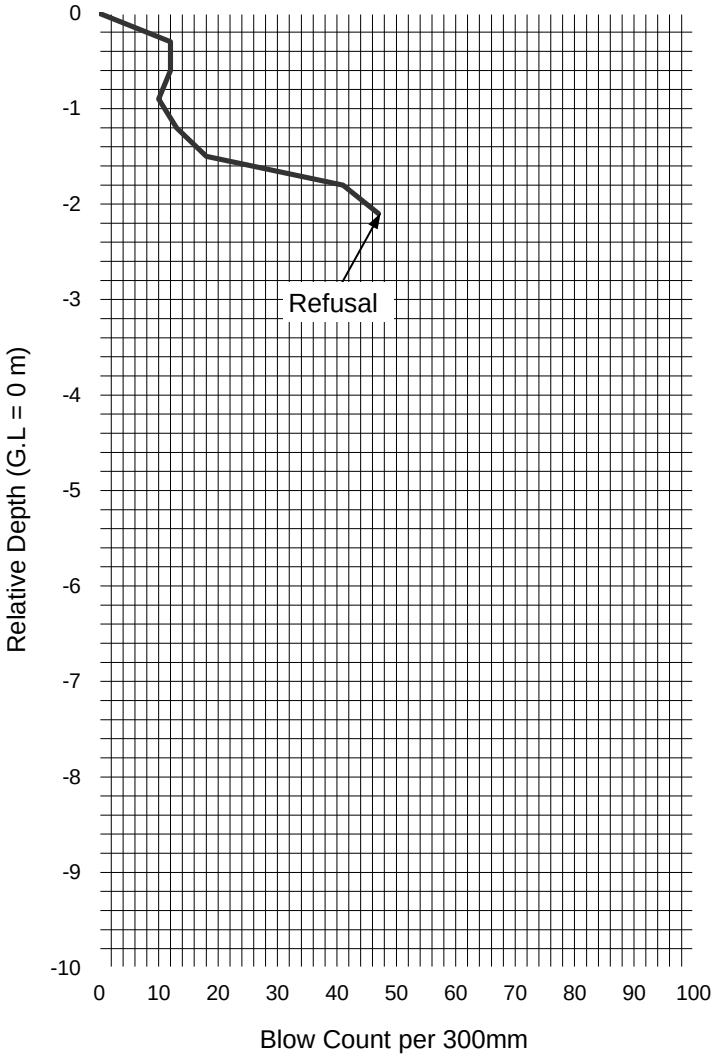
Dynamic Cone Penetrometer

Test No. : 16

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	12
-0.6	12
-0.9	10
-1.2	13
-1.5	18
-1.8	41
-2.1	47

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

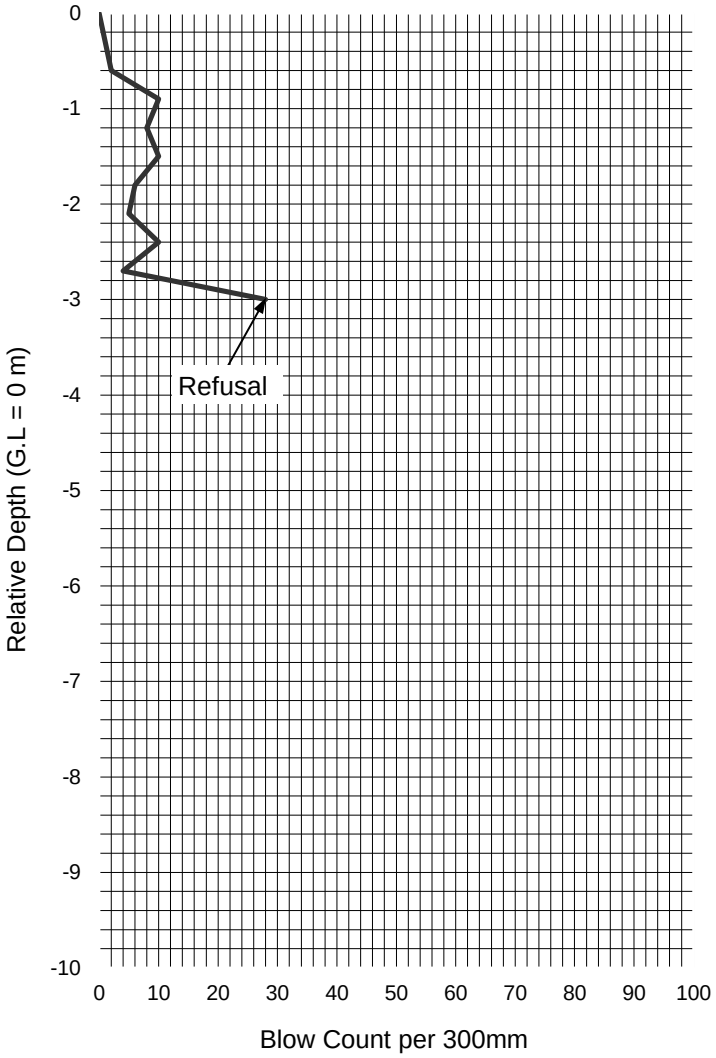
Dynamic Cone Penetrometer

Test No. : 17

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	1
-0.6	2
-0.9	10
-1.2	8
-1.5	10
-1.8	6
-2.1	5
-2.4	10
-2.7	4
-3.0	28

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

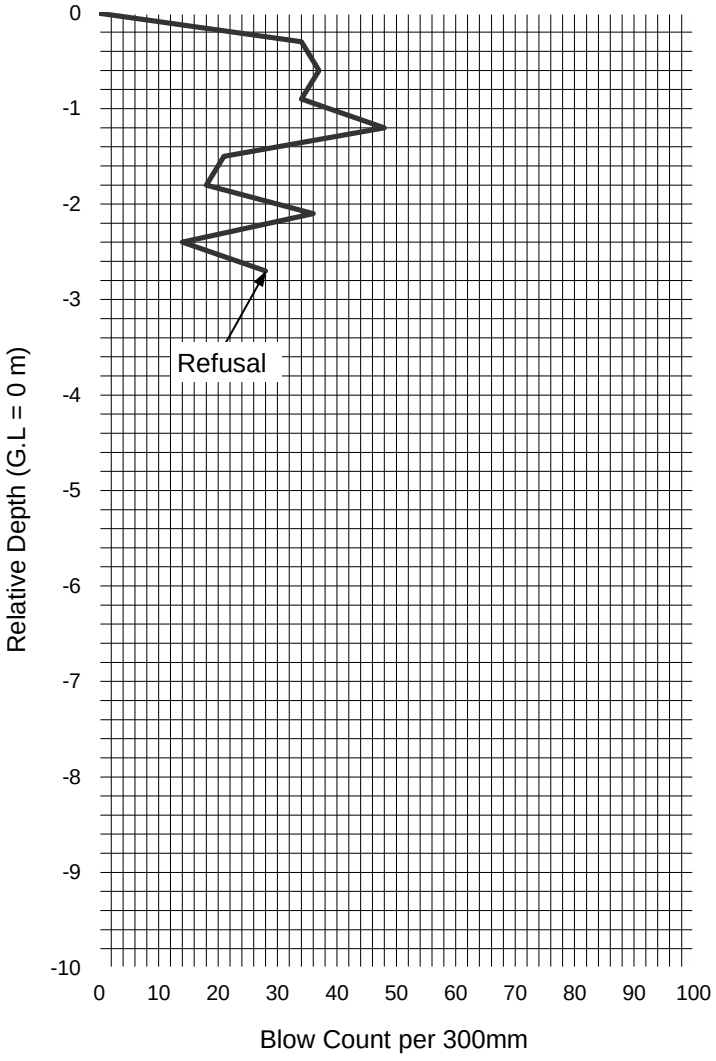
Dynamic Cone Penetrometer

Test No. : 18

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	34
-0.6	37
-0.9	34
-1.2	48
-1.5	21
-1.8	18
-2.1	36
-2.4	14
-2.7	28

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

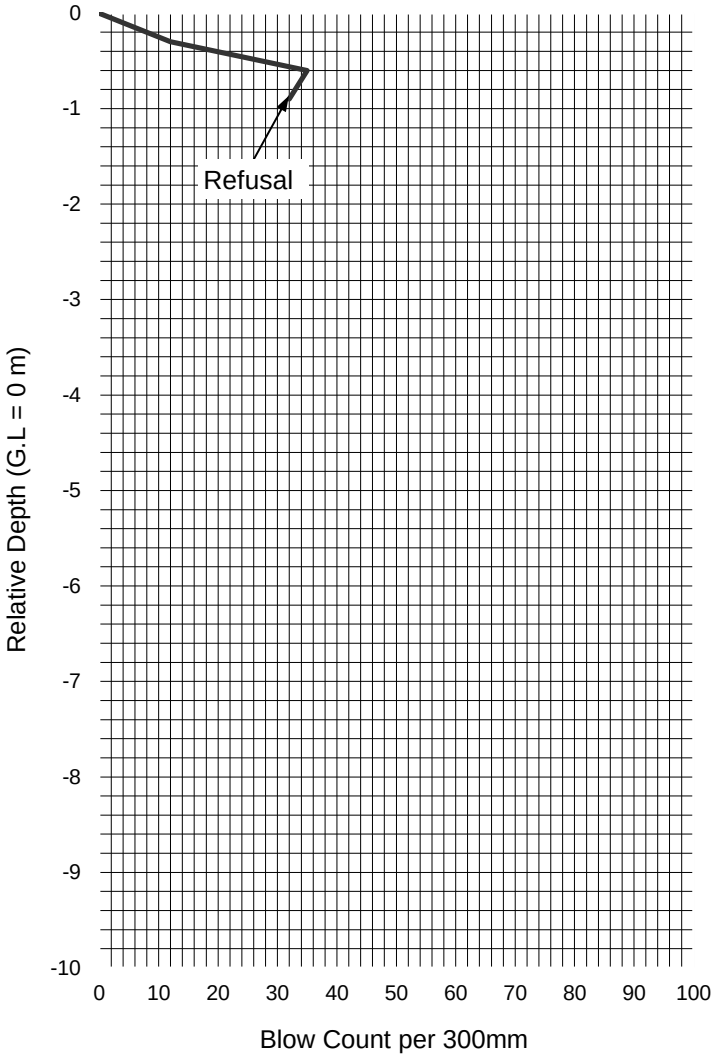
Dynamic Cone Penetrometer

Test No. : 19

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	12
-0.6	35
-0.9	32

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

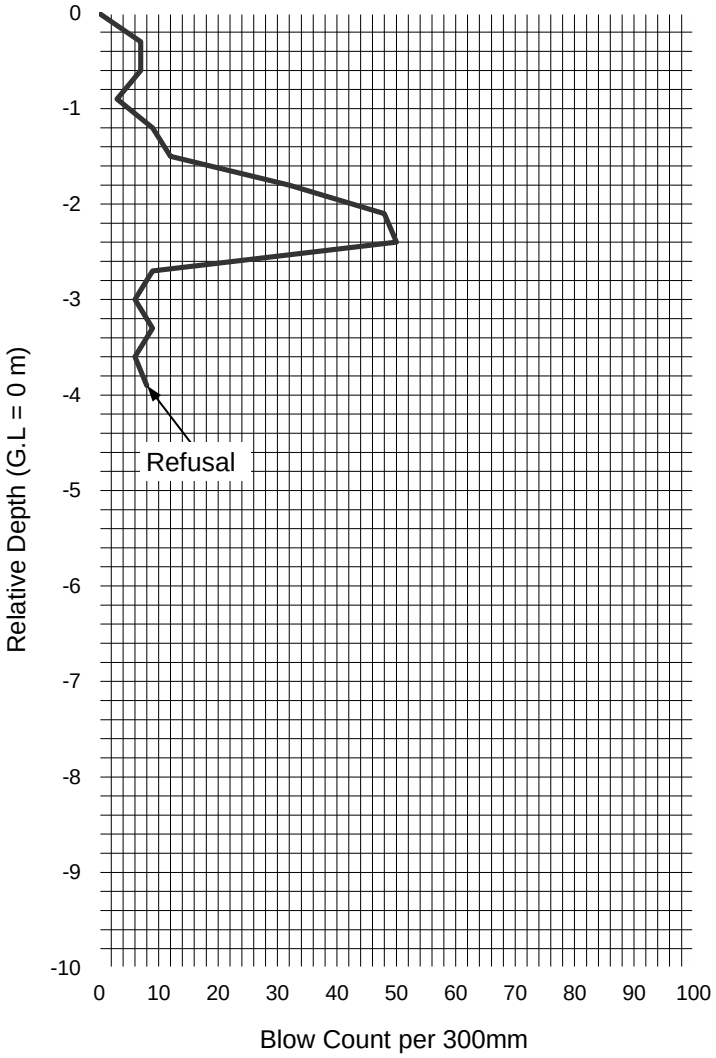
Dynamic Cone Penetrometer

Test No. : 20

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	7
-0.6	7
-0.9	3
-1.2	9
-1.5	12
-1.8	32
-2.1	48
-2.4	50
-2.7	9
-3.0	6
-3.3	9
-3.6	6
-3.9	8

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

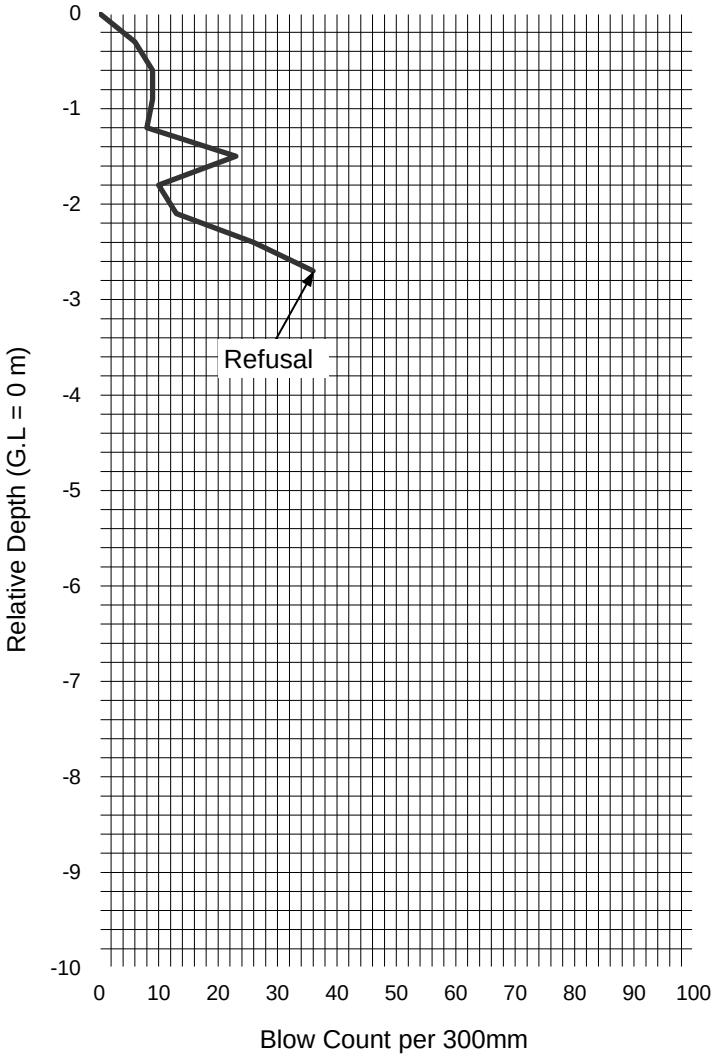
Dynamic Cone Penetrometer

Test No. : 21

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	6
-0.6	9
-0.9	9
-1.2	8
-1.5	23
-1.8	10
-2.1	13
-2.4	26
-2.7	36

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

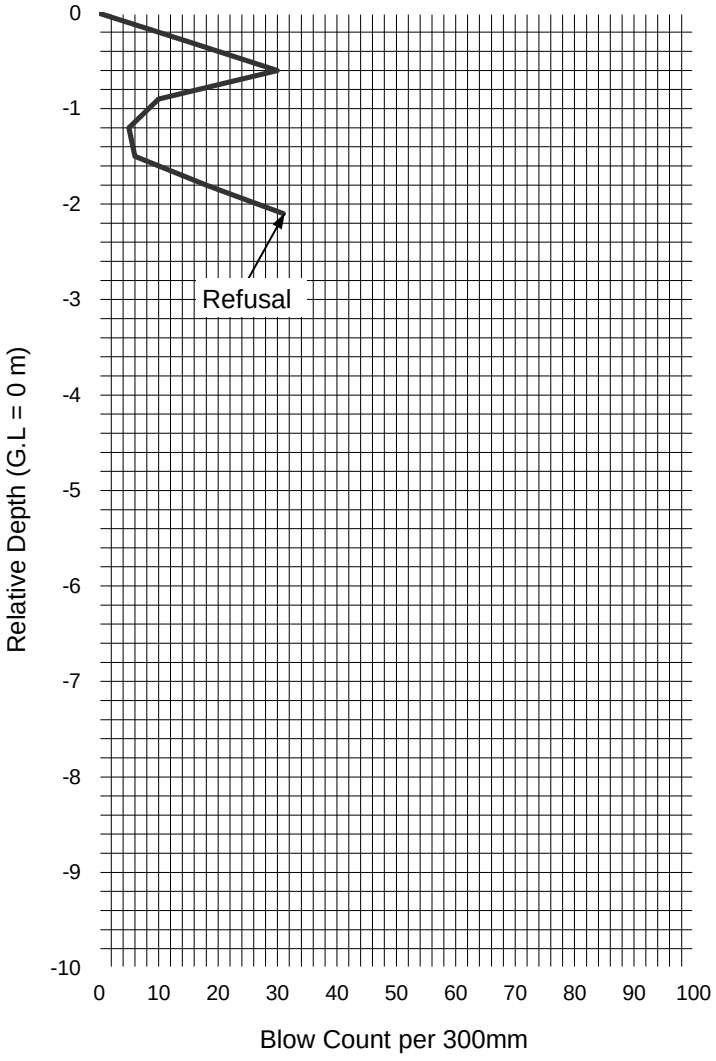
Dynamic Cone Penetrometer

Test No. : 22

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	15
-0.6	30
-0.9	10
-1.2	5
-1.5	6
-1.8	18
-2.1	31

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

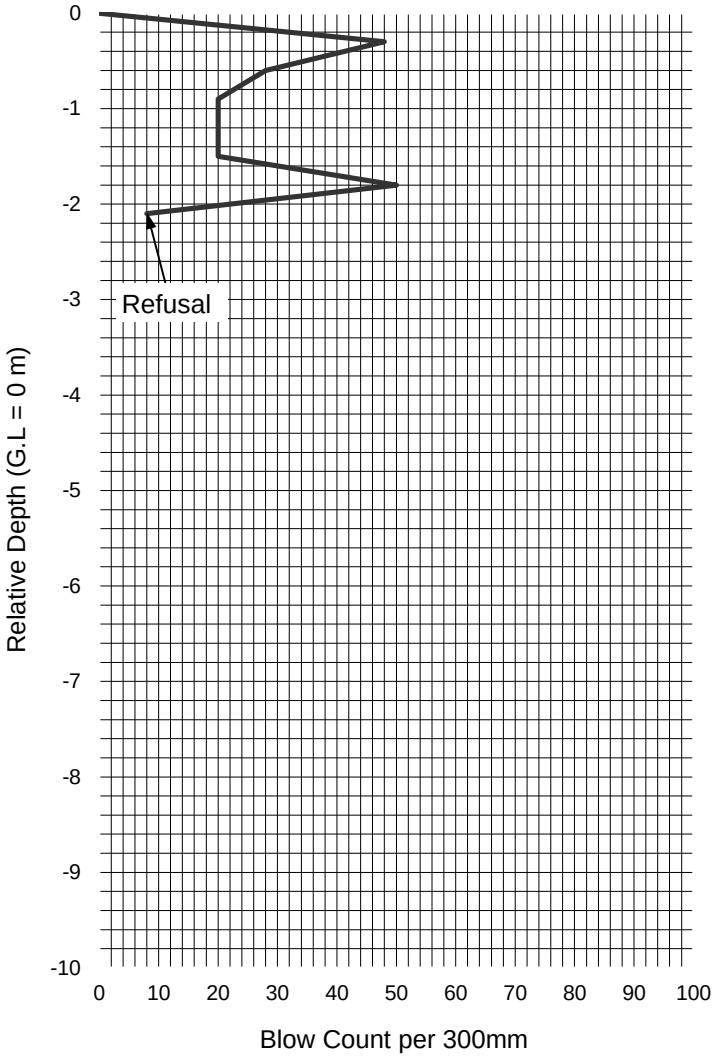
Dynamic Cone Penetrometer

Test No. : 23

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	48
-0.6	28
-0.9	20
-1.2	20
-1.5	20
-1.8	50
-2.1	8

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

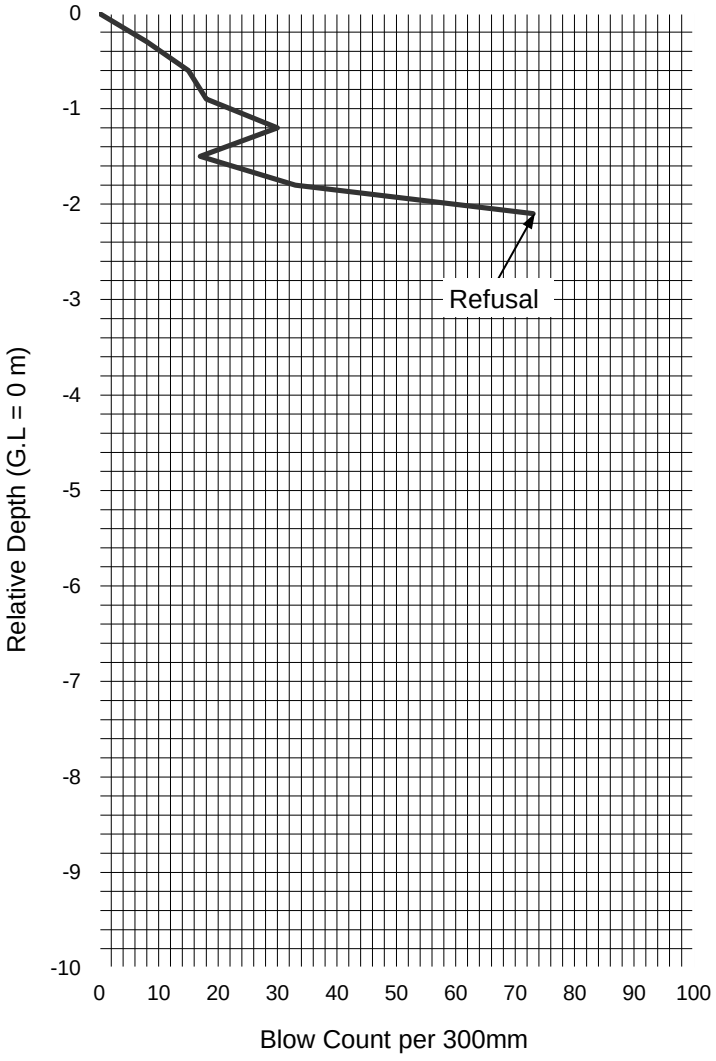
Dynamic Cone Penetrometer

Test No. : 24

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	8
-0.6	15
-0.9	18
-1.2	30
-1.5	17
-1.8	33
-2.1	73

