GEORGE MUNICIPALITY

PROJECT 20 (5): UPGRADING THEMBALETHU BULK SEWER – PHASE 3 AND 4

CONCEPT & VIABILITY REPORT

REPORT NO: 1762: REV NO. 1

3 MAY 2024

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GEORGE MUNICIPALITY

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1. INTRODUCTION

1.1 BACKGROUND

The purpose of this Concept and Viability Report is to establish George Municipality's requirements and preferences for the concept design for the upgrading of bulk sewer mains in Thembalethu in support of the Upgrading of Informal Settlements Programme (UISP). The Phase 3 and 4 bulk sewer mains are required to accommodate upstream flow as well as future housing developments to allow fully serviceable sites and the implementation of formal housing units in the identified areas. The proposed bulk sewer forms part of the overall bulk sewer upgrades required in Thembalethu as part of the Sanitation Master Plan.

The Municipality is placed under strain when dealing with the operation and maintenance of these sewerage systems due to constant blockages by foreign matter, not only causing a financial burden but resulting in environmental spillages and increased operation and maintenance requirement. The informal areas within Thembalethu currently do not have waterborne sanitation systems and a portion of this project will address these services allowing formal development of the area by extending the current bulk network to include areas that can easily be connected to the existing sanitation infrastructure. The existing upstream bulk sewers and pump stations will be utilised, where possible sewage will be conveyed through the new bulk sewer Phase 3 and 4 to the Outeniqua Waste Water Treatment Works (WWTW).

The bulk sewer will be implemented in a phased approach subject to available funding.

1.2 TERMS OF REFERENCE

George Municipality has appointed Lukhozi Consulting Engineers (Pty) Ltd as their professional engineering service provider for the Upgrading of Thembalethu Bulk Sewer Phase 3 and Phase 4.

The scope of services under the appointment is outlined below:

- Inception, concept design, detail design, documentation & procurement and implementation of Thembalethu Phase 3 and 4 bulk sewerage Infrastructure.
- Advise on criteria that could influence the project life cycle cost significantly.
- Provide the necessary information within the agreed scope of the project to other consultants involved.

- Provision of additional services required to develop and implement the project including construction monitoring.

1.3 PURPOSE OF THE REPORT

The purpose of this report is to provide details pertaining to the concept and viability planning, design, and implementation of Thembalethu Bulk Sewers- Phase 3 and 4.

This report outlines the recommended levels of services to be installed in conformance with the minimum design standards and requirements and, serves to establish the design criteria to be applied to the project.

1.4 PROJECT TEAM

The parties listed below will be involved in the planning, design and implementation of this project.

Employer ..... George Municipality (GM)
Consulting Engineer ..... Lukhozi Consulting Engineers Pty (Ltd)
Geotechnical Engineers ..... Outeniqua Geotechnical Services
Engineering Surveyors ..... Joubert & Brink Surveys (Pty) Ltd
Health and Safety Agents ..... Xaks Consulting
Environmental Assessment Practitioner (EAP) ..... Cape EAPrac

Refer to **Annexure A** – project organogram, for details of the Professional teams' members.

2. SITE DETAILS

2.1 LOCALITY

Thembalethu is located within the jurisdictional boundaries of George Local Municipality of the Western Cape Province.

Coordinates of the centre of the area are 34°0'39.94" S & 22°28'38.70" E.

Access to Thembalethu is obtained via the Thembalethu interchange on the N2 national road from Knysna to Mossel Bay. The site spans along the western boundary of Thembalethu along the Schaapkop River. Access to the site is via Nelson Mandela Boulevard and residential roads, where available.

Refer to locality plan in **Figure 1** below.

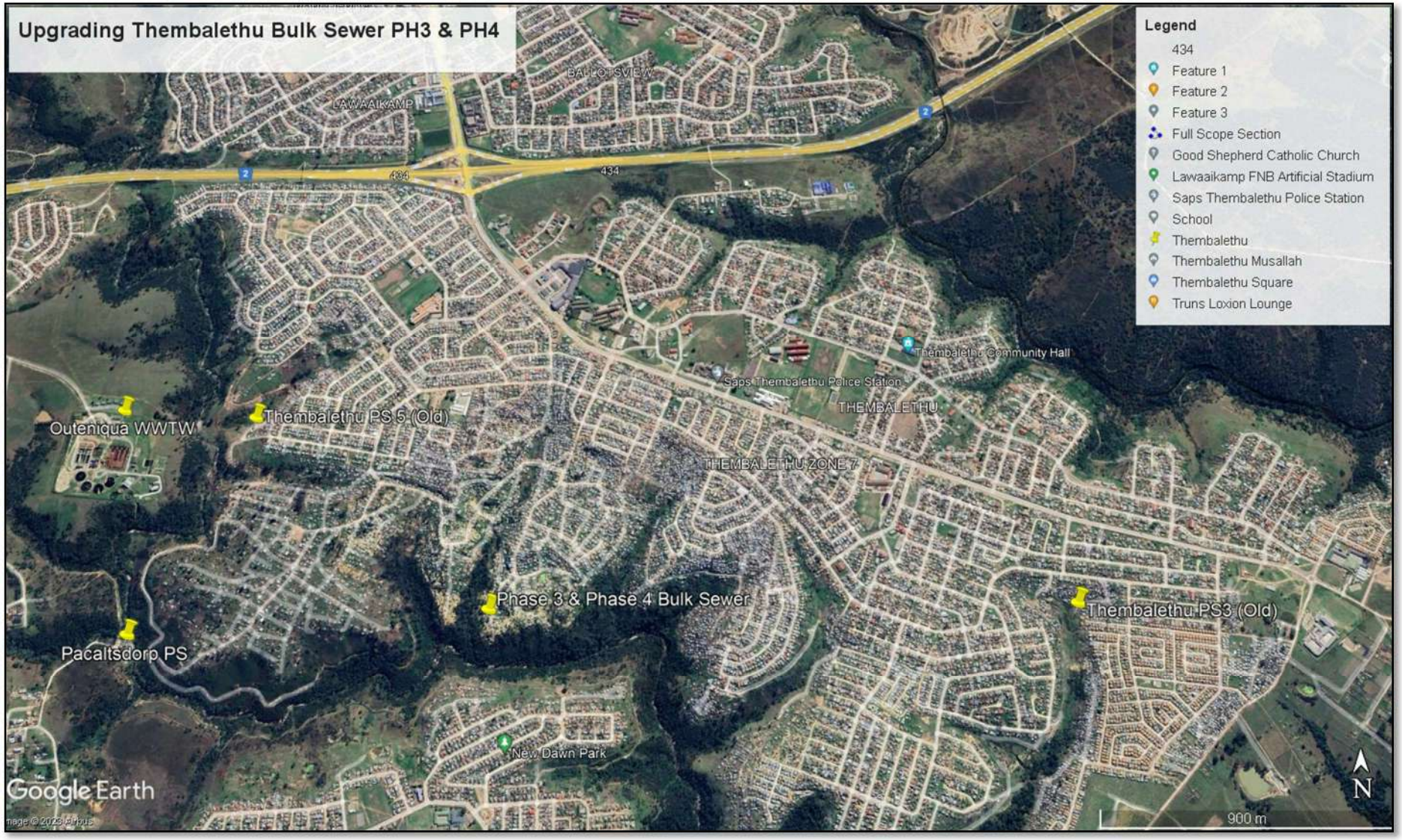


Figure 1: Locality of the planned Phase 3 & Phase 4 bulk sewer and decommissioned Thembalethu pump station no. 3

2.2 ENGINEERING SURVEY

Joubert and Brink Surveys were appointed as the engineering surveyor for this project. A LiDAR and Topographical survey were performed for areas being considered under the Thembalethu Bulk Sewers- Phase 3 and 4 scope of works. The engineering survey was completed, and the final information supplied to Lukhozi on 20 November 2023 and has been used in the concept & viability design.

2.3 GEOTECHNICAL INVESTIGATION

Outeniqua Lab and Geotechnical Services were appointed as the geotechnical engineering sub-consultant for this project. A geotechnical site investigation and report was prepared and submitted for areas being considered under the Thembalethu Bulk Sewers- Phase 3 and 4 scope of works. This is required to focus on identifying potential hazards, defining ground conditions, and offering detailed soil profiles and groundwater occurrence. The geotechnical site investigation was completed in December 2023 and the provisional soil test data was supplied on 14 December 2023. The final soil test and report was submitted on 1 February 2024. A copy of the geotechnical report is attached as Annexure B to this report.

Early indications from the soil test data show that the area will be suitable for the installation of sewers, with soils generally expected to be classified as ‘soft excavation’ over the majority of the route. Some trench shoring may be required in isolated areas with poor soil stability and dewatering of marshy areas may also be needed. These specifics will be confirmed through field and laboratory testing which will form part of the detailed geotechnical investigation report.

2.4 ENVIRONMENTAL INVESTIGATION

An Environmental Assessment Practitioner (EAP), Cape EAPrac, has been appointed to assess the Thembalethu Bulk Sewers- Phase 3 and 4 scope, and commence with the application to the Department of Environmental Affairs & Development Planning (DEA&DP), necessary permit/s with Department of Forestry, Fisheries and the Environment (DFFE) and necessary Water Use License Authorisation (WULA).

An existing environmental authorisation is in place for the implementation of various sanitation infrastructure in Thembalethu, including the Phase 3 & 4 bulk sewers. However, any change to the scope or alignment of the authorisation will require amendment.

The EAP, fresh water ecologist and other specialists undertook a site inspection on 1 November 2023, to determine the environmental sensitivity in relation to any potentially concerning environmental features.

CAPE EAPrac completed the Notice of Intent (NOI) and submitted it to the DEA&DP on 1 December 2023. A feedback letter with respect to the NOI letter was received from DEA&DP on 26 January 2024. The Department indicated that a Part 1 amendment to the existing Environmental Authorisation (EA) can be applied for if the proposed amendment will not change the scope of a valid environmental authorisation, nor increase the level or nature of the impact, which impact was initially assessed and considered when an application was made for an environmental authorisation; or relates to the change of ownership or transfer of rights and obligations. They further indicated that since the

proposed amendment (i.e. this Phase 3 & 4) will change the scope of the authorisation (i.e. new pipeline route not currently in the authorisation), regardless of what the reason is, a Part 1 amendment process cannot be followed for this change. DEA&DP is therefore of the opinion that a Part 2 amendment should be applied for instead.

Further environmental investigation and specialist studies will proceed as required by DEA&DP and a Part 2 amendment which will identify any environmental concerns that may affect the implementation of the Thembalethu Bulk Sewers- Phase 3 and 4 scope. This will be further addressed as the detail design stage will proceed.

Necessary adjustments to the designs will be made based on the final findings of the Basic Assessment if required.

3. SCOPE OF WORKS

3.1 PORTION 2

The Phase 3 and Phase 4 bulk sewers will serve the following areas that will tie into an existing 250mm Diameter bulk sewer line, situated south and south-east of the UISP Areas 5 & 6A and will gravitate to the existing Pacaltsdorp Sewer Pump Station 1. This pump station transfers the sewage to the Outeniqua WWTW, see Figure 2 below. This scope of work is seen as Portion 2.

During the detailed design stage it will be determined if the existing 250mm diameter bulk sewer line requires an upgrade to accommodate the new bulk sewer that will service Phase 3 and Phase 4 internal sewers.

Table 1: Portion 2 Estimated Bulk Gravity Sewers per concept design

Phase	Area	Anticipated Length	Planned Pipe Dia
3	Area 2 and the remainder of the bulk services required to fully service Area 5, 6A and 6B	Approx. 1460m	200mm (160mm was the proposed diameter per the Municipality's project appointment. This diameter is regarded as too small for bulk sewer reticulation for this area due to the small hydraulic loading and the nature and characteristics of the sewage)
4	Old All Brick Quarry Area	Approx. 970m	
Total estimated length of Planned Bulk Gravity Sewer		**2 430m**	

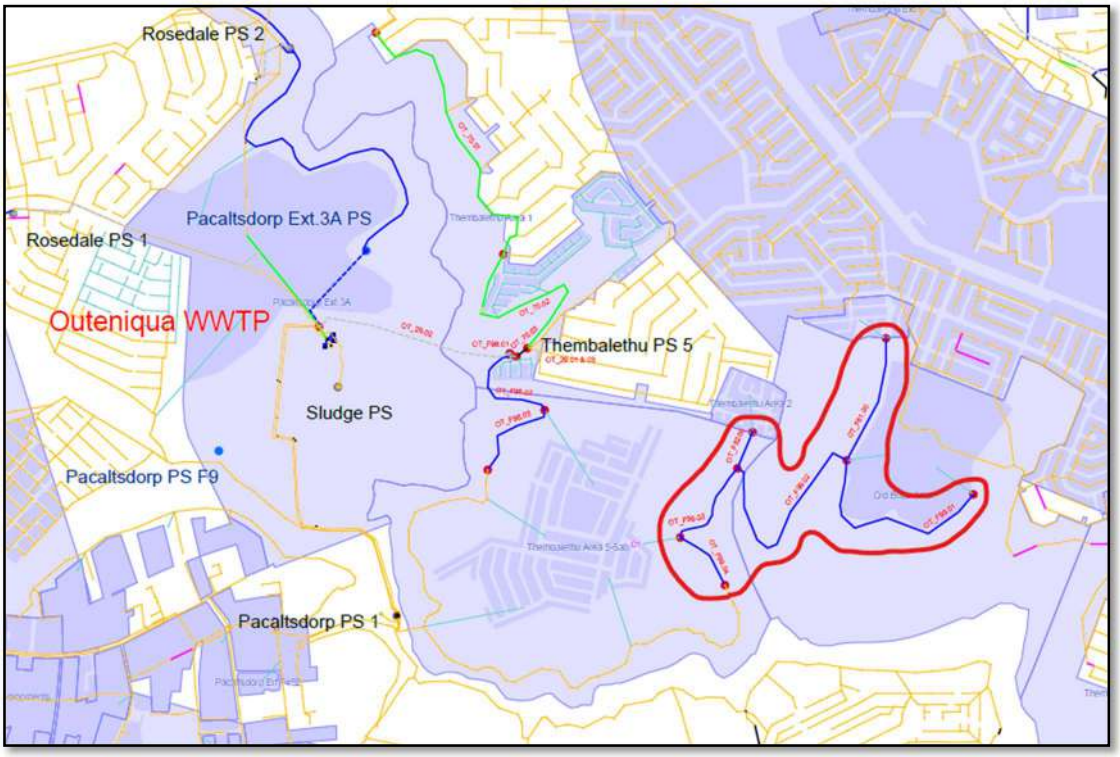


Figure 2: Portion 2 - Phase 3 and Phase 4 gravity bulk sewer (Outlined in red)

3.2 PORTION 1

A portion of the existing gravity sewer near the old, decommissioned Thembalethu sewer pump station no. 3 must be connected to the existing gravity sewer network to the western embankment of Ward 21 existing bulk sewer. This portion of the work is situated east of the planned Phase 3 and Phase 4 bulk sewer lines, but in totality creates the western bulk sewer line at this portion. Refer to Figure 3 below.

This portion of the scope of construction works will include the following as a minimum:

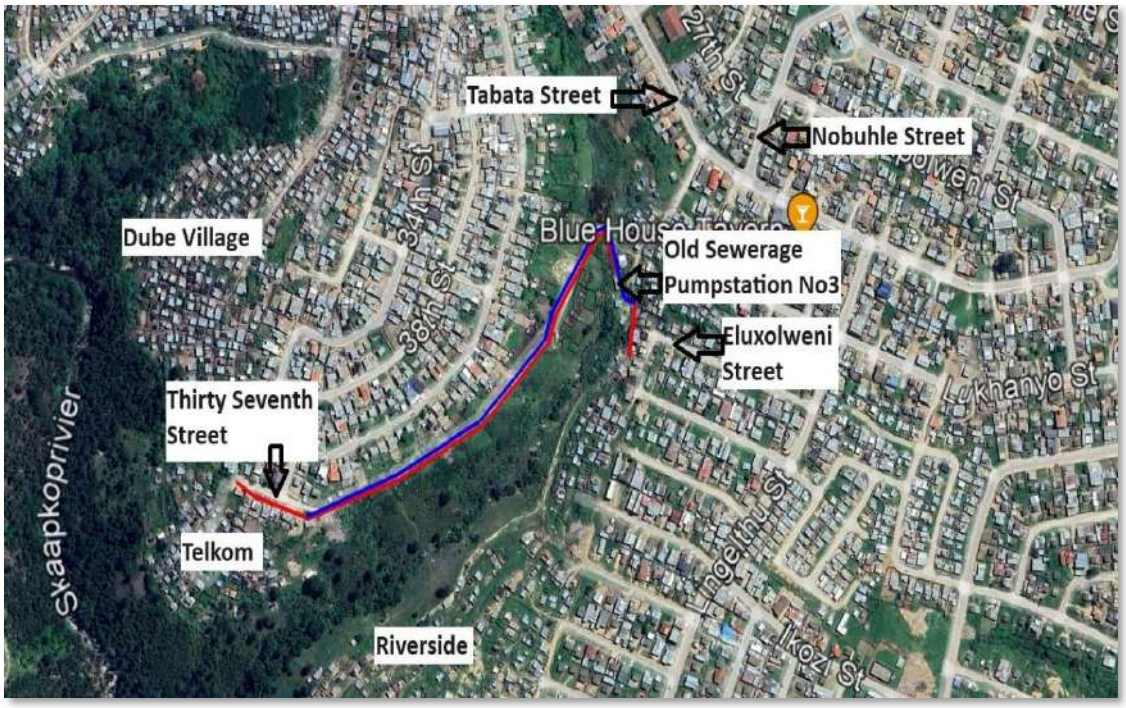
- Sewer connection to existing gravity sewer
- Stream crossing
- Construction of associated manholes
- Bulk earthworks and stabilization of erosion donga
- Stormwater crossing for future draining of Siyabulela and Eluxolweni Streets.

This scope of work is currently under construction, as part of T/ING/008/2020: The Appointment of Ad-Hoc Civil Engineering Contractors for a period of three years.

Table 2: Portion 1 Estimated Bulk Gravity Sewers per concept design

Portion	Area	Anticipated Length	Planned Pipe Dia
1A	Ward 9	316 m (200 mm Dia) 50 m (355 mm Dia)	200 mm and 355 mm Dia as per the existing pipeline with steeper falls of minimum 1 in 150
1B	Ward 21	120 m (355 mm Dia)	355 mm Dia as per the existing pipeline with steeper falls of minimum 1 in 150

Portion	Area	Anticipated Length	Planned Pipe Dia
Total estimated length of Planned Bulk Gravity Sewer for Portion 1		**486m**	



Legend:
Existing bulk sewer with poor gradient
New bulk sewer with min fall 1 in 150

Figure 3: Portion 1A&B Ward 9 & Ward 21 existing bulk sewer upgrade

4. WAYLEAVE APPLICATION STATUS

Planning wayleave applications to be submitted when applied for. Table 3 below indicates the status and outcome of each application.

Construction wayleaves will be applied for prior to commencing with construction by the applicable contractor/s.

Table 3: Wayleave Application Status

Service Provider	Service Affected	Comments
George: Electricity Department	Yes	Must be notified 5 days prior any construction. Electrical Representatives to inspect area prior excavation. Form to be filled out.
George: Civil Engineering Services	Yes	Sewer and water affected.
George: Environmental Services	Yes	Check if yellow woods or other protected trees will be in the way of new bulk sewer.

5. SUB-CONSULTANTS AND SPECIALIST SERVICE PROVIDERS

5.1 HEALTH AND SAFETY INVESTIGATION

George Municipality has appointed Xaks Consulting as the H&S Agent on 24 May 2023 for this project and will be involved during all required stages of the project.

The Health and Safety Agent is required to:

a) Attend design meetings.
b) Prepare baseline risk assessment and site-specific health and safety specification. A draft of the baseline risk assessment and site-specific health and safety specification was completed on 14 August 2023. This baseline risk assessment and site-specific health and safety specification will have to be reviewed and finalised during the compilation of the tender document for construction for portion 2. Review the bill of quantities to confirm there are sufficient items and acceptable quantities and pricing prior to and post pricing.
c) Evaluate and approve the successful Contractor's Health and Safety Plan, which will be prepared in response to the risk assessment and specification.
d) Prepare and apply for a Construction Work Permit if required.
e) Attend monthly site meetings and perform monthly audits (minimum two site visits per month).
f) Prepare and submit monthly Health and Safety audit reports.
g) Manage the Contractor's compliance with his Health and Safety Plans, the Health and Safety Specifications and the OHS legislation.
h) Prepare and submit a Health and Safety close-out report on completion of both construction contracts.
i) Accept the duties and responsibilities of the Client as set out in the Construction Regulations.

6. CONCEPT DESIGN CRITERIA

6.1 STANDARDS APPLIED

The following references will be used for the design of the sewerage reticulation network:

- The Neighbourhood Planning & Design Guide: Section K - Sanitation (Red Book 2019)
- SANS 10400-P: Drainage
- George Municipality Civil Engineering Services: Civil Engineering Standards & Requirements for Services (Updated January 2009)

6.2 SEWER FLOW

The Instantaneous Peak Wet Weather Flows (IPWWF) for each of the drainage areas have been calculated using the sewer flow and peak factor method contained in section K.4 of the Human Settlements Planning and Design Guidelines (Red Book 2019). The following was allowed for in the design.

• Unit Hydrographs	:	UH 4	(PDDWF)
• Peak factor	:	2.0	(IPDWF)

- Groundwater infiltration rate : 0.03 (l/min/m/m Ø)
- Allowance for stormwater ingress : 50 % (IPWWF)

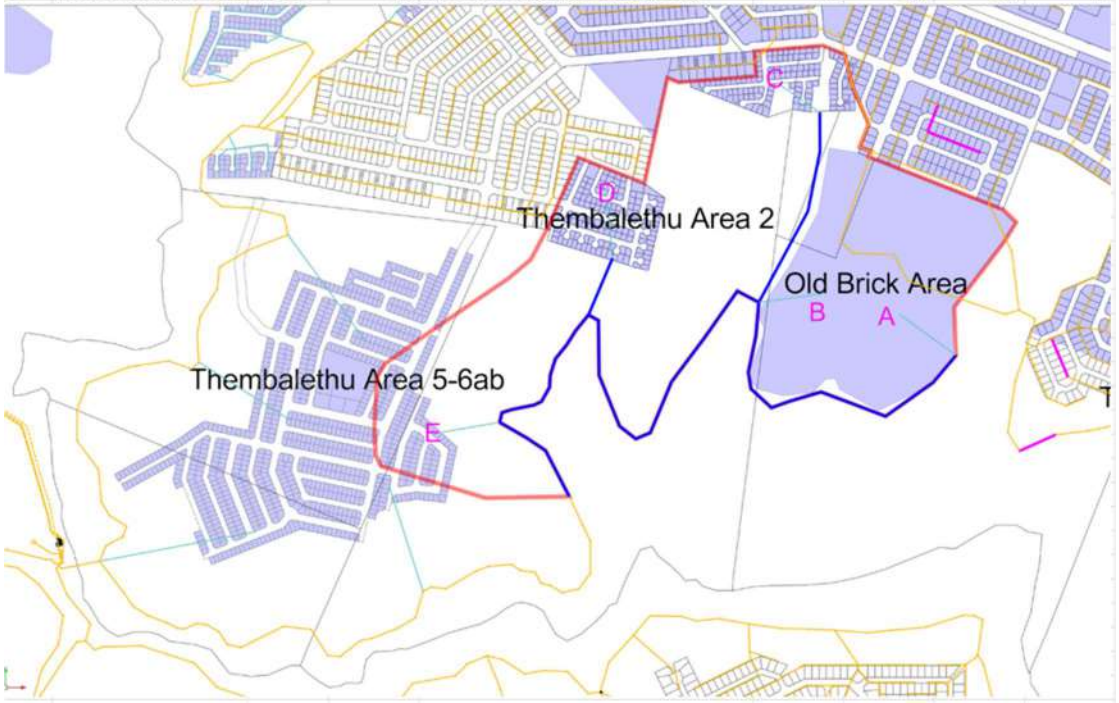
Refer to **Annexure C** attached to this Report for the design flow calculations for the bulk sewer as determined by Lukhozi.

6.2.1 Future Development flows

Table 4 provides a summary of the accumulated flows per drainage areas to a collection point that will drain via the proposed bulk sewers titled phase 3 and 4 in Thembalethu from the recent Sanitation Master Plan.

Table 4: GLS Design flows for Phase 3 and 4

Point	Future Development	Link Code	Portion	Landuse	Units	AADD (kL/d)	PDDWF (kL/d)	MP Design Flow (L/s)
A	Old Brick Area	FG_1120	50%	Low cost housing, very high density (G&W)	206	80,1	78,8	2,0
B	Old Brick Area	FG_1127	50%	Low cost housing, very high density (G&W)	206	80,1	78,8	2,0
C	Thembalethu Area 2	FG_0021	50%	Low cost housing, high density (G&W)	125	55,6	53,4	1,3
D	Thembalethu Area 2	FG_0035	50%	Low cost housing, high density (G&W)	125	55,6	53,4	1,3
E	Thembalethu Area 5-6ab	FG_0030	16%	Low cost housing, high density (G&W)	152	67,3	64,7	1,6



In accordance with the sanitation master plan, the theoretical design flows of the gravity sewer is indicated in **Table 5** below.

Table 5: GLS latest design flows for Phase 3 and 4

Drainage_Area	Model_Type	MP_Item_Type	MP_Item_No	Project_No	Project_Description	MP_Description	Design_Flow	Design_Flow_Unit
Outeniqua WWTW	Gravity	FM	OT_F81.00	RET_OT_060	Construct Thembalethu (2) outfall sewer	New Gravity	1.35	L/s
Outeniqua WWTW	Gravity	FM	OT_F82.00	RET_OT_060	Construct Thembalethu (2) outfall sewer	New Gravity	1.32	L/s
Outeniqua WWTW	Gravity	FM	OT_F99.01	RET_OT_061	Construct Old Brick Area outfall sewer	New Gravity	2.03	L/s
Outeniqua WWTW	Gravity	FM	OT_F99.02	RET_OT_060	Construct Thembalethu (2) outfall sewer	New Gravity	5.41	L/s
Outeniqua WWTW	Gravity	FM	OT_F99.03	RET_OT_060	Construct Thembalethu (2) outfall sewer	New Gravity	6.76	L/s
Outeniqua WWTW	Gravity	FM	OT_F99.04	RET_OT_060	Construct Thembalethu (2) outfall sewer	New Gravity	8.37	L/s

From the design flow calculations, as indicated by GLS, it can be seen that the future design flows are in the order of 1.3 to 2.0 l/s for the various areas with a maximum total design flow of 8.2l/s to 8.4 l/s. The design flow calculations as determined by Lukhozi (including an additional 50% stormwater infiltration) are in the order of 2.04 l/s to 6.75 l/s with a maximum total design flow of 13.5 l/s. The design flows are higher than the calculations as seen on GLS master planning reports, however this is mainly due to the high stormwater infiltration, of 50%, designed for by Lukhozi. When working on an average stormwater infiltration rate of 15% the flows compare closer with the flows as calculated by GLS i.e. in the order of 1.96 l/s to 5.2 l/s with a maximum total design flow of 10.35 l/s. We find the flows rates as calculated by GLS in a low design. It is necessary to determine the peak flow when sizing the proposed bulk sewer infrastructure and we therefore recommend the maximum design flow rate of 13.5l/s, as calculated by Lukhozi, be used for design purposes.

6.3 SEWERS

6.3.1 Bulk Sewer

The bulk sewers will be installed at an absolute minimum gradient of 1 in 150 per the Municipality's requirements.

The site is not a "greenfield" site since there are informal dwellings that exist along most of the planned bulk sewers proposed route. It can therefore be classified as "brownfield" site. This will mean some informal dwellings will have to be moved to temporary positions during construction to enable the installation of the bulk sewer pipelines as can be seen on the concept design layouts attached to the report. Refer to Annexure D. The exact scope of dwellings to be relocated is unknown and will be determined during detail design and the construction stages.

In addition to the extend of the informal dwellings that are restricting access and construction, benching of steep sloped areas will be required to allow access, and create workable platforms and allow maintenance of the bulk sewer pipelines in future. Sufficient allowance will be made in the tender document to perform this activity ahead of construction. Reinstatement and rehabilitation will be required of all disturbed areas.

The proposed bulk sewers will be positioned along the boundaries of existing informal areas, to allow drainage of the areas below gradients of 1 in 25. However, it will not be possible to drain all the existing informal dwellings. Some of these dwellings are developed at embankments steeper than 1 in 25, where the Municipality does not allow formal development. It is recommended, that these dwellings also be relocated to formal areas as part of the Thembalethu Upgrading of Informal Settlement Programme(UISP) for the area, by the Housing Department.

Single stop and go traffic lane will be created during construction to allow residents access to their properties during the construction phase. Re-instatement of existing roads, stormwater, water and sewer reticulation will form part of the works where required.

The anticipated length of bulk sewer and manholes to be constructed are indicated in Table 6 below.

Table 6: Summary of quantities

Phase	Estimated Sewer Pipe Length (m) / Dia (mm)	Estimated Manholes (No.)
3 (Pipeline A from SMH A34 to SMH A61 including pipelines B and C see drawings Annexure D)	Approx. 1470 (200mm Dia)	48
4 (Pipeline A from SMH A1 to SMH A34 see drawings Annexure D)	Approx. 970 (200mm Dia)	34
TOTAL	**2 430**	**82**
Portion 1A	316m (200mm Dia) 50m(355 mm Dia)	11
Portion 1B	120m(355 mm Dia)	6
TOTAL	**486**	**17**

6.3.2 Design

The bulk sewers are designed to the following standards:

- Minimum full pipe velocity : 0.7 m/s (due to the low design flows calculated velocities are as low as 0.4-0.5m/s)
- Maximum full pipe velocity : 2.2 m/s
- Minimum cover to pipes : 1.0 m below finished road level 0.8 m below finished ground level.
- Maximum depth : 4.0 m below finished ground level
- Maximum manhole spacing : 80 m
- Minimum pipe size : 200 mm diameter
- Minimum Erf Connection size : 110 mm diameter
- Minimum gradient sewer main : 1:150 (per George Municipality requirements)

The sewerage reticulation will be designed according to the minimum diameters and gradients shown.

6.3.3 Pipe Materials

Sewer mains will be uPVC Class 34 heavy-duty solid wall complying with SANS 1601, with a pipe stiffness of 400 kPa and smooth inner and outer walls complete with integral sockets, joints, and rubber seal rings.

All fittings will comply with SANS 791.

6.3.4 Manholes

Sewer manholes are to be constructed using 1.0 m diameter precast concrete rings to depths in accordance with the designs and drawings. Manholes deeper than 1.5 m will be reduced to 0.75 m diameter precast rings up to a depth of 1.5 m and 1.0 m diameter precast rings for the rest of the depth. Heavy duty precast concrete type manhole cover and frames will be used for all manholes constructed in the roadways. The manhole cover for sewers with diameter 315 mm Diameter and below will be standard concrete manhole covers. The

manhole cover for sewers with diameter above 355 mm Diameter will be specially made security concrete manhole covers to prevent the public from tampering with manholes.

Finished manhole cover levels will be flush with road level in roadways, 50 mm above finished ground level in road reserves and 500 mm above finished ground level in open spaces.

Precast manhole sections will comply with SANS 1294.

6.3.5 Main stream crossings

Due to the topography of Thembalethu and Skaapkop River that flow at the foot hills, various minor and main streams commence within the settlement until it reaches the river.

Because the proposed new gravity sewer follows the lowest possible contour line to obtain maximum drainage, three(3) main stream crossings will have to be crossed and accommodated in the design along the length of the bulk sewer pipelines. The sewer pipelines will have to cross these main stream crossings by means of a sewer pipe bridges as indicated on the layout and long section drawings.

It is proposed that the main stream and/or river crossings be constructed with reinforced concrete bridge structures. The detail for these crossings is shown on the stream crossings and stormwater detailed drawings found in Annexure D of this document.

The reasons for proposing reinforced concrete bridge structures are as follows;

a) Concrete is renowned for its exceptional durability, with concrete exhibiting resistance to corrosion, fire, and external forces. They can withstand challenging environments and provide long-lasting service life, reducing maintenance and replacement costs.
b) Concrete possess excellent structural strength, enabling it to bear heavy loads and resist deformation under pressure.
c) Properly designed concrete mixes can be resistant to chemical attacks, such as sulphur or acidic substances, making them suitable for a wide range of applications, including sewer systems and industrial environments.
d) Concrete offers a reliable and cost-effective solution due to its longevity and minimal maintenance requirements. It requires fewer repairs and replacements compared to alternative materials, resulting in reduced lifecycle costs.
e) It is robust and will last for years as can be seen at other concrete pipe bridges in the Thembalethu area.
f) The bridge structure can be designed in such a way that the bulk sewer pipe can be safely supported within the concrete bridge structure with concrete lids supported over its entire length. This can protect the pipe against vandalism and also allow pipe replacement by removing the concrete lids with lifting equipment should maintenance be required in future.

Steel bridge structures were considered but are not recommended due to the following reasons;

a) Steel in the Thembalethu area is prone to vandalism and/or theft.
b) Steel is not resistant to chemical attacks where leaks can occur, such as sulphur or acidic substances, making them unsuitable for this installation.

c) The main disadvantage of steel bridges, compared to concrete, is that they corrode under the action of the atmosphere, easily rust, and have high maintenance costs, which are expensive in comparison to concrete bridge structures.
d) Steel bridges have design limitations, which can make them unsuitable for certain applications, such as long-span bridges and high-load bridges.
e) Some people may find steel bridges to be unattractive or visually intrusive, particularly in scenic or historic areas.
f) Steel bridges require ongoing maintenance and inspections to ensure their safety and structural integrity over the long term.

Pipe and/or rectangular culverts are proposed for the minor stream crossings. The detail for these minor crossings will also be designed during the detailed design stage.

6.3.6 Minor stream crossings

Due to the topography of Thembalethu and Skaapkop River that flow at the foot hills, various minor and main streams commence within the settlement until it reaches the river.

Because the proposed new gravity sewer follows the lowest possible contour line to obtain maximum drainage, various minor stream crossings will also have to be crossed and accommodated in the design along the length of the bulk sewer pipeline. At these various minor stream crossings the sewer pipelines will have to be protected from being undermined or scoured away by stormwater by means of stormwater protection measures as indicated on the detail drawings.

Piping of stormwater is proposed above or below the new bulk sewer pipelines. The detail of these minor stream crossings is detailed under the drawings found in Annexure D of this document. The inlets and outlets to these stormwater piped structures will be protected by a combination of soil rip-rap, gabion baskets and reno mattresses where required, to prevent erosion. It is recommended that the exposed faces of these baskets and mattresses be protected by means of “shotcrete”/gunite from vandalism as well as theft experienced in the Thembalethu area.

6.3.7 Erf Connections

Erf connections (if/where required) will be constructed for each erf indicated on the drawings and will comprise of 110 mm uPVC pipe. Typically, erf connections extend 1.0 m into the erf boundary however, this is a brownfields project with established homes with concrete block boundary walls, fencing, retaining block walls etc. The Employer should therefore consider revising this standard to have the erf connection terminate just outside the boundary of the erf, to avoid any potential damage that may occur to this privately owned infrastructure.

Each erf will receive a single erf connection from the main sewer and where feasible, will be positioned in a manner that aligns itself with the existing sewers, septic / conservancy tanks (if any) to allow for ease of connection.

Female stop end pieces to be solvent welded to the ends of erf connection pipes after the required air testing has been carried out.

It is further recommended that the George Municipality:

- Confirm the funding availability.
- Approve this report and provide instruction to commence with the detailed design stage.

2024/05/03
KOENRAAD POTGIETER (Pr Tech Eng)
PROFESSIONAL ENGINEERING TECHNOLOGIST

08/05/2024
GREG TUCKER (Pr Eng, Pr CPM)
MANAGING DIRECTOR

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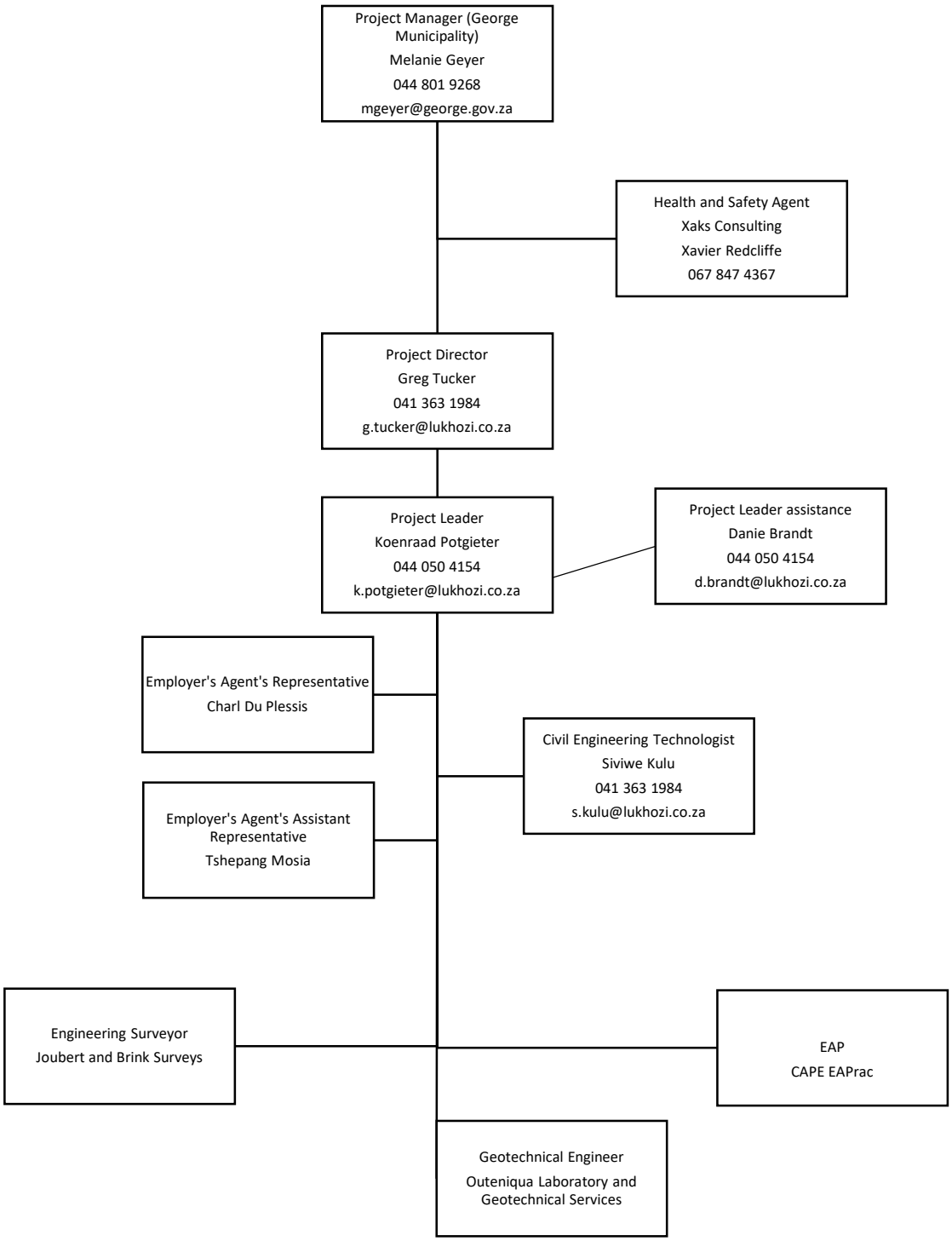
Date: 3 May 2024

ANNEXURE A

PROJECT ORGANOGRAM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Geotechnical Engineer
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ANNEXURE B

GEOTECHNICAL REPORT

GEOTECHNICAL REPORT

PROPOSED UPGRADES FOR THE THEMBALETHU BULK SEWER – PHASE 3 AND 4, GEORGE MUNICIPALITY

24 January 2024 (Rev 0)

Prepared by:
OUTENIQUA GEOTECHNICAL SERVICES
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Prepared for:
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Ref No: 2023\Lukhozi\ Thembalethu Bulk Sewer – Phase 3 And 4 George\Report\Geotech Report 24.1.2024 Rev0

Report review history:

Revision No	Date	Prepared by:	Reviewed by:	Approved by:
0	24.1.2023	I Paton Pr Sci Nat Pr Tech Eng	S Ntanzi BSc Geol	I Paton Pr Sci Nat Pr Tech Eng
				

Authors qualifications and affiliations:

Iain Paton has post graduate degrees in Geology and Geotechnical Engineering and has over 25 years' experience in the mining, energy and construction industries. Iain Paton is a registered geotechnical professional with the Engineering Council of South Africa (ECSA) and the South African Council for Natural and Scientific Professions (SACNSP). Iain Paton is a member of the Geotechnical Division of the South African Institute of Civil Engineering (SAICE), South African Institute of Engineering and Environmental Geologists (SAIEG), the and the Institute of Municipal Engineering of South Africa (IMESA).

Declaration of independence:

The authors of this report are independent professional consultant with no vested interest in the project, other than remuneration for work associated with the compilation of this report.

General limitations:

1. The investigation has been conducted in accordance with generally accepted engineering practice, and the opinions and conclusions expressed in the report are made in good faith based on the information at hand at the time of the investigation.
2. The contents of this report are valid as of the date of preparation. However, changes in the condition of the site can occur over time as a result or either natural processes or human activity. In addition, advancements in the practice of geotechnical engineering and changes in applicable practice codes may affect the validity of this report. Consequently, this report should not be relied upon after an eclipsed period of one year without a review by this firm for verification of validity. This warranty is in lieu of all other warranties, either expressed or implied.
3. Unless otherwise stated, the investigation did not include any specialist studies, including but not limited to the evaluation or assessment of any potential environmental hazards or groundwater contamination that may be present.
4. The investigation is conducted within the constraints of the budget and time and therefore limited information was available. Although the confidence in the information is reasonably high, some variation in the geotechnical conditions should be expected during and after construction. The nature and extent of variations across the site may not become evident until construction. If variations then become apparent this could affect the proposed project, and it may be necessary to re-evaluate recommendations in this report. Therefore, it is recommended that Outeniqua Geotechnical Services is retained to provide specialist geotechnical engineering services during construction in order to observe compliance with the design concepts, specifications and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. Any significant deviation from the expected geotechnical conditions should be brought to the author's attention for further investigation.
5. The assessment and interpretation of the geotechnical information and the design of structures and services and the management of risk is the responsibility of the appointed engineer.

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1. Introduction

1.1 Background information

An upgrade of the bulk sewer infrastructure has been proposed in Thembalethu Phase 3 and 4 in the George Municipality of the Western Cape (see location of site in Figure 1 and topographic map in Figure 2). The proposed bulk sewer system will be required to manage sewage from the various UISP areas and accommodating all internal reticulation requirements for the proposed formal housing requirements in the area.

The Phase 3 and 4 bulk sewers will serve areas situated south and south-east of the UISP Areas 5 & 6A and will tie into an existing 250mm diameter bulk sewer line. The sewer line will gravitate to the existing Pacaltsdorp Sewer Pump Station 1 which then transfers the sewerage to the Outeniqua WWTW.

The site was investigated in order to determine the geology and general geotechnical properties of the site for the structural and civil engineering designs.

1.2 Scope of work

The scope of the work was to conduct a broad-scope geotechnical site investigation along the proposed pipeline route to assess and insitu soil types, excavatability, material useability and soil bearing capacity along the route, and the following methods were proposed and accepted by the consultants:

- Review the geological and geotechnical data for the area.
- Conduct a subsurface investigation consisting of the following methods:
    - Excavate a limited number of test pits across the site.
    - Profile and photograph a series of test pits according to SAICE Code of Practice.
    - Collect and transport soil samples for testing at SANAS-accredited civil engineering laboratory.
    - Conduct insitu DCP penetrometer testing at each test position to max depth of GL-2.0m or refusal.
- Analyse results and prepare a detailed factual and interpretive report containing all information from the investigation and including recommendations for the design of earthworks, structures and services or any further investigations.

1.3 Available information

The following information was available for consultation:

- 1:50 000 and 1:250 000 geological maps of the area, obtained from the Council for Geoscience.
- Topo-cadastral data for the area, obtained from the National Geospatial Institute (NGI).
- Aerial photos of the area, obtained from the NGI and Google Earth.
- Site layout plans provided by the consultant.