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

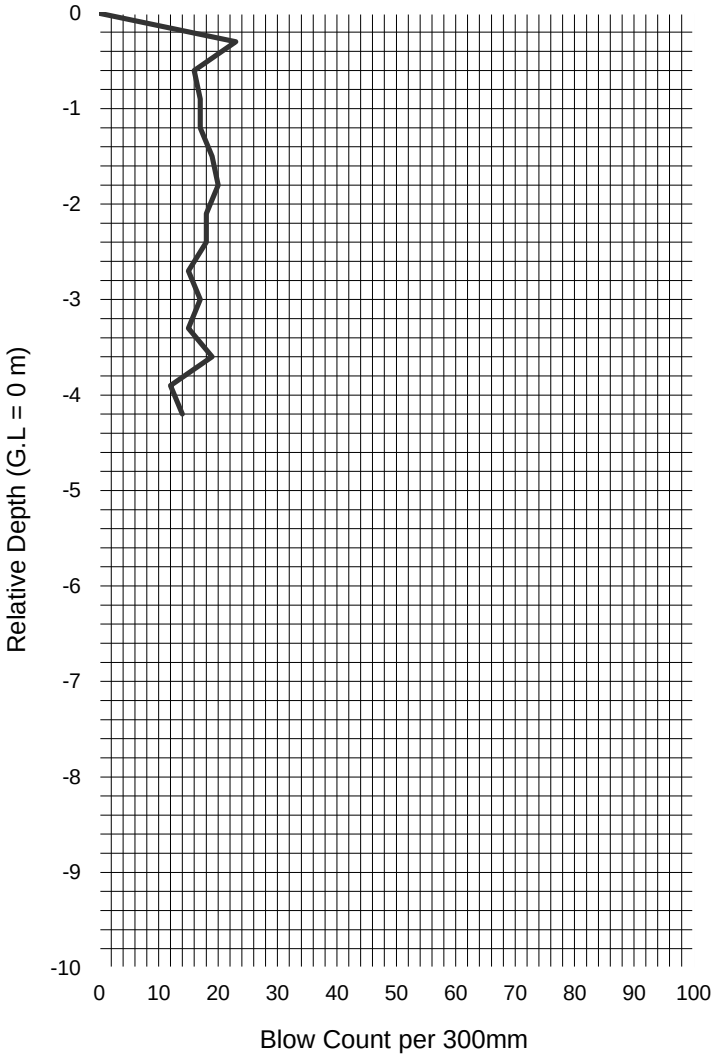
Dynamic Cone Penetrometer

Test No. : 25

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	23
-0.6	16
-0.9	17
-1.2	17
-1.5	19
-1.8	20
-2.1	18
-2.4	18
-2.7	15
-3.0	17
-3.3	15
-3.6	19
-3.9	12
-4.2	14

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

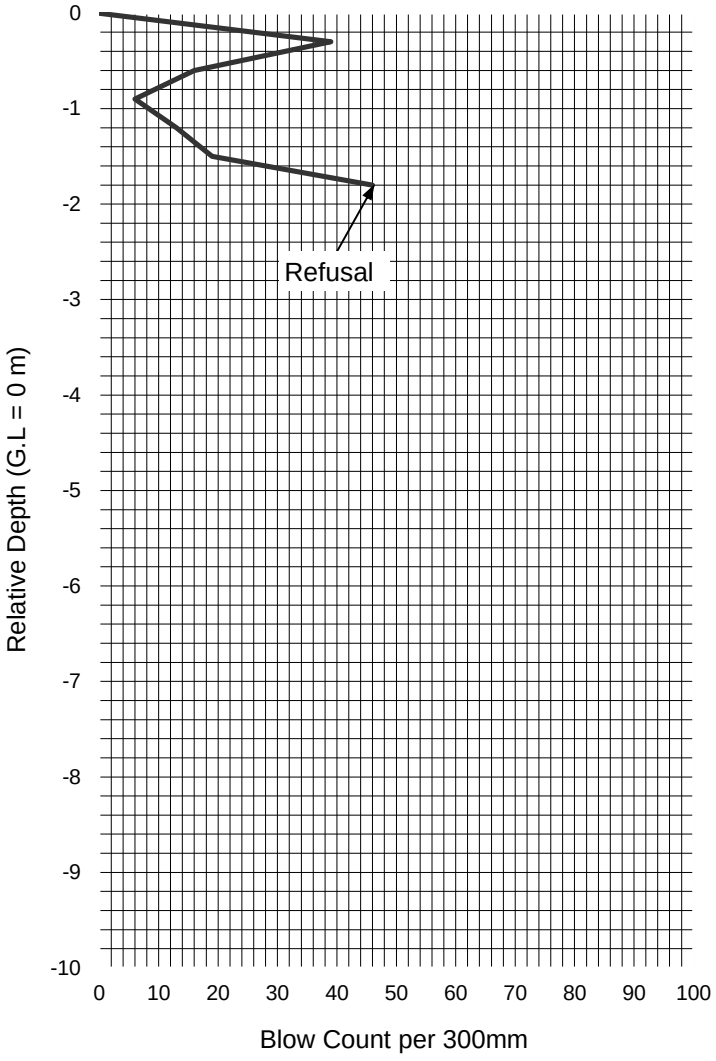
Dynamic Cone Penetrometer

Test No. : 26

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	39
-0.6	16
-0.9	6
-1.2	13
-1.5	19
-1.8	46

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

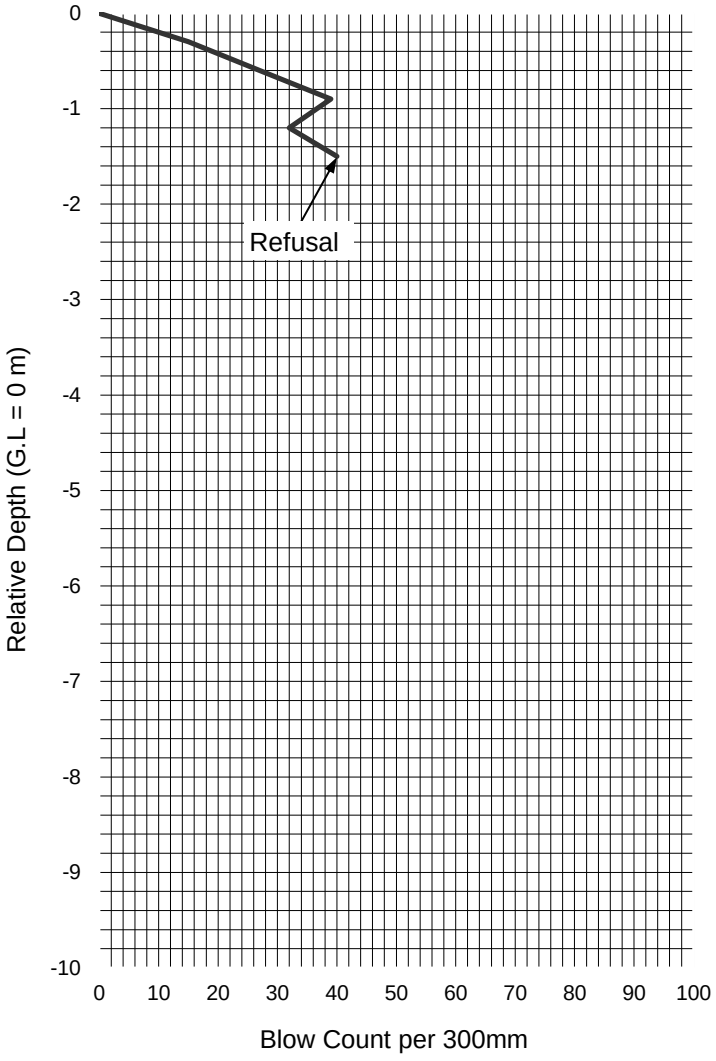
Dynamic Cone Penetrometer

Test No. : 27

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	15
-0.6	27
-0.9	39
-1.2	32
-1.5	40

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

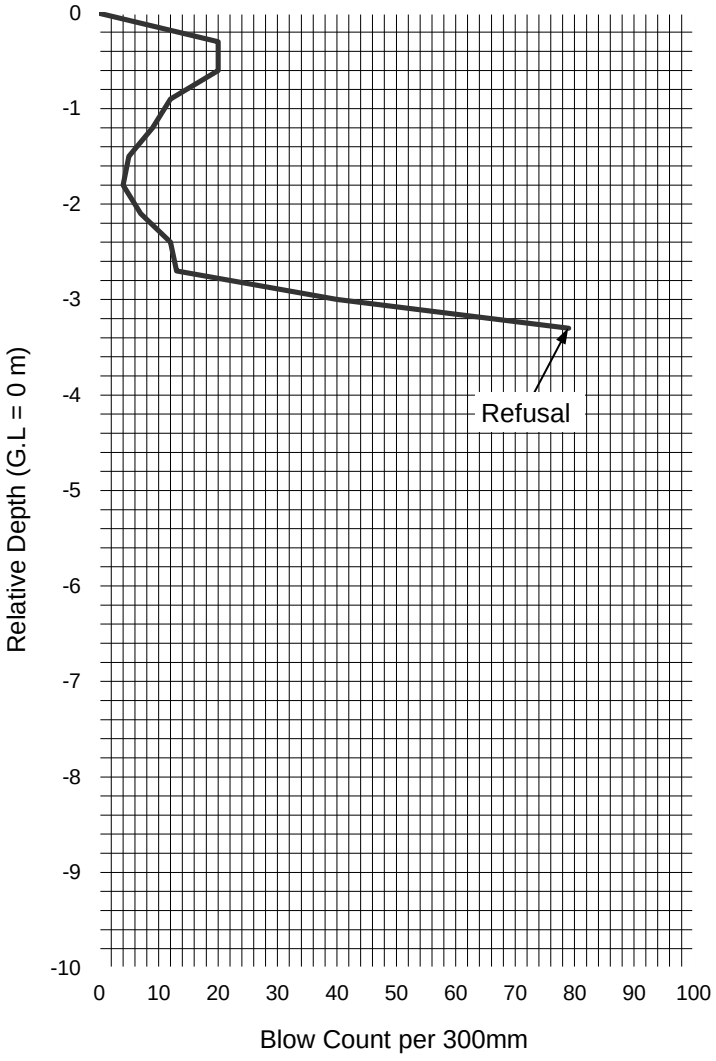
Dynamic Cone Penetrometer

Test No. : 28

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	20
-0.6	20
-0.9	12
-1.2	9
-1.5	5
-1.8	4
-2.1	7
-2.4	12
-2.7	13
-3.0	40
-3.3	79

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

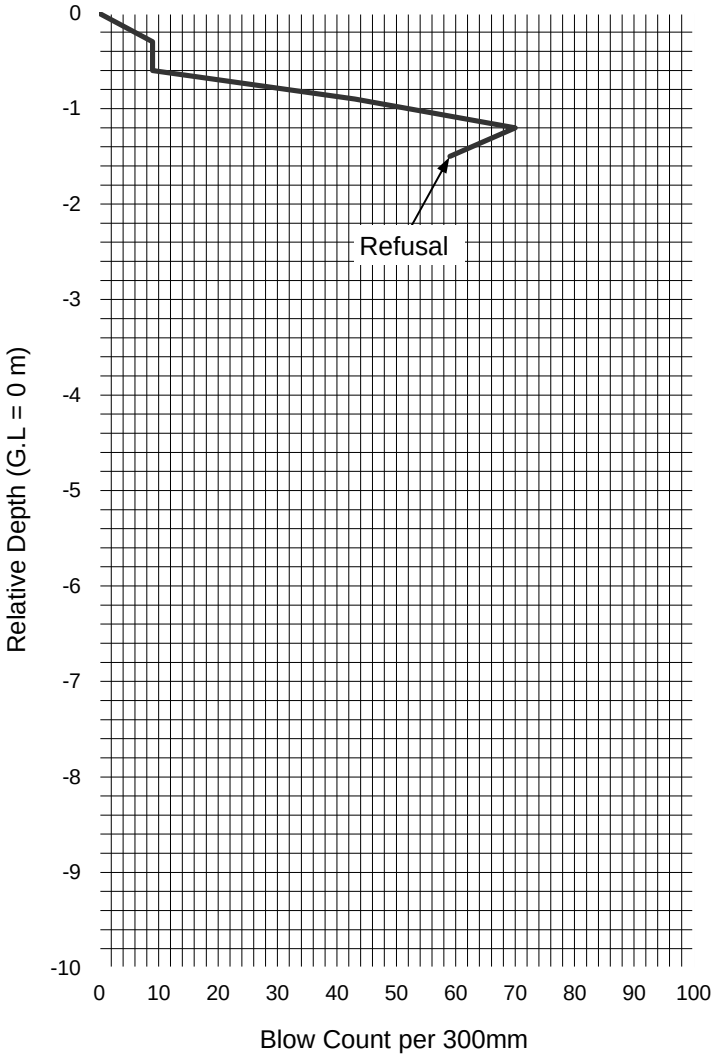
Dynamic Cone Penetrometer

Test No. : 29

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	9
-0.6	9
-0.9	43
-1.2	70
-1.5	59

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

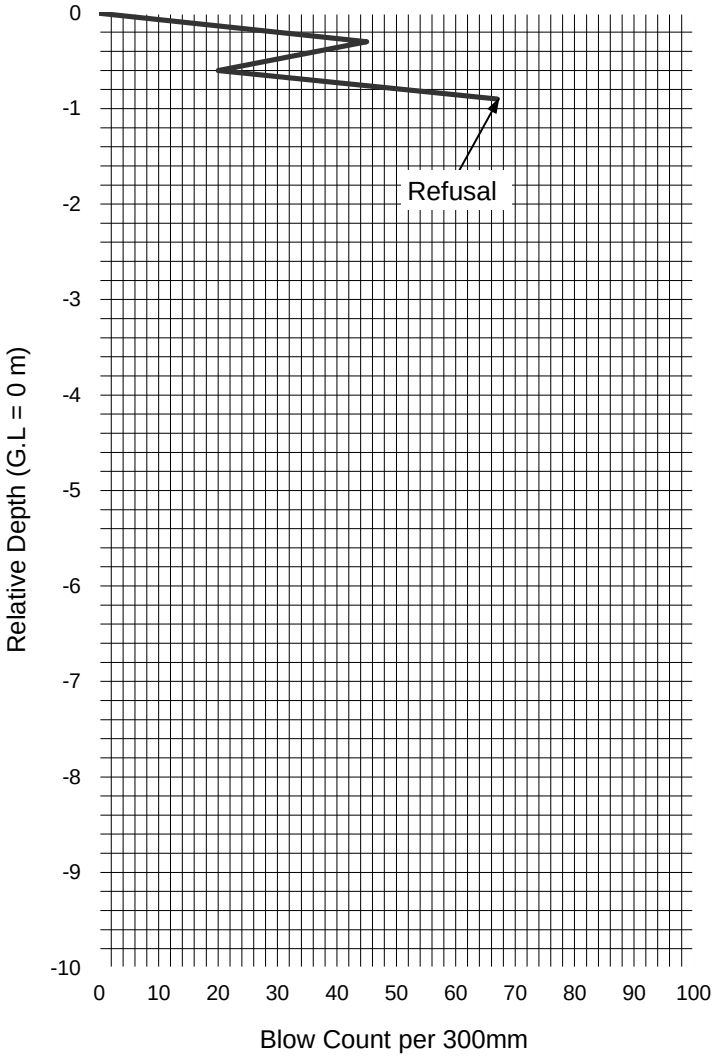
Dynamic Cone Penetrometer

Test No. : 30

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	45
-0.6	20
-0.9	67

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

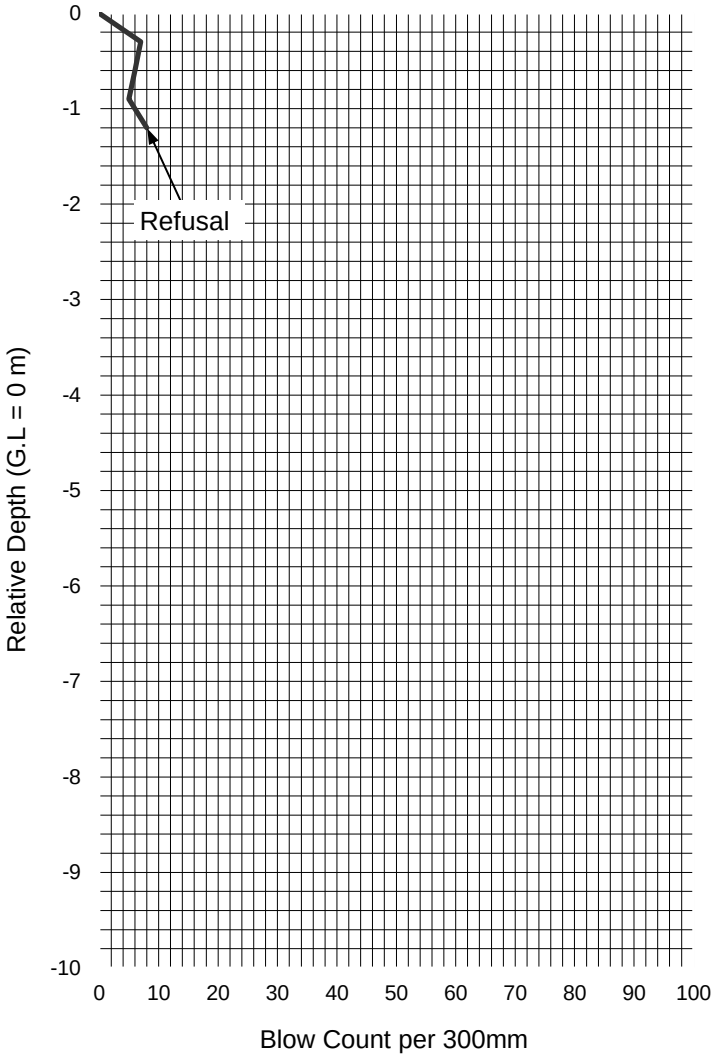
Dynamic Cone Penetrometer

Test No. : 31

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	7
-0.6	6
-0.9	5
-1.2	8

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

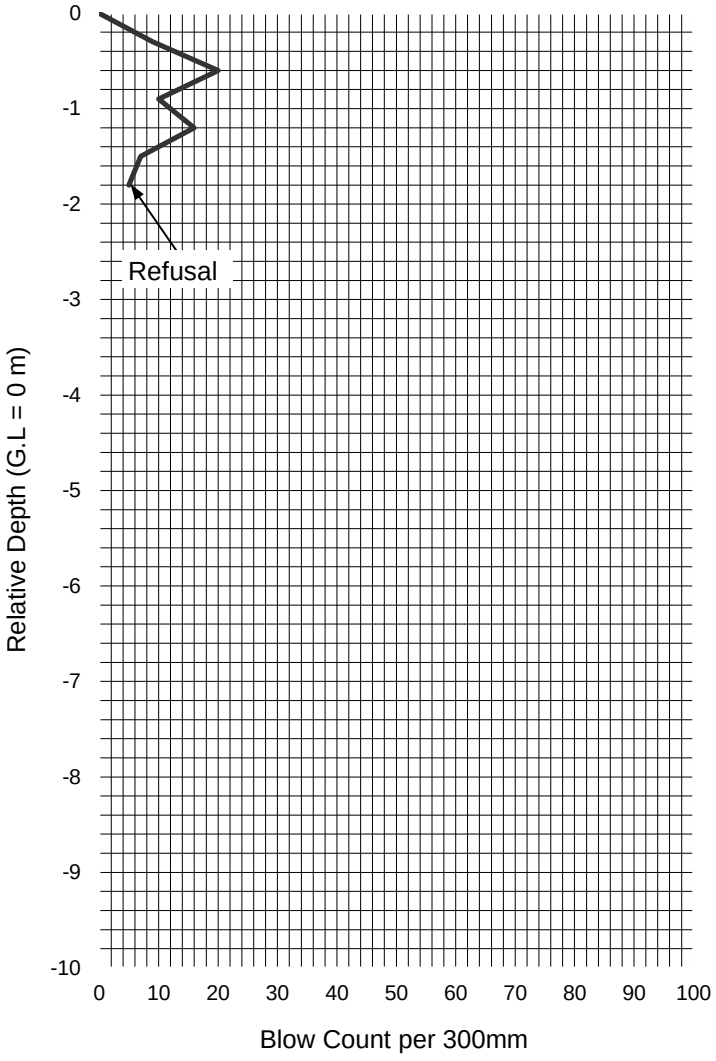
Dynamic Cone Penetrometer

Test No. : 32

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	9
-0.6	20
-0.9	10
-1.2	16
-1.5	7
-1.8	5

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

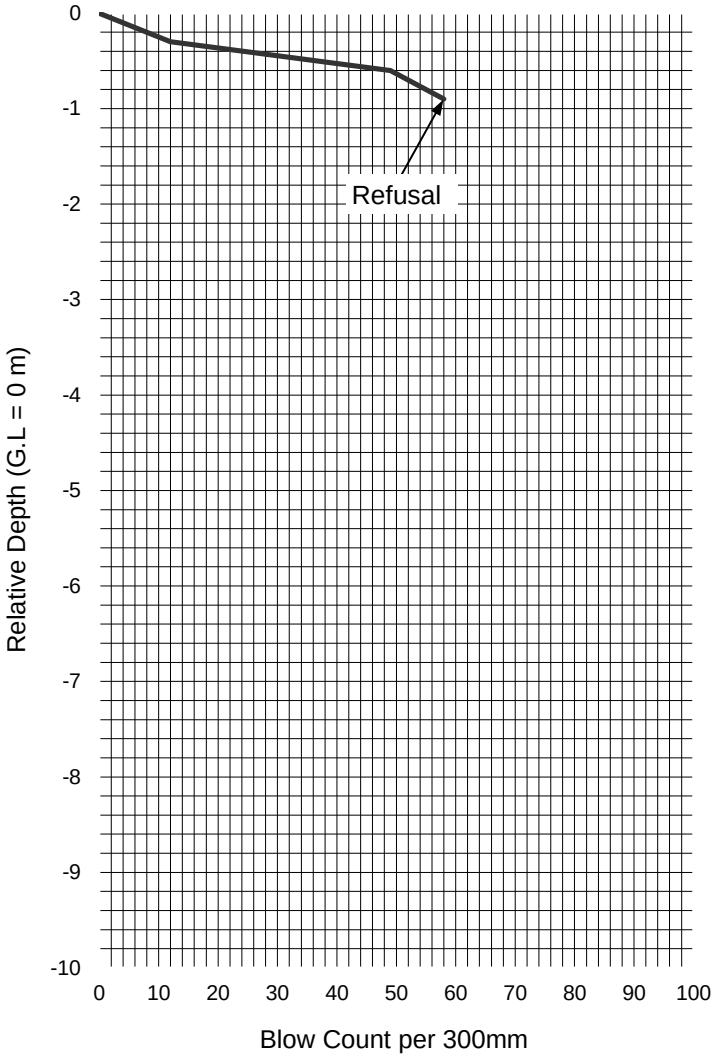
Dynamic Cone Penetrometer

Test No. : 33

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	12
-0.6	49
-0.9	58

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

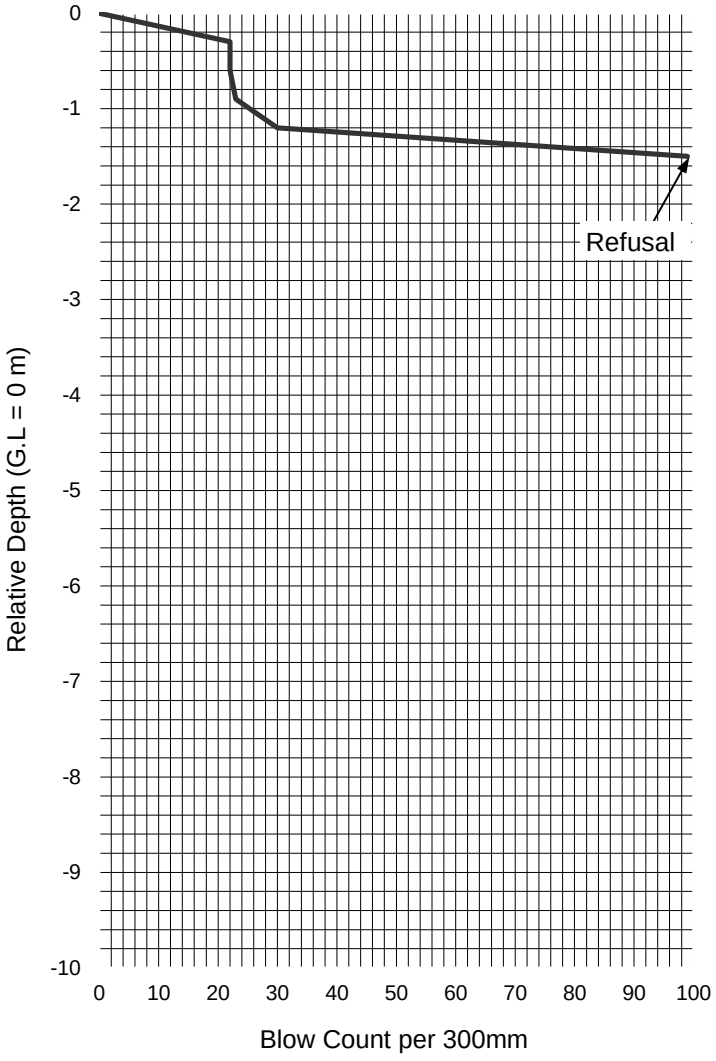
Dynamic Cone Penetrometer

Test No. : 34

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	22
-0.6	22
-0.9	23
-1.2	30
-1.5	99