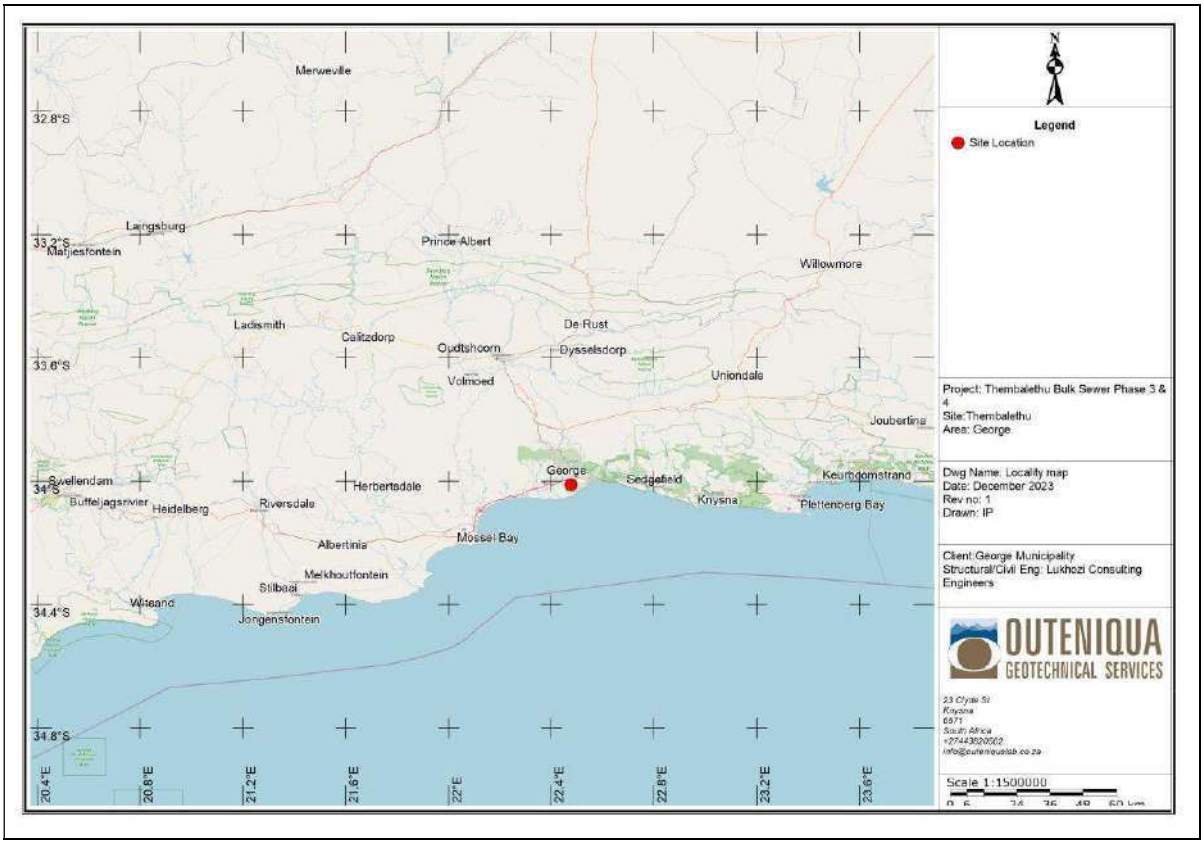


Figure 1: Site locality map

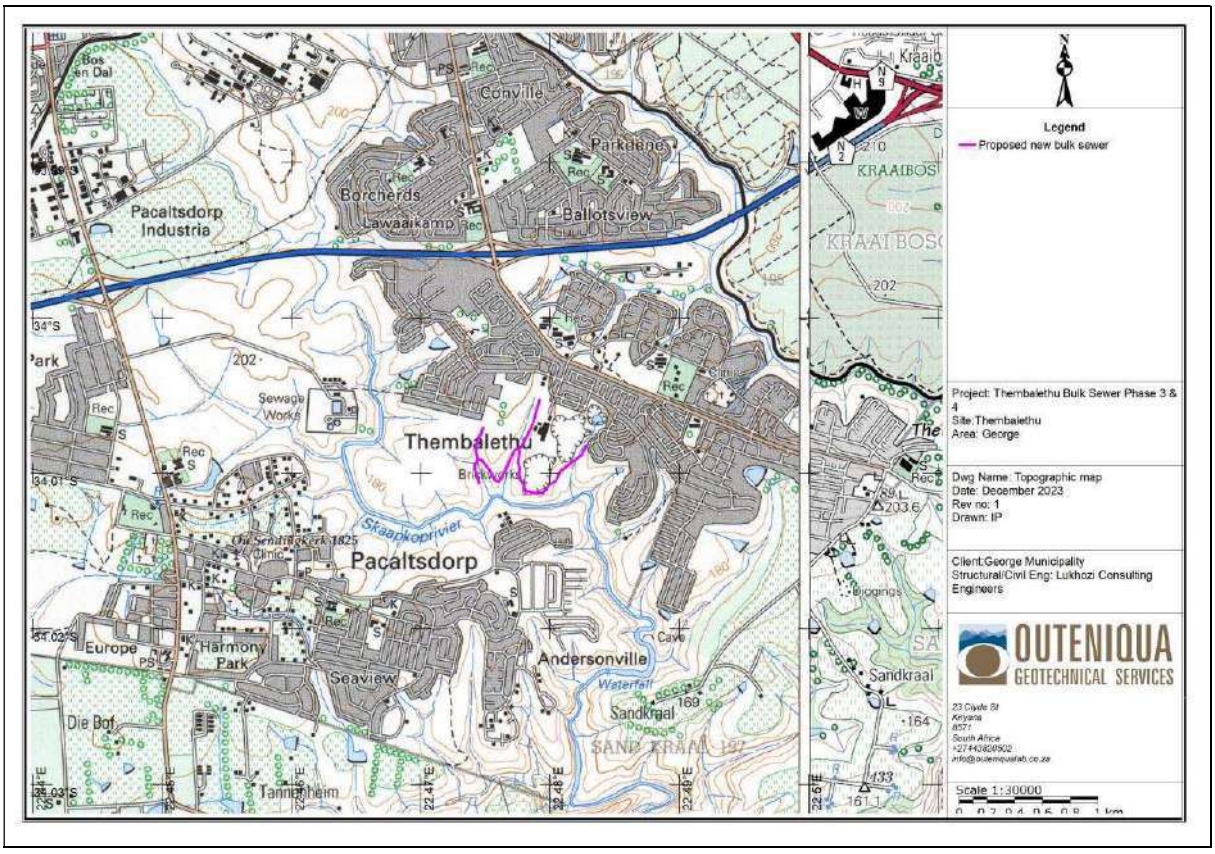


Figure 2: Topographic map of the area showing the proposed bulk sewer lines

2. Site description

The site was located in the township of Thembalethu, approximately 6km southeast of

George Central Business District (CBD). The site area was accessible via 13th Street and Mfayana Street, south of the formal Thembalethu Township (see Figure 2).

The natural topography of the area is generally characterised by gently sloping plateau areas (gradient 1:10 – 1:50), which then slope downward at moderate to steep gradients into the surrounding natural watercourses that drain southward into tributaries of Skaapkop River (see Figure 3). The site area was largely occupied by informal dwellings (shacks) and kraal structures and access around the site was limited to a few gravel roads and many footpaths. The vegetation cover was highly transformed and sparse in most areas but dense towards the main natural drainage lines, consisting of long grass, fynbos and alien trees (see Figure 4 and Figure 6). There were several small dams and poorly drained areas (ponds) where stormwater had collected and there was some existing stormwater infrastructure noted in some areas (See Figure 7).

The local site topography and ground surface conditions at the time of the investigation were very uneven in places due to historical mining operations associated with the old Allbrick Quarry, and there were several old excavations, erosion dongas and mounds of soil, producing a highly irregular ground surface (see Figure 8 to Figure 10).

The climate of the area was classified as temperate and seasonally wet, with a Wienert N-Value of approximately 2-3. The surface conditions on the site at the time of the investigation were very moist to wet due to recent heavy rains with several ponds of stagnant water lying about the site.

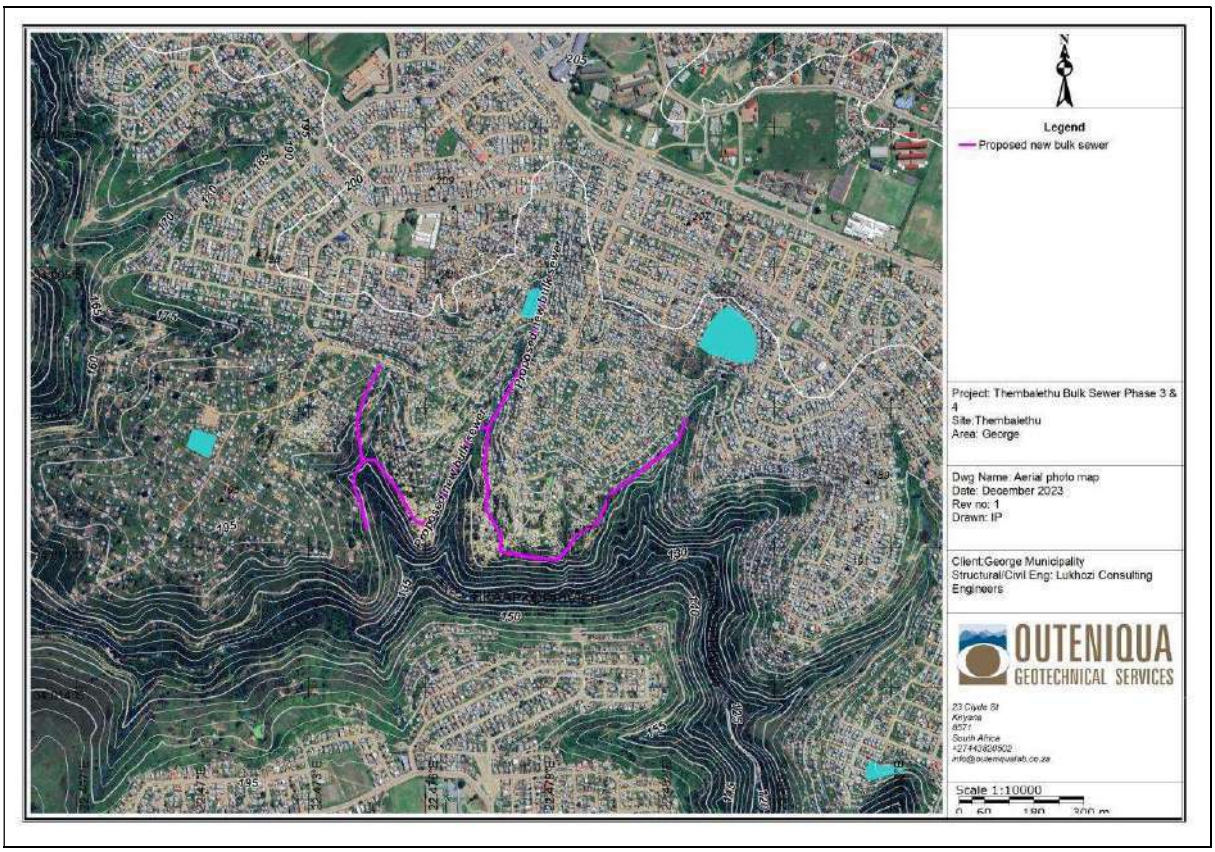


Figure 3: Aerial photo of the site area

Figure 4: Gravel access roads on the site

Figure 5: Footpaths on site

Figure 6: Typical site conditions

Figure 7: Existing stormwater pipe culvert near TP4

Figure 8: Old quarry area on site

Figure 9: Mounds of soil associated with the old mining activities

Figure 10: Erosion dongas commonly seen on the site

3. Methods of investigation

A review of available geotechnical data was conducted prior to mobilising to site. Once on site, a brief site walk-over inspection was conducted before commencing with the subsurface investigation.

The subsurface investigation consisted of 8 test pits excavated with a pick and shovel (See **Appendix 1** for a plan of the test positions). The subsurface investigations were conducted in order to establish the near-surface geology and general geotechnical profile of the site. The soil profiles and photographs of the test pits were included in **Appendix 2** of this report.

Samples of insitu soils were collected from test pits for Foundation Indicator (grading, Atterberg limits and moisture content), Modified AASHTO maximum dry density, optimum moisture content and CBR. The tests were conducted at a SANAS-accredited civil engineering laboratory in accordance with standard South African test methods. See **Appendix 3** for details.

In situ dynamic cone penetrometer (DCP) tests were conducted at each of the test pit positions. The tests were done in accordance with TMH6 ST6. The probes were driven from ground surface to a depth of NGL-2.0m or refusal. Details of the tests were included in **Appendix 4** of this report.

The site testing data was then collated and assessed by a professional engineering geologist/geotechnical engineer.

4. Results of the site investigation

4.1 Regional geology

The geological mapping of the area indicated that the site was underlain by granite of the Maalgaten suite of the George pluton (see Figure 11) which is well exposed in old

mining excavations across the site (see Figure 12). The George pluton consists of several granitic bodies that were intruded into older country rocks of the Kaaimans Group of meta-sediments during the Cambrian era. Younger meta-sedimentary rocks of the Peninsula Formation (Table Mountain group) occur to the north of the George area. The George pluton has been subjected to intense deformation, similar to that of the older country rocks of the Kaaimans Formation and typically exhibit strong penetrative planar and linear fabrics. In some places the granite has been intensely sheared, mainly along its margins. There are no major geological faults in the immediate vicinity of the site, and there is a low risk of seismic activity in the area.

The Maalgaten granite is the most voluminous lithological unit of the George pluton which underlies most of the George area. The granite rock is poorly exposed in the George area and is typically covered by a thick soil overburden of weathered saprolite. The underlying "fresh" zone is typically dark to light grey, slightly weathered to unweathered, moderately to slightly fractured, medium hard to very hard. The dominant mineral types are quartz, K-feldspar, plagioclase, muscovite, chlorite, biotite and epidote.

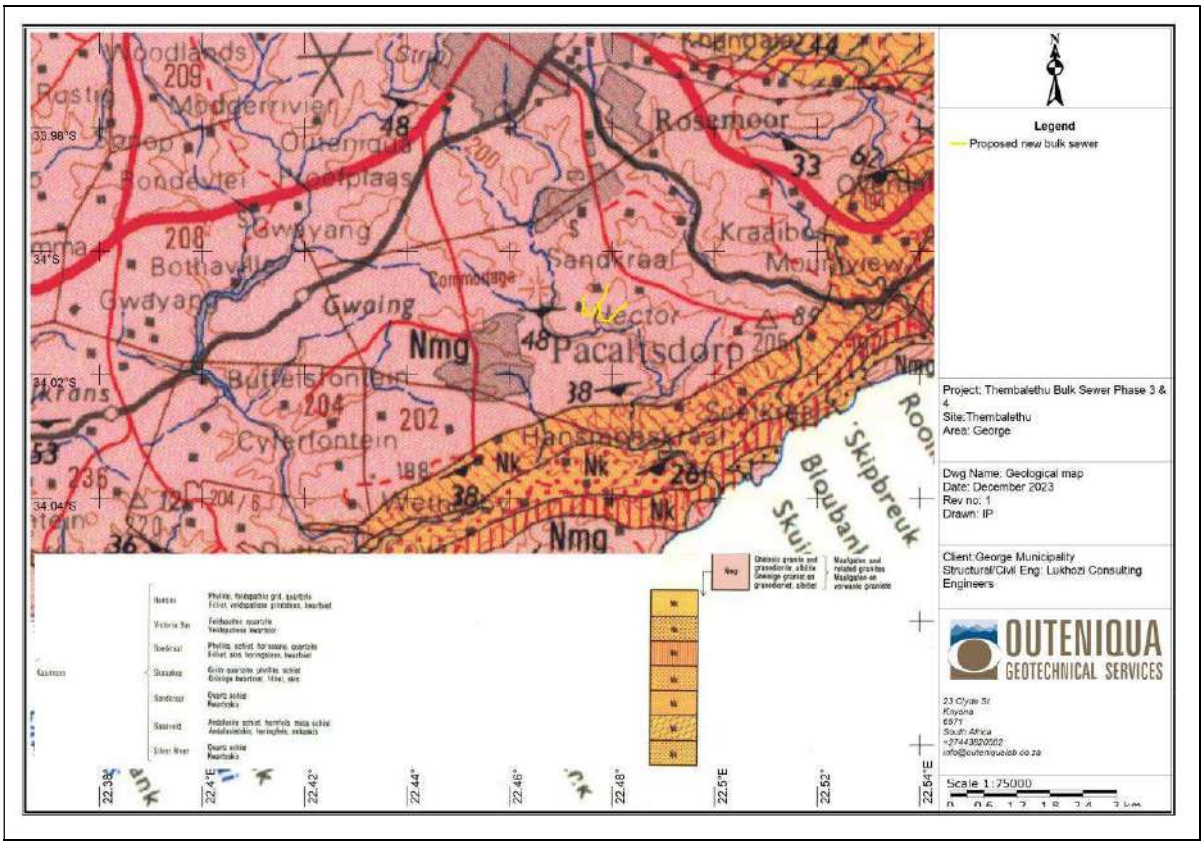


Figure 11: Geological map of the area

Figure 12: Exposure of weathered granite near site

4.2 Local soil and rock types

Test pits conducted on the site (see Figure 13) indicated that the general soil profile consisted of the following horizons for surface downward (See also Figure 14):

- Imported fill (disturbed/dumped soil) – Silty/clayey gravelly sand
- Colluvium/hillwash (topsoil) silty sand
- Pedogenic ferricrete (plinthite/laterite) – silty/clayey sandy gravel
- Residual completely weathered granite clayey/silty gravelly sand or silty sandy gravel.

The underlying rock profile consisted of a "weathered zone" underlain by a "fresh zone". The weathered zone typically ranges from light grey to light orange brown, highly to moderately weathered, highly fractured, very soft to soft rock which can probably be ripped using mechanical methods. Apart from some isolated metapelitic xenoliths (schist, phyllite), no other rock types or formations occur in the quarry area.

The soil horizons were described in detail in the following paragraphs.

Figure 13: Test pits conducted on site

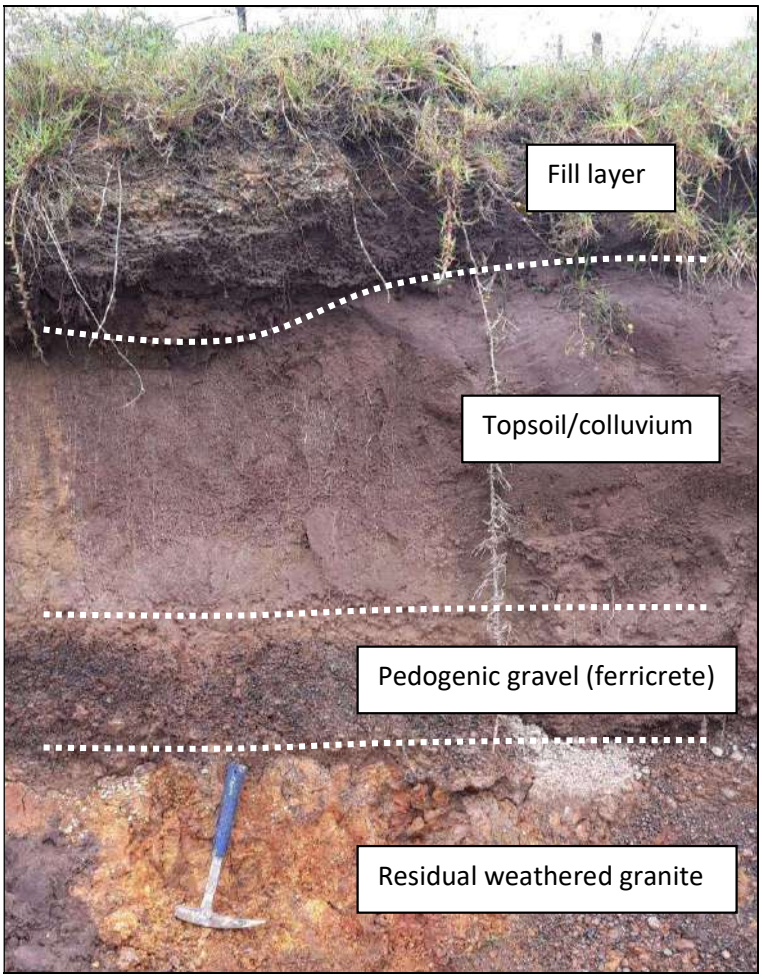


Figure 14: Typical soil profile observed in the area

Imported Fill

Superficial fill material recorded in some test pits was generally described as moist, dark

yellow to dark red orange, clayey/silty sandy gravel or clayey/silty sand with varying consistency. In some areas, this fill layer also contained building rubble (see Figure 15) and rubbish. The thickness of this horizon varied widely but was typically less than 1m but exceeded 1.5m in some areas.

Transported soil (Colluvium and alluvium)

The naturally transported soil appeared to primarily consist of moist, dark grey/brown, silty fine sand. In the upper portion of the horizon, the soil is described as loose and pinholed, with some organic content. Lower down, horizon may transition to an intact state. Sporadic occurrences of alluvial gravel were also encountered, exhibiting a more dense consistency compared to the finer colluvial soils.

Residual

The residual soil, derived from the in situ weathering of the underlying granite rock, was generally described as moist, light yellowish/reddish orange in colour, medium dense/firm to dense/stiff, fissured/intact clayey silty gravelly sand or clayey sandy gravel (see Figure 16). Some localised black staining along fissures indicated groundwater seepage. Overall, the residual soil profile pointed towards a well-established granitic base with a potential localized variation in moisture content.

Figure 15: Brick rubble fill encountered at TP1

Figure 16: Typical soil types exposed at TP5

A map of the test positions was provided in Figure 17 and a summary of the test pit data was provided in Figure 18 and Table 1.

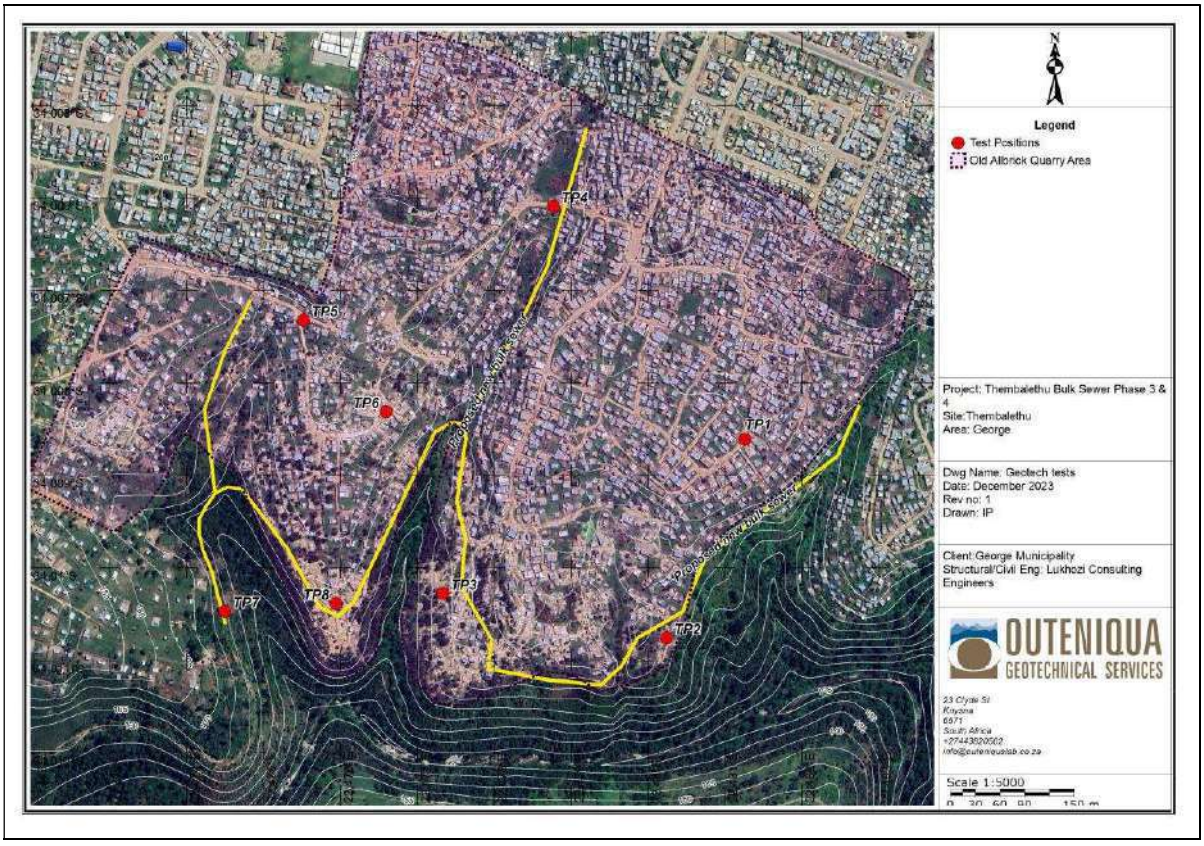


Figure 17: Geotechnical map

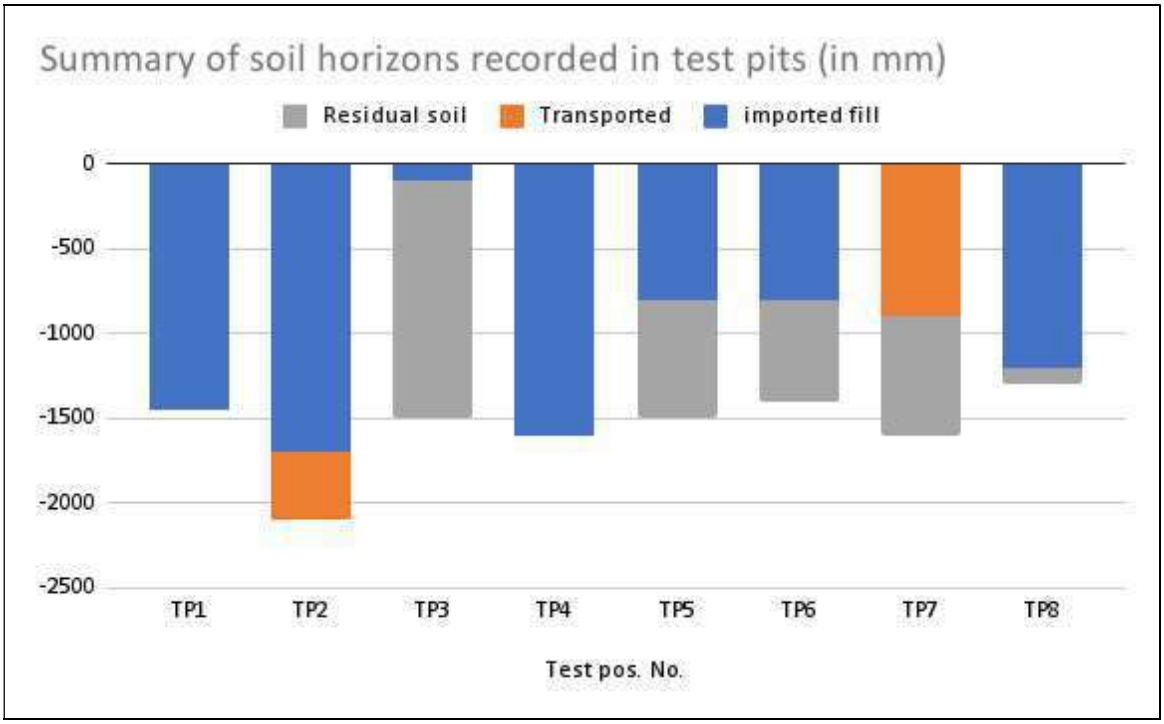


Figure 18: Summary of the soil profiles

Table 1: Summary of test pit data (layer thickness in mm)

Test pos. No.	*Imported soil (fill)*	*Colluvium/ alluvium*	*Residual*	*Total depth of test pit*	*Refusal depth*
TP1	0-1450	-	-	1450	-
TP2	0-1700	1700-2100	-	2100	-
TP3	0-100	-	100-1500	1500	-
TP4	0-800	-	800-1500	1500	-
TP5	-	0-2500	-	2500	-
TP6	0-800	-	800-1600	1600	-
TP7	-	0-900	900-1600	1600	-
TP8	0-1200	-	100	1300	-

4.3 Groundwater

During the investigation, free groundwater was not encountered in any of the test pits but there was evidence of previous seepage from existing exposures and in some mottled soils. Seasonal seepage was also expected due to the typical wet climate of the area.

4.4 Insitu tests

In situ penetration tests (DCP) conducted through the upper 2m of the profile indicated the that the soil was typically variable in consistency/strength. The fill material was typically loose/very loose (see TP2, TP4, TP5 & TP6) but the natural soil profile was relatively dense (medium dense to dense/stiff). There were some localised increases in penetration rate near the upper contact of the residual soil, which may indicate the presence of moist soil or seepage (e.g. at TP7 @1m).

4.5 Lab tests

Representative samples of the insitu soil types were collected for Foundation Indicator tests to determine the particle size distribution (grading) and Atterberg limits. The results of the Foundation Indicator tests were shown in Table 2 and an analysis of the particle size distributuions were presented in Figure 19.

Table 2: Summary of Foundation Indicator tests

Test Pit No	Sample Depth (mm)	Atterberg Limits			Particle Analysis (%)				MC*	PE**	USC ***
		PI	LL	LS	Clay	Silt	Sand	Gravel			
TP1	0-300	12	28	6	14	25	27	34	0	LOW	GC
TP2	0-700	14	29	7	25	18	40	17	0	LOW	SC
TP3	100-1500	9	36	5	13	26	28	33	0	LOW	GM
TP4	1300-1600	13	25	7	16	34	36	14	0	LOW	CL
TP5	400-800	15	30	8	3	10	32	55	0	LOW	GC
TP6	0-800	12	43	6	12	60	21	7	0	LOW	ML
TP7	800-1600	13	38	13	28	18	39	15	0	LOW	SM
TP8	0-1200	12	38	6	12	38	35	15	0	LOW	ML

* Insitu Moisture Content ** Potential Expansiveness *** Unified Soil Classification

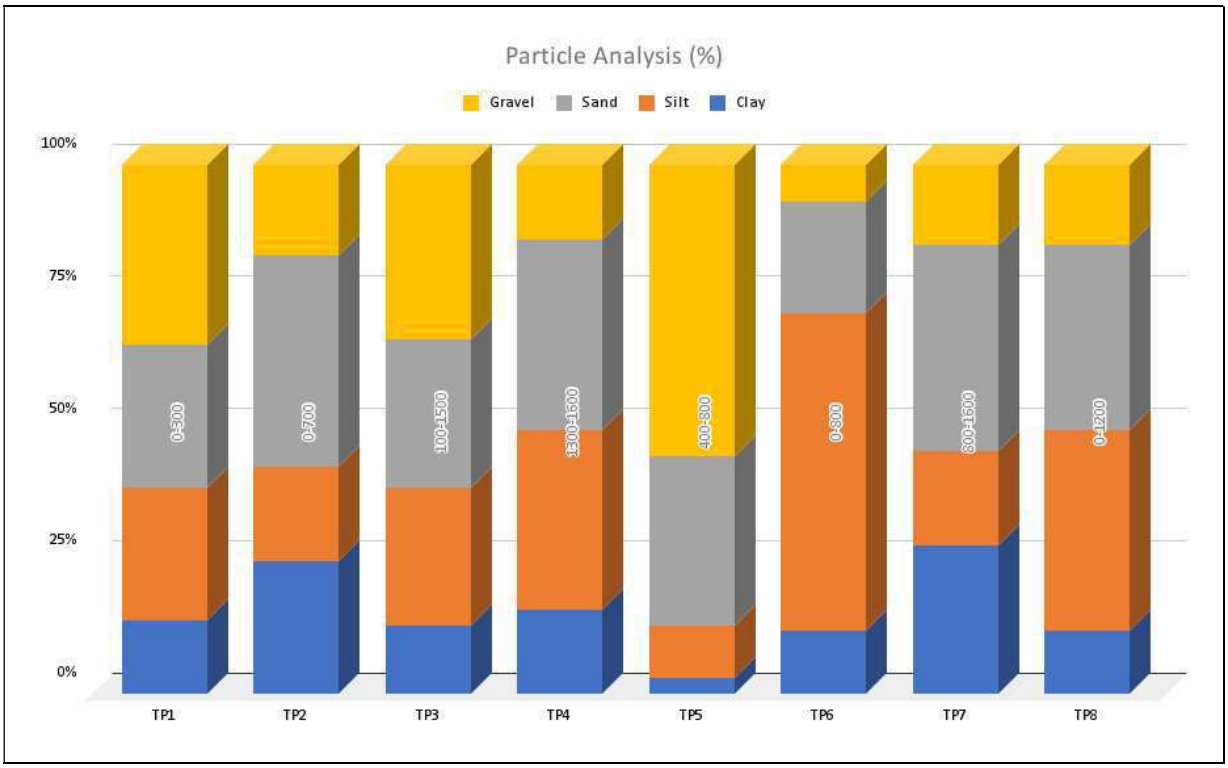


Figure 19: Particle size distribution

The results of the tests indicated that the soils in the test pits exhibited a range of particle sizes from clay to gravel. The clay content of the soils ranged from 3% to 28%, and the silt content ranged from 10% to 60%. The plasticity index (PI) was typically low-medium, ranging from 9 to 14%.

The soil samples recovered from test pits were classified according to the Unified Soil

Classification System (USCS), based on their grain size distribution and plasticity, as:

- CL (clays with low to medium plasticity)
- ML (silty fine sands, silts)
- SM (Silty sands)
- SC (clayey sands)
- GC (clayey gravels)

Representative samples were collected for maximum dry density (Mod. AASHTO), CBR & Road Indicator tests to determine the potential of the material for structural fill purposes and/or for subgrade fill in pavement designs. The results of the tests were summarised in Table 3.

Table 3: Summary of CBR tests

Test Pit No	*Sample Depth (mm)*	*CBR at*					*Swell (%)*	*PI (%)*	*GM*	*MDD / OMC*	*COLTO Class*
		100 %	*98%*	*95%*	*93%*	*90%*					
TP1	0-300	7	6	5	5	4	1.5	12	1.51	1948/ 9.3	G9 Subgrade
TP2	0-700	5	3	2	1	1	2.4	14	1.37	1876/ 12.8	Not Classified
TP3	100-1500	6	5	4	4	3	1.8	9	1.89	1957/ 8.0	Not Classified
TP4	1300-1600	9	5	6	5	3	1.3	13	1.1	1.14	Not Classified
TP5	400-800	14	10	6	4	2	1.7	15	1.9	2006/ 8.2	Not Classified
TP6	0-800	2	2	1	1	1	6	12	0.72	1750/ 13.3	Not Classified
TP7	900-1600	4	2	1	1	1	2.9	13	1.21	1868/ 11.2	Not Classified
TP8	0-1200	3	3	2	2	1	2.8	12	1.22	1978/ 8.4	Not Classified

The CBR test results indicated that the soils encountered on site were generally poor quality. General site observations did, however, indicate some sporadic deposits of coarser-grained soils such as sands & gravels related to the old quarrying activity which could be potentially useful as general/bulk fill on platforms or lower subgrade fill in roads but these were not sampled and would have to be identified in further investigations.

5. Geotechnical assessment

5.1 Groundwater, permeability and site drainage

Localised groundwater seepage, possible small springs and surface water ponding was expected in the area, requiring attention to site drainage and stormwater management. High percentages of surface run-off due to low permeability soils was also expected.

5.2 Excavations and natural slope stability

Anticipated excavation classification in terms of SABS1200D for the proposed pipeline were provisionally classified under "Soft" class.

The proposed pipeline route runs across a highly variable topography due to the historical mining operations and current human activity, and there were several excavations, erosion dongas and heaps of soil with potentially unstable steep slopes on the site.

Trench sidewalls up to 1.5m deep were expected to be marginally stable for short periods of time with minimal shoring/overbreak required, but excavations deeper than 1.5m would require battering of sidewalls to approx. 45°.

6. Recommendations

The design of structures and civil services remains the responsibility of the appointed civil and structural engineers. The recommendations contained herein do not supersede or override any applicable standards, codes, project specifications or designs provided by the appointed engineers.

The following recommendations were based on limited information gained from the site investigation, and although the confidence in the information was high, some variation in ground conditions was expected to occur between information points. All geotechnical information should therefore be confirmed during construction and if necessary, additional investigations may have to be commissioned. Any significant variations should be brought to the attention of the authors or appointed geotechnical engineers for comment or further recommendations. It was recommended that the structural engineer discuss his/her conceptual design with the geotechnical engineers to ensure that any calculations and recommendations were in line with current information.

The following recommendations were provided for consideration by the civil engineers:

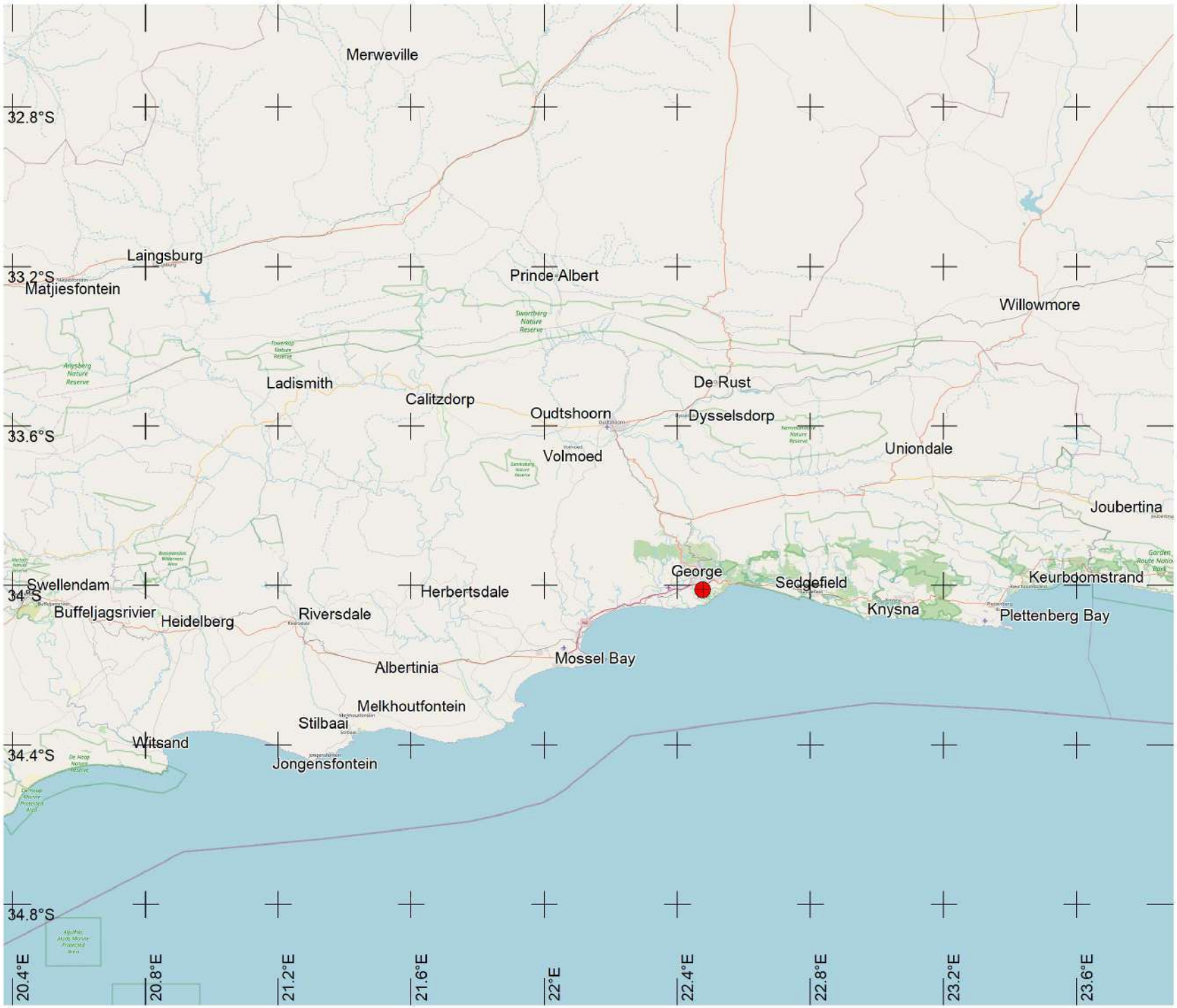
- Difficult access, steep slopes, and unsafe working conditions were expected along the route, requiring consideration for appropriate plant and site clearance along the proposed sewer line route. Crossing of natural drainage lines also requires careful consideration of poor/wet ground conditions and high erosion potential.
- Some dewatering of excavations may be required in places (mainly near existing drainage lines/low areas).
- Pipelines should be embedded in a cradle of well compacted imported material at a minimum depth of 1.5m. Pipe bedding and blanket materials should be imported selected granular material as per SABS 1200LB. Compaction of pipe cradle materials should be done in accordance with SABS 1200LB.
- Soil obtained from excavations should be stockpiled and inspected by the engineer for possible use as selected main fill material over the pipe cradle. General fill should be compacted to min 93%MDD.
- Structures such as manholes, pumpstations and pipe support structures (thrust blocks, piers, etc) should be founded on dense residual (insitu) soil at a minimum depth of NGL-1m and vertical bearing pressures should be limited to 150kPa. It is further recommended that the founding conditions be verified by a geotechnical engineer before foundations are cast.

7. Conclusions

The investigations indicated that the design of the proposed pipeline route presents some technical challenges, including access, existing informal dwelllings, topography variations, old quarrying areas, site drainage problems and poor soils. Some preliminary recommendations were provided for consideration by the design engineers but all information should be verified during construction.

Appendix 1

Maps



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Legend

Site Location

Project: Thembalethu Bulk Sewer Phase 3 & 4
Site:Thembalethu
Area: George

Dwg Name: Locality map
Date: December 2023
Rev no: 1
Drawn: IP

Client:George Municipality
Structural/Civil Eng: Lukhozi Consulting Engineers

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Scale 1:1500000

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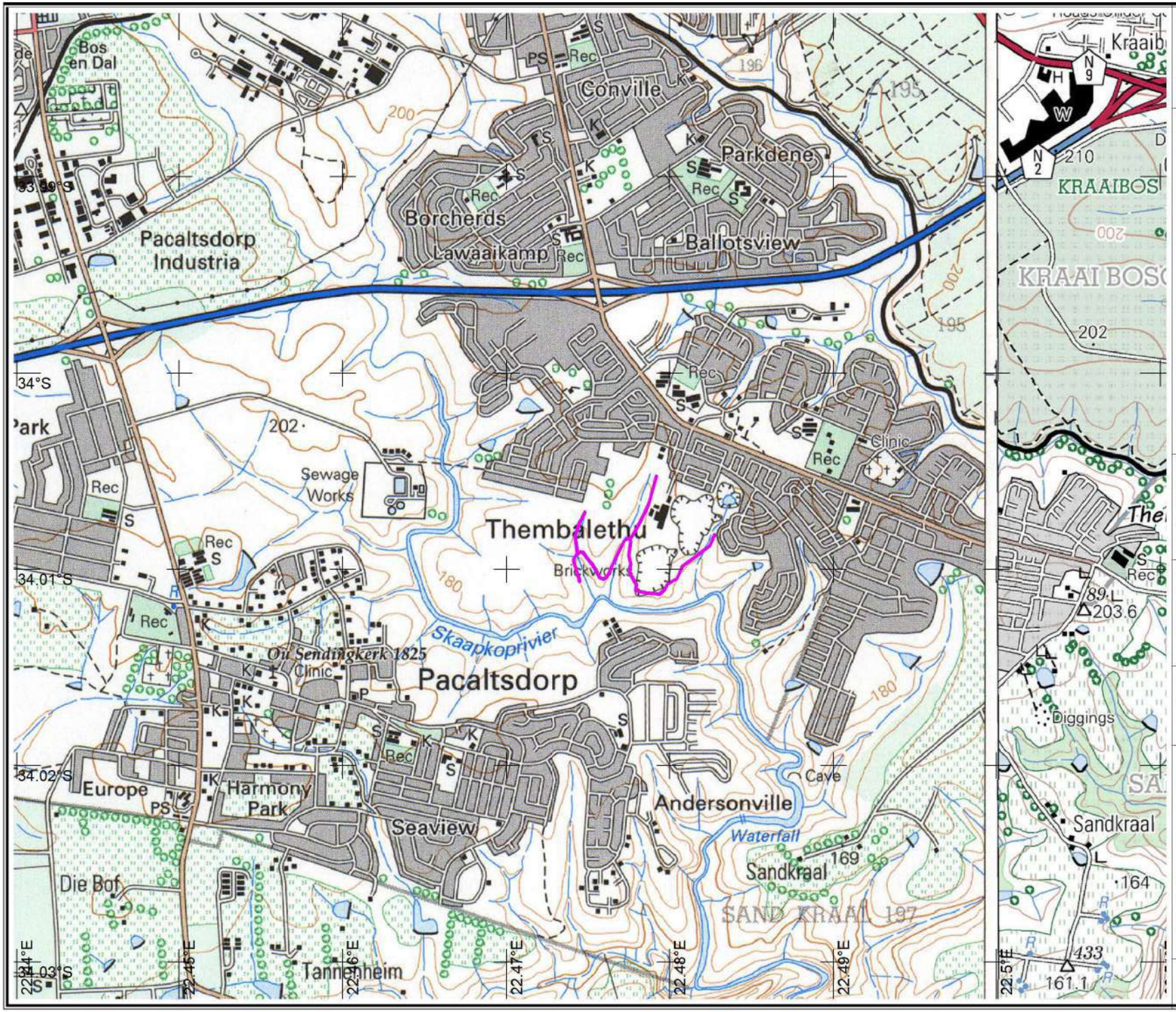