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

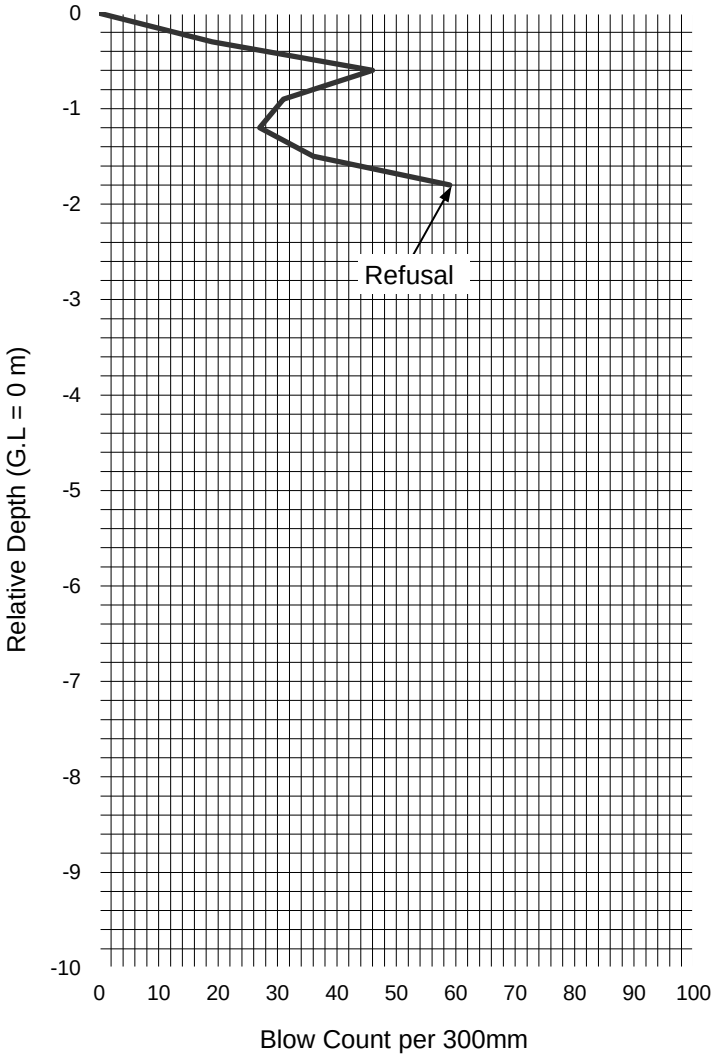
Dynamic Cone Penetrometer

Test No. : 35

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	19
-0.6	46
-0.9	31
-1.2	27
-1.5	36
-1.8	59

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

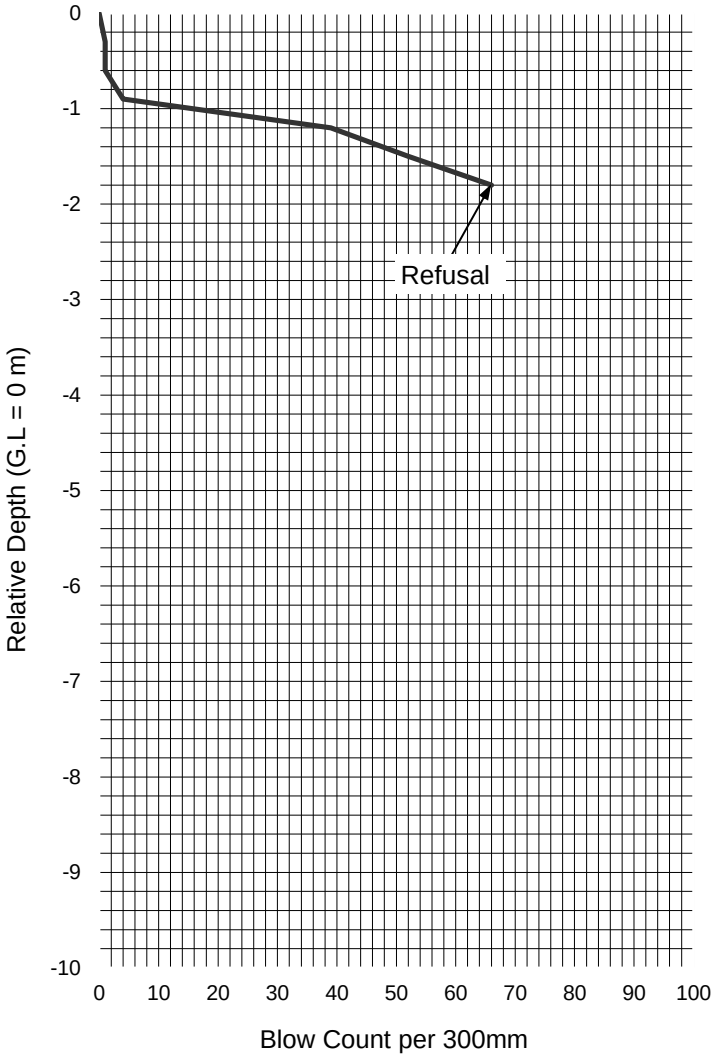
Dynamic Cone Penetrometer

Test No. : S1

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	1
-0.6	1
-0.9	4
-1.2	39
-1.5	52
-1.8	66

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

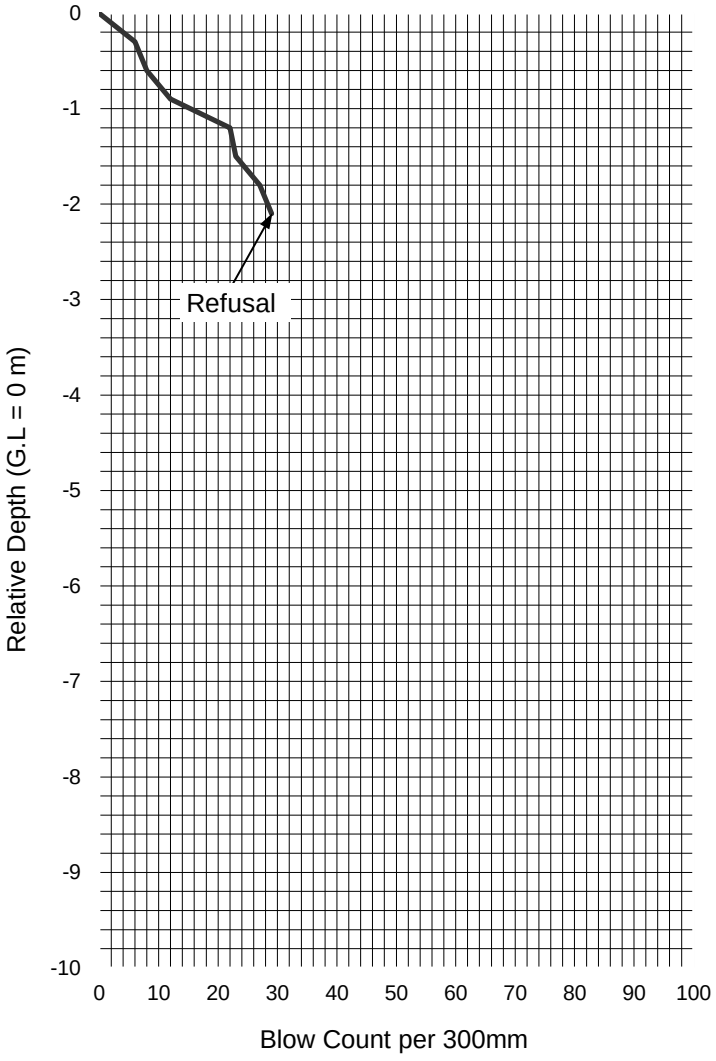
Dynamic Cone Penetrometer

Test No. : S2

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	6
-0.6	8
-0.9	12
-1.2	22
-1.5	23
-1.8	27
-2.1	29

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

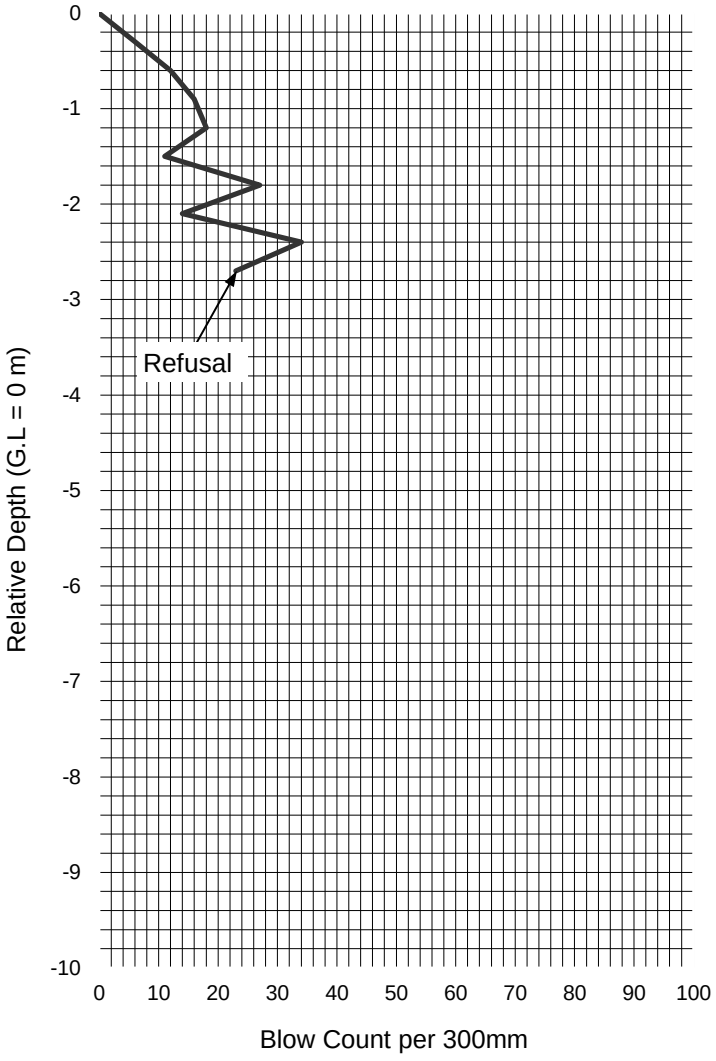
Dynamic Cone Penetrometer

Test No. : S3

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	6
-0.6	12
-0.9	16
-1.2	18
-1.5	11
-1.8	27
-2.1	14
-2.4	34
-2.7	23

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

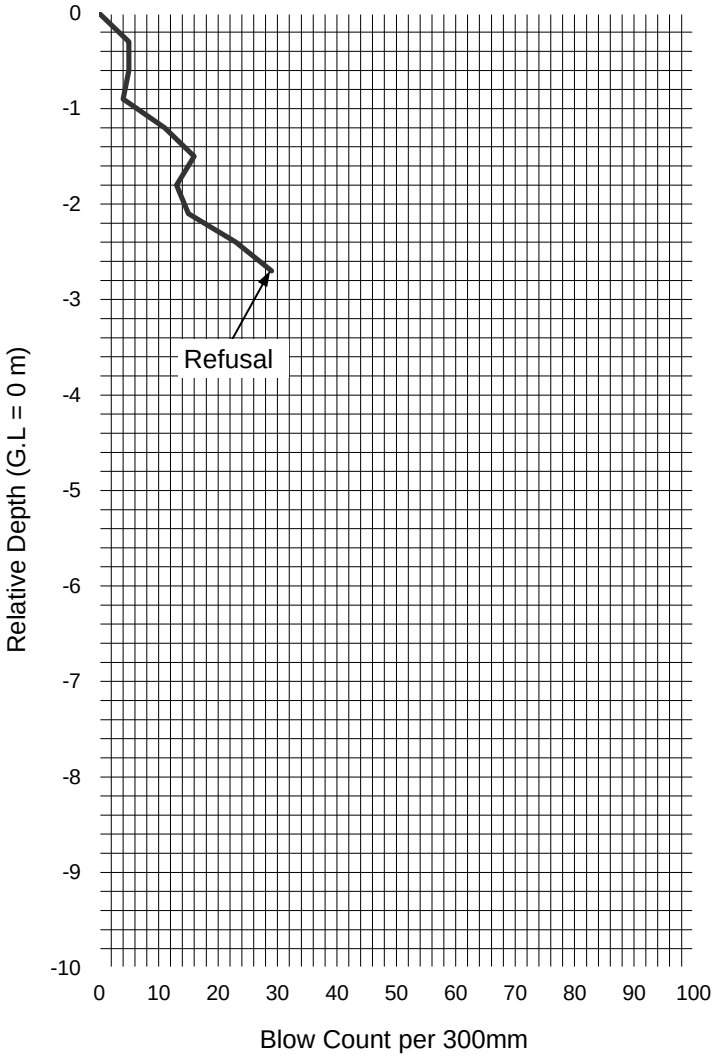
Dynamic Cone Penetrometer

Test No. : S4

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17-20/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	5
-0.6	5
-0.9	4
-1.2	11
-1.5	16
-1.8	13
-2.1	15
-2.4	23
-2.7	29

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

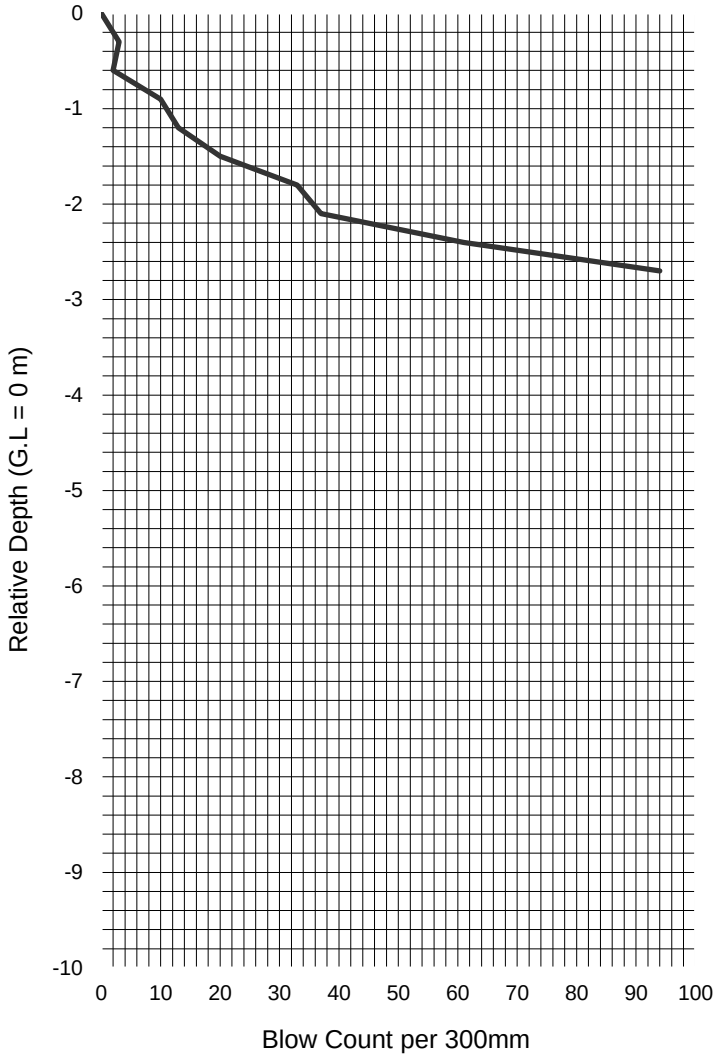
Dynamic Cone Penetrometer

Test No. : PJ1

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	3
-0.6	2
-0.9	10
-1.2	13
-1.5	20
-1.8	33
-2.1	37
-2.4	61
-2.7	94

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

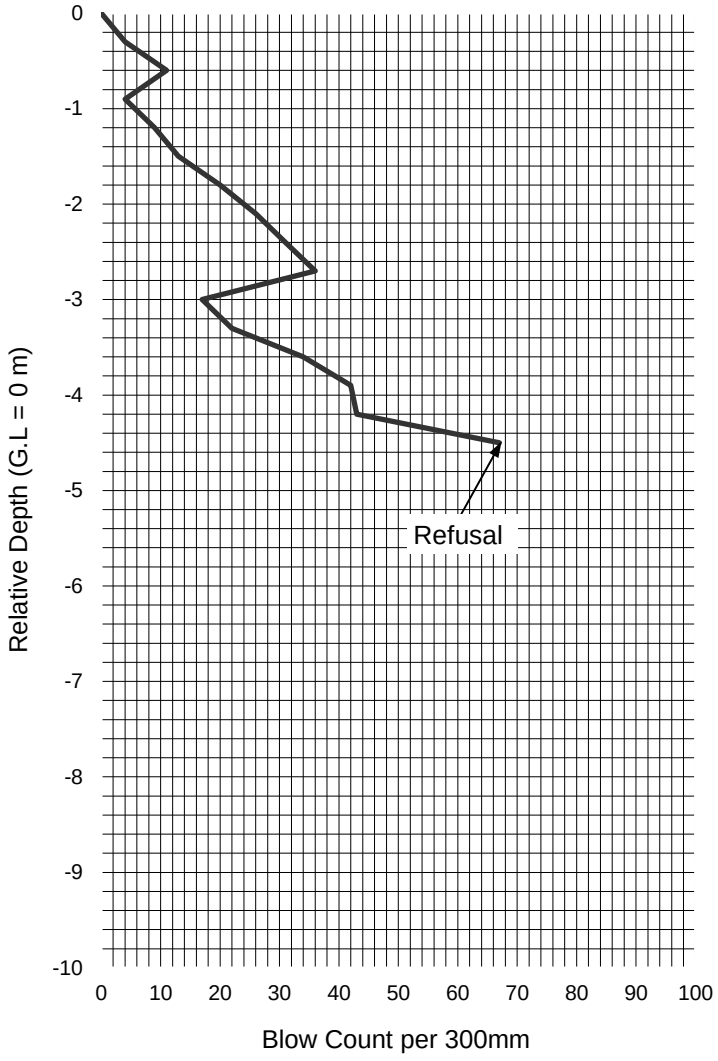
Dynamic Cone Penetrometer

Test No. : PJ2

Project : **Sewer Reticulation**
Client: **Ethekwini Municipality Water and Sanitation**
Date: 20/10/2017 Remarks: -
Test Location: Inanda Glebe -
Date of Test: 17/10/2017 Depth Interval (m) : 0.3

Depth (m)	Count Blows/0.3m
0	0
-0.3	4
-0.6	11
-0.9	4
-1.2	9
-1.5	13
-1.8	20
-2.1	26
-2.4	31
-2.7	36
-3.0	17
-3.3	22
-3.6	34
-3.9	42
-4.2	43
-4.5	67

Blow Count vs Depth



Reference No. : 32010

Drennan Maud & Partners.

Fig. No. -

Note: DCP Blow Count equals the number of blows of a 10kg hammer dropping 450mm required to drive a 25mm diameter 60^{o} cone a distance of 300mm.

APPENDIX C

LABORATORY SOIL TEST RESULTS

Laboratory Test Summary

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4380210361
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8952
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7520

Job Description: Sewer Reticulation Inanda Glebe - Ref.32010
Job no.: 8548
Date: 07-11-2017

Lab no.		10073	10074	10075	10076	10077	10078	10079	10080	10081	10082
Location		IP.PJ 1	IP.PJ 2	IP.1	IP.2	IP.3	IP.4	IP.S3	IP.S4	IP.5	IP.7
Depth		0.3 - 1.1	0.0 - 0.5	0.0 - 1.6	0.0 - 0.45	0.55 - 1.40	0.85 - 1.05	0.0 - 0.85	0.55 - 1.10	0.5 - 0.8	0.5 - 0.85
Description		Alluvium	Alluvium	Residual Dolerite	Colluvium	Residual	Natal Group	Alluvium	Alluvium	Colluvium	Colluvium
		-	-	-	-	Natal Group	-	-	-	-	-
Binder Material		-	-	-	-	-	-	-	-	-	-
Particle Size (mm)	75										
	53										
	37.5										
	26.5										
	19	100	100			100	100	100		100	100
	13.2	94	99			97	92	97		91	97
	9.5	93	99	100	100	93	84	96	100	86	96
	4.75	91	98	100	100	81	71	96	100	71	90
	2	83	96	99	99	60	57	96	99	42	79
	0.425	70	85	97	94	47	44	90	93	34	74
	0.25	65	78	96	90	45	41	82	85	32	72
	0.15	60	71	95	85	43	37	73	77	29	69
	0.075	51	60	94	78	39	32	59	66	24	65
Hydrometer	0.05										
	0.02										
	0.005										
	0.002										
Soil Mortar	Coarse Sand <2.0 >0.425mm	15.1	11.8	2.0	4.7	22.3	23.0	6.9	6.5	17.9	6.9
	Fine Sand <0.425>0.05mm	84.9	88.2	98.0	95.3	77.7	77.0	93.1	93.5	82.1	93.1
	Silt <0.05 >0.005										
	Clay <0.005										
Atterberg Limits	Liquid Limit % (m/m)	28.1	26.8	53.5	33.1	32.1	30.2	22.8	26	20.8	49.2
	Plasticity Index	7.7	6.4	26.8	8.7	8.6	10.2	8.4	9.1	5.1	17.6
	Linear Shrinkage %	6	4.7	12	7.3	6	6.7	2.7	7.3	3.3	10
	Natural MC %	-	-	-	-	-	-	-	-	-	-
Mod AASHTO Density	Dry Density kg/m^3	1743	1761	1419	1643	1863	1708	1860	1826	2022	1655
	OMC %	14.9	12.1	30.4	20.8	13.9	15.9	11.1	12.3	11.2	20.3
CBR	100% MDD	3.5	4	8.5	8.8	9.7	6.2	3	8	20	4.9
	98%	3.5	3.8	8.4	8.3	9.6	5.3	2.8	5.4	16	3.8
	95%	3.4	3.4	7.5	7.6	9.3	4.1	2.4	3.1	12	2.6
	93% (Inferred) *	3	3	4	6	7	3	2	2	10	2
	90%	3.4	2.2	1.3	4.1	4.6	2.6	1.6	1.4	7	1
	CBR Swell (%)	0.51	2.94	0.94	1.16	1.73	2.28	1.18	1.86	0.00	3.21
AASHTO Soil Classification *		A - 4 (1)	A - 4 (2)	A - 7 - 6 (29)	A - 4 (6)	A - 4 (0)	A - 2 - 6 (0)	A - 4 (2)	A - 4 (4)	A - 1 - b (0)	A - 7 - 5 (11)
Grading Modulus		0.96	0.59	0.10	0.29	1.54	1.66	0.55	0.42	2.00	0.82
TRH 14 (1985) *		G10	>G10	G10	G10	>G10	>G10	>G10	>G10	G9	>G10
Compactibility Factor										0.355	

Technical Signatory: .....

TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4560215861
68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10073 **Borehole/Pit no.:** IP.PJ 1
Description: Alluvium

Depth: 0.3 - 1.1 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	94.4
9.5	93.1
4.75	91.0
2	82.8
0.425	70.2
0.25	65.1
0.15	59.7
0.075	50.7
0.05	
0.02	
0.005	
0.002	

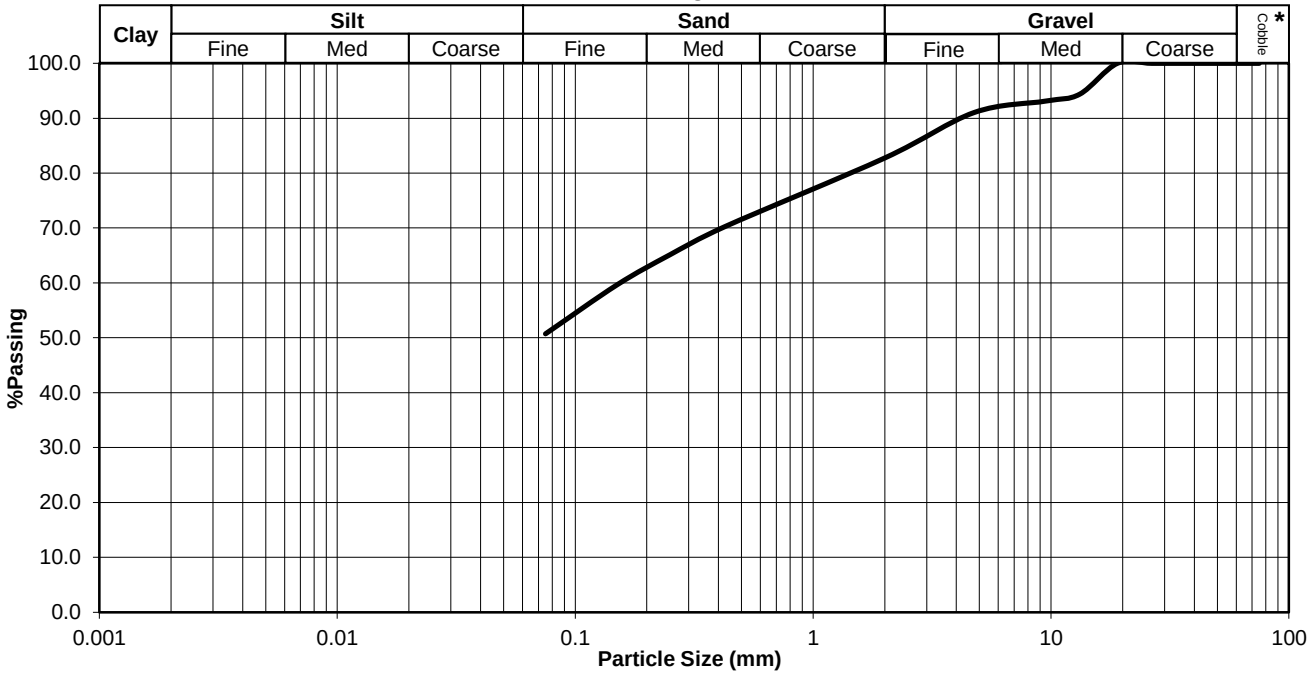
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	17.2
Coarse	0.0
Medium	8.4
Fine	8.8
Sand%	62.5
Coarse	11.1
Medium	9.2
Fine	42.1
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit, %	28.1
Plasticity Index	7.7
Linear Shrinkage, % (L/L)	6

GRADING	
D10 Size (mm)	
Uniformity Coefficient	*
Grading Modulus	0.96

CLASSIFICATION *	
Potential Expansiveness	
Group Index	1
AASHTO Soil Classification	A - 4
Unified Classification	

Grading Curve



Ref no.: 8548 Fig no.: -

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THEKWINI SOILS LAB. CC
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68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10074 **Borehole/Pit no.:** IP.PJ 2
Description: Alluvium

Depth: 0.0 - 0.5 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	99.2
9.5	98.6
4.75	98.2
2	96.3
0.425	84.9
0.25	78.1
0.15	70.9
0.075	59.7
0.05	
0.02	
0.005	
0.002	

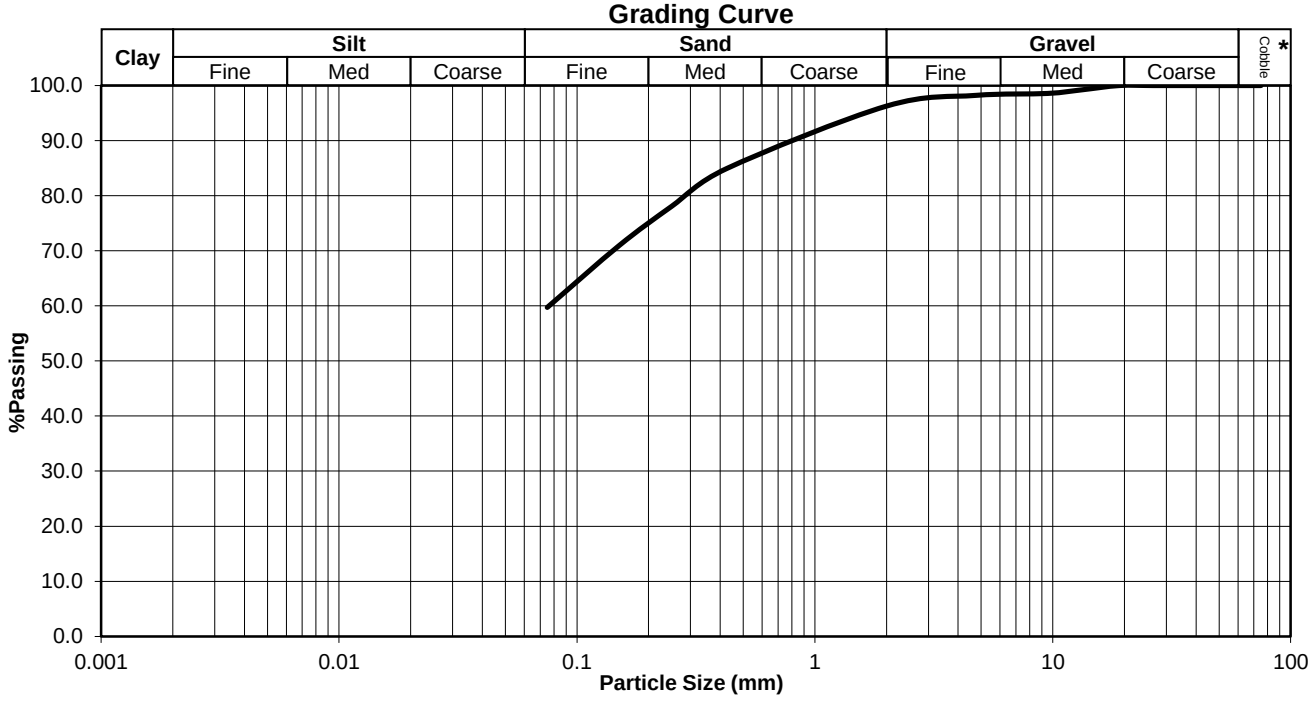
M.I.T SIZE CLASSIFICATION *		
Cobble%		0.0
Gravel%		3.7
Coarse		0.0
Medium		1.7
Fine		2.0
Sand%		72.4
Coarse		10.1
Medium		11.7
Fine		50.6
Silt%		
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY	
Liquid Limit	26.8
Plasticity Index	6.4
Linear Shrinkage	4.7

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	0.59

CLASSIFICATION *	
Potential Expansiveness	
Group Index	2
AASHTO Soil Classification	A - 4
Unified Classification	

Grading Curve



Ref no.: 8548 Fig no.: -

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68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920
sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10075 **Borehole/Pit no.:** IP.1
Description: Residual Dolerite

Depth: 0.0 - 1.6 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.9
2	99.2
0.425	97.2
0.25	96.2
0.15	95.0
0.075	93.6
0.05	
0.02	
0.005	
0.002	

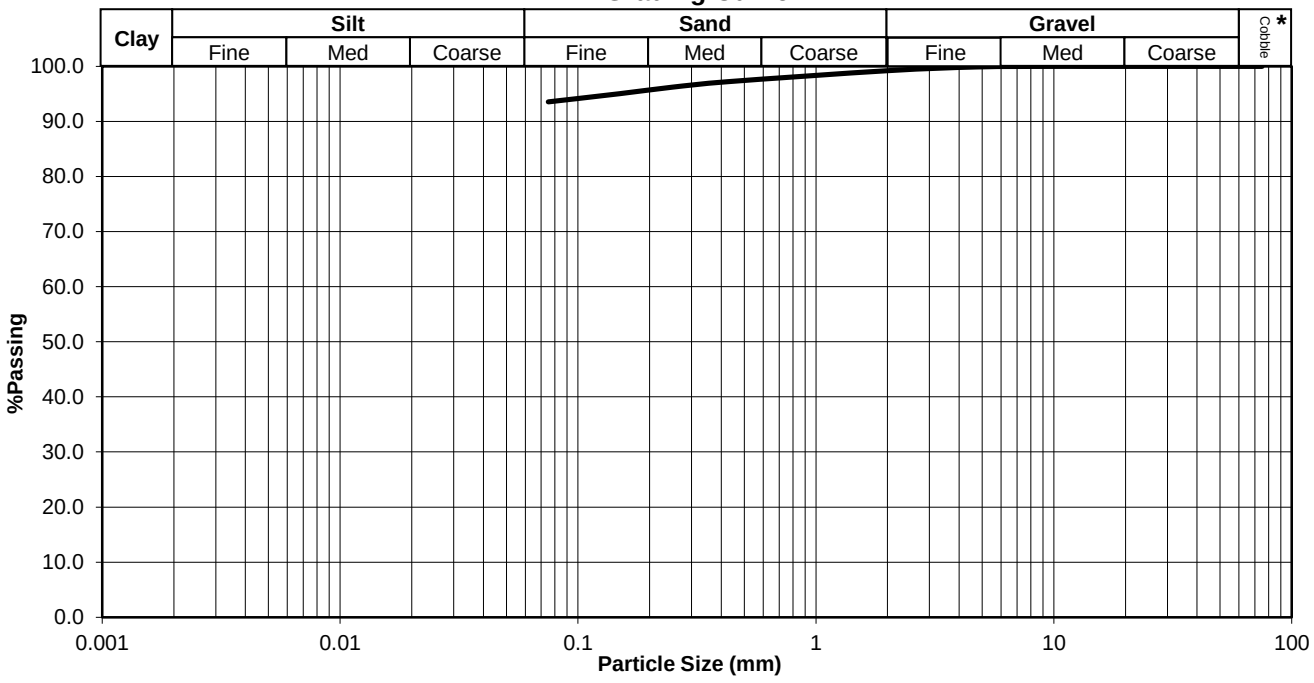
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	0.8
Coarse	0.0
Medium	0.1
Fine	0.7
Sand%	61.8
Coarse	1.8
Medium	1.8
Fine	58.2
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit	53.5
Plasticity Index	26.8
Linear Shrinkage	12

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	0.10

CLASSIFICATION *	
Potential Expansiveness	
Group Index	29
AASHTO Soil Classification	A - 7 - 6
Unified Classification	

Grading Curve



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P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10076 **Borehole/Pit no.:** IP.2
Description: Colluvium

Depth: 0.0 - 0.45 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.9
2	98.9
0.425	94.3
0.25	90.1
0.15	85.2
0.075	78.2
0.05	
0.02	
0.005	
0.002	

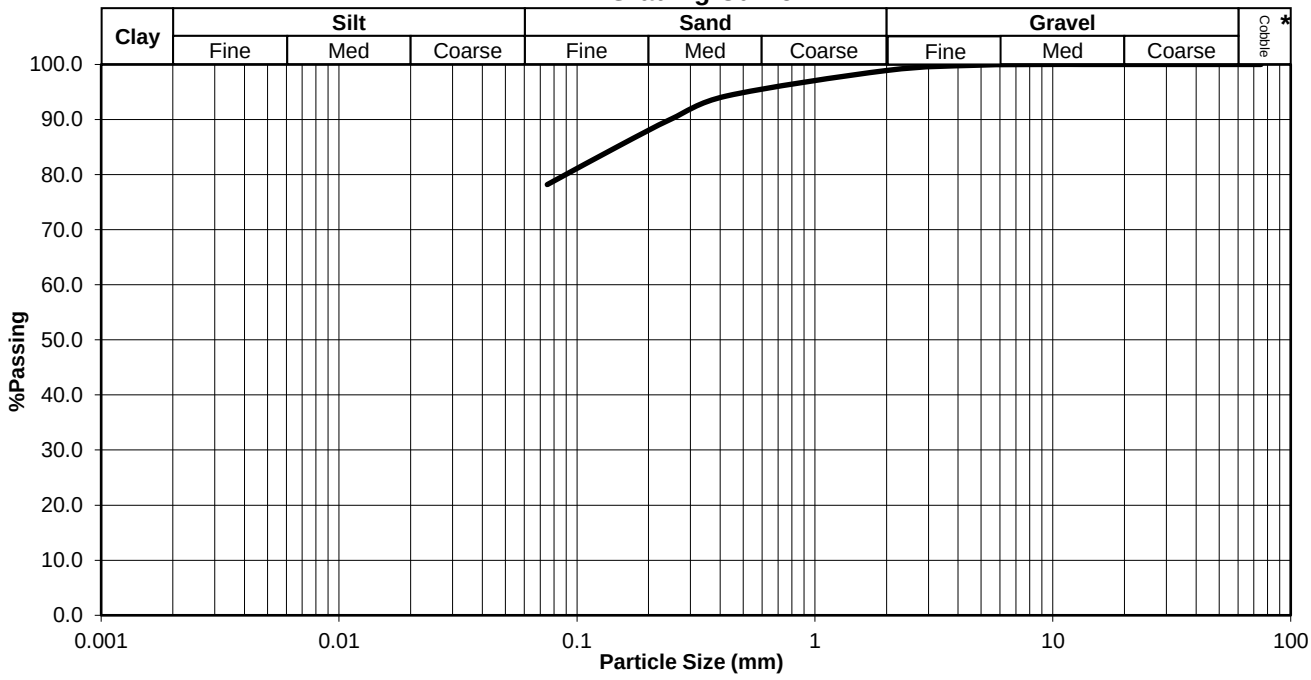
M.I.T SIZE CLASSIFICATION *		
Cobble%		0.0
Gravel%	1.1	
Coarse		0.0
Medium		0.1
Fine		1.0
Sand%	67.6	
Coarse		4.1
Medium		7.1
Fine		56.4
Silt%		
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY	
Liquid Limit	33.1
Plasticity Index	8.7
Linear Shrinkage	7.3

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	0.29

CLASSIFICATION *	
Potential Expansiveness	
Group Index	6
AASHTO Soil Classification	A - 4
Unified Classification	

Grading Curve



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P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10077 **Borehole/Pit no.:** IP.3
Description: Residual
Depth: 0.55 - 1.40 Natal Group

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	97.3
9.5	93.0
4.75	81.3
2	60.5
0.425	47.0
0.25	45.0
0.15	42.6
0.075	38.7
0.05	
0.02	
0.005	
0.002	

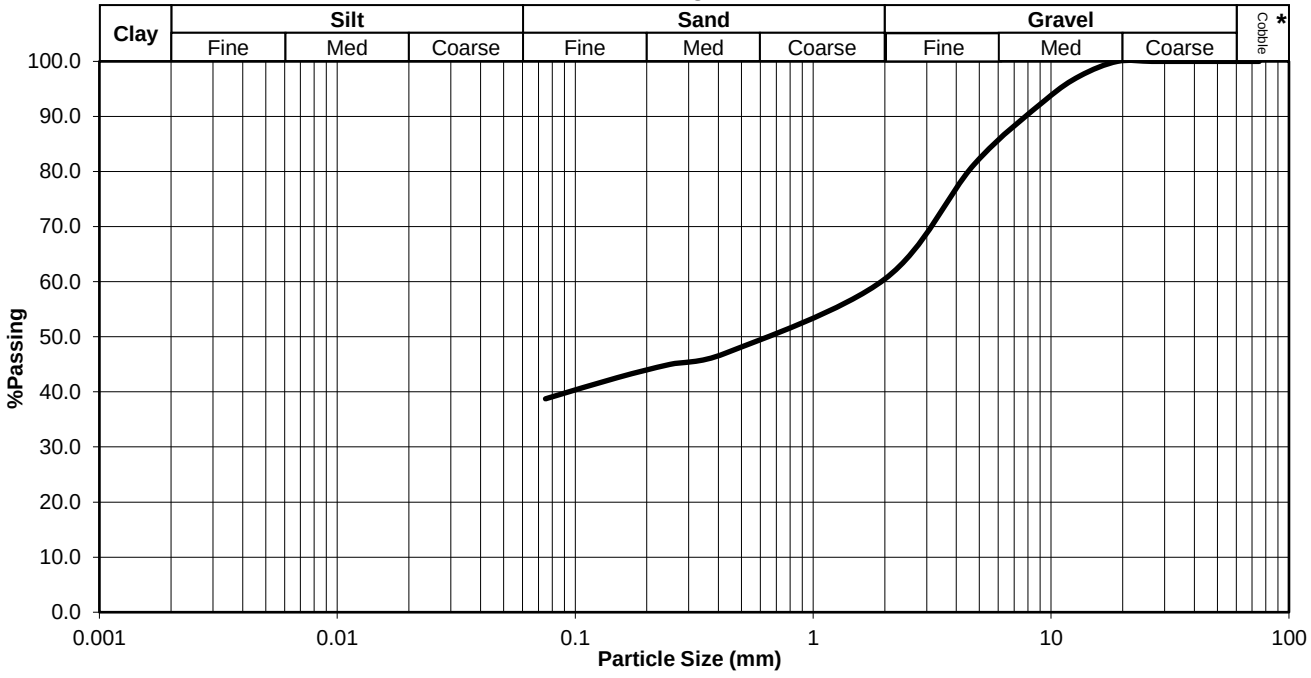
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	39.5
Coarse	0.0
Medium	15.6
Fine	23.9
Sand%	45.0
Coarse	12.0
Medium	4.7
Fine	28.3
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit	32.1
Plasticity Index	8.6
Linear Shrinkage	6

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	1.54

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 4
Unified Classification	

Grading Curve



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Tel : (031) 201-8992
P.O. Box 30464, MAYVILLE, 4058
Fax : (031) 201-7920

sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10078 **Borehole/Pit no.:** IP.4
Description: Natal Group

Depth: 0.85 - 1.05 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	92.3
9.5	84.2
4.75	71.2
2	57.4
0.425	44.2
0.25	40.6
0.15	36.9
0.075	32.3
0.05	
0.02	
0.005	
0.002	

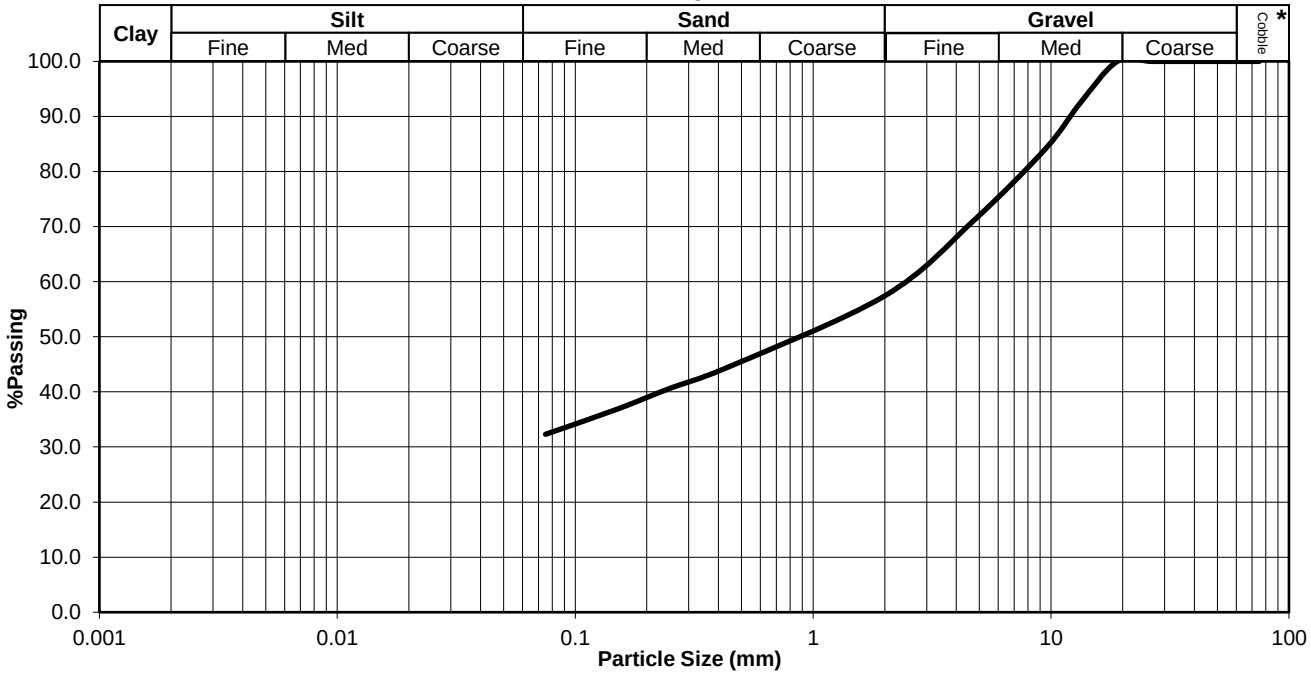
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	42.6
Coarse	0.0
Medium	25.4
Fine	17.2
Sand%	44.5
Coarse	11.7
Medium	7.0
Fine	25.8
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit	30.2
Plasticity Index	10.2
Linear Shrinkage	6.7

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	1.66

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 6
Unified Classification	

Grading Curve



Ref no.: 8548 Fig no.: -

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TEST REPORT

MATERIALS ANALYSIS

THEKWINI SOILS LAB. CC
V.A.T. REGISTRATION NO. 4560213961
68 Ridge Road, Tollgate, DURBAN
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Fax : (031) 201-7920

sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10079 **Borehole/Pit no.:** IP.S3
Description: Alluvium

Depth: 0.0 - 0.85 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	97.1
9.5	96.4
4.75	96.4
2	96.2
0.425	89.6
0.25	82.1
0.15	72.8
0.075	59.2
0.05	
0.02	
0.005	
0.002	

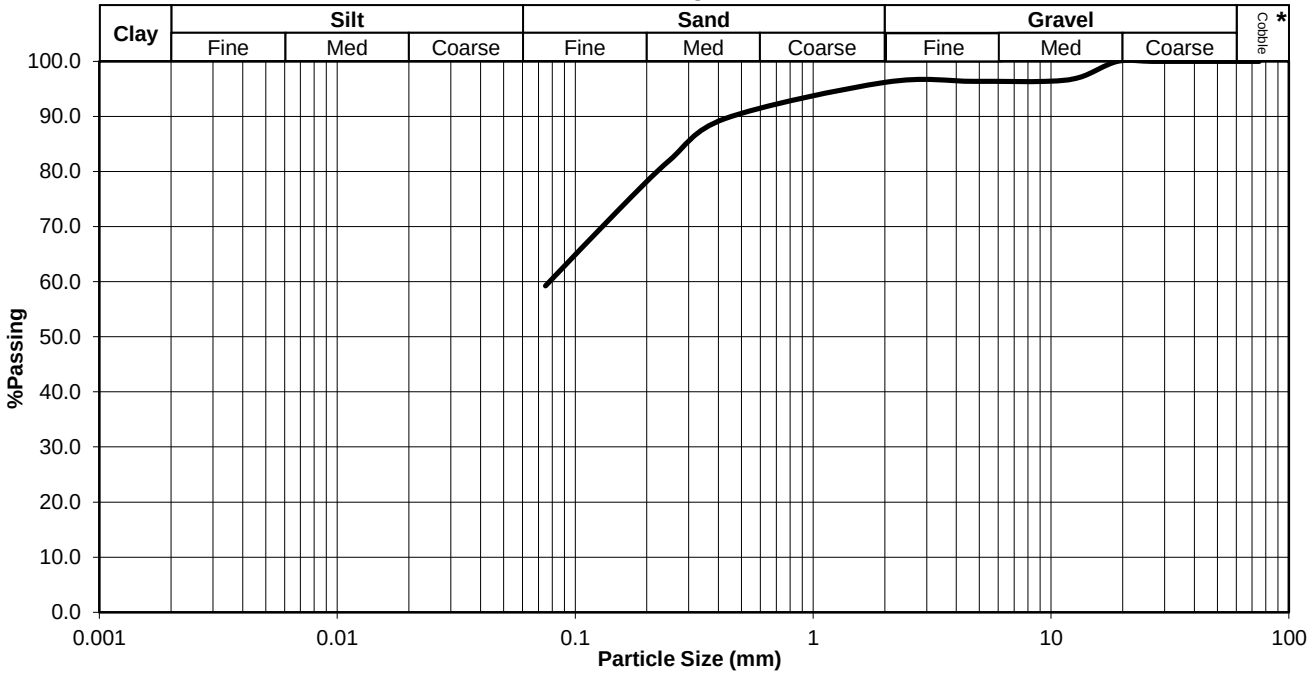
M.I.T SIZE CLASSIFICATION *		
Cobble%		0.0
Gravel%	3.8	
Coarse		0.0
Medium		3.6
Fine		0.2
Sand%	72.5	
Coarse		5.9
Medium		12.9
Fine		53.7
Silt%		
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY	
Liquid Limit	22.8
Plasticity Index	8.4
Linear Shrinkage	2.7

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	0.55

CLASSIFICATION *	
Potential Expansiveness	
Group Index	2
AASHTO Soil Classification	A - 4
Unified Classification	

Grading Curve



Ref no.: 8548 Fig no.: -

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sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10080 **Borehole/Pit no.:** IP.S4
Description: Alluvium

Depth: 0.55 - 1.10 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.5
2	99.0
0.425	92.6
0.25	84.6
0.15	76.7
0.075	66.3
0.05	
0.02	
0.005	
0.002	