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Legend

Proposed new bulk sewer

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Site:Thembalethu
Area: George

Dwg Name: Topographic map
Date: December 2023
Rev no: 1
Drawn: IP

Client:George Municipality
Structural/Civil Eng: Lukhozi Consulting Engineers

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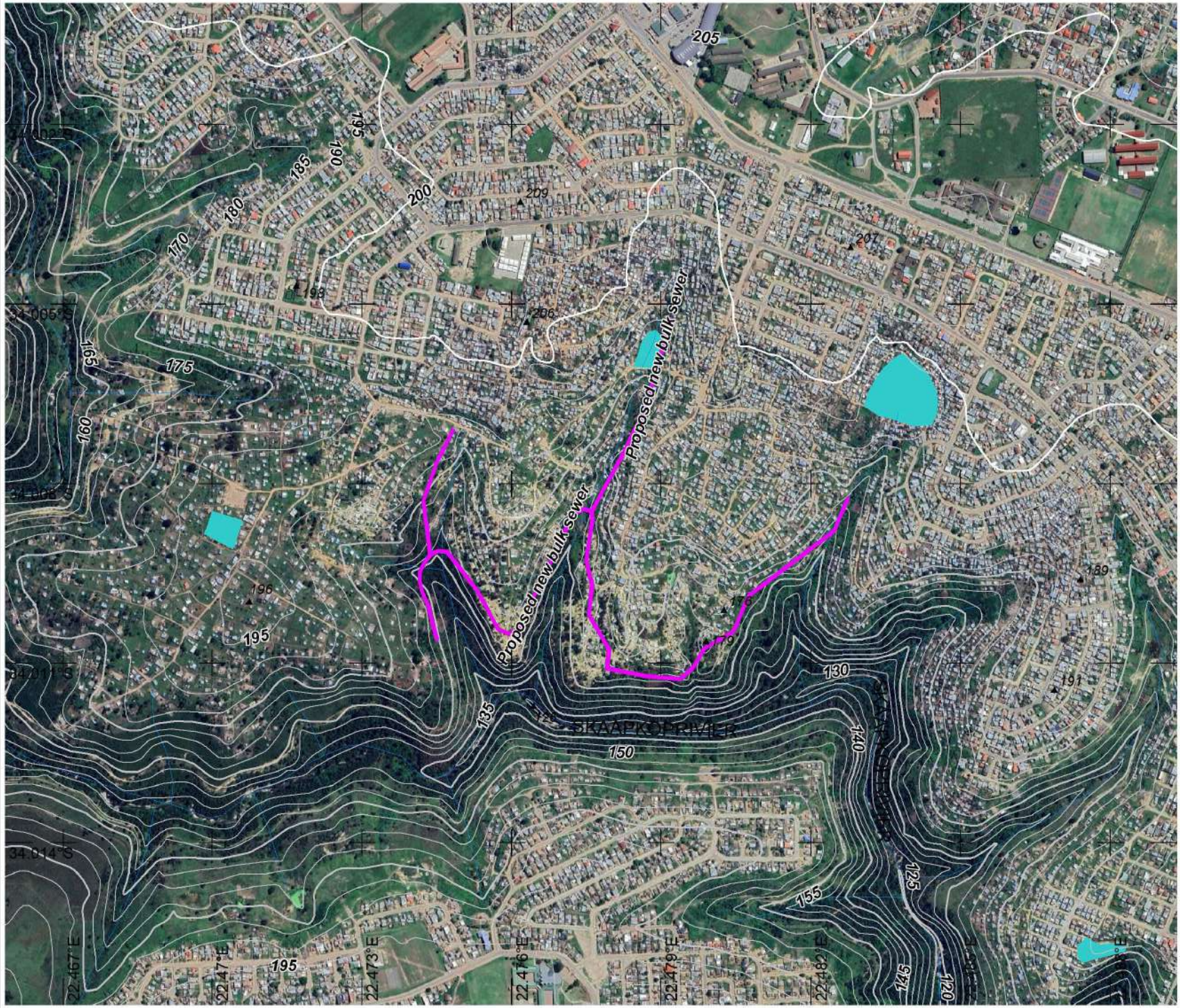

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Legend

Proposed new bulk sewer

Project: Thembalethu Bulk Sewer Phase 3 & 4
Site:Thembalethu
Area: George

Dwg Name: Aerial photo map
Date: December 2023
Rev no: 1
Drawn: IP

Client:George Municipality
Structural/Civil Eng: Lukhozi Consulting Engineers

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Scale 1:10000

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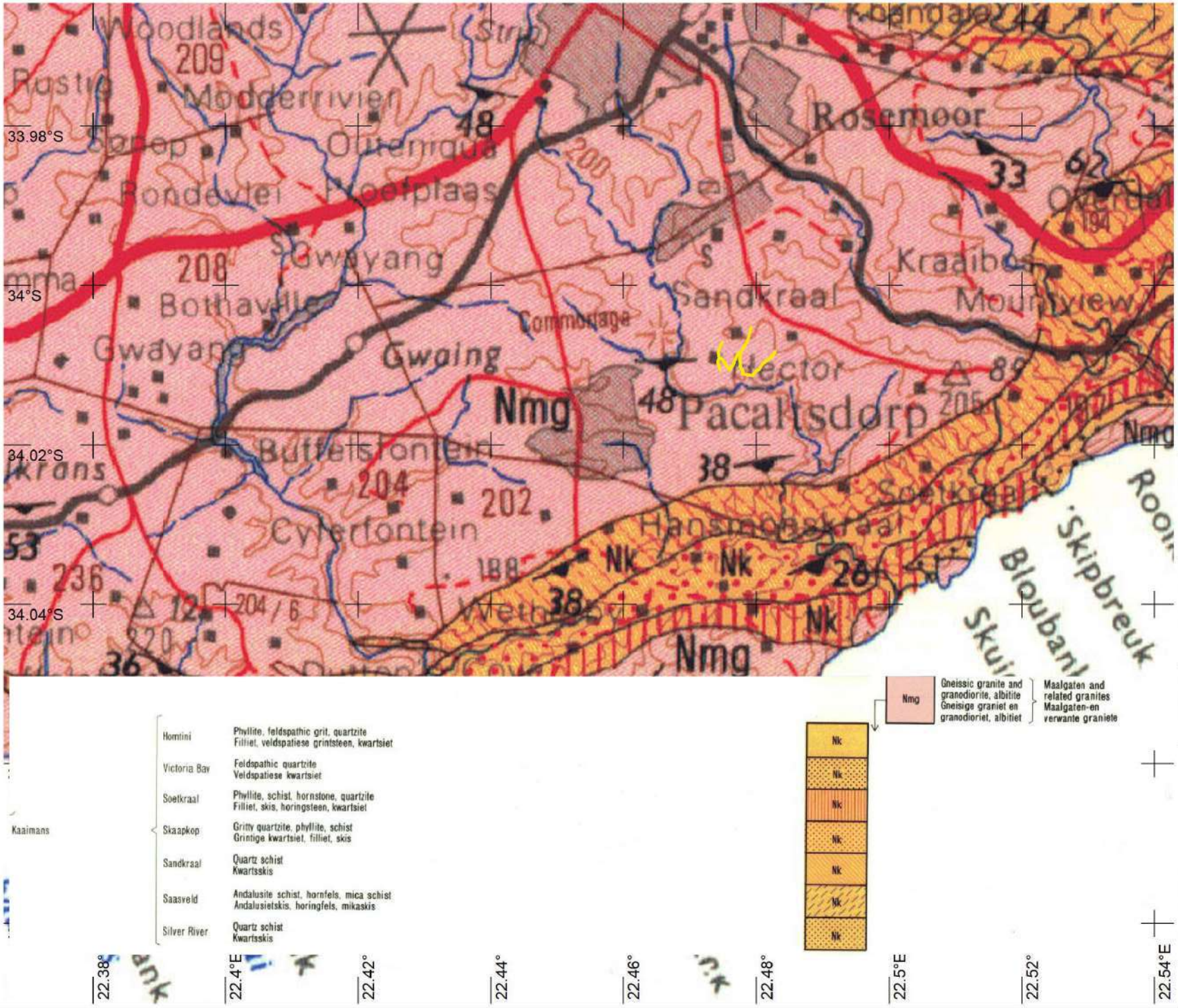

N

Legend

Proposed new bulk sewer

Project: Thembalethu Bulk Sewer Phase 3 & 4
Site:Thembalethu
Area: George

Dwg Name: Geological map
Date: December 2023
Rev no: 1
Drawn: IP

Client:George Municipality
Structural/Civil Eng: Lukhozi Consulting Engineers

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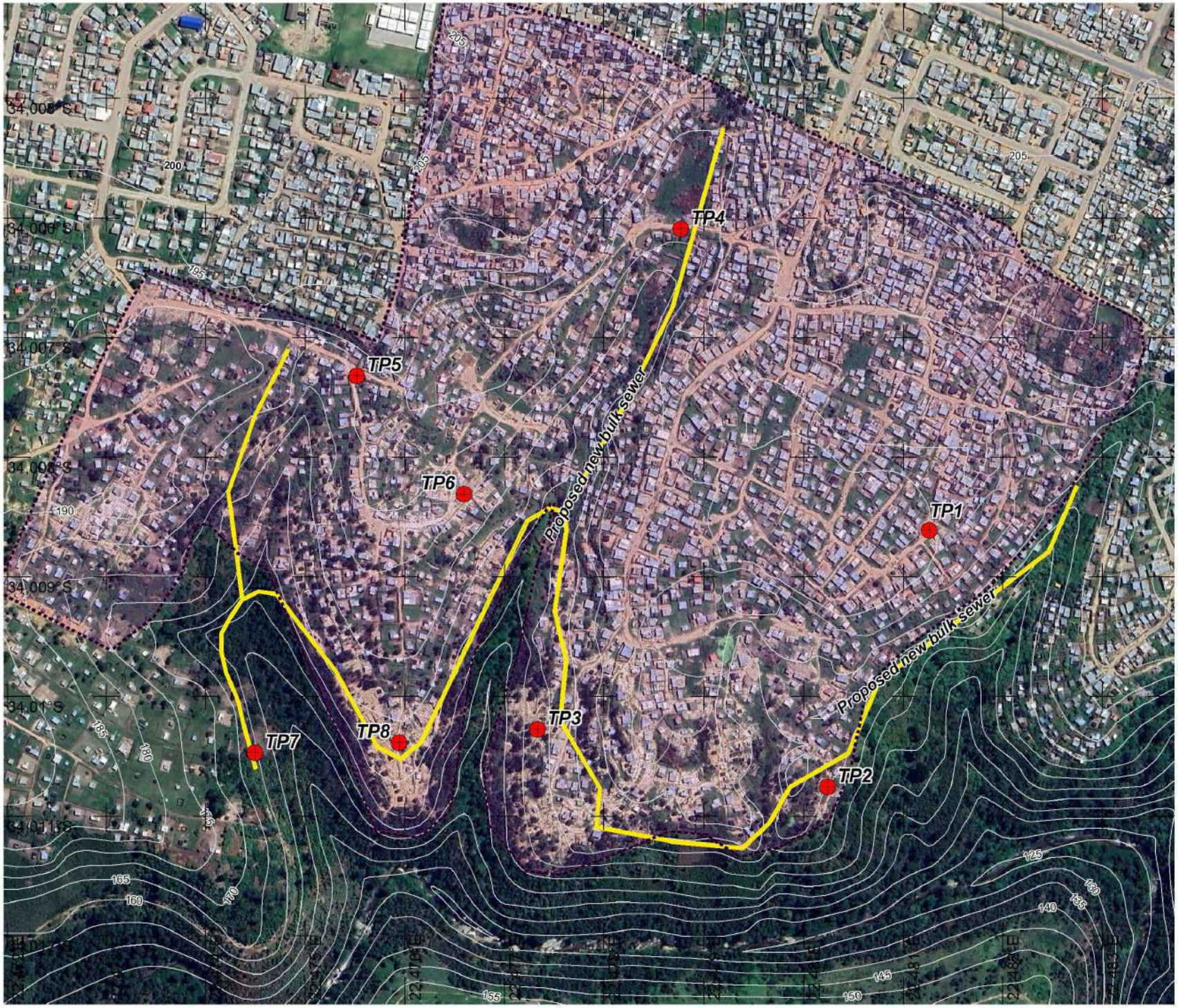
Scale 1:75000

0 0.6 1.2 1.8 2.4 3 km



N

Legend

- Test Positions
- Old Allbrick Quarry Area

Project: Thembalethu Bulk Sewer Phase 3 & 4
Site:Thembalethu
Area: George

Dwg Name: Geotech tests
Date: December 2023
Rev no: 1
Drawn: IP

Client:George Municipality
Structural/Civil Eng: Lukhozi Consulting Engineers

OUTENIQUA GEOTECHNICAL SERVICES

23 Clyde St
Knysna
6571
South Africa
+27443820502
info@outeniqualab.co.za

Scale 1:5000

0 30 60 90 150 m

Appendix 2

Test pit profiles

OUTENIQUA GEOTECHNICAL SERVICES

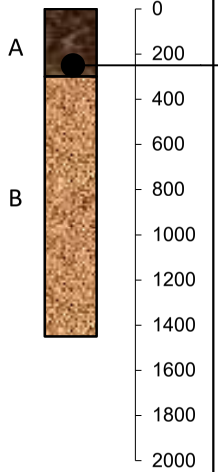
Geotechnical Soil Profile

Client:	Lukhozi Consulting Engineers
Project:	Thembalethu Bulk Sewer Phase 3 & 4
Area:	George Municipality
Date:	14.11.2023
Excavator:	By Hand

TP 1

Datum: NGL | Co-ords: 23 Y0047919 X3764737

Key to symbols: Sample taken | Groundwater



(0 to 300) Slightly moist, dark reddish brown, medium dense, intact, **CLAYEY SILTY SANDY GRAVEL**, imported (fill made ground)

Foundation Indicator & MOD/CBR/Indicator

(300 to 1450) Moist, dark red, dense, intact, **BRICK FILL RUBBLE**, imported (fill made ground)

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

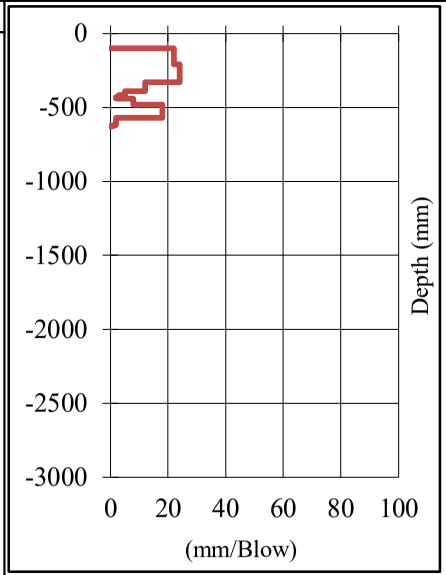
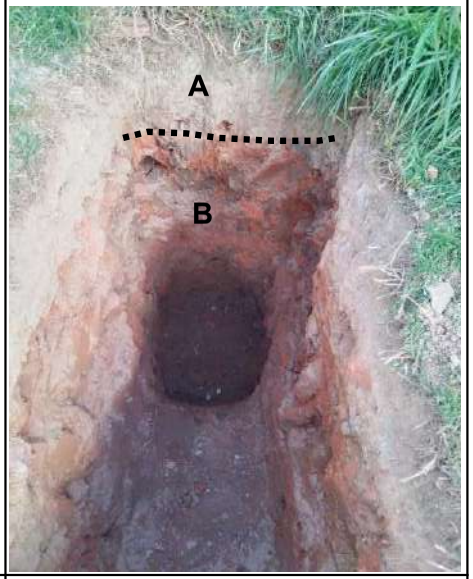


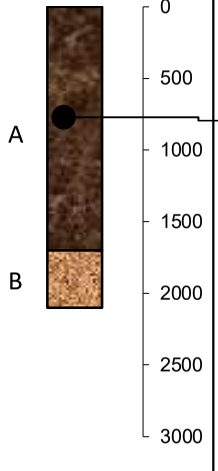
Photo of Test Pit



TP 2

Datum: NGL | Co-ords: 23 Y0048012 X3764976

Key to symbols: Sample taken | Groundwater



(0 to 1700) Very moist, dark yellow, very loose, intact, **GRAVELLY SILTY CLAYEY SAND & RUBBISH**, imported (fill worked ground)

Foundation Indicator & MOD/CBR/Indicator

(1700 to 2100) Moist, dark grey, loose, pinholed, **SILTY SAND**, transported.

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

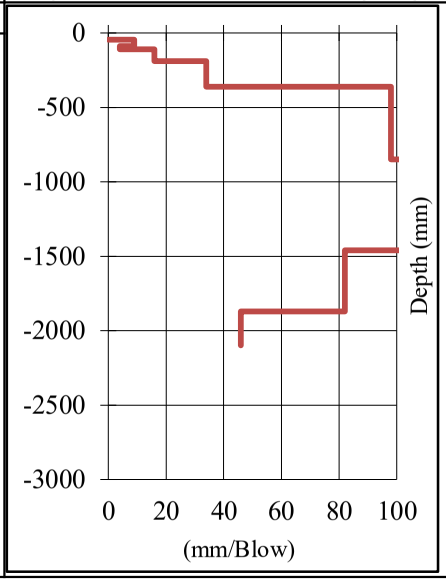
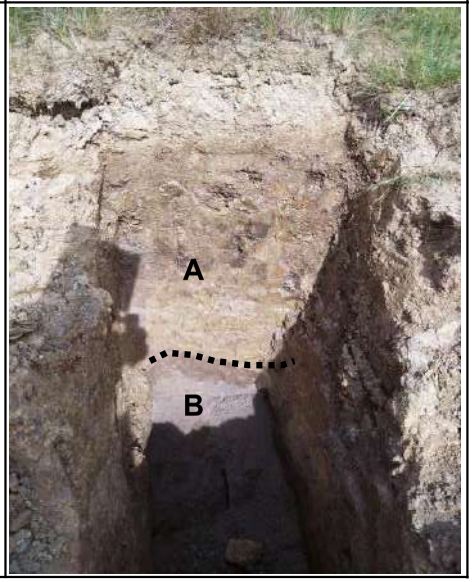


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

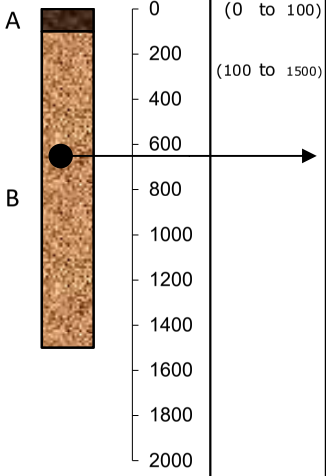
Geotechnical Soil Profile

Client:	Lukhozi Consulting Engineers
Project:	Thembalethu Bulk Sewer Phase 3 & 4
Area:	George Municipality
Date:	14.11.2023
Excavator:	By Hand

TP 3

Datum: NGL | Co-ords: 23 Y0048281 X3764924

Key to symbols: ● Sample taken | Groundwater



(0 to 100) Moist, dark yellowish orange, dense, intact, **SANDY GRAVEL**, imported (fill made ground)

(100 to 1500) Moist, light yellowish orange, dense to very dense, intact, **CLAYEY SILTY SANDY GRAVEL**, residual.

Foundation Indicator & MOD/CBR/Indicator

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

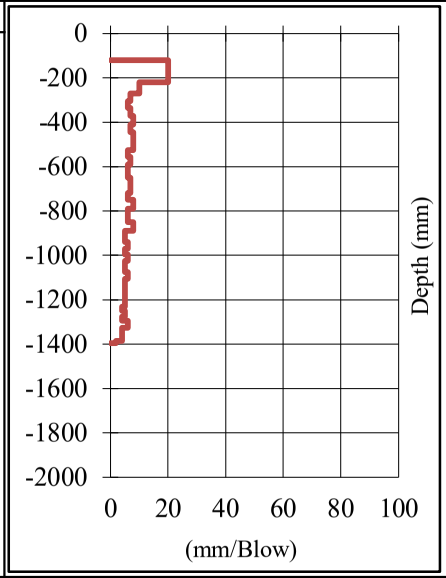
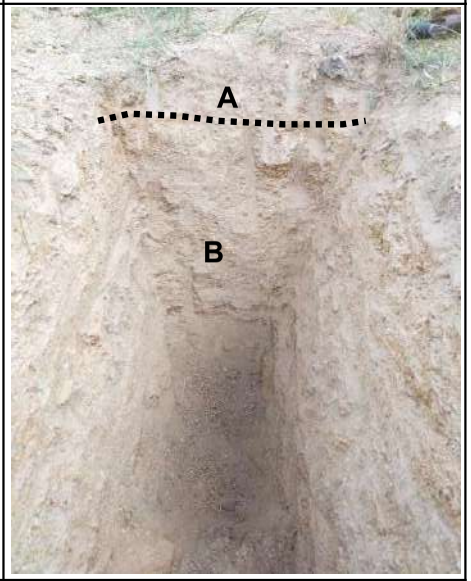


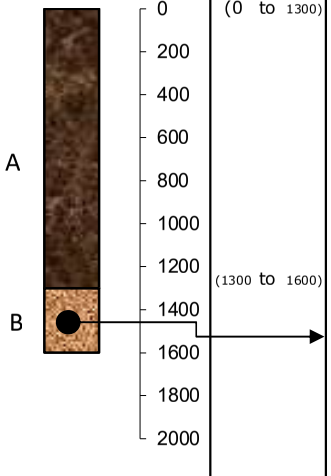
Photo of Test Pit



TP 4

Datum: NGL | Co-ords: 23 Y0048150 X3764459

Key to symbols: ● Sample taken | Groundwater



(0 to 1300) Slightly moist, dark reddish brown, medium dense, intact, **SILTY SANDY GRAVEL**, imported (fill made ground)

(1300 to 1600) Moist, light brown to dark red brown, medium dense, intact, **GRAVELLY CLAYEY SILTY SAND**, imported (fill made ground)

Foundation Indicator & MOD/CBR/Indicator

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

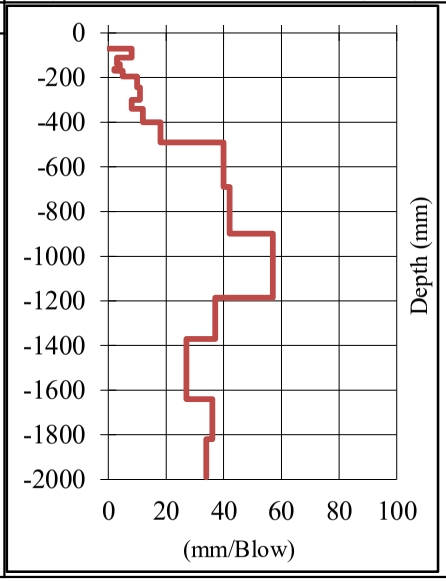
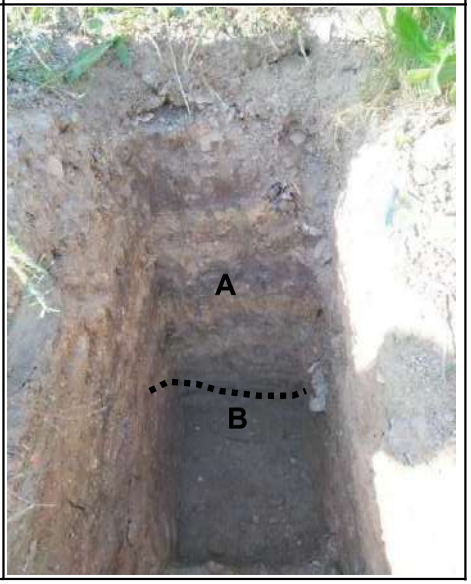


Photo of Test Pit



OUTENIQUA GEOTECHNICAL SERVICES

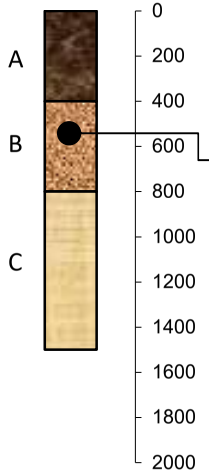
Geotechnical Soil Profile

Client:	Lukhozi Consulting Engineers
Project:	Thembalethu Bulk Sewer Phase 3 & 4
Area:	George Municipality
Date:	14.11.2023
Excavator:	By Hand

TP 5

Datum: NGL | Co-ords: 23 Y0048450 X3764597

Key to symbols: ● Sample taken | Groundwater



(0 to 400) Slightly moist, dark reddish brown, medium dense, intact, **SILTY SANDY GRAVEL**, imported (fill made ground)

(400 to 800) Moist, dark yellowish orange, dense, intact, **SILTY SANDY GRAVEL**, imported (fill made ground)

Foundation Indicator & MOD/CBR/Indicator

(800 to 1500) Moist, light yellowish orange, very dense, intact, **SILTY SANDY GRAVEL**, residual.