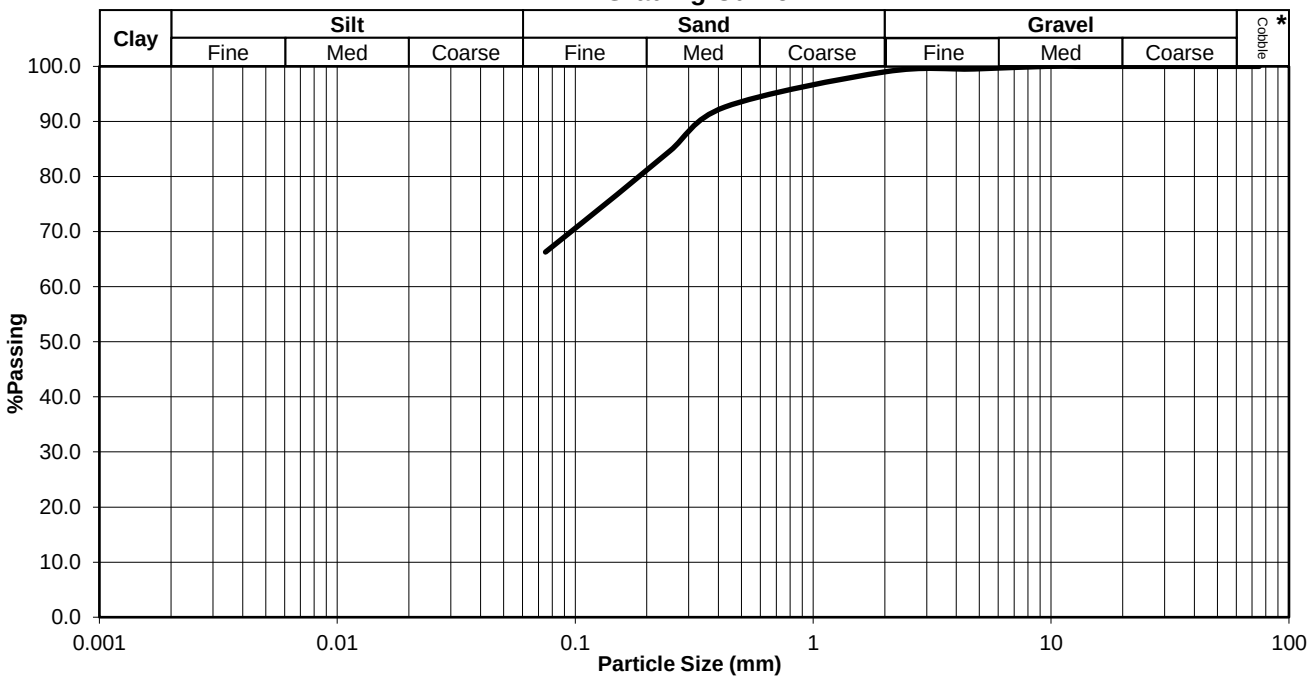
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	1.0
Coarse	0.0
Medium	0.3
Fine	0.6
Sand%	72.5
Coarse	5.7
Medium	12.6
Fine	54.2
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit	26
Plasticity Index	9.1
Linear Shrinkage	7.3

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	0.42

CLASSIFICATION *	
Potential Expansiveness	
Group Index	4
AASHTO Soil Classification	A - 4
Unified Classification	

Grading Curve



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sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10081 **Borehole/Pit no.:** IP.5
Description: Colluvium
Depth: 0.5 - 0.8 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	91.4
9.5	85.6
4.75	70.7
2	41.8
0.425	34.3
0.25	31.9
0.15	28.9
0.075	24.1
0.05	
0.02	
0.005	
0.002	

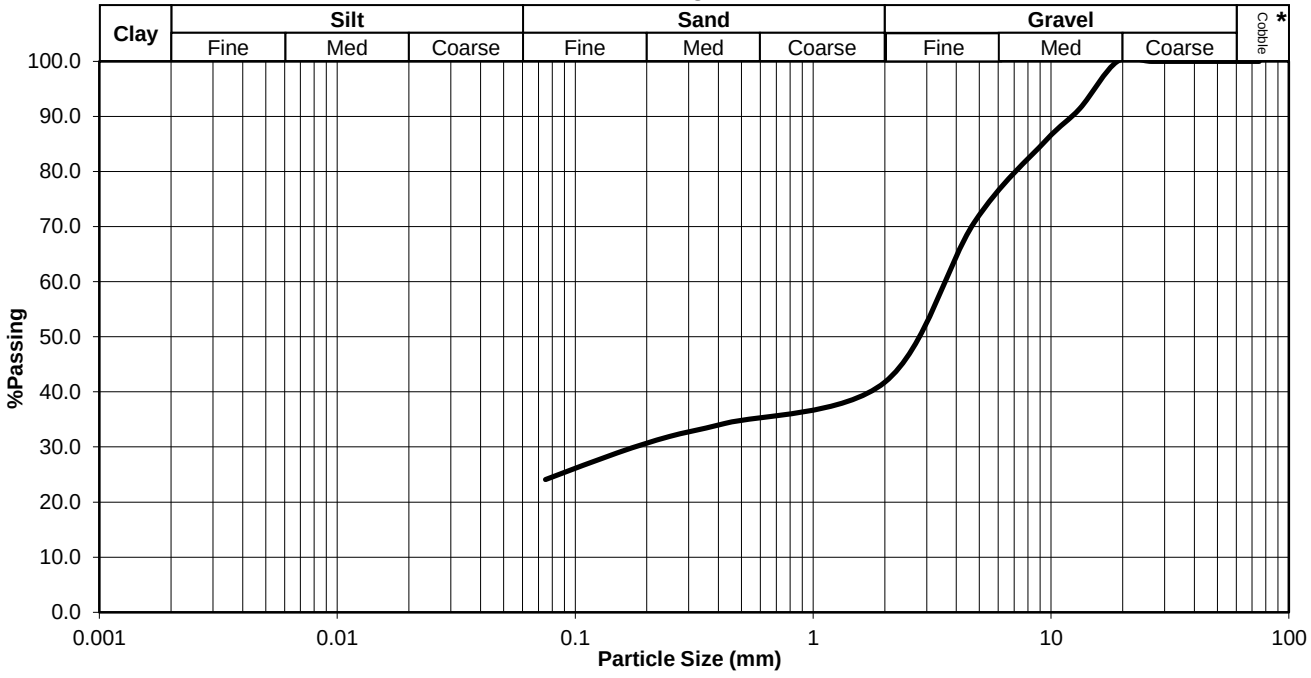
M.I.T SIZE CLASSIFICATION *		
Cobble%		0.0
Gravel%		58.2
Coarse		0.0
Medium		25.4
Fine		32.9
Sand%		32.1
Coarse		6.7
Medium		4.7
Fine		20.8
Silt%		
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY	
Liquid Limit	20.8
Plasticity Index	5.1
Linear Shrinkage	3.3

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	2.00

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 1 - b
Unified Classification	

Grading Curve



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Project: Sewer Reticulation Inanda Glebe - Ref.32010

Ref no.: 8548 **Lab no.:** 10082 **Borehole/Pit no.:** IP.7
Description: Colluvium
Depth: 0.5 - 0.85 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	97.5
9.5	95.8
4.75	89.9
2	79.3
0.425	73.9
0.25	71.6
0.15	68.9
0.075	64.8
0.05	
0.02	
0.005	
0.002	

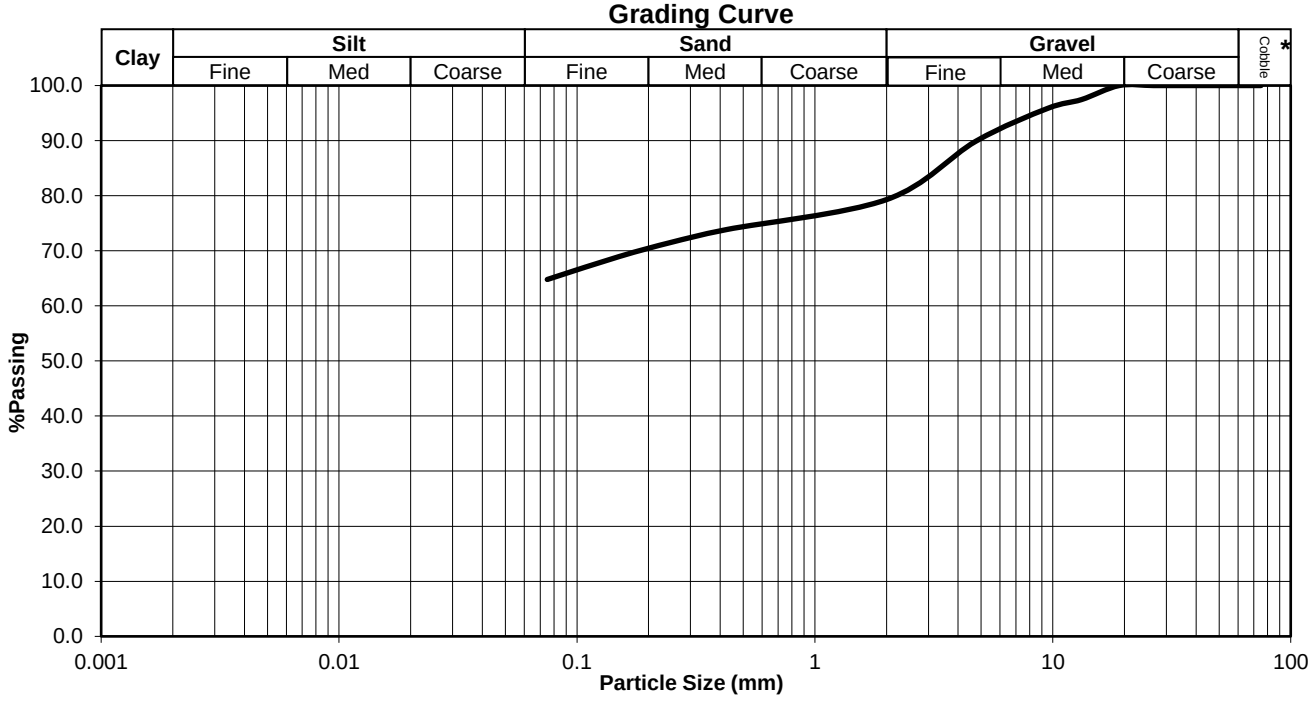
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	20.7
Coarse	0.0
Medium	8.5
Fine	12.2
Sand%	53.4
Coarse	4.8
Medium	4.2
Fine	44.3
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit	49.2
Plasticity Index	17.6
Linear Shrinkage	10

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	0.82

CLASSIFICATION *	
Potential Expansiveness	
Group Index	11
AASHTO Soil Classification	A - 7 - 5
Unified Classification	

Grading Curve



Ref no.: 8548 Fig no.: -

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Laboratory Test Summary

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68 Ridge Road, Tollgate, DURBAN
Tel : (031) 201-8952
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Job Description: Sewer Reticulation Inanda Glebe - Ref.8548
Job no.: 8548(A)
Date: 07-11-2017

Lab no.		10083	10084	10085	10086	10087	10118				
Location		IP.10	IP.8	IP.S2	IP.S2	IP.11	IP.12				
Depth		0.6 - 1.10	0.0 - 2.0	0.5 - 1.0	1.0 - 1.9	0.5 - 1.4	0.0 - 1.6				
Description		Natal Group	Fill	Alluvium	Residual Natal	Colluvium	Fill				
		Sandstone	-	-	Group	-	-				
Binder Material		-	-	-	-	-	-				
Particle Size (mm)	75										
	53										
	37.5										
	26.5										
	19	100	100			100	100				
	13.2	96	98	100		98	83				
	9.5	85	96	100		94	81				
	4.75	69	93	100	100	87	78				
	2	54	89	99	100	74	72				
	0.425	39	63	91	93	56	41				
	0.25	35	38	59	65	49	32				
	0.15	31	27	40	48	42	27				
	0.075	26	21	29	40	35	23				
Hydrometer	0.05										
	0.02										
	0.005										
	0.002										
Soil Mortar	Coarse Sand <2.0 >0.425mm	27.0	29.2	8.1	6.9	24.1	43.0				
	Fine Sand <0.425>0.05mm	73.0	70.8	91.9	93.1	75.9	57.0				
	Silt <0.05 >0.005										
	Clay <0.005										
Atterberg Limits	Liquid Limit % (m/m)	26.8	21	14.8	20.4	21.1	25.5				
	Plasticity Index	8.6	0	0	7.9	5.3	7.5				
	Linear Shrinkage %	3.3	0	0	2	2	3.3				
	Natural MC %	-	-	-	-	-	-				
Mod AASHTO Density	Dry Density kg/m^3	1812	1927	1979	1865	1950	1961				
	OMC %	13.8	9.7	9.2	12.8	10.7	9.2				
CBR	100% MDD	15	15	22	1.4	18	11				
	98%	13	15	18	1.4	16	10				
	95%	10	15	12	1.3	13	9				
	93% (Inferred) *	6	11	8	1	7	8				
	90%	3	7.5	5	1.3	3	7				
	CBR Swell (%)	1.05	0.00	0.82	1.64	0.69	0.57				
AASHTO Soil Classification *		A - 2 - 4 (0)	A - 2 - 4 (0)	A - 2 - 4 (0)	A - 4 (0)	A - 2 - 4 (0)	A - 2 - 4 (0)				
Grading Modulus		1.81	1.26	0.80	0.67	1.34	1.63				
TRH 14 (1985) *		G10	G8	G9	>G10	G9	G9				
Compactibility Factor		0.391									

Technical Signatory: .....

TEST REPORT

MATERIALS ANALYSIS

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sanas testing Laboratory

Project: Sewer Reticulation Inanda Glebe - Ref.8548

Ref no.: 8548(A) **Lab no.:** 10083 **Borehole/Pit no.:** IP.10
Description: Natal Group Sandstone

Depth: 0.6 - 1.10

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	95.6
9.5	85.4
4.75	69.3
2	53.7
0.425	39.2
0.25	35.0
0.15	31.1
0.075	26.2
0.05	
0.02	
0.005	
0.002	

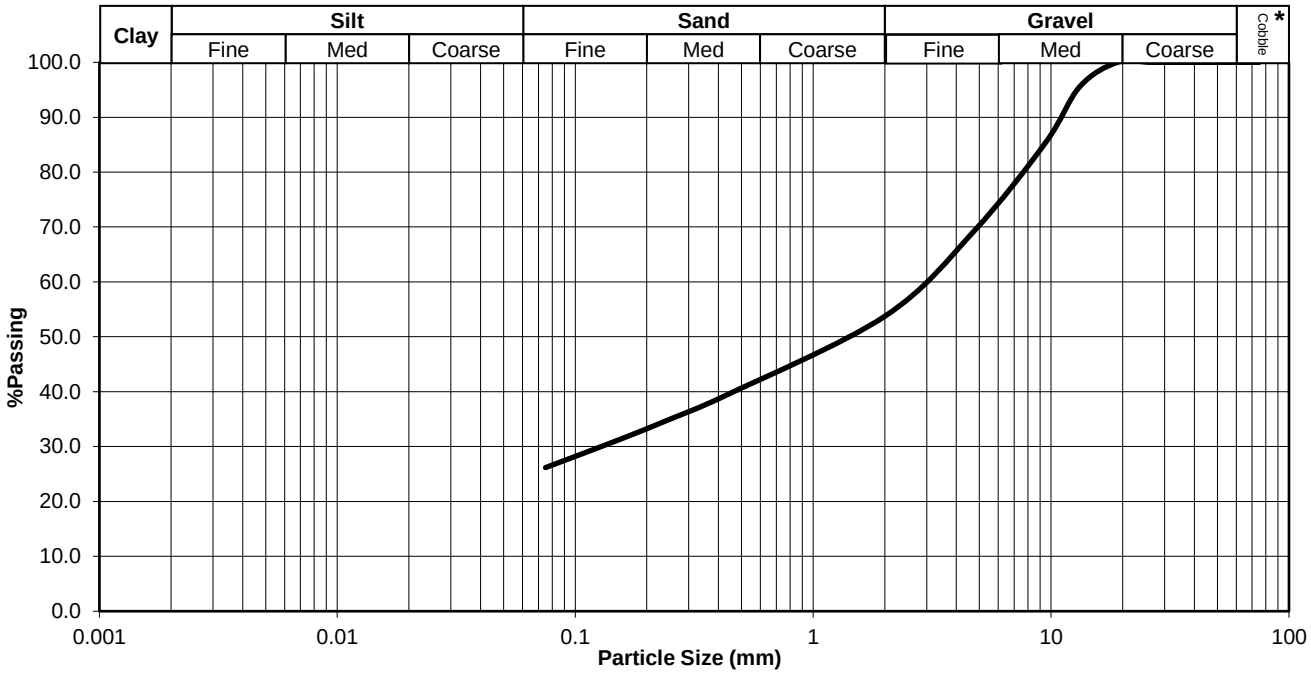
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	46.3
Coarse	0.0
Medium	26.5
Fine	19.8
Sand%	43.3
Coarse	12.9
Medium	7.8
Fine	22.6
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit, %	26.8
Plasticity Index	8.6
Linear Shrinkage, % (L/L)	3.3

GRADING	
D10 Size (mm)	
Uniformity Coefficient	*
Grading Modulus	1.81

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	

Grading Curve



Ref no.: 8548(A) Fig no.: -

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Project: Sewer Reticulation Inanda Glebe - Ref.8548

Ref no.: 8548(A) **Lab no.:** 10084 **Borehole/Pit no.:** IP.8
Description: Fill

Depth: 0.0 - 2.0 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	97.7
9.5	96.1
4.75	93.4
2	89.4
0.425	63.3
0.25	37.8
0.15	27.0
0.075	21.4
0.05	
0.02	
0.005	
0.002	

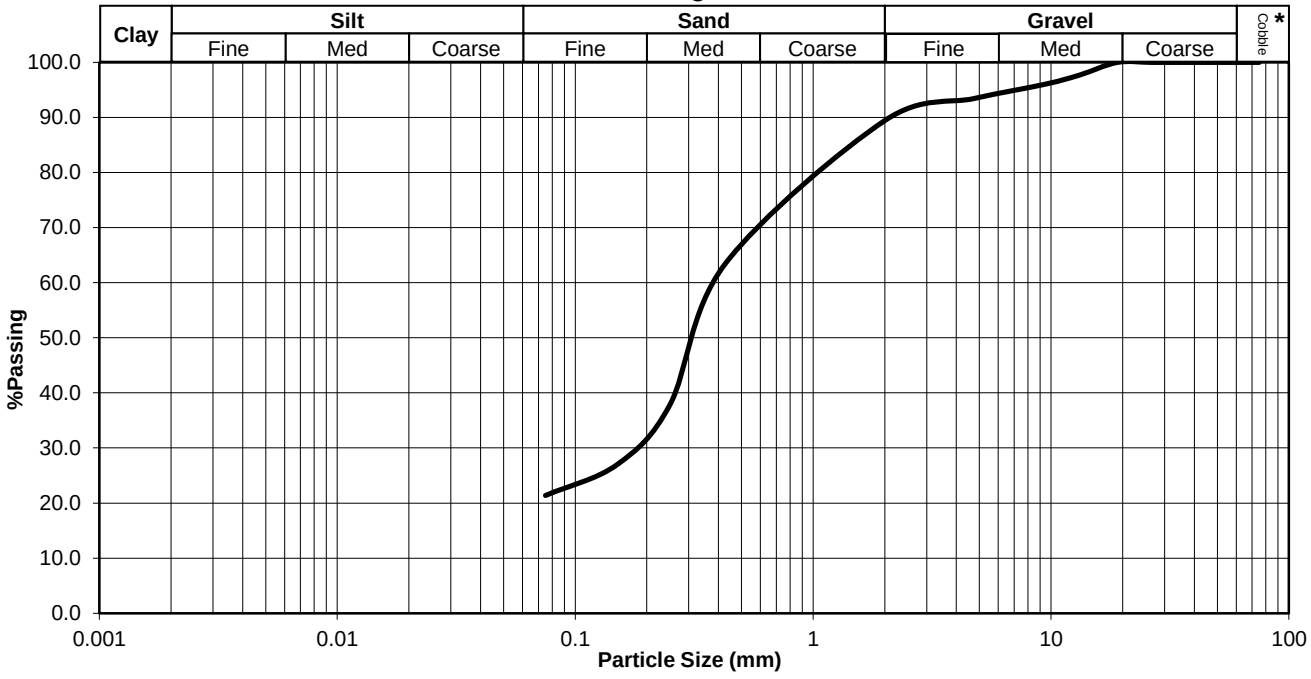
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	10.6
Coarse	0.0
Medium	5.9
Fine	4.7
Sand%	80.9
Coarse	23.2
Medium	33.8
Fine	23.9
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit	21
Plasticity Index	0
Linear Shrinkage	0

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	1.26

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	

Grading Curve



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Project: Sewer Reticulation Inanda Glebe - Ref.8548

Ref no.: 8548(A) **Lab no.:** 10085 **Borehole/Pit no.:** IP.S2
Description: Alluvium

Depth: 0.5 - 1.0 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	99.7
4.75	99.6
2	99.4
0.425	91.4
0.25	58.8
0.15	39.9
0.075	29.1
0.05	
0.02	
0.005	
0.002	

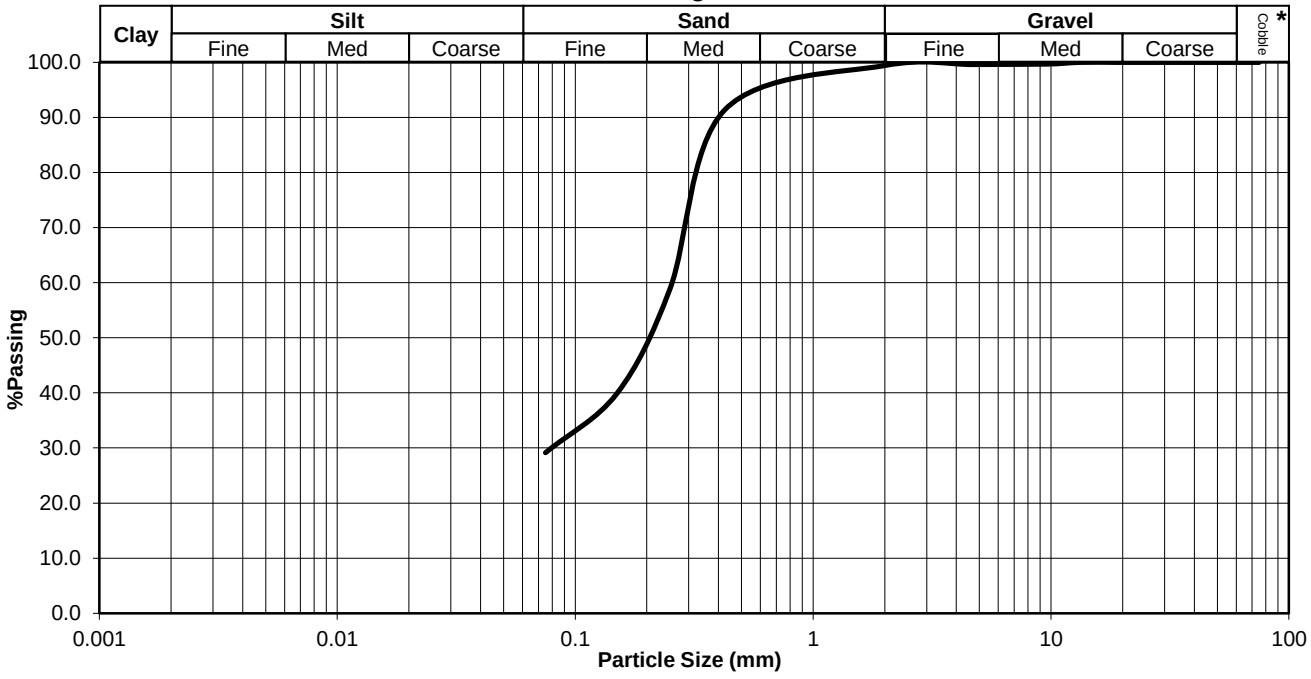
M.I.T SIZE CLASSIFICATION *		
Cobble%		0.0
Gravel%	0.6	
Coarse		0.0
Medium		0.4
Fine		0.2
Sand%	87.8	
Coarse		7.2
Medium		42.9
Fine		37.7
Silt%		
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY	
Liquid Limit	14.8
Plasticity Index	0
Linear Shrinkage	0

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	0.80

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	

Grading Curve



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Project: Sewer Reticulation Inanda Glebe - Ref.8548

Ref no.: 8548(A) **Lab no.:** 10086 **Borehole/Pit no.:** IP.S2

Description: Residual Natal Group

Depth: 1.0 - 1.9

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	100.0
2	99.8
0.425	93.0
0.25	64.9
0.15	48.4
0.075	40.1
0.05	
0.02	
0.005	
0.002	

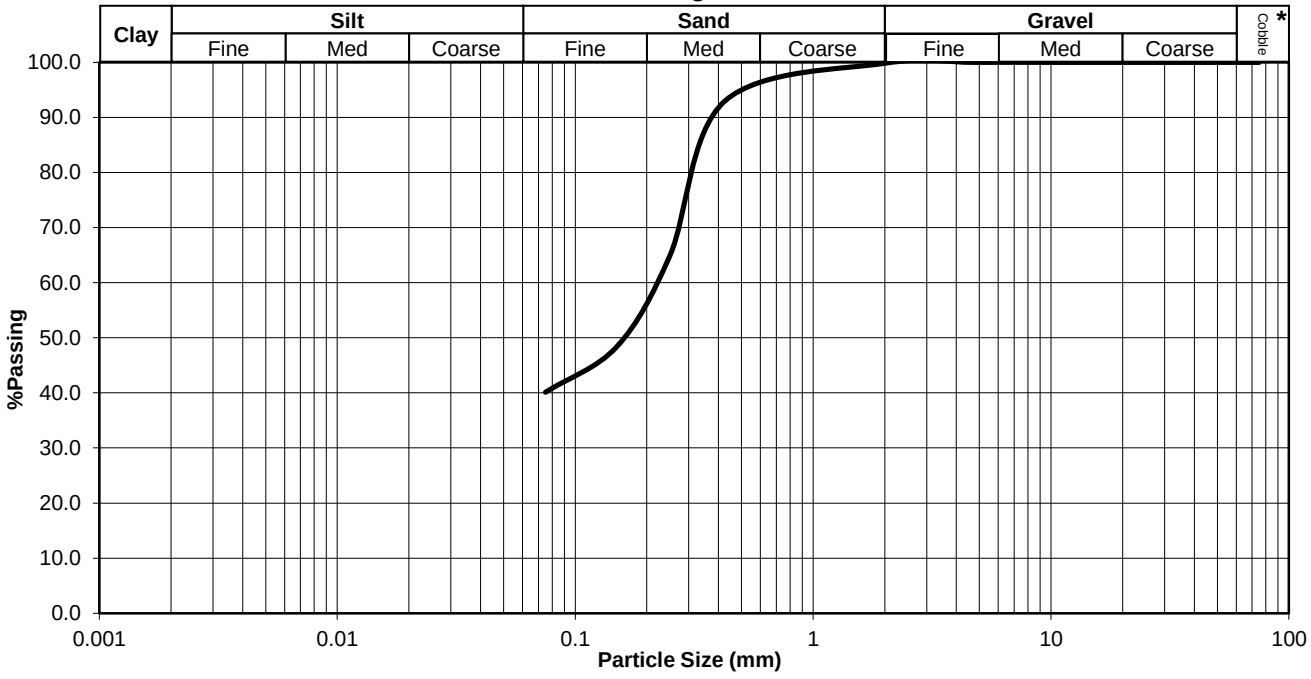
M.I.T SIZE CLASSIFICATION *		
Cobble%		0.0
Gravel%	0.2	
Coarse		0.0
Medium		0.0
Fine		0.2
Sand%	83.8	
Coarse		6.1
Medium		37.0
Fine		40.6
Silt%		
Coarse		
Medium		
Fine		
Clay%		

PLASTICITY	
Liquid Limit	20.4
Plasticity Index	7.9
Linear Shrinkage	2

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	0.67

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 4
Unified Classification	

Grading Curve



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Project: Sewer Reticulation Inanda Glebe - Ref.8548

Ref no.: 8548(A) **Lab no.:** 10087 **Borehole/Pit no.:** IP.11
Description: Colluvium

Depth: 0.5 - 1.4 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	97.8
9.5	94.4
4.75	86.9
2	74.5
0.425	56.5
0.25	48.5
0.15	42.3
0.075	34.8
0.05	
0.02	
0.005	
0.002	

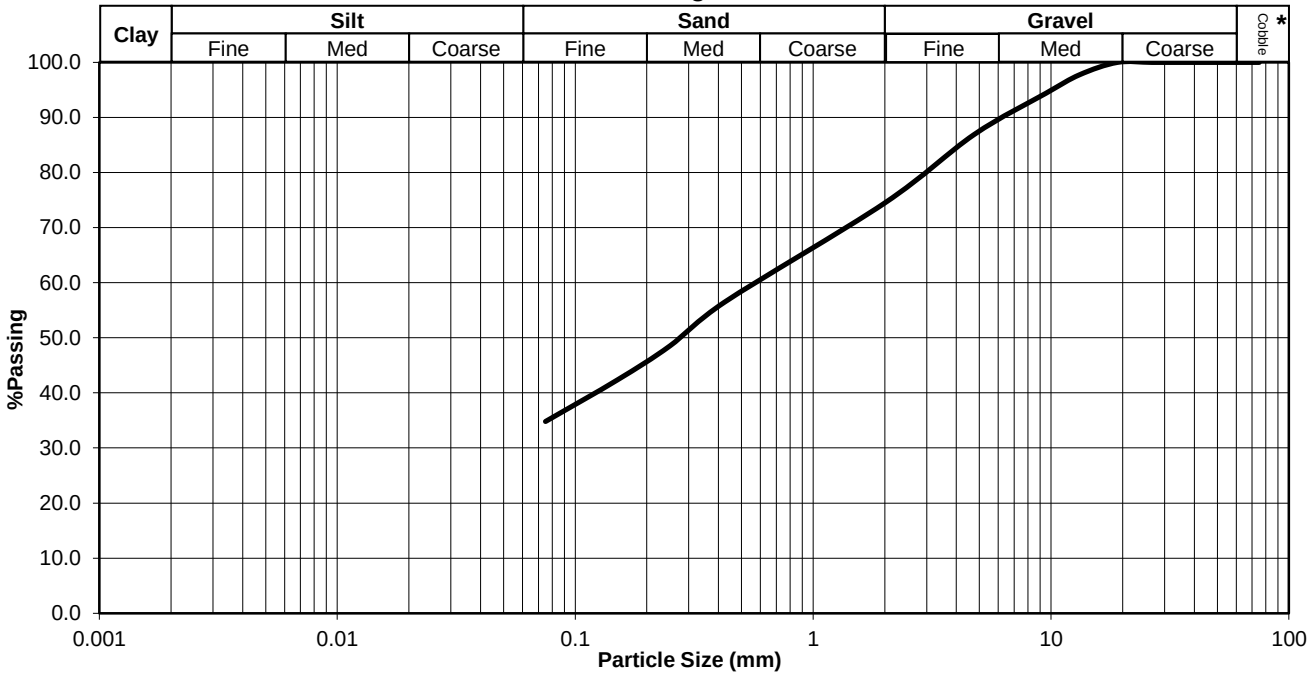
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	25.5
Coarse	0.0
Medium	11.1
Fine	14.4
Sand%	60.6
Coarse	16.0
Medium	13.1
Fine	31.5
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit	21.1
Plasticity Index	5.3
Linear Shrinkage	2

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	1.34

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	

Grading Curve



Ref no.: 8548(A) Fig no.: -

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Project: Sewer Reticulation Inanda Glebe - Ref.8548

Ref no.: 8548(A) **Lab no.:** 10118 **Borehole/Pit no.:** IP.12
Description: Fill

Depth: 0.0 - 1.6 -

Test Methods: TMH1 METHOD A1(a), A2, A3 & A4, ASTMD422

Grading Analysis	
Grain Size (mm)	%Passing
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
13.2	83.4
9.5	81.0
4.75	78.1
2	72.5
0.425	41.3
0.25	32.0
0.15	26.6
0.075	23.1
0.05	
0.02	
0.005	
0.002	

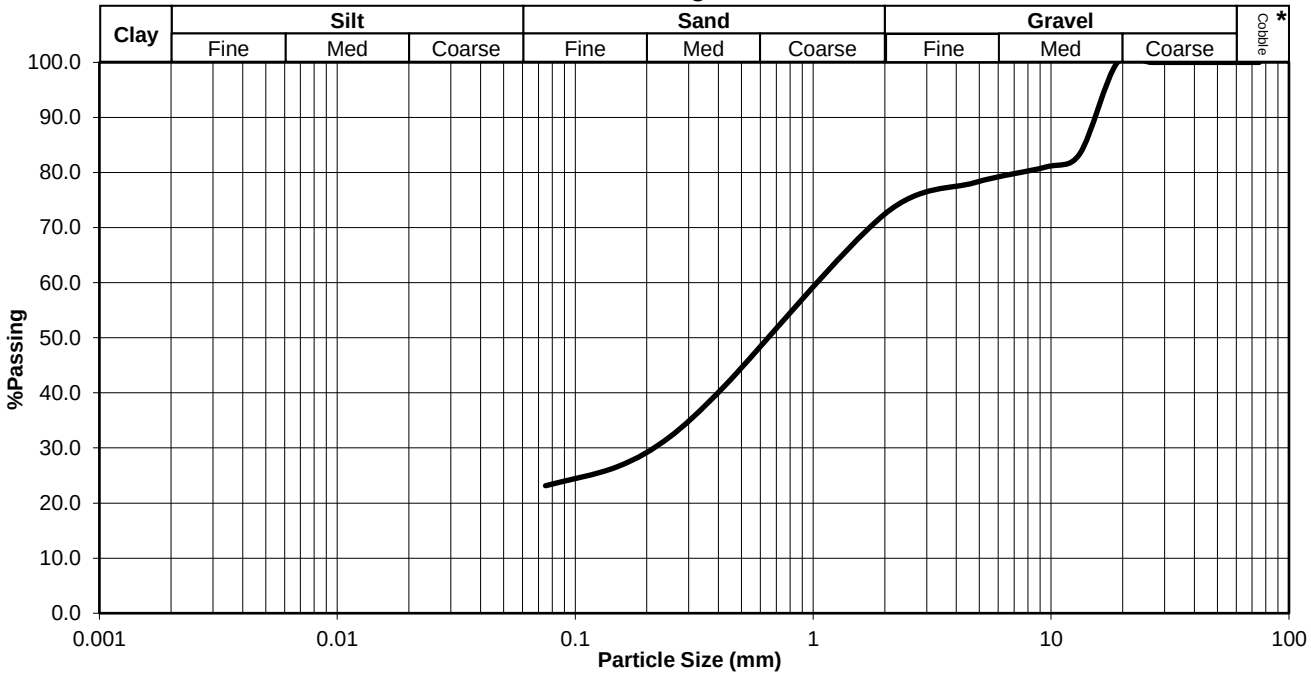
M.I.T SIZE CLASSIFICATION *	
Cobble%	0.0
Gravel%	27.5
Coarse	0.0
Medium	21.1
Fine	6.4
Sand%	63.2
Coarse	27.7
Medium	15.4
Fine	20.0
Silt%	
Coarse	
Medium	
Fine	
Clay%	

PLASTICITY	
Liquid Limit	25.5
Plasticity Index	7.5
Linear Shrinkage	3.3

GRADING	
D10 Size (mm)	
Uniformity Coefficient	
Grading Modulus	1.63

CLASSIFICATION *	
Potential Expansiveness	
Group Index	0
AASHTO Soil Classification	A - 2 - 4
Unified Classification	

Grading Curve



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Appendix F

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

FOR THE CONSTRUCTION OF THE INANDA GLEBE SEWER RETICULATION

[EIA REFERENCE NUMBER: DM/0004/2018]

March 2018

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Acronyms Used	
Acronym	**Definition**
EDTEA	Department of Economic Development, Tourism and Environmental Affairs (Kwa-Zulu Natal)
DW&S	Department of Water and Sanitation
ECO	Environmental Control Officer
EWS	Ethekwini Water and Sanitation
EMP	Environmental Management Plan
I&AP	Interested and Affected Party(ies)
PM	Project Manager

1. INTRODUCTION

1.1. Background Information

1World Consultants (Pty) Ltd has been appointed as the independent Environmental Assessment Practitioner, by eThekwini Water and Sanitation (EWS), to undertake the Basic Assessment Process for the proposed Inanda Glebe Sewer Reticulation Project. This project proposes the construction of a 13km, 160mm diameter, HDuPVC sewer reticulation and numerous 1000mm diameter precast concrete ring manholes, in Inanda Glebe, eThekwini Municipality, KwaZulu-Natal. The purpose of this sewer reticulation project is to upgrade facilities in the area with the aim of eliminating latrines by constructing new waterborne sewage systems.
An Environmental Authorisation DM//0002/2014 in terms of GNR543 of the EIA Regulations 2010 was granted for the Ntuzuma E Sewer Outfall project – the outfall sewer to which this Inanda Glebe reticulation drains. The Client now seeks to link the reticulation system to the abovementioned Ntuzuma E Sewer Outfall project. Upon confirmation with the competent authority (KZN-EDTEA), the project would need to follow a new application process in accordance with the 2017 EIA Regulations. An amendment to the Environmental Authorisation DM//0002/2014 in accordance with the 2014 EIA Regulations is not applicable.

The proposed Inanda Glebe sewer reticulation will connect to the Ntuzuma E outfall. Construction is likely to require the use of an excavator with a rock pecker along the majority of the line. This is due to the fact that shallow bed rock is encountered over much of the area. A minimum working area of 10 m will be required to allow for access and excavation. Where a significant amount of material is required to be stored, this working width is allowed to be modified. For example on steep crossfalls (gradient across the path surface which allows water to flow towards the lower path edge), it will be required to construct a platform for the excavator and construction vehicles. The platforms will tend to be on the low side of the trench, but should not exceed 10m in total, i.e. 3m on one side and 5-7m on lower side. This will generally only be where excavations are deep and or rocky, requiring the use of an excavator.
The projects includes a number of stream/ wetland crossings and in other areas the pipe is likely to be within 32m of a watercourse.

The benefits for constructing the gravity sewers in this area are as follows:

- Existing pit latrines upstream of the sewer can be made redundant.
- The sewer will allow for the development of additional housing with the catchment.

To minimize impact on the environment, the Engineer has confirmed that particular attention, during both the design and construction stages of the project, will be given to the following aspects:

- Manholes will be constructed proud of the ground to prevent sewage overflowing the manhole and to also prevent unwanted ingress of surface water into the sewer pipeline.
- Mixing of concrete for the manhole bases will be allowed only at designated locations which will be cleared up and rehabilitated. All other concrete products for the manholes will be imported from suppliers.
- Local borrow pits will not be required as bedding and will be imported from commercial sources.
- Topsoil will be stockpiled separately for re-use once the trench has been backfilled.
- Soil stripping and surface storm water flows will be monitored to lessen the risk of soil erosion.
- Access for plant will be approved by the engineer prior to construction.
- Construction equipment and vehicles will be checked for good working order and that there are no fuel or oil leaks.

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Table 1: Project Specifications

	Glebe Sewer Reticulation
Ward	44
Property Description	Middle/low income residential
Pipeline Specifications	11km long, 160mm Ø, max of 1200mm trench width, 1m trench depth, 3m construction servitude
Development Final Footprint	Length x breadth = 11 000m long x 3m wide = 33 000m^2

As per GNR 327 and 324 of the EIA Regulations, 2017, a Basic Assessment (BA) Process has been undertaken. All the environmental outcomes, impacts and residual risks of the proposed Listed Activity being applied for have been noted in this BA Report and assessed accordingly by the Environmental Assessment Practitioner (EAP). The requirements of the BA Process have been followed as per Appendix 1 of GNR 326 (2017) and are consequently adhered to in this report.

It must be noted that the Listed Activities in terms of GNR 327 of the 2017 EIA Regulations are applicable to this proposed project and will trigger activities in both the construction and operational phases. This BA Report focuses on the potential impacts that may arise during the construction and operational phases and provides recommended mitigation measures.

Ultimately, the outcome of a BA Process must be to provide the Competent Authority, the Department of Economic Development, Tourism and Environmental Affairs (EDTEA), with sufficient information to provide an informed decision on the Application, in terms of Environmental Authorisation (EA), in order to avoid or mitigate any detrimental impacts that the activity may inflict on the receiving environment.

The proposed construction of the sewer reticulation is located in Glebe which falls within the Inanda area situated in ward 44 of the eThekwini Municipality. Inanda is a township that is found in eastern KwaZulu Natal, approximately 24km from Durban. Inanda occupies an extensive area and is subdivided into smaller townships, such as; Inanda Newtowns A, B and C, Amaoti and Emachobeni. Towns surrounding the study area include Inanada Namibia, approximately 470m away on a north-easterly direction and Ntuzuma E, approximately 1.1km in a south-easterly direction. The study area can be accessed via the M25 in Kwa-Mashu through the settlement of Ntuzuma and along Somiso Road.

The proposed site is approximately 14.5km away from the Indian Ocean. The study area is encompassed by built up residential areas and other privately-owned settlements. Numerous developments within the study area have taken place such as residential housing projects; tar roads and pipeline projects. This has resulted to a major transformation of the terrain within the study area which then gave rise to a diverse array of alien vegetation. Durban Metropolitan Open Space System (D'MOSS) area has been identified to the west of the study site and the Mgeni river is located approximately 1km away from the study site.

The proposed development site can be regarded as greatly transformed, with very little remaining indigenous vegetation that occurs within the area and have been replaced by crop species *(Zea mays, Colocasia esculenta)* and common invasive species usually associated with disturbed KZN areas. The general lack of naturally occurring vegetation is due to the human activity subjected to this local habitat in the form of mass clearing for informal residential areas and subsistence farming found throughout this area. Section K will provide a summary of the specialist findings.

Map 1 below depicts both phase 1 (Ntuzuma E Sewer Outfall) and phase 2 (Inanda Glebe Sewer Reticulation). An A3 copy of the map can be reviewed under **Appendix B of the BAR.** The 21-digit Surveyor General (SG) number for the property affected is provided below. The co-ordinates for the proposed development are also provided in Table 2.

Table 2: Co-ordinates of the proposed development

	Inanda Glebe Sewer Reticulation
Property Description	Informal Residential
GPS Coordinates of the center point of the reticulation	29º 43' 05.25" S; 30º 55' 01.15" E
Surveyor General (SG) Code	
Property	**21-digit SG Code**
Pipe Jacking	NOFT00000001609300000
Stream Crossing 1	NOFT01530000142700000
Stream Crossing 2	NOFT01530000142600000
Property 114	NOFT01530000185500000
Property 83	NOFT01530000148700000
Property 94 (Tie-in)	NOFT01530000148500000
Property 81 (Tie-in)	NOFT01530000152100000

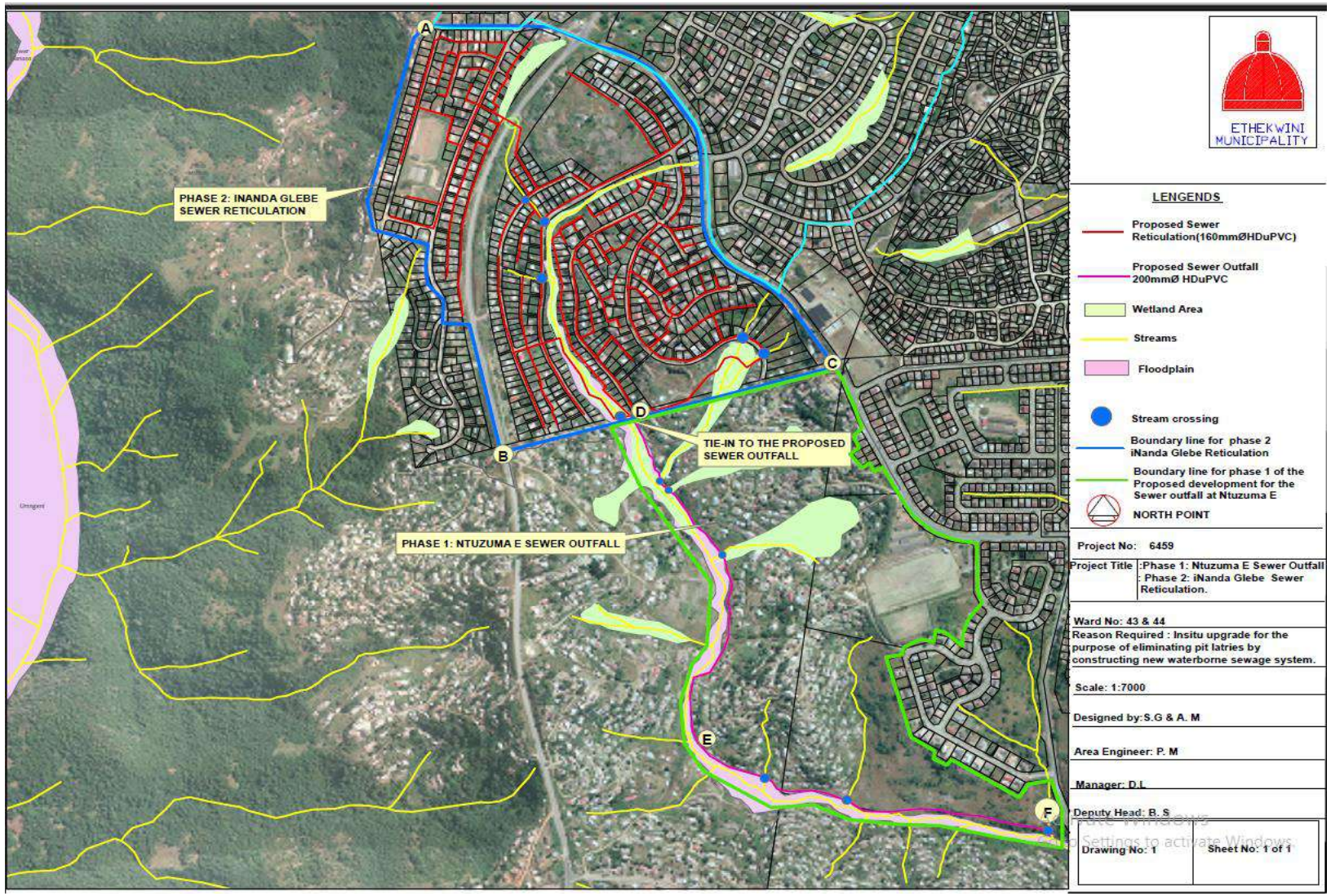

Figure 1: Phase 1 Ntuzuma E Outfall and Phase 2 Inanda Glebe Sewer Reticulation

1.2. Points to Consider

- Wetlands and Watercourses, regarding the impacts of excavating and trenching within a wetland instead of pipe jacking
- Residential Zoning of the Area
    - Motor vehicle and pedestrian traffic impacts in the construction and operational phases must be considered.
    - Nuisance factor must be considered
- Traffic pressures and access
- Soil erosion and stormwater
- Ground water pollution
- Surface water pollution
- Risk of alien invasive encroachment into disturbed areas
- Flora - damage and removal of existing indigenous vegetation
- Fauna - Hunting/ Fishing/ Poaching by construction workers
- Waste and littering around the site
- Noise disturbance
- Air quality
- Public safety and health
- Existing infrastructure disturbance
- Social impacts
- Noise and Disturbance

2. PROJECT RESPONSIBILITIES

The project team will consist of the Project Manager from eThekwini Municipality, the Project Engineer, the Environmental Control Officer (ECO) and the Contractor.

2.1. Project Engineer

The Project Engineer will provide the project specifications of the construction phase. The contractor is legally bound to follow these specifications unless agreed upon by the Engineer. The engineer has the following responsibilities:

- Monitor compliance of the project, following provision of inspection reports provided by the ECO;
- Assess the Contractors performance with regard to compliance and keep records on a monthly basis;
- Facilitate the site handover to the Contractor.

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Contact Person	Nokwanda Buthelezi
Address	03 Prior Road, Durban, 4001
Telephone	031 322 8480
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2.2. Environmental Control Officer

The ECO is responsible for monitoring and reporting that the contractor and applicant are implementing and following the EMP during the construction and operational phases (for the timeframe specified in the conditions of the

environmental authorisation) and to liaise and report to EDTEA. The following will fall within the ECO responsibilities:

- Have a working knowledge of the recommendations and mitigation measures as provided in this EMP and of the permits, authorisations and licenses.
- Conduct monthly audits of the construction site according to the EMP and according to the conditions of the environmental authorisation.
- Provide the contractor with environmental training and a copy of the EMP and ensure in writing that it is understood.
- Liaise regularly with the contractor and project manager.
- Recommend corrective steps for any non-compliance activity on site with respect to the EMP.
- Compile a monthly audit report highlighting compliance and non-compliance with the EMP and submit to EDTEA.
- All agreements between the contractor and the ECO with regard to the EMP will be in writing and co-signed by the Project Manager.
- The ECO will **not** be on site on a daily basis and the Contractor is responsible for implementing the EMP. The Contractor will be provided with a contact number for the ECO.