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

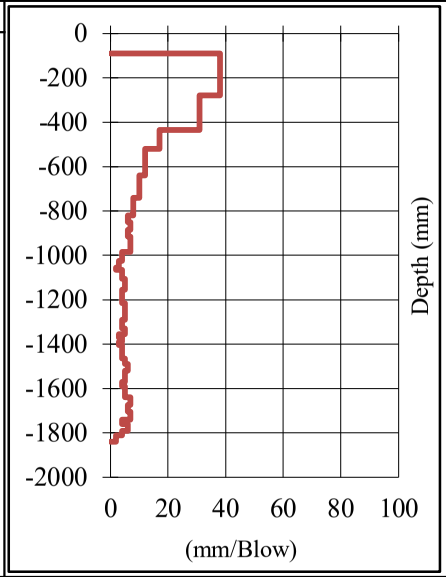
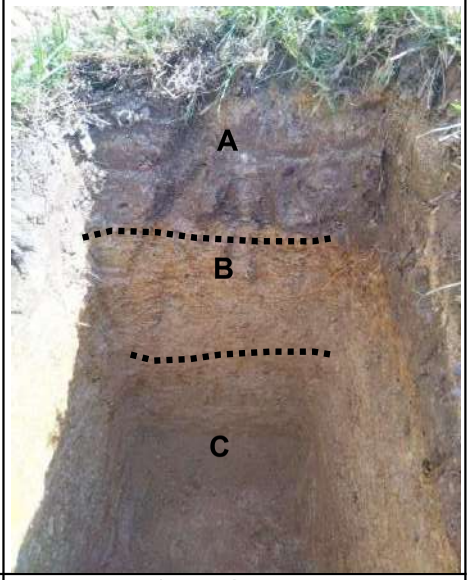


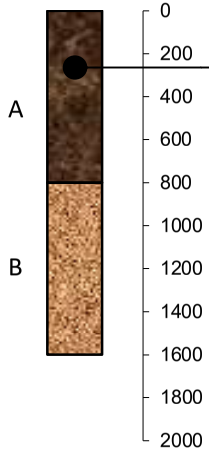
Photo of Test Pit



TP 6

Datum: NGL | Co-ords: 23 Y0048351 X3764706

Key to symbols: ● Sample taken | Groundwater



(0 to 800) Moist, light brown, medium dense, intact, **CLAYEY SANDY SILT & RUBBISH**, imported (fill made ground)

Foundation Indicator & MOD/CBR/Indicator

(800 to 1600) Moist, dark brown, stiff, slickensided, **CLAYEY GRAVELLY SAND GRAVEL**, residual.

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

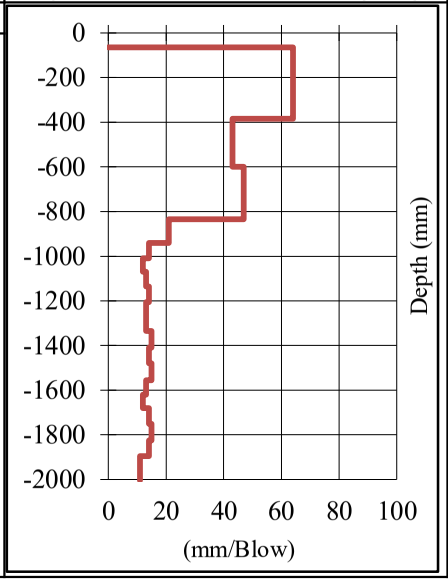
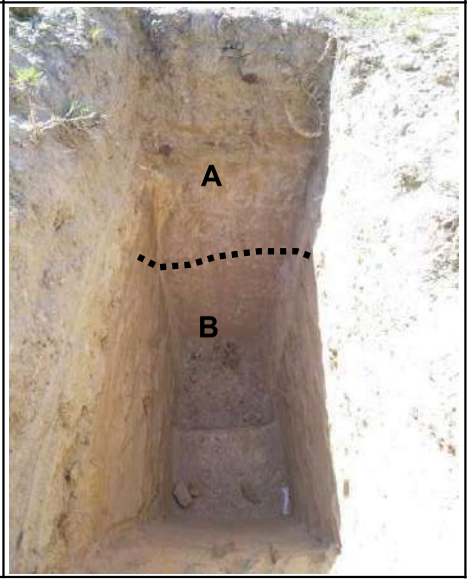


Photo of Test Pit



Geotechnical Soil Profile

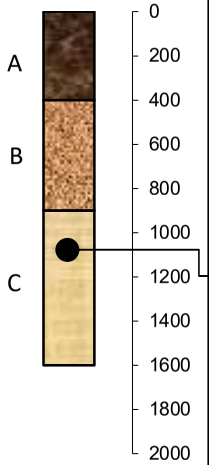
OUTENIQUA GEOTECHNICAL SERVICES

Client:	Lukhozi Consulting Engineers
Project:	Thembalethu Bulk Sewer Phase 3 & 4
Area:	George Municipality
Date:	14.11.2023
Excavator:	By Hand

TP 7

Datum: NGL | Co-ords: 23 Y0048543 X3764947

Key to symbols: ● Sample taken | Groundwater



(0 to 400) Moist, dark grey, loose, intact, **SILTY SAND**, Transported

(400 to 900) Moist, dark reddish brown, medium dense, **SANDY GRAVEL**, transported.

(900 to 1600) Moist, dark yellowish orange stained black, medium dense, **GRAVELLY CLAYEY SILTY SAND**, residual.

Foundation Indicator & MOD/CBR/Indicator

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

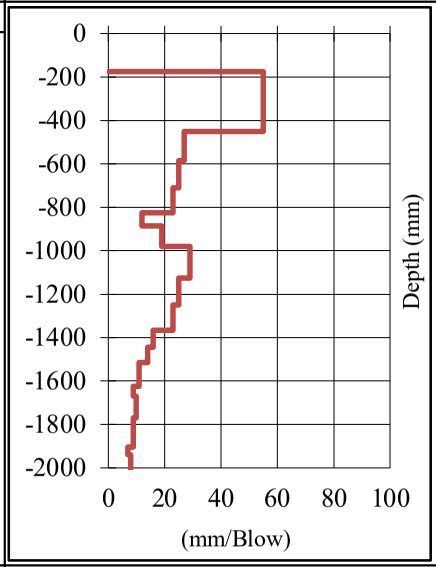
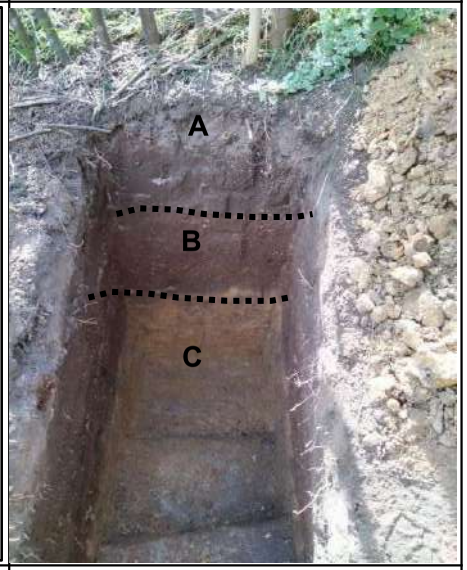


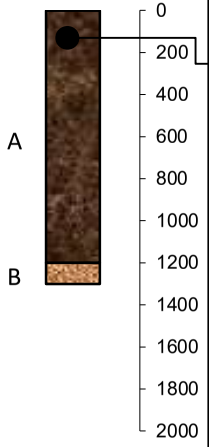
Photo of Test Pit



TP 8

Datum: NGL | Co-ords: 23 Y0048410 X3764937

Key to symbols: ● Sample taken | Groundwater



(0 to 1200) Moist, light brown, dense, intact, **CLAYEY SANDY SILTY GRAVEL**, imported (fill made ground)

Foundation Indicator & MOD/CBR/Indicator

(1200 to 1300) Moist, light yellowish orange, very dense, intact, **GRAVELLY SILTY CLAYEY SAND**, residual.

TP Stopped
No Water

Dynamic Cone Penetrometer (DCP)

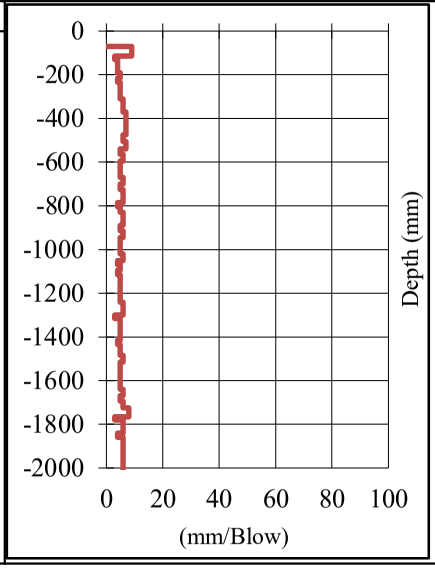
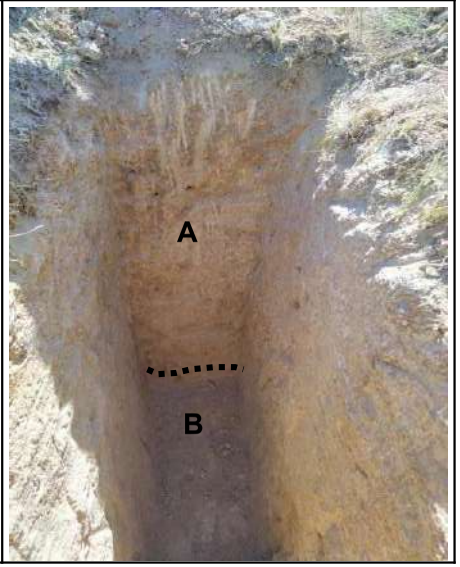


Photo of Test Pit



Appendix 3

Lab test data

OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za T0347

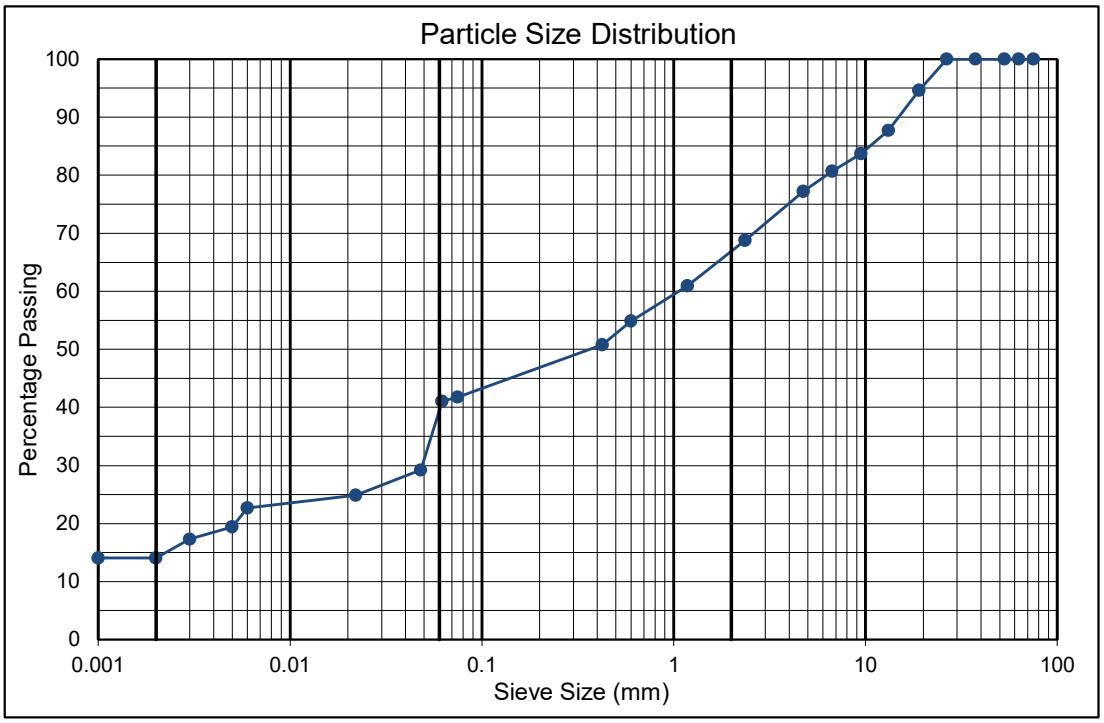
Customer :	Outeniqua Geotechnical Services P O Box 964 Knysna 6570	Project :	Proposed Upgrade of the Thembalethu Bulk Sewer PH3 & 4 - George Municipality
		Date Received :	22/11/2023
		Date Reported :	29/11/2023
		Req. Number :	4102/23
Attention :	Iain Paton	No. of Pages :	1/8

TEST REPORT

FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)		TP1
Depth (mm):		0-300
Sample No.:		87333
Materials Description	Source	In-situ
	Colour	Dark Reddish Brown
	Soil Type	Clayey Gravel with Sand
	Classification	Existing

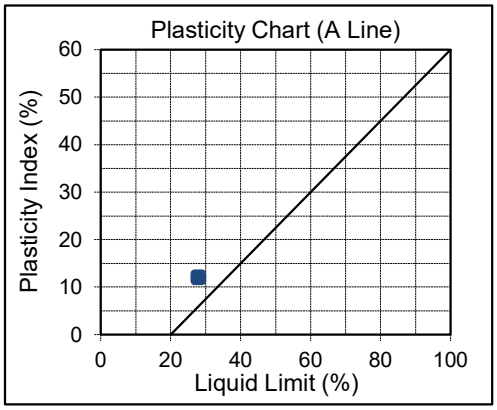
75.0mm	100
63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	95
13.2mm	88
9.5mm	84
6.7mm	81
4.75mm	77
2.36mm	69
1.18mm	61
0.6mm	55
0.425mm	51
0.075mm	42
0.062mm	41
0.048mm	29
0.022mm	25
0.006mm	23
0.005mm	19
0.003mm	17
0.002mm	14
0.001mm	14

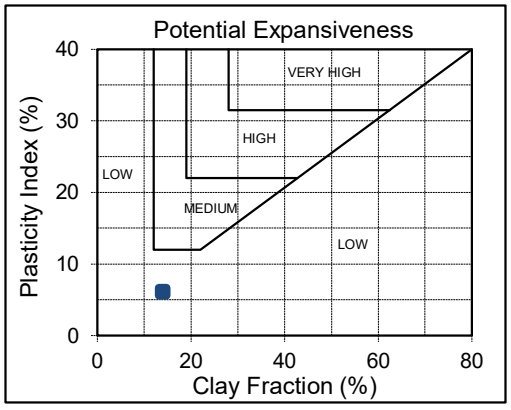


Liquid Limit (%)	28
Plasticity Index (%)	12
Linear Shrinkage (%)	6
Moisture Content (%)	0.0

% Clay	14
% Silt	25
% Sand	27
% Gravel	34

Unified Soil Classification	GC
AASHTO Soil Classification	A-6





- **Specimen delivered to Outeniqua Lab in good order.**

Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za T0347

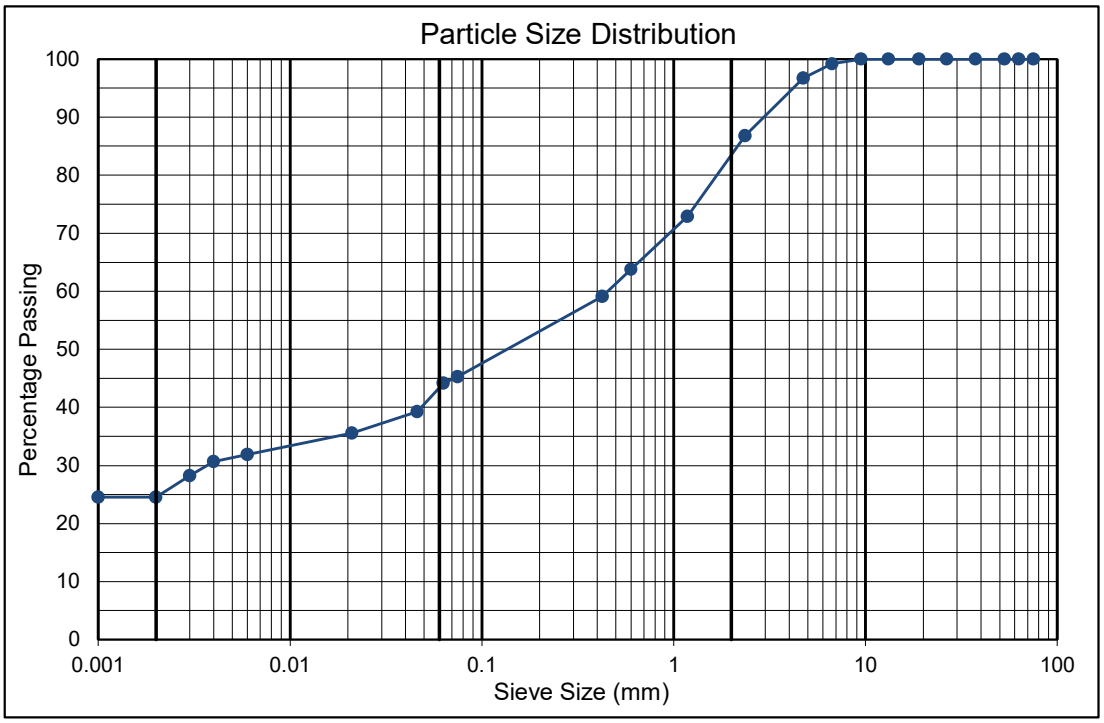
Customer :	Outeniqua Geotechnical Services P O Box 964 Knysna 6570	Project :	Proposed Upgrade of the Thembalethu Bulk Sewer PH3 & 4 - George Municipality
		Date Received :	22/11/2023
		Date Reported :	29/11/2023
		Req. Number :	4102/23
Attention :	Iain Paton	No. of Pages :	2/8

TEST REPORT

FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)		TP2
Depth (mm):		0-700
Sample No.:		87334
Materials Description	Source	In-situ
	Colour	Dark Yellowish Brown
	Soil Type	Clayey Sandy Gravel
	Classification	Existing

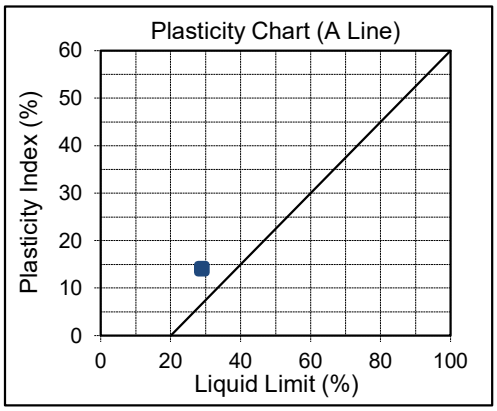
Percentage Passing	
75.0mm	100
63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	99
4.75mm	97
2.36mm	87
1.18mm	73
0.6mm	64
0.425mm	59
0.075mm	45
0.063mm	44
0.046mm	39
0.021mm	36
0.006mm	32
0.004mm	31
0.003mm	28
0.002mm	25
0.001mm	25

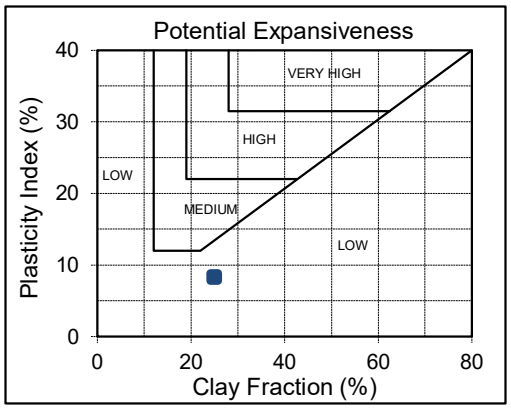


Liquid Limit (%)	29
Plasticity Index (%)	14
Linear Shrinkage (%)	7
Moisture Content (%)	0.0