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2.3. Contractor and Sub-Contractors

The Contractor is responsible for implementing and adhering to the EMP during the construction phase, in all respects as stipulated. Compliance with the EMP by staff during the construction must be ensured by the contractor and this must be recorded by the contractor for audit purposes. The following will be the responsibility of the Contractor:

- Be familiar with the EMP and all conditions of authorisations, licenses and/or permits.
- Supply construction method statement for implementation of the EMP, which includes mitigation measures.
- Attend training provided by the ECO, and relay training to all staff and sub-contractors. Proof of training must be kept on record.
- Maintain an environmental file that must contain the following documents:
    - Company environmental policy
    - Hazardous material handling and storage protocols
    - Spill Contingency Plan
    - Emergency Response Plan and Contact Numbers
    - Waste disposal certificates
    - Servicing of portable toilets

- Maintain an environmental complaint register that must have carbon copies and numbered pages, to record all incidents that occur on site during construction. Incidents include but may not be limited to:
    - Public involvement / complaints

- Occupational health and safety incidents
- Incidents involving hazardous materials and/or equipment on site
- Non-compliance incidents
- Spills into or around watercourses
- Encountering fauna of interest
- Finding archaeological artefacts and/or human remains

- Bear any costs associated with non-compliance and/or damage to the environment as a result of not implementing the EMP or due to negligence.

2.4. Developer (eThekwini Water & Sanitation)

The Developer is legally ultimately responsible for the overall compliance with the conditions of the environmental authorisation, since any authorisation and/or license is in the name of eThekwini Water & Sanitation. The following fall within the responsibilities of the Municipality:

- Be familiar with the recommendations and mitigation measures of the EMP and ensure that the contractor and all staff agree to adhere to it.
- Monitor site activities on an ongoing basis or contract the service out.
- Conduct internal audits of the site.
- Ensure the contractor confines their activities to within the demarcated area.
- Rectify transgressions via communication with the contractor and staff and the ECO.
- Liaise with the ECO with regard to audit reports to be provided to EDTEA.

3. THE ENVIRONMENTAL MANAGEMENT PLAN

The focus of the environmental management plan is to allow installation of the sewer reticulation infrastructure whilst still protecting the environment. Particular reference is given to the following key aims:

- Ensure general protection of the receiving environment via compliance with all applicable laws, protocols and guidelines.
- Ensure that water courses and wetlands are protected.
- Prevent or minimise pollution of the receiving environment.
- Minimise disturbance of the environment and aim to protect flora and fauna.
- Prevent soil erosion and soil degradation.
- Facilitate the rehabilitation of disturbed areas.
- Restrict the nuisance factor by providing protocols for staff and/or vehicles.

Damage to water courses, vegetation, animal life, surroundings roads (by construction vehicles), etc. may result from the proposed construction activities. Chemicals such as paints, sealants, coatings, adhesives and solvents may contaminate the soils, groundwater and watercourses should proper procedure not be followed.

3.1. Objectives of the EMP

The objectives of the EMP are to:

- Ensure compliance with local, provincial, national and/or international regulations, standards and guidelines,

relating to the protection of the environment.

- Clarify roles and responsibilities of the team members.
- Identify measures of mitigating any potential negative impacts thereby reducing or eliminating them.
- Provide detail on specific actions required for minimising negative impacts and provide tools or methods for monitoring the effectiveness of mitigation measures.
- Optimise positive impacts to maximise the benefit thereof.
- Provide management of concerns/complaints from I&AP's.
- Provide monitoring and auditing processes during all phases of the development.
- Provide methods of compliance monitoring and reporting of the monitoring.
- Provide waste management, recycling and re-use strategies.

3.2. Environmental Monitoring

A monitoring program to ensure compliance with the EMP will be implemented for the duration of the proposed construction. The program will include the following:

- Monthly site visits and audits (subject to the conditions of any environmental authorisation or license) which will be conducted by the Environmental Control Officer (ECO) to ensure compliance to the final EMP.
- Provide corrective recommendations to rectify any non-compliance.
- Compilation and submission of audit reports to EDTEA providing rating of compliance with the EMP. Any evidence of damage to areas outside the construction zone will be recorded via photographs as well as a record of the date and time of damage, type of damage and reason for damage. The contractor will be liable for damages should it have resulted from non-compliance to the EMP.
- A register of complaints from I&AP's will be opened and maintained. Complaints and concerns must be responded to immediately.

Note – The EMP has been prepared during pre-construction and must be regarded as a working document that may be updated if and when necessary. Any amendments made to the proposed construction must be submitted to the Competent Authority as an amendment to the authorisation for approval before being implemented.

3.3. Compliance with the EMP

The EMP specifies the requirements to be implemented by the developer in order to minimise and manage any potential environmental impacts. The provisions of this EMP will be legally binding to eThekwini Water and Sanitation or any authority to whom responsibility has been delegated to, for the proposed development, for the duration of the construction phase.

The EMP is legally binding to the contractors/sub-contractor(s) and must be included in the Contractual Clauses. A copy of the approved EMP must be kept on site during construction and operation. In terms of the Environmental Conservation Act and the National Environmental Management Act, those parties responsible for damage to the environment must pay the costs to repair and compensate for environmental and/or human health as well as for preventative measures to avoid or reduce further damage. The Contractor must make provisions in the budget for implementation of the EMP.

Non-compliances may result in the application of penalty(ies) following non-compliance after a written warning by the ECO. Failure to rectify non-compliances within one (1) week of the issue OR a repeat offense will result in a fine issued by the ECO.

The following rates will apply for issuing of fines:

Table 3: Fine Rates to be Applied

Offense	Fine Amount
Failure to demarcate working areas	R 1 000
Working or trespassing outside of the demarcated areas	R 3 000
Failure to strip topsoil with intact vegetation	R 5 000
Failure to stockpile topsoil correctly	R 3 000
Failure to stockpile materials in designated areas	R 1 000
Failure to implement dust suppression actions	R 1 000
Washing of vehicles on site	R 1 000
Pollution of surface or ground water	R 2 000
Failure to implement stormwater management plans	R 2 000
Failure to control stormwater runoff	R 3 000
Soil erosion	R 3 000
Failure to provide adequate sanitation	R 1 000
Failure to erect temporary fencing around trenches	R 1 000
Failure to provide adequate waste disposal facilities and services	R 5 000
Failure to re-instate disturbed areas within a specified time frame	R 3 000
Removal of protected flora without a permit to do so	Specified by DAFF
Any non-compliance of the project specifications	R 1 000

The fines will be paid by the Contractor to the Developer to be utilised in the landscaping and/or rehabilitation of the site.

3.4. Layout of the EMP

The EMP is presented in two phases namely, the construction phase and the rehabilitation phase of the water infrastructure. Each phase has specific mitigation measures that address potential impacts which may be unique to that phase.

- Design and Construction Phase – This phase includes pre-construction activities including the site handover, site establishment, environmental training and access routing. The specifications of all mitigation measures, the responsibilities and the procedures for this phase must form part of the contract documentation. Hence, the relevant personnel will be required to comply with this phase of the EMP.
- Rehabilitation Phase – This phase of the EMP provides for the removal of the contractor's camp, rehabilitation of the site and any disturbed areas and handover to the Client.

3.5. Training

Contractors and workers must receive basic training in environmental awareness i.e. minimisation of impacts to sensitive elements, waste management, water pollution and the requirements of the EMP.

3.6. Implementation of EMP by Contractor

The contractor must ensure that the EMP is implemented and complied with at all times. Should clarity be required the contractor must contact the ECO for advice. The ECO must provide the contractor with contact details.

3.7. Environmental File

The Environmental File comprises the following documents and must be kept on site in order to record compliance:

- Copy of any Environmental Authorisation, licenses, permits, Stormwater Management Plan, and the approved Final EMP.
- Supply construction method statement for implementation of the EMP, which includes mitigation measures.
- Record of complaints from I&AP's capturing the time, date, location and nature of complaint as well as the actions taken and by whom. The complaints register must have carbon copy pages and numbered pages.
- Emergency Response Plan and Record of emergencies and incidents.
- Spill Contingency Plans.
- Proof of Training.
- Emergency contacts and numbers.
- Material Safety Data Sheets for any hazardous substances.
- Dust suppression records.
- Written corrective action instructions provided by the ECO (including emails).
- Any Non-Conformance Reports (NCR) that have been issued to the contractor and/or sub-contractor(s). A Non-Conformance follows non-compliance to rectifying a problem area and must be reported to the Competent Authorities. A Non-Conformance Report typically contains the following information:
    - Details on the non-conformance;
    - Any plant or equipment involved;
    - Any chemicals or hazardous substances involved;
    - Details on the non-conforming action;
    - Nature of associated risk(s);
    - Corrective actions to rectify non-conformance, as agreed by all parties concerned;
    - Timeframes for corrective measures to be implemented;
    - Record of compliance by corrective actions, as verified by the ECO.

3.8. Environmental Emergency Response Plan

The Contractor is responsible for preparing an Environmental Emergency Response Plan. This is to exhibit the Contractors ability to respond appropriately to incidents that may have detrimental impacts on the environment. Such incidents include the following among others:

- Accidental spillage of hazardous substances (oil, fuels, sewage, etc.);
- Accidental toxic air emissions;
- Accidental discharges to watercourses and onto land;
- Specific impacts from accidental incidents, e.g. mass death of fish, etc.

The emergency response plan must include for the following:

- Provide actions to be taken in the event of an emergency, in the appropriate logical sequence of events;

- Emergency contact numbers;
- Roles of designated emergency response team members from the contractor's team;
- Incident recording;
- Remediation measures to be implemented;
- Information on hazardous substances, plant and equipment, including warnings and potential risks;
- Proof of emergency response training, including proof of emergency preparedness, as per legal requirements.

3.9. Method Statements

Beside the emergency response plan, the Contractor must provide the following method statements in the environmental file:

- Construction site establishment, including buffer establishment in the wetland section(s),
- Excavations and trenching (especially with regard to sections within wetland(s))
- Dust suppression;
- Cement mixing/concrete batching,
- Contaminated/used water,
- Erosion control and stormwater management,
- Storage, handling and decanting of fuel (diesel) and other hazardous substances,
- Bunding
- Project management including training,
- Personnel and public safety,
- Protection of fauna and flora,
- Rehabilitation of disturbed areas,
- Solid and liquid waste management,
- Top soil management including storage and re-use,
- Sourcing and Storage of materials,
- Rest and Wash areas, including toilets
- Interaction with public and stakeholders
- Site closure plans and steps
- Implementation of the wetland rehabilitation plan

4. RELEVANT LEGISLATION

4.1. Applicable Legislation and Guidelines

In terms of the Environmental Impact Assessment (EIA) Regulations (2017), promulgated in terms of the National Environmental Management Act, 1998 (NEMA), certain Listed Activities are specified for which either a Basic Assessment (GNR 327 and 324) or a full Scoping and EIA (GNR 325) is required. The following Listed Activity in Government Notice (GN) R 327 (Listing Notice 1) are triggered, requiring a Basic Assessment (BA) Process for the proposed construction of the Inanda Glebe Sewer Reticulation.

The EMP presented covers activities authorised by the competent authority (EDTEA) only. Activities not approved must be submitted for environmental authorisation, before commencement. Should the impacts identified in the BAR be more

significant than assessed, the environmental management plan must be reviewed; and updated if necessary. The EMP is not independent of the BAR, therefore both must be read in conjunction with each other.

Table 4: Relevant Activities from EIA Regulations, 2017.

Regulation Year	Listing Activity NEMA	Description of Activity	Applicability to the Project
2017	LN 1; Activity 19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.	The pipeline will cross the HGM 2 and HGM 3 identified on site. A total of 228.38m^3 of soil will be excavated.

The draft environmental management plan is submitted and is subject to approval by the Department of Economic Development, Tourism and Environmental Affairs. The environmental management plan is formulated to include only those aspects pertaining to the environmental authorisation. It may not have taken all the necessary legislation and regulations, pertaining to the actual development activities. The appointed project manager and/or developer must ensure adherence to the necessary legal requirements.

Examples of such legislation or regulations, amongst others, include:

- The Constitution (1996)
- Labour Relations Act (1995)
- National Building Regulations and Building Standards Act (1977)
- Health Act (1977)
- National Water Act (1998)
- Occupational Health and Safety Act (1994)
- National public health and food hygiene regulations
- National Water Act 1998 (Act 36 of 1998)

The EMP covers legislative requirements derived from the following:

- National Environmental Management Act (2014)
- National Water Act
- National Environment Management Act: Biodiversity Act

5. DESIGN AND PRE-CONSTRUCTION PHASES

The design and pre-construction phases include all activities that are required to render the project ready to begin construction.

5.1. Authorisations, Permits, Licenses:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
All legally required authorisations, permits and licenses must be obtained prior to commencement of construction.	Developer	Once
The Developer must appoint an EAP and/or ECO	Developer	Once
All I&AP's and stakeholders must be notified prior to commencement of construction	Developer/Contractor	Once

5.2. Appointment of Contractor:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
An experience and suitably qualified contractor must be appointed	Developer/Engineer	Once
The EMP must form part of the contractual agreements with any Contractor which must include any Sub-Contractor(s). The Contractor must take cognisance of this when budgeting during the tender process.	Developer	Once
The Contractor must comply fully with the authorisations, permits and licenses pertaining to the construction phase of the project.	Developer/Contractor	Once
Tender documents must allow for the employment of local community members.	Developer/Contractor	Once
The Contractor must provide Method Statements pertaining to implementation of the EMP, emergency response plans, stormwater management, hazardous substance handling and storage, spill contingency plans, environmental incidents records file and complaints register.	Developer/Contractor	Once
The Method Statements must be submitted to the ECO for record keeping.	Developer/Contractor	Once

5.3. Appointment of ECO:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
An independent ECO must be appointed to monitor the implementation of the EMP	Developer	Once
The Appointed ECO must monitor the project from an environmental perspective, as per the conditions of any authorisations, permits and licenses and according to the EMP. The findings of each inspection must be documented in a monthly report.	ECO	Monthly or as specified in the Environmental Authorisation

5.4. Environmental Training:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
The Contractor must receive environmental training to adequately implement the EMP.	Developer/ECO	Once
The Contractor must relay training received to all staff and sub-contractors, in a language easily understandable to them. All contractor's representatives, sub-contractors and staff must acknowledge receipt of training in writing.	Contractor/SHE Officer/ECO	
Toolbox sessions must be scheduled and must include refreshers on environmental responsibilities.	Contractor/SHE Officer	

5.5. Environmental Planning and Design:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**

The site and/or route must be confirmed to be within servitudes or not. If not within servitudes, the environment must be closely examined for sensitive elements in terms of flora and fauna.	Developer/ ECO	Once
Any erosion control measures must be incorporated, by the engineer, into the design of the water infrastructure. These may be sandbags, hessian sheets, retention or replacement of vegetation, gabion walls, etc.	Engineer	Once
Records of relocated flora and fauna must be kept.	Contractor/ ECO	Once
A set of "before" photographs must be captured for record keeping purposes and to monitor any degradation of the environment.	Contractor/ ECO	Once
Ensure Stormwater Management Measures are in place.	Contractor	Monthly or as specified in the Environmental Authorisation

5.6. Environmental Education and Training:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
All site personnel must have a basic level environmental awareness training session. Topics covered must include: o What is meant by "The Environment" and the "wetland"? o Why the environment/wetland needs to be protected and conserved? o How construction activities can impact on the environment/wetland? o What can be done to mitigate against such impacts? o Awareness of emergency and spill response provisions. o Social responsibility during construction of the pipeline e.g. being considerate of the local community who share the roads.	ECO	Once

The ECO must provide training to the Contractor's representatives. It is the Contractors responsibility to provide the site foremen with environmental training and to ensure that the foremen have sufficient understanding to pass this information onto the construction staff. Translators may be used to ensure training is thorough.	ECO/ Contractor	Once
Training by the contractor must be provided to the staff members in the use of the appropriate firefighting equipment.	Contractor	Weekly/ monthly
Environmental awareness posters on site may be used to further facilitate compliance to the EMP.	Contractor	Weekly/ monthly
The need for a clean site policy must be explained to the workers. This includes prohibiting sanitation activities outside of the ablution facilities and toilets provided by the Contractor.	Contractor	Weekly
Staff operating equipment (e.g. loaders, excavators, etc.) must be adequately trained and sensitized to any potential hazards associated with their tasks.	Contractor	Weekly/ Monthly
Although the Contractor is responsible for ensuring that the environmental awareness training of staff members is put in place, it must be the direct responsibility of the appointed ECO to carry out the training. Each staff member must sign a register confirming their attendance at this training. This register must be included in the site Environmental file.	ECO	Once
The contractor must monitor the performance of the workers to ensure that the training was properly understood and is being followed.	Contractor	Weekly
The ECO must monitor the construction phase periodically to ascertain if training was effective.	ECO	Monthly

6. CONSTRUCTION PHASE

The construction phase includes all activities on the site that are required to render the sewer reticulation operational. Environmental training must be provided to the contractor before commencement of construction activities.

Clearing of Vegetation and Earthworks:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
All NEMBA category 1a and 1b invasive alien plant species should be removed and disposed of appropriately prior to the sewer reticulation upgrade. The sewer reticulation upgrade sites should be inspected regularly to identify and remove emerging IAP species.	Contractor/ ECO	Ongoing
Where possible the existing vegetation along the pipeline route should be carefully removed and stored for replacement after the pipeline has been laid and backfill process completed.	Contractor/ ECO	Ongoing
Care should be taken not to remove indigenous vegetation unnecessarily from the sensitive wetland areas and their associated buffers during all phases of construction.	Contractor/ ECO	Ongoing
The removal of alien vegetation should be undertaken manually by hand near sensitive areas. The use of heavy machinery should be kept to minimum near sensitive environments.	Contractor/ ECO	Ongoing
Fauna found within the sewer reticulation upgrade zones should be moved to the closest natural or semi-natural habitat zone away from any human induced anthropogenic activities.	Contractor/ ECO	Ongoing
Rocks and excess soil to be reused as building material if/where possible. Any work undertaken must follow good civil engineering practices. Topsoil must be stripped and stockpiled for later re-use. All stock piles must be covered with suitable material to prevent loss of sediment via wind/ water. Stockpiling of soil etc. must not be on or near slopes and water courses.	Contractor	Ongoing
Unless otherwise permitted in writing by the Engineer, not more than 200m of trench in any one place and not more than 500m in total shall be opened in advance of the pipe laying operation.	Contractor	Ongoing

All trenching is to be adequately barricaded to protect vehicles, pedestrians, pets and livestock.	Contractor	Ongoing
No excavations must be left open over weekends and public holidays unless properly protected.	Contractor	Ongoing
Only orange barricade netting is allowed to barricade open trenches. Open trenches must be barricaded and maintained at all times.	Contractor	Ongoing
All removed vegetation must be completely cleared from the site. Vegetation and/or vegetation waste must not be burned.	Contractor	Ongoing
Employees, contractors, etc. must be made aware of no-go areas (which would include neighbouring properties), and boundaries of the activity site. Chevron tape must be used to aid in this regard.	Contractor	Ongoing
Although not directly related to overall stability, slumping and erosion of some areas of the cut and fill banks can be expected during wet weather. This must be minimised by specific treatment of the finishing of the bank slopes.	Contractor	Ongoing

Loss of Biodiversity:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
With the correct supervision and implementation, it should be possible to ensure that these areas remain undisturbed by the works.	Contractor/ECO	Ongoing
Disturbance and habitat loss must be kept to a minimum.	Contractor/ECO	Ongoing
All trenches must be clearly demarcated and barricaded on site at all times.	Contractor/ECO	Ongoing
Care must be taken to keep soils stabilized when removing vegetation during construction and as part of alien plant eradication and strict on-site soil erosion measure must be implemented.	Contractor/ECO	Ongoing
Topsoil must be stockpiled for eventual return during top soil back-filling and rehabilitation. These must be weed free and must not stand for a prolonged period of time.	Contractor	Once
Sub-soil and topsoil must be stored separately onsite.	Contractor	Once
Care must be taken to prevent the contamination of ground water with accidental fuel and oil spills from earth-moving and construction equipment and vehicles. Adequate usage of drip trays and bunded storage zone must be implemented on site.	Contractor	Ongoing
Trenched must have one sloped side to allow animals which fall in to get out.	Contractor	Ongoing

Trenches must be checked daily while open for animals which may be unable to get out	Contractor	Ongoing
Any animals found must be returned uninjured to suitable safe habitat.	Contractor	Ongoing
Hunting and trapping of any animals by staff must be prevented. This includes reptiles which must be handled by a professional	Contractor	Ongoing
A pre-construction walk-through must be implemented by the ECO at the crossing points in the wetland and river areas before excavation takes place on site. This will be used to identify any species of conservation importance that may have occupied the site after the compilation of this report.	ECO	Once
Should any species be found that are protected, either provincially or Nationally, the correct permit should be applied for in advance and the conditions of those permits should be followed to prevent or offset impacts during construction.	Contractor/ECO	Ongoing
Alien invasive plant eradication plan must be implemented on an ongoing basis to limit the establishment of exotic species during the rehabilitation of the disturbed areas.	ECO	Ongoing
The ECO must supply the Contractor with list a list of problematic alien invasive plant species that are likely to occupy the site during construction.	ECO	Once
Regular Environmental Toolbox Talks must be implemented by the Contractor on site	Contractor	Ongoing
Noise levels including vibrations caused by drilling must be kept to a minimum to prevent animals abandoning nearby habitats.	Contractor	Ongoing

Erosion		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Minimise the extent of disturbance in high risk areas. This is probably best achieved through hand excavation and backfilling of trenches. Otherwise strict control and use of the smallest machines possible should occur.	Contractor	Ongoing
Ensure that work progresses, and trenches are backfilled rapidly. The opening of small sections of trench at any one time should help to ensure that this occurs.	Contractor	Ongoing
Ensure that work occurs during dry periods and that appropriate erosion protection (geo-jute, berms, etc.) is used to protect the works during wet periods.	Contractor	Ongoing

Soil management and rehabilitation is also important in order to ensure that vegetative cover establishes over the backfill led trench/ disturbed areas as rapidly as possible.	Contractor/ ECO	Ongoing
Should any species be found that are protected, either provincially or Nationally, the correct permit should be applied for in advance and the conditions of those permits should be followed to prevent or offset impacts during construction.	ECO	Ongoing

Wetland Crossing:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Soil stockpiles must be protected from erosion, surrounded by suitable earthen buns and covered by erosion control blanket to prevent the transfer of sediment into HGM 1 and RR 1.	Contractor/ ECO	Ongoing
It is recommended sewer reticulation pipeline route to be adjusted slightly away from HGM 1 and RR 1 which will in turn eliminate impacts on these systems.	Contractor	Once
Trenching, refill and backfill must take cognizance of maintaining the hydrological flow regime of the HGM 1 and RR 1.	Contractor	Ongoing
All banks or slopes should be profiled to maintain to the geomorphological integrity of the HGM unit (HGM 1).	Contractor	Ongoing
Disturbed wetland areas should be re-vegetated immediately after construction has been undertaken with wetland vegetation indigenous to the area.	ECO	Once
Access to floodplain must be strictly controlled.	Contractor	Ongoing
Empty vessels must not be left behind and must be removed as soon as possible to minimise pollution of the soils and water.	Contractor	Ongoing
Mixing of cement must not be done in the flood plain. No cement batching activities must take place near the water course and wetland	Contractor	Ongoing

areas.		
Water from the river must not be used for mixing and mixing must be done on an impervious structure e.g. in a wheelbarrow. Any spillage of concrete must be cleaned immediately and care must be taken to avoid spillage.	Contractor	Ongoing

Traffic and Access Control:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Construction vehicles and personnel must adhere to business hours. This may be relaxed to accommodate abnormal vehicles so that they do not hinder daily life and/or regular traffic.	Contractor	Once
Pointsmen to guide traffic for entry and exit of construction vehicles must be used. Signage for presence of construction vehicles must be erected.	ECO	Monthly
Construction phase must be as short as possible. Reliable building contractors must be employed.	Contractor/ Engineer/ECO	Monthly or as specified in the Environmental Authorisation
The site must be wet regularly to minimise dust. Vegetation must be removed as and where required only.	Contractor/ ECO	Once
Vehicles must park on demarcated site only.	Contractor	Ongoing
Contractors will access portions of land that are fenced off, by removing these fences and re-instating them at cost to the project, upon completion of works within that area.	Contractor/ ECO	Ongoing