% Clay	25
% Silt	18
% Sand	40
% Gravel	17

Unified Soil Classification	SC
AASHTO Soil Classification	A-6





- **Specimen delivered to Outeniqua Lab in good order.**

Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

6 Mirrorball Street, George : PO Box 3186, George Industria, 6536

Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

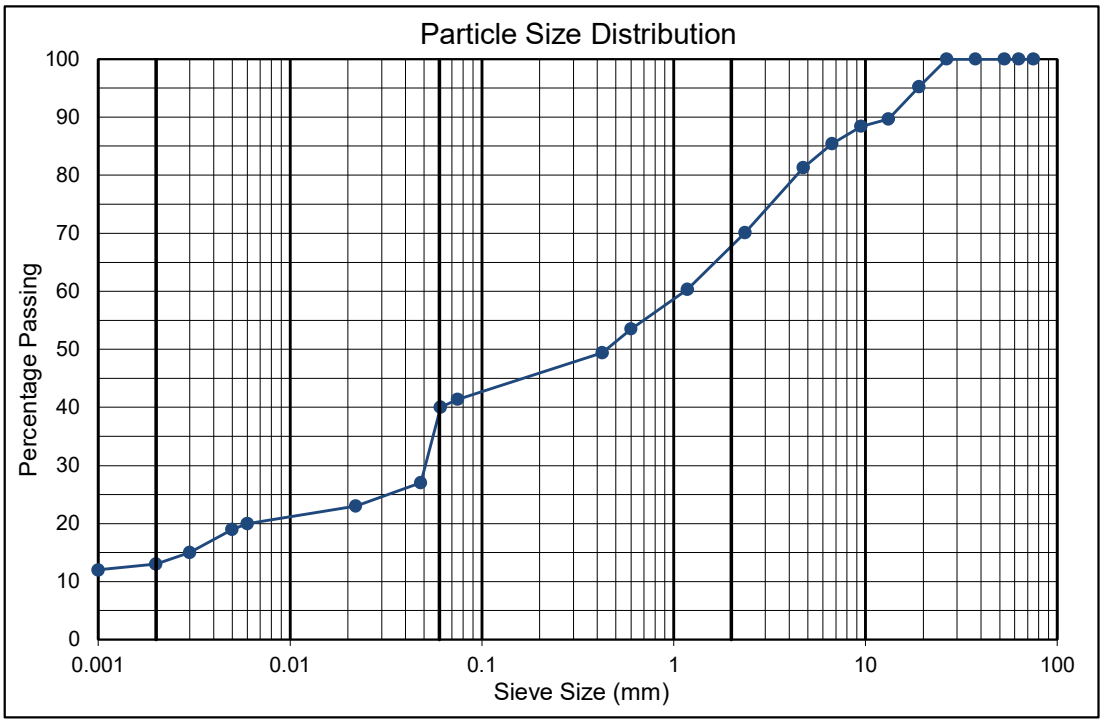
Customer :	Outeniqua Geotechnical Services P O Box 964 Knysna 6570	Project :	Proposed Upgrade of the Thembalethu Bulk Sewer PH3 & 4 - George Municipality
		Date Received :	22/11/2023
		Date Reported :	29/11/2023
		Req. Number :	4102/23
Attention :	Iain Paton	No. of Pages :	3/8

TEST REPORT

FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)		TP3
Depth (mm):		100-1500
Sample No.:		87335
Materials Description	Source	In-situ
	Colour	Light Yellowish Orange
	Soil Type	Silty Sandy Gravel
	Classification	Existing

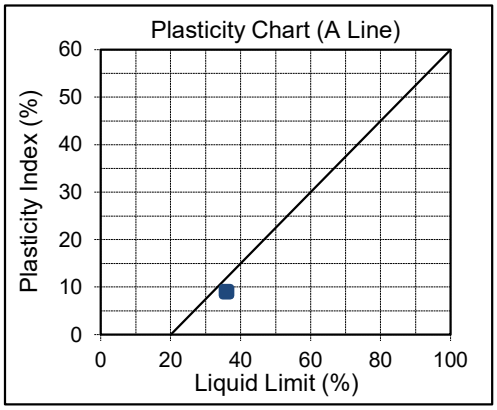
75.0mm	100
63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	95
13.2mm	90
9.5mm	88
6.7mm	85
4.75mm	81
2.36mm	70
1.18mm	60
0.6mm	54
0.425mm	49
0.075mm	41
0.061mm	40
0.048mm	27
0.022mm	23
0.006mm	20
0.005mm	19
0.003mm	15
0.002mm	13
0.001mm	12

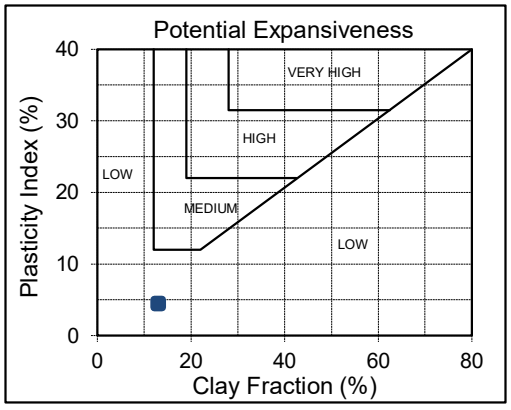


Liquid Limit (%)	36
Plasticity Index (%)	9
Linear Shrinkage (%)	5
Moisture Content (%)	0.0

% Clay	13
% Silt	26
% Sand	28
% Gravel	33

Unified Soil Classification	GM
AASHTO Soil Classification	A-4





- **Specimen delivered to Outeniqua Lab in good order.**

Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

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Tel: 044 8743274 : Fax: 044 8745779 : e-mail: llewelyn@outeniqualab.co.za

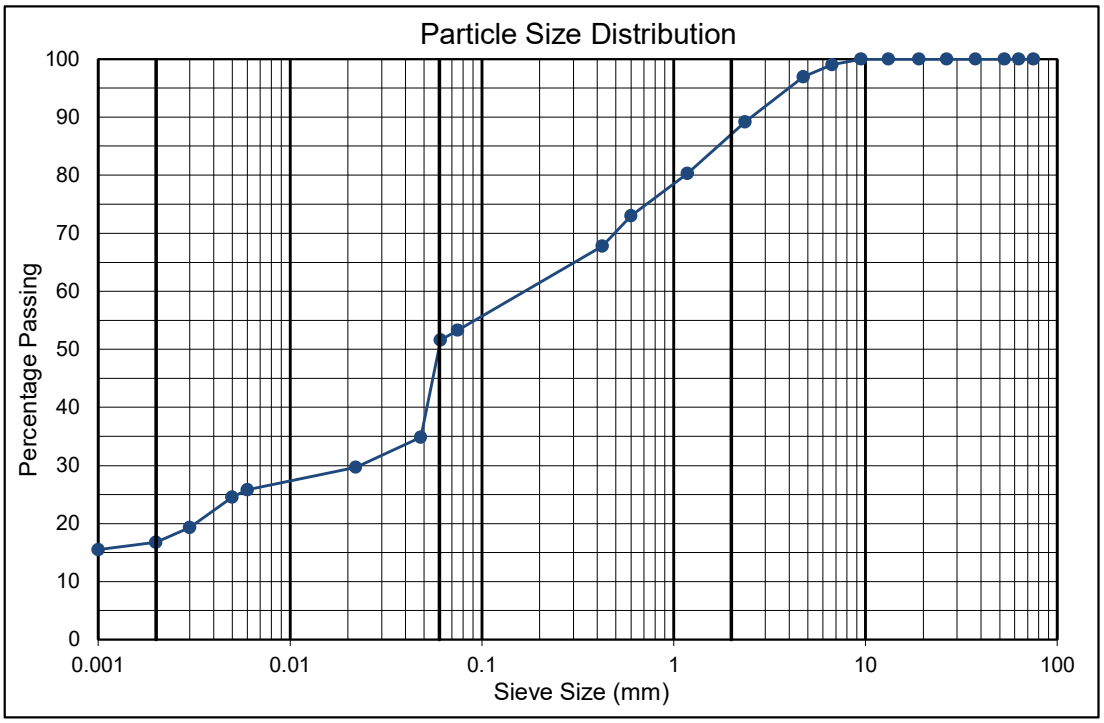
Customer :	Outeniqua Geotechnical Services P O Box 964 Knysna 6570	Project :	Proposed Upgrade of the Thembalethu Bulk Sewer PH3 & 4 - George Municipality
		Date Received :	22/11/2023
		Date Reported :	29/11/2023
		Req. Number :	4102/23
Attention :	Iain Paton	No. of Pages :	4/8

TEST REPORT

FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)		TP4
Depth (mm):		1300-1600
Sample No.:		87336
Materials Description	Source	In-situ
	Colour	Dark Reddish Brown
	Soil Type	Silty Sandy Gravel
	Classification	Existing

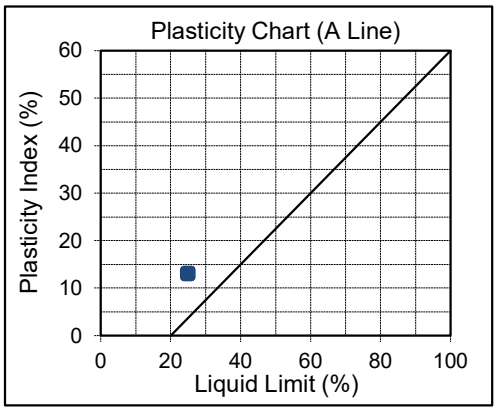
75.0mm	100
63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	99
4.75mm	97
2.36mm	89
1.18mm	80
0.6mm	73
0.425mm	68
0.075mm	53
0.061mm	52
0.048mm	35
0.022mm	30
0.006mm	26
0.005mm	25
0.003mm	19
0.002mm	17
0.001mm	15

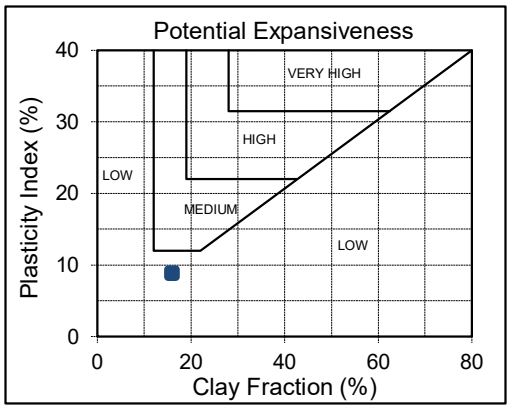


Liquid Limit (%)	25
Plasticity Index (%)	13
Linear Shrinkage (%)	7
Moisture Content (%)	0.0

% Clay	16
% Silt	34
% Sand	36
% Gravel	14

Unified Soil Classification	CL
AASHTO Soil Classification	A-6





- **Specimen delivered to Outeniqua Lab in good order.**

Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

Materials Testing Laboratory

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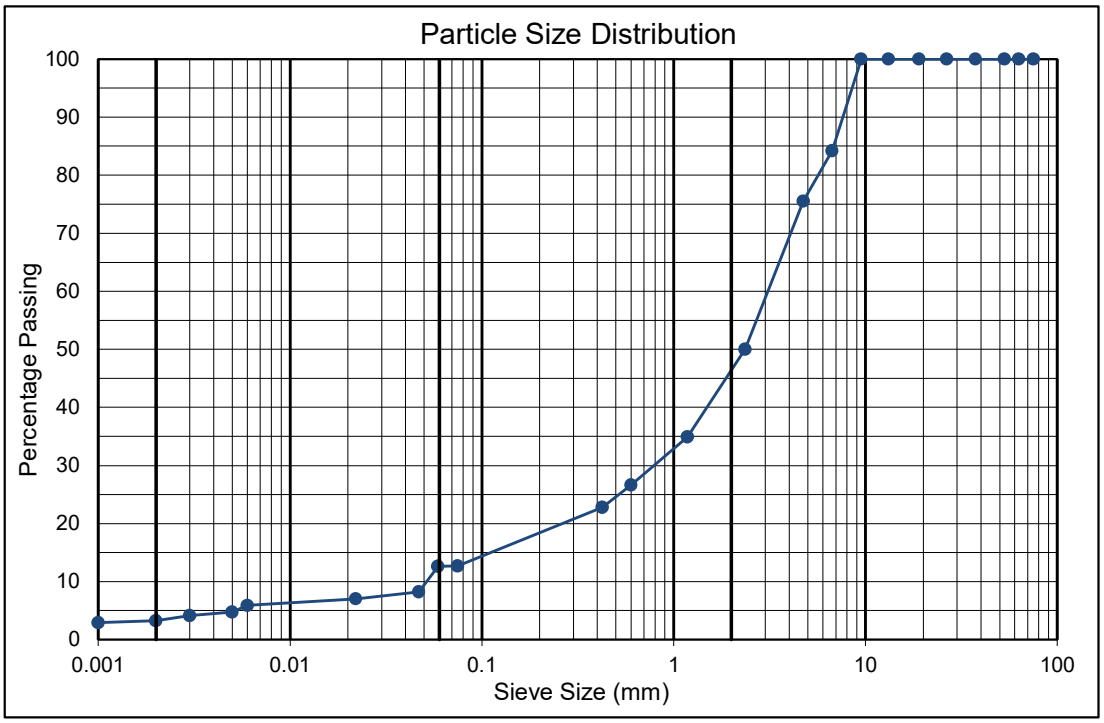
Attention :	Iain Paton	No. of Pages :	5/8

TEST REPORT

FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)		TP5
Depth (mm):		400-8000
Sample No.:		87337
Materials Description	Source	In-situ
	Colour	Dark Yellowish Orange
	Soil Type	Silty Sandy Gravel
	Classification	Existing

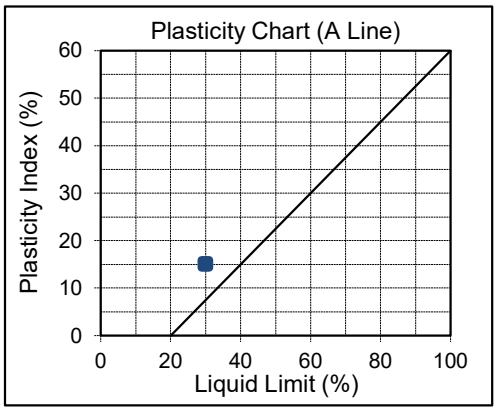
75.0mm	100
63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	84
4.75mm	76
2.36mm	50
1.18mm	35
0.6mm	27
0.425mm	23
0.075mm	13
0.059mm	13
0.047mm	8
0.022mm	7
0.006mm	6
0.005mm	5
0.003mm	4
0.002mm	3
0.001mm	3

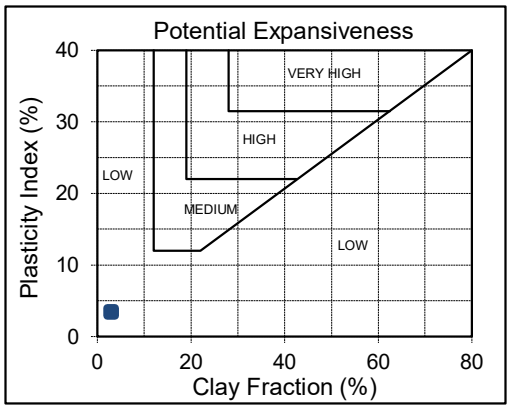


Liquid Limit (%)	30
Plasticity Index (%)	15
Linear Shrinkage (%)	8
Moisture Content (%)	0.0

% Clay	3
% Silt	10
% Sand	32
% Gravel	55

Unified Soil Classification	GC
AASHTO Soil Classification	A-2-6





- **Specimen delivered to Outeniqua Lab in good order.**

Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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Attention :	Iain Paton	No. of Pages :	6/8

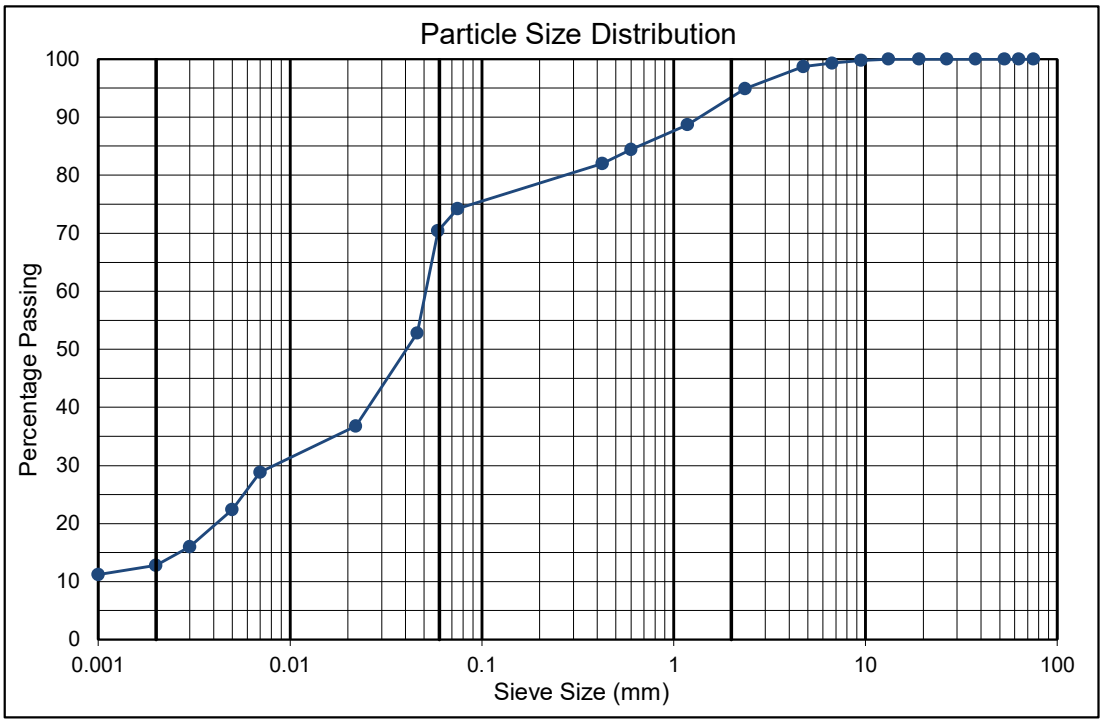
TEST REPORT

FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)		TP6
Depth (mm):		0-800
Sample No.:		87338
Materials Description	Source	In-situ
	Colour	Light Brown
	Soil Type	Silty Sandy Gravel
	Classification	Existing

75.0mm	100
63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	99
4.75mm	99
2.36mm	95
1.18mm	89
0.6mm	84
0.425mm	82
0.075mm	74
0.059mm	70
0.046mm	53
0.022mm	37
0.007mm	29
0.005mm	22
0.003mm	16
0.002mm	13
0.001mm	11

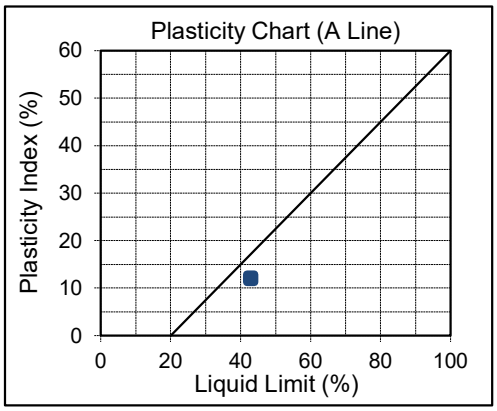
Percentage Passing

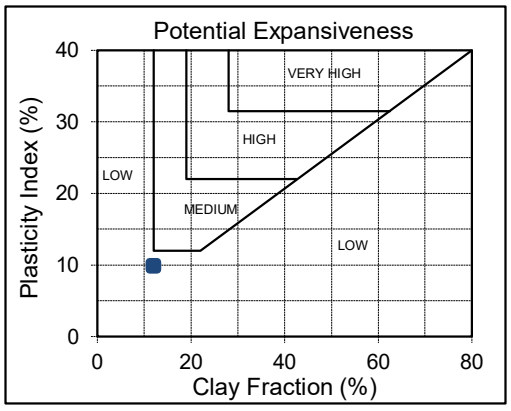


Liquid Limit (%)	43
Plasticity Index (%)	12
Linear Shrinkage (%)	6
Moisture Content (%)	0.0

% Clay	12
% Silt	60
% Sand	21
% Gravel	7

Unified Soil Classification	ML
AASHTO Soil Classification	A-7-5





- **Specimen delivered to Outeniqua Lab in good order.**

Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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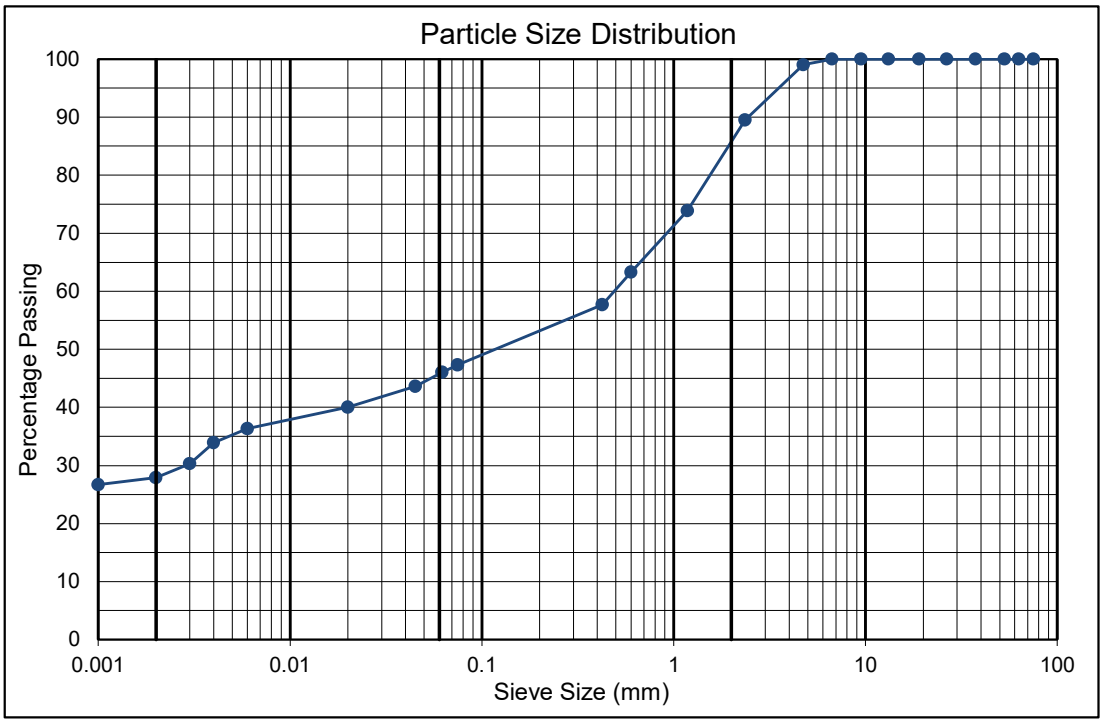
Attention :	Iain Paton	No. of Pages :	7/8

TEST REPORT

FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)		TP7
Depth (mm):		900-1600
Sample No.:		87339
Materials Description	Source	In-situ
	Colour	Dark Yellowish Orange Stained Black
	Soil Type	Silty Sandy Gravel
	Classification	Existing

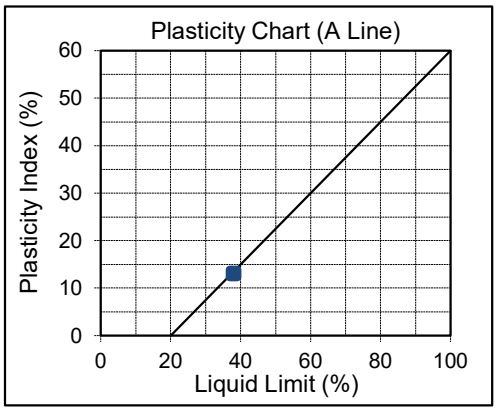
	Percentage Passing
75.0mm	100
63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	99
2.36mm	90
1.18mm	74
0.6mm	63
0.425mm	58
0.075mm	47
0.062mm	46
0.045mm	44
0.02mm	40
0.006mm	36
0.004mm	34
0.003mm	30
0.002mm	28
0.001mm	27

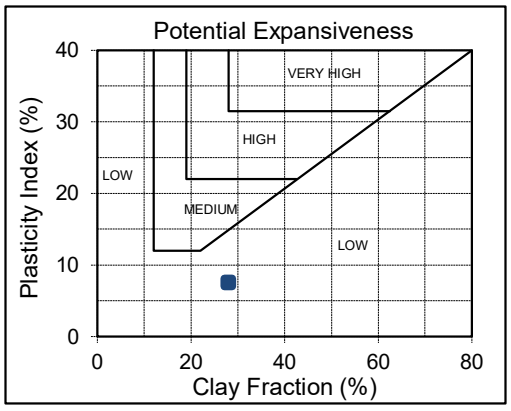


Liquid Limit (%)	38
Plasticity Index (%)	13
Linear Shrinkage (%)	7
Moisture Content (%)	0.0

% Clay	28
% Silt	18
% Sand	39
% Gravel	15

Unified Soil Classification	SM
AASHTO Soil Classification	A-6





- **Specimen delivered to Outeniqua Lab in good order.**

Ruaan Lesch
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For Outeniqua Lab (Pty) Ltd.

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Attention :	Iain Paton	No. of Pages :	8/8

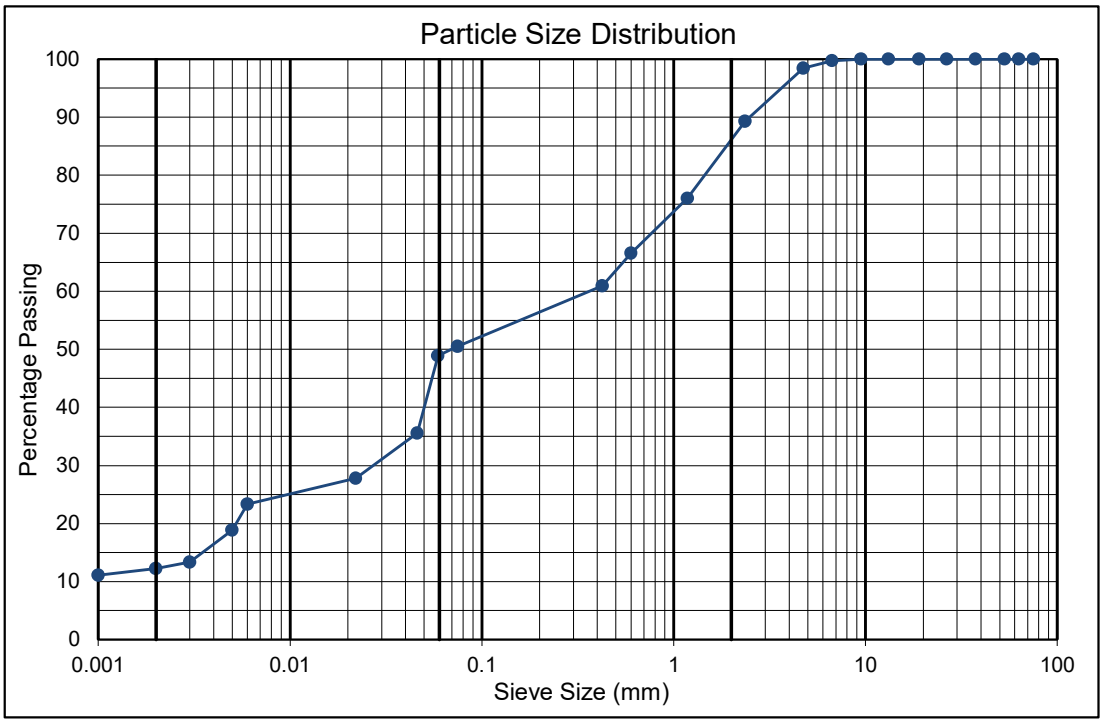
TEST REPORT

FOUNDATION INDICATOR - (ASTM Method D422)

Sample Position (SV)		TP8
Depth (mm):		0-1200
Sample No.:		87340
Materials Description	Source	In-situ
	Colour	Light Brown
	Soil Type	Silty Sandy Gravel
	Classification	Existing

75.0mm	100
63.0mm	100
53.0mm	100
37.5mm	100
26.5mm	100
19mm	100
13.2mm	100
9.5mm	100
6.7mm	100
4.75mm	98
2.36mm	89
1.18mm	76
0.6mm	67
0.425mm	61
0.075mm	51
0.059mm	49
0.046mm	36
0.022mm	28
0.006mm	23
0.005mm	19
0.003mm	13
0.002mm	12
0.001mm	11

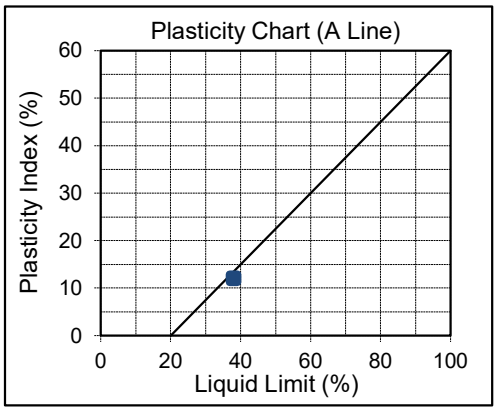
Percentage Passing

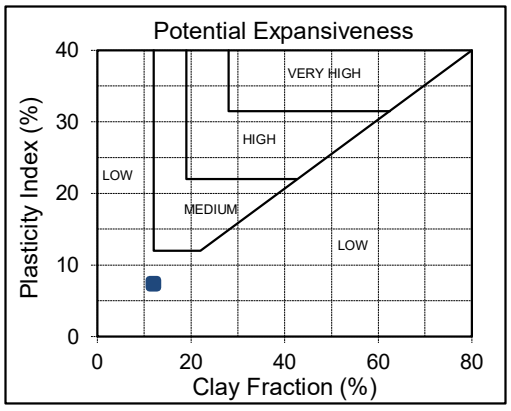


Liquid Limit (%)	38
Plasticity Index (%)	12
Linear Shrinkage (%)	6
Moisture Content (%)	0.0

% Clay	12
% Silt	38
% Sand	35
% Gravel	15

Unified Soil Classification	ML
AASHTO Soil Classification	A-6





- **Specimen delivered to Outeniqua Lab in good order.**

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For Outeniqua Lab (Pty) Ltd.

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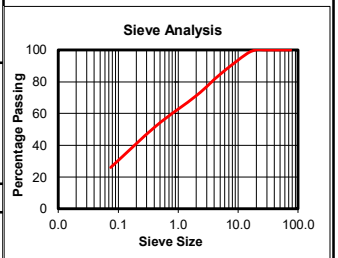
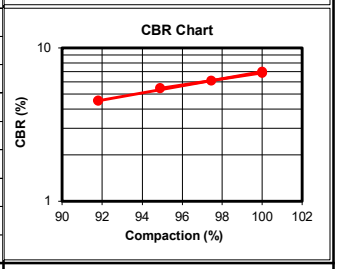
Attention :	Iain Paton	No. of Pages :	1/8

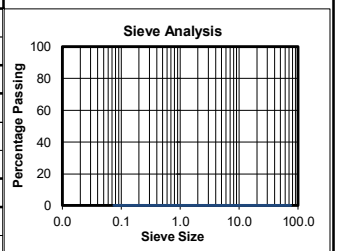
TEST REPORT
CALIFORNIA BEARING RATIO

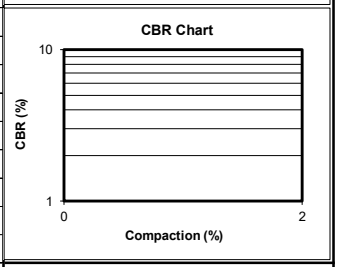
Sample Position (SV)		TP1	COLTO: G9 Subgrade				
Depth (mm)		0-300					
Sample No		87333					
Materials Description	Source	In-situ					
	Colour	Dark Reddish Brown					
	Soil Type	Clayey Gravel with Sand					
	Classification	Proposed (G9)					
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion			
	63 mm	100					
	50 mm	100					
	37.5 mm	100					
	28 mm	100					
	20 mm	100					
	14 mm	98					
	5 mm	85					
	2 mm	71					
	0.425 mm	52					
	0.075 mm	26.0					
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		1.51	0.75 - 2.70	✓			
Coarse Sand Soil-Mortar (%)		27					
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		28					
Plasticity Index (%)		12	≤ 12	✳			
Linear Shrinkage (%)		6.0					
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m³)	1948					
	Optimum Moisture Content (%)	9.3					
	Mould Moisture Content (%)	9.2					
A	Relative Compaction (%)	100.0					
	Swell (%)	1.5	≤ 1.5	✓			
B	Relative Compaction (%)	94.9					
	Swell (%)	1.6					
C	Relative Compaction (%)	91.8					
	Swell (%)	1.9					
CBR	@100% Max Dry Density	7					
	@98% Max Dry Density	6					
	@95% Max Dry Density	5					
	@93% Max Dry Density	5	≥ 7	✳			
	@90% Max Dry Density	4					
Material Condition							
Insitu Moisture Content (%)							
Soil Classification Of The Material Based Only On The Tests Results Above							
COLTO Specification:		G9 Subgrade					
AASHTO System		A-2-6					
Unified System		SC					

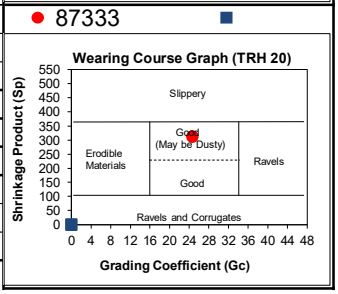
87333











- **Tests marked with a (*) are NOT SANAS Accredited results.**
- **Specimens delivered to Outeniqua Lab in good order.**

Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

1. The opinion column is an interpretation of the direct comparison between the quoted specification and the single test sample results obtained. The compliant (✓), non compliant (×) and uncertain (✳) opinion indicators are based on an approximate 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
2. The uncertain (✳) indicates that the test result is either equal to or is above / below the specified limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliant (✓) or non compliant (×) based on a 95% level of confidence with reference to SAMM GUIDANCE 1, Issue 2 : 20 June 2007 Section 2.
3. This report (with attachments) is the correct record of all measurements made, and may not be reproduced other than with full written approval from the Director of Outeniqua Lab (Pty) Ltd.
4. Measuring Equipment, traceable to National Standards is used where applicable. Results reported in this Test Report relate only to the items tested and are an indication only of the sample provided and/or taken.
5. While every care is taken to ensure the correctness of all tests and reports, neither Outeniqua Lab (Pty) Ltd nor its employees shall be liable in any way whatever for any error made in the execution or reporting of tests or any erroneous conclusions drawn therefrom or for any consequence thereof.

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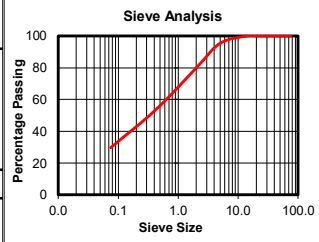
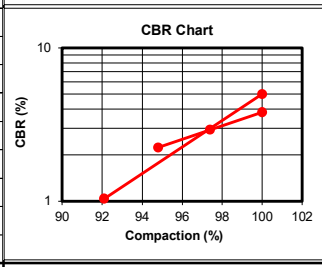
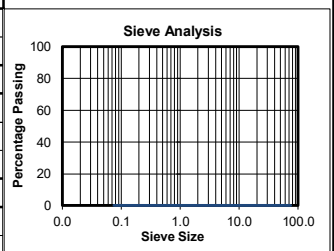
TEST REPORT
CALIFORNIA BEARING RATIO

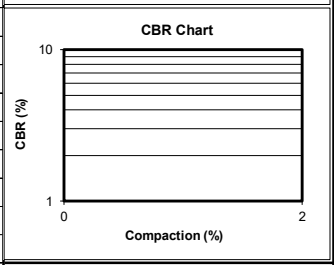
Sample Position (SV)		TP2	COLTO: Not Classified				
Depth (mm)		0-700					
Sample No		87334					
Materials Description	Source	In-situ					
	Colour	Dark Yellowish Brown					
	Soil Type	Clayey Sandy Gravel					
	Classification	Existing					
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion			
	63 mm	100					
	50 mm	100					
	37.5 mm	100					
	28 mm	100					
	20 mm	100					
	14 mm	100					
	5 mm	95					
	2 mm	80					
	0.425 mm	54					
	0.075 mm	29.7					
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		1.37					
Coarse Sand Soil-Mortar (%)		33					
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		29					
Plasticity Index (%)		14					
Linear Shrinkage (%)		7.0					
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m^3)	1876					
	Optimum Moisture Content (%)	12.8					
	Mould Moisture Content (%)	12.9					
A	Relative Compaction (%)	100.0					
	Swell (%)	2.4					
B	Relative Compaction (%)	94.8					
	Swell (%)	2.7					
C	Relative Compaction (%)	92.1					
	Swell (%)	2.9					
CBR	@100% Max Dry Density	5					
	@98% Max Dry Density	3					
	@95% Max Dry Density	2					
	@93% Max Dry Density	1					
	@90% Max Dry Density	1					
Material Condition							
Insitu Moisture Content (%)							
Soil Classification Of The Material Based Only On The Tests Results Above							
COLTO Specification:		Not Classified					
AASHTO System		A-2-6					
Unified System		SC					

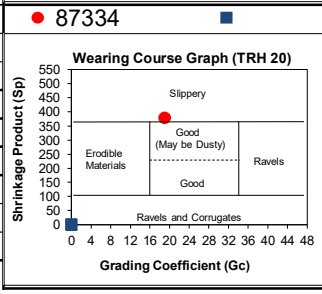
87334











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Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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Registration No. 95/07742/07

Materials Testing Laboratory

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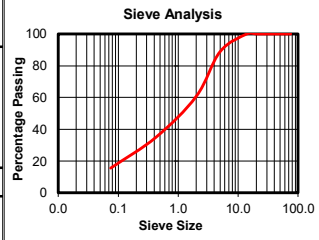
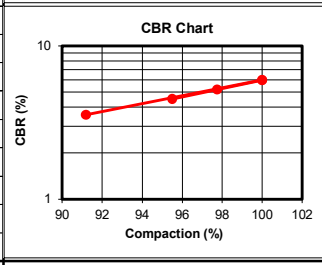
		Date Received :	22/11/2023
		Date Reported :	29/11/2023
		Req. Number :	4102/23
Attention :	Iain Paton	No. of Pages :	3/8

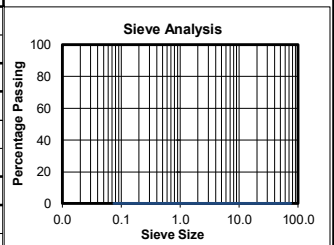
TEST REPORT
CALIFORNIA BEARING RATIO

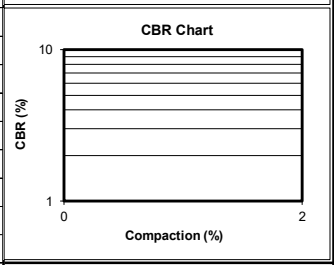
Sample Position (SV)		TP3	COLTO: Not Classified				
Depth (mm)		100-1500					
Sample No		87335					
Materials Description	Source	In-situ					
	Colour	Light Yellowish Orange					
	Soil Type	Silty Sandy Gravel					
	Classification	Existing					
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion			
	63 mm	100					
	50 mm	100					
	37.5 mm	100					
	28 mm	100					
	20 mm	100					
	14 mm	100					
	5 mm	89					
	2 mm	61					
	0.425 mm	35					
	0.075 mm	15.5					
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		1.89					
Coarse Sand Soil-Mortar (%)		42					
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		36					
Plasticity Index (%)		9					
Linear Shrinkage (%)		4.5					
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m^3)	1957					
	Optimum Moisture Content (%)	8.0					
	Mould Moisture Content (%)	8.1					
A	Relative Compaction (%)	100.0					
	Swell (%)	1.8					
B	Relative Compaction (%)	95.5					
	Swell (%)	2.0					
C	Relative Compaction (%)	91.2					
	Swell (%)	2.5					
CBR	@100% Max Dry Density	6					
	@98% Max Dry Density	5					
	@95% Max Dry Density	4					
	@93% Max Dry Density	4					
	@90% Max Dry Density	3					
Material Condition							
Insitu Moisture Content (%)							
Soil Classification Of The Material Based Only On The Tests Results Above							
COLTO Specification:		Not Classified					
AASHTO System		A-2-4					
Unified System		SM					

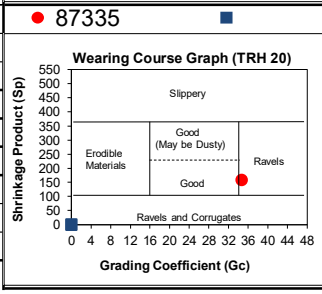
87335











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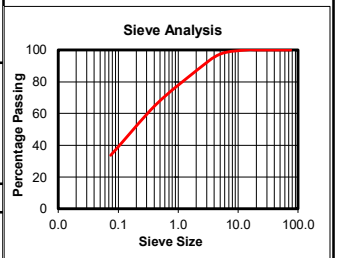
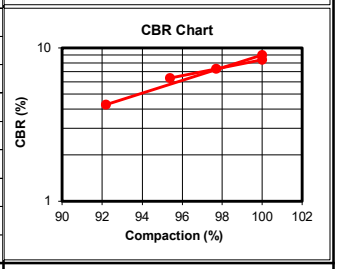
Attention :	Iain Paton	No. of Pages :	4/8

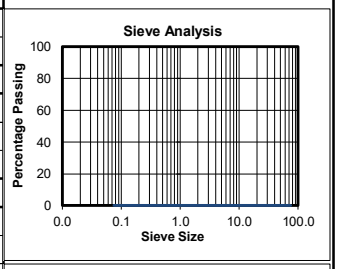
TEST REPORT
CALIFORNIA BEARING RATIO

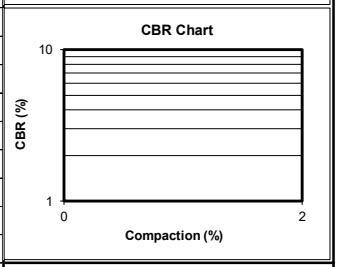
Sample Position (SV)		TP4	COLTO: Not Classified				
Depth (mm)		1300-1600					
Sample No		87336					
Materials Description	Source	In-situ					
	Colour	Dark Reddish Brown					
	Soil Type	Silty Sandy Gravel					
	Classification	Existing					
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion			
	63 mm	100					
	50 mm	100					
	37.5 mm	100					
	28 mm	100					
	20 mm	100					
	14 mm	100					
	5 mm	97					
	2 mm	87					
	0.425 mm	65					
	0.075 mm	33.6					
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		1.14					
Coarse Sand Soil-Mortar (%)		25					
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		25					
Plasticity Index (%)		13					
Linear Shrinkage (%)		6.5					
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m^3)	1971					
	Optimum Moisture Content (%)	9.8					
	Mould Moisture Content (%)	9.9					
A	Relative Compaction (%)	100.0					
	Swell (%)	1.3					
B	Relative Compaction (%)	95.4					
	Swell (%)	1.5					
C	Relative Compaction (%)	92.2					
	Swell (%)	1.8					
CBR	@100% Max Dry Density	9					
	@98% Max Dry Density	8					
	@95% Max Dry Density	6					
	@93% Max Dry Density	5					
	@90% Max Dry Density	3					
Material Condition							
Insitu Moisture Content (%)							
Soil Classification Of The Material Based Only On The Tests Results Above							
COLTO Specification:		Not Classified					
AASHTO System		A-2-6					
Unified System		SC					

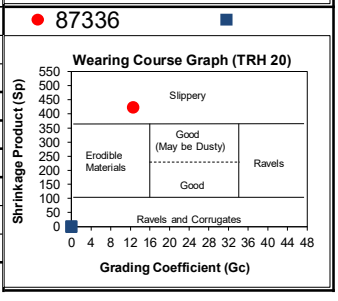
87336











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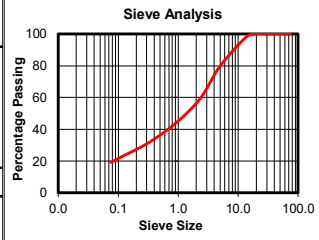
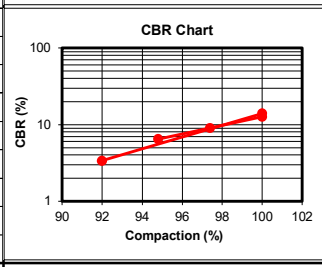
		Date Reported :	29/11/2023
		Req. Number :	4102/23
Attention :	Iain Paton	No. of Pages :	5/8

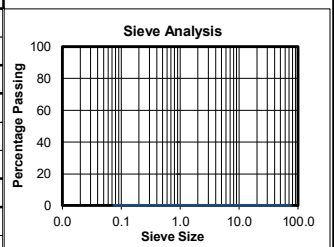
TEST REPORT
CALIFORNIA BEARING RATIO

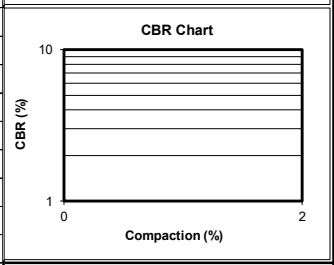
Sample Position (SV)		TP5	COLTO: Not Classified				
Depth (mm)		400-800					
Sample No		87337					
Materials Description	Source	In-situ					
	Colour	Dark Yellowish Orange					
	Soil