Hydrological Impacts:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**

Excavation and construction should take place during the dry season.	Contractor	Ongoing
The movement of soil should only take place twice, to remove and replace the soil.	Contractor	Once
During installation, the excavated soil from the trench should be placed on the upslope side of the trench, minimizing the risk of excess sediment entering the freshwater ecosystems.	Contractor	Once
The soil profile should be restored to the natural structure with topsoil and subsoil being replaced in sequence.	Contractor	Ongoing
The backfill within the trench should be compacted to a similar permeability of the surrounding soils.	Contractor	Ongoing
The compaction of soil caused by vehicles and machinery should be reversed.	Contractor	Once
Transplanting of plants within the freshwater ecosystems to re-vegetate the in-filled trench.	ECO	Once
The crossings should be rehabilitated to ensure that no barriers exist within the stream and that in-stream habitat is similar to the current situation.	Contractor/ ECO	Once

Pollution due to site operations:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Careful storage and handling of materials such as fuels, paints and chemicals to minimize the risk of spillage onto open ground or into surface water systems. All potentially polluting materials should be stored in closed containers away from sensitive areas.	Contractor/ ECO	Ongoing
Storage areas that contain hazardous substances must be bunded with an appropriate impermeable material.	Contractor/ ECO	Ongoing
Spills in bunded areas must be cleaned up, removed and disposed of safely from the bunded area as soon as after detection as possible.	Contractor/ ECO	Ongoing
Mixing/ decanting of all chemicals and hazardous substances including concrete and asphalt must take place either on a tray or on an impermeable surface away from sensitive areas. Waste from these should then be disposed of to a suitable waste site.	Contractor/ ECO	Ongoing
Bins and/ or skips should be provided at convenient intervals for disposal of waste within the construction area. These shall be regularly emptied. Bins should have liner bags for efficient control and safe disposal of waste. Recycling should be facilitated and encouraged.	Contractor/ ECO	Ongoing

Littering on site should be prohibited and the site should be cleared of litter at the end of each day.		
Where waterborne sewerage is not available, temporary chemical toilets must be provided by a company that is approved by the Municipality/ Engineer/ Environmental Consultant. These shall be maintained in a clean state by a registered chemical waste company. These must be located within the Contractors camp and on site as agreed by the Municipality/ Engineer/ Environmental Consultant. The construction of 'long drop' toilets is forbidden.	Contractor/ ECO	Ongoing
Provision should be made during set up for all polluted runoff to be treated to the Department of Water Affair's/ Municipality's/ Engineer's/ Environmental Consultant's approval before being discharged into the stormwater/ surface water system.	Contractor/ ECO	Once
A spill contingency plan must be prepared for the construction phase.	ECO	Once
The responsibility rests with the applicant to identify any sources or potential sources of pollution from his undertaking and to take appropriate measures to prevent any pollution of the environment.	Applicant	Ongoing

Noise and Dust:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Construction operations and deliveries should be restricted to normal working hours. When works are to be undertaken within residential properties, o The extent and timing of the works shall be agreed with the property owner/ resident; o Photographic records shall be prepared by the contractor pre-construction detailing the condition of the site prior to the works progress and mitigation measures weekly/ monthly; o All necessary measures shall be in place to ensure that the property is secure; o A supervisor shall be on the property during all work to supervise workers; o Rehabilitation works shall be undertaken as quickly as possible to the same standard as existing finishes/ planting prior to disturbance by the workers.	Contractor	Ongoing
People from adjacent areas should be kept informed of the need and extent of noisy disruptive processes, particularly blasting activities.	Contractor	Ongoing
The contractor should ensure that plant where appropriate is fitted with properly functioning silencers.	Contractor	Ongoing
The Contractor's camp is to be located in a suitable location outside the residential area and approved by the Municipality.	Contractor	Ongoing

Air Pollution:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Damping down of exposed soil areas, to reduce dust pollution.	Contractor	Ongoing
No fires should be permitted.	Contractor	Ongoing
Limit stripping of vegetation and existing material to necessary working areas.	Contractor	Ongoing
Vehicles and machinery must be kept in good working order to limit emissions and oil spillage.	Contractor	Ongoing
Chemical toilets shall be used for the workforce.	Contractor	Ongoing
Toilets, cooking areas and waste collection areas must be located away from houses.	Contractor	Ongoing

Visual Impacts:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
The site must be well maintained and neat.	Contractor	Ongoing
The contractor must adhere to project schedule in order to minimise the length of the construction period.	Contractor	Ongoing
Inspections of the site by an Environmental Control Officer are required.	ECO	Ongoing
Upon completion of the repair and maintenance activities undertaken during the operational phase, the site must be well maintained and neat.	Contractor	Ongoing
The contractor tasked with the maintenance of the pipeline must adhere to project schedule in order to minimise the length of the maintenance and repair period.	Contractor	Ongoing

Waste and Litter:

ACTIONS AND MITIGATION MEASURES	RESPONSIBLE PERSON(S)	MONITORING FREQUENCY
No dumping of any materials or storage of any equipment should be allowed within the wetland areas.	Contractor	Ongoing
Waste must be separated especially with regard to hazardous waste. This would include soils that have been contaminated by cement, fuel, paints, etc. Care must be taken to avoid contamination of soils.	Contractor	Ongoing
Personnel must be trained in etiquette regarding littering and waste management.	Contractor	Ongoing
Appropriate scavenger proof vessels for wastes must be provided in suitable locations and must be adequate in number.	Contractor	Ongoing
A waste storage area must be allocated and adhered to.	ECO	Ongoing
Waste must be disposed of at registered landfill sites or appropriate facilities. Proof of disposal must be provided when requested.	ECO	Ongoing
Staff must have a system of housekeeping to ensure litter is minimised.	ECO	Ongoing

Damage to existing services:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Check the location of all underground and above ground services as well as working requirements with all service providers prior to commencing excavation.	Contractor	Ongoing
Proving the location of all underground service prior to trench excavation.	Contractor	Ongoing
Working in accordance with service providers requirements adjacent to their service runs.	Contractor	Ongoing
Should damage to service runs occur, taking all necessary measures to minimize damage, inform the relevant service provider immediately and undertake all necessary remedial work including the employment of specialist contractors in order to minimize disruption of the service.	Contractor	Ongoing

Injury to local people and construction workers:

ACTIONS AND MITIGATION MEASURES	RESPONSIBLE PERSON(S)	MONITORING FREQUENCY
Residents must be made aware of the works.	ECO/ EAP	Once
Trenches must not be left open and unmarked.	Contractor	Ongoing
Supervisors are to be vigilant particularly of children who may come close to the construction works without realizing the danger to themselves.	Contractor	Ongoing
Appropriate barricades and signs must be used where necessary.	Contractor/ ECO	Ongoing
All relevant Health and Safety legislation as required in South Africa should be strictly adhered to. This includes the Occupational Health and Safety Act.	Contractor/ ECO	Ongoing
Implementation of safety measures and work procedures.	ECO	Ongoing
The most dangerous operations are likely to be the operation of heavy machinery and plant and blasting. Mitigation should ensure that all plant and machinery is properly maintained and is operated in accordance with safety requirements and manufacturer's recommendations.	Contractor	Ongoing
The engineer shall have the right to order the immediate removal from the site of any plant which he may deem to be unsatisfactory for the proper execution of the work.	Engineer	Ongoing
All relevant Health and Safety legislation as required in South Africa should be strictly adhered to. This includes the Occupational Health and Safety Act. This is particularly important during blasting operations.	Contractor/ ECO	Ongoing
Fire safety measures must be included in the design of the facility. Fire safety equipment must be provided on site during construction.	ECO	Ongoing
First aid kits are required on site as well as an incident records file.	ECO	Ongoing
Construction related vehicles must adhere to speed limits of the surrounding roads and a limit of 20km/hr on site.	Contractor	Ongoing
Safety gear including hard hats and safety shoes must be provided and worn at all times while on site.	Contractor/ ECO	Ongoing
Emergency numbers must be clearly visible on site.	Contractor/ ECO	Ongoing
Trespassing and/or utilising the site as a thorough fare is prohibited by unauthorised persons.	Contractor	Ongoing
Contractor staff are prohibited from trespassing over the site boundaries.	Contractor	Ongoing

Interaction with neighbours and objecting parties at the site must be well documented. A complaints register must be readily available on site. Interaction with external parties must be courteous.	Contractor/ ECO	Ongoing

Disturbance to existing infrastructure and impact on heritage resources:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Stakeholders must be notified as soon as possible. This includes the community, the municipalities, the service providers and ward councillor.	ECO	Ongoing
Servitudes of infrastructure must be confirmed prior to design of the development and permission granted.	ECO	Once
No-Go areas must be demarcated. This would include any known existing grave sites.	Contractor/ ECO	Ongoing
For any chance finds, all work must cease in the area affected and the Contractor must immediately inform the Project Manager. A registered heritage specialist must be called to site for inspection. The relevant heritage resource agency (AMAFA) must also be informed about the finding. The heritage specialist will assess the significance of the resource and provide guidance on the way forward.	Contractor	Ongoing
Permits to be obtained from AMAFA if heritage resources are to be removed, destroyed or altered.	ECO	Ongoing
All heritage resources found in close proximity to the construction area to be protected by a 10m buffer in which no construction can take place. The buffer material (danger tape, fencing, etc.) must be highly visible to construction crews.	Contractor/ ECO	Ongoing
Under no circumstances may any heritage material be destroyed or removed from site unless under direction of a heritage specialist.	Contractor/ ECO	Ongoing
Should any remains be found on site that is potentially human remains, the South African Police Service should also be contacted.	Contractor/ ECO	Ongoing
If there are chance finds of fossils during construction, a paleontologist must be called to the site in order to assess the fossils and rescue them if necessary (with an AMAFA permit). The fossils must then be housed in a suitable, recognized institute.	ECO	Ongoing

Socio Economic Impacts:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE**	**MONITORING**

	PERSON(S)	FREQUENCY
Community members, leaders and taxi associations must be notified as soon as possible by posting notice boards with illustrations on site.	ECO	Once
Local people must be employed where possible.	Contractor	Ongoing
Traditional leaders and/or ward councillors must be involved in the public participation and they will aid in appeasing the community.	ECO	Ongoing

Health and Safety:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Unskilled labour must be trained relevantly including environmental training. Workers must receive thorough training in using potentially dangerous equipment or chemicals.	Contractor	Ongoing
The ECO is not responsible for the health and safety policies of workers on site. The EMP briefly addresses this issue since the main aim of the EMP is protection of the environment and surrounds.	Contactor	Ongoing
Safety measures, work procedures and first aid must be implemented on site. First aid facilities must be available on site at all times. Compliance with the Occupational Health and Safety Act is the responsibility of the contractor.	Contractor	Ongoing
The contractor is responsible for ensuring that all equipment is maintained in a safe operating condition.	Contractor	Ongoing
A safety officer must be appointed and keep records of health and safety incidents on site. Any incidents must be reported to the project manager immediately.	Contractor	Ongoing
Protective gear such as safety harnesses, hard hats, safety shoes and other equipment must be provided by the contractor. Workers have the right to refuse work in unsafe conditions. No person may enter the site without training and appropriate protective gear	Contractor	Ongoing
A record of drugs administered or precautions taken and the time and dates when this was done must be kept. This can be used in court if necessary for any claims	Contractor	Once
The contractor must ensure that workers are educated about HIV/AIDS and its risks	Contractor	Once

Material stockpiles or stacks, such as pipes must be stable and well secured to avoid collapse and possible injury to site workers	Contractor	Ongoing
Eating and resting areas must be regularly serviced and cleaned to ensure hygiene	Contractor	Ongoing
Hazardous working areas must be marked	Contractor	Ongoing
Emergency numbers for local police and emergency personnel/units must be placed in a prominent area	Contractor	Ongoing
Trespassing and/or utilising the site as a thorough fare is prohibiting by unauthorised persons. Contractor staff are prohibited from trespassing over the site boundaries	Contractor	Ongoing
Interaction with neighbours and objecting parties at the site must be well documented. A complaints register must be readily available on site. Interaction with external parties must be courteous.	Contractor	Ongoing

Security:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Access to the equipment and facilities on site must be strictly controlled and authorised only by the contractor. 24-hour security on site could aid in theft control.	Contractor	Ongoing
Trespassing on adjoining properties by workers is prohibited.	Contractor	Ongoing
All houses, walls, fences, gardens, trees and livestock situated within the site are private property. No encroachment is to be made onto these properties by the contractor or his employees, without the owner's consent.	Contractor	Ongoing
The Contractor shall advise the community liaison officer to notify property owners at least two days in advance of the activities to be carried out inside their properties. Property owners consent should be obtained prior to excavation through crops and properties, etc.	Contractor	Ongoing
Movement and access to properties are to be maintained for all current residents at all times during the contract.	Contractor	Ongoing
Existing services to individual properties within the site, e.g. water reticulation, electrical reticulation and telephone lines shall be kept operational as much as possible.	Contractor	Ongoing

Fire Management:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Fire-fighting equipment must be provided at strategic points, including fire blankets as per OHSA.	Contractor	Ongoing
All staff must be trained in fire hazard control and firefighting techniques.	Contractor	Ongoing
All flammable substances must be stored in dry areas which do not pose an ignition risk.	Contractor	Ongoing
No open fires are allowed on site.	Contractor	Ongoing

Incident Reporting:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Incidents regarding complaints of noise and disturbances must be recorded by the contractor and/or his representative immediately with details of time of incident, time of complaint and nature of complaint.	Contractor	Ongoing
Incidents regarding minor injuries must be recorded in an incidents and injuries file detailing time of incident, nature of incident and any medication and/or medical supplies provided from the first aid kit that must be available on site at all times.	Contractor	Ongoing
Incidents regarding safety breaches including non-compliance to the safety guidelines must be recorded detailing the time of the incident, the persons involved/responsible and the nature of the incident.	Contractor	Ongoing
Incidents regarding major spills of more than 5ℓ of a hazardous material must be dealt with in the manner described previously and recorded and reported within two days of the spill. The incident must be reported to the ECO who will relay it to the DW&S and EDTEA.	Contractor	Ongoing
Any other incidents of concern that are covered in the various sections of this EMP must be recorded appropriately in an incident records file and reported to the ECO during the monthly audit.	Contractor	Ongoing

The records file and other paperwork including the EMP, Emergency Protocols and waybills for appropriate disposals must be available in the site office for inspection at any given time.	Contractor	Ongoing

Remedial Actions:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Depending on the nature and extent of the spill, contaminated soil must be either excavated or treated on-site. Excavation of contaminated soil must involve careful removal of soil using appropriate tools to storage containers until disposed of at a registered hazardous landfill site. The application of soil absorbent materials as well as oil-digestive powders to the contaminated soil may be required. Contaminated remediation materials must also be removed from spill area, stored and disposed of with due diligence.	Contractor	Ongoing
Spill incidents must be recorded and reported to Department of Water Affairs (DW&S), the ECO and any other relevant authorities. In the event of a spill, the following steps can be taken: • Stop the source of the spill; • Contain the spill; • Report the spill; • Remove the spilled product for treatment or authorised disposal; • Determine if there is any soil, groundwater or other environmental impact; • If necessary, remedial action must be taken in consultation with the relevant government departments. • The incident must be documented and recorded. Mitigation measures to prevent recurrences must immediately be devised and implemented	Contractor	Ongoing

Reference Marks, Site Establishment and Contractor's Camp:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
The Contractor will have the responsibility of referencing each and every setting out peg on the Contract, in a position such that the reference pegs will not be disturbed by his operations on the site, and to safeguard and maintain such reference pegs until the completion of the Works.	Engineer/Contractor	Once
The Contractor shall provide the Engineer with a record of the position of the reference pegs and he shall assist the Engineer throughout the Contract in the checking of the setting out of the Works, using these reference pegs.	Contractor	Once
Choice of site for Contractors Camp requires authorisation by ECO and must take into account the location of local residents and/or ecologically sensitive areas, including the watercourse, flood plains and slip/unstable zones.	ECO	Once
The camp must not be situated within any flood plains/wetlands. The route construction servitude must be demarcated with chevron tape or similar measures. Visually the site must be as compact as the required equipment and personnel allows. Suitable control measures over the contractor's area, plant and material storage to mitigate any visual impact must be implemented. Excess materials, equipment etc. must not be stored at site but rather brought in only as and when required. Equipment and materials must be stacked in a compact and safe manner. The site must have the contractors name signage including contact details. The site must have signage indicating that safety attire is required. The site must have "no unauthorised entry" signs at the boundary of the camp site	Contractor	Once
The contractor must make his own arrangements concerning the supply of electrical power, water, telephone and other services. All required amenities, including ablution facilities must be moved to the site before the main workforce arrives	Contractor	Once

The toilets must be situated more than 50m from any watercourse edge (Section 1(24 and 29) National Water Act (36 of 1998))	Contractor	Once
The Contractor must inform all site staff to make use of the supplied ablution facilities and under no circumstances must sanitary activities be allowed elsewhere, including the floodplains and watercourse. Washing of laundry is prohibited at the site	Contractor	Once
No open fires for cooking, etc. are allowed within the contractor's camp	Contractor	Ongoing
Progressive and systematic finishing and tidying will form an essential part of this Contract. On no account must spoil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others, and in the event of this occurring, the Employer shall have the right to withhold payment for as long as may be necessary in respect of the relevant Works in the area(s) concerned without thereby prejudicing the rights of others to institute claims against the Contractor on the ground of unnecessary obstruction. All finishing and tidying shall be carried out to the best advantage of the project as a whole.	Contractor	Once

Scope of Work:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Contractor must provide method statements and adhere to the agreed scope of works.	Contractors	Once
Contractors must provide project schedules that will enforce penalties for delays.	Contractors	Once

Closure of Construction Camp Site:

- Once installation of the pipeline has been completed and all excess material has been removed, the camp site must be rehabilitated.
- Any spilled concrete must be removed and any soil compacted during the construction phase must be ripped, levelled and re-vegetated or surfaced.
- After all construction work is complete, the contractor is required to dismantle/detach/demolish and remove the temporary facility from site and make good all damage, to the satisfaction of the engineer and ECO.
- All structures comprising the camp site must be removed from the site.
- The camp, storage and waste storage areas must be inspected for spills of substances such as paint, oil, etc. and these must be cleaned up.
- All temporary worker facilities must be removed or decommissioned.
- Copies of all certificates from any waste disposals are to be provided to the ECO.

- Burying of any waste on site is prohibited. All waste must be disposed of at the appropriate facilities.
- The contractor must repair any damage that the construction works may have caused to neighbouring sites.
- The ECO must be notified of the complete decommissioning of the site camp after which the ECO will perform a final audit of the site.

7. REHABILITATION AND OPERATIONAL PHASE/ MAINTENANCE PHASE

The Rehabilitation Phase refers to the closing of the camp site and site handover to the Developer. The Operational Phase is briefly addressed and refers to the Management and Maintenance of the Pipeline.

Excavation:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
❖ The alignment of the trench and adjacent areas should be clearly marked off before excavation and related construction activities are undertaken. All activities should be restricted to a 15m construction servitude. This will limit rehabilitation efforts primarily to the construction zone.	Contractor/ ECO	Ongoing
❖ Where possible the existing vegetation should be carefully removed during construction and stored for replacement during wetland rehabilitation.	Contractor/ ECO	Ongoing
❖ The topsoil and subsoil should be excavated and stored separately in order to re-construct the soil profile during back-filling.	Contractor	Ongoing
❖ The excavated material should be protected from erosion if it is going to be exposed for a long period of time. Stockpiled material should be covered with erosion control blankets and surrounded by earthen berms to prevent material from eroding down slope or downstream.	Contractor	Ongoing
❖ The trench should be backfilled immediately after the pipe has been laid and the backfilled material should be replaced in the order in which it was removed. The sub-soil should be replaced first followed by the top-soils in-order to re-construct the soil profile.	Contractor	Ongoing
❖ The backfill material should be moistened and compacted every 100mm to the density of the surrounding area. Once filled, the backfill	Contractor	Ongoing

material should be compacted to the same height as the natural ground profile.		
❖ Reno-mattresses should be installed (downstream and upstream of the trench) to stabilize banks that are unstable at the wetland crossing point.	Engineer/ Contractor	Once
❖ Sediment that has dispersed upslope of the wetland should be removed by hand. In addition, all waste material should be collected and disposed of appropriately.	Contractor	Ongoing
Re-Vegetation:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
❖ All NEMBA category 1a and 1b invasive alien plant species should be removed and disposed of appropriately prior to rehabilitation. Alien vegetation should be removed through manual clearing. The material should be cut and stored outside the wetland and the recommended wetland buffer zone. Thereafter, all cuttings should be removed and legally disposed of at a landfill site. Cut stumps should then be treated with an appropriate herbicide to prevent further growth. Appropriate herbicides should be prescribed by the contractor.	Contractor	Once
❖ The vegetation removed during the clearing phase should be replanted to rehabilitate the wetland.	Contractor	Once
❖ Preferably vegetation should be planted at the start of the wet season.	Contractor	Once
❖ Prior to re-vegetation the soil should be prepared accordingly. Where there is significant compaction, the soils in these areas should be loosened to encourage the establishment of planted vegetation. Where there is good topsoil, these areas should remain un-disturbed.	Contractor	Once
❖ It is important that vegetation is planted immediately after backfilling of the trench is complete to limit sedimentation impacts on the wetland.	Contractor	Once
❖ The wetland should be re-seeded with wetland plants to fill any remaining gaps with the wetland plants. The wetland plants sourced should be indigenous as well as suited to the conditions of the temporary and seasonal zones.	ECO	Once
❖ Diversion structures should be placed along the trench to reduce sediment runoff opportunities and ensure vegetation growth.	Contractor	Once

❖ The diversion structures utilized should preferably consist of berms of biodegradable sacks filled with soil.	Contractor	Once
❖ The berms should be placed 2m apart along the disturbed area. The number of berms utilized should be reviewed by the onsite environmental control officer. The number of berms utilized can be increased or decreased as per the recommendations of the onsite environmental control officer.	ECO	Ongoing
❖ Biodegradable erosion control blankets should be used to stabilise the disturbed banks on either side of the central wetland channel.	Contractor	Once

Monitoring:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Quarterly inspections of the wetland crossings should be carried out for one year after construction to monitor vegetation cover and wetland condition.	ECO	Once

Employees:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Staff of EWS must take cognisance of this EMP as well as the eThekwini Standard EMP for construction, maintenance and management.	Developer	Ongoing
Staff must abide by the mitigation measures that apply to waste management, sanitation, surface water pollution, traffic, access, soil erosion, stormwater management, protection of flora and fauna, public safety & health and the noise and disturbance factor.		
Employees must receive necessary training with regard to environmental management.		
Employees must wear uniforms, supplied by the employer.		

Management and Maintenance:		
ACTIONS AND MITIGATION MEASURES	**RESPONSIBLE PERSON(S)**	**MONITORING FREQUENCY**
Pipeline monitoring will be the most effective measure in identifying possible leakages. Laying the pipes in soils that are not conducive to lateral flow may prevent excessive erosive.	Developer	Ongoing
Immediate repair operation for any damaged portion of the infrastructure must be taken.		
Buffer zones, gabion walls, ripraps etc., must be implemented to prevent stormwater from pooling and to direct stormwater to existing stormwater infrastructure on the surrounding roads and residential area		

8. PROPOSED MONITORING AND AUDITING

8.1. Site Audits

- The route and construction activities must be inspected during the construction and operational phases, according to the conditions of the environmental authorisation, which is generally once a month during construction.
- The date and time of the inspection may not be available to the contractor and/or developer.
- The audit must be executed by an independent environmental control officer (ECO).

8.2. Audit Methodology

- The inspection will cover all aspects stipulated in the proposed management plan.
- Each action will be assigned according to "Adequately done", "Inadequately done" and "Not done".
- The ECO may adjust actions should they not be effective in protecting sensitive elements or mitigating threats. This may require an amendment to the EMP and EDTEA must be consulted prior to any changes.
- Audits will be well documented in Monthly Audit Reports and submitted to the Competent Authority and the Project Manager.

8.3. Responsibility

- Ultimately, the client (eThekwini Water and Sanitation) is responsible for the implementation of the environmental management plan.
- Should a concern be raised by an interested and affected party and/or stakeholder, EDTEA will refer to the monthly audit reports from the ECO.
- The ECO is not responsible for the implementation of the EMP but is responsible for auditing the developer's and contractor's compliance to the EMP.
- Following the rehabilitation of the affected site and the final ECO inspection and report, a site handover to the developer must be scheduled.

CLOSING COMMENTS

- This Final EMP will be submitted to KZN EDTEA for approval.
- The Client's/Contractor's Environmental Code of Conduct, the Wetland Rehabilitation measures, the stormwater management plan and specialist study reports must be provided as Appendices to this EMP in the Environmental File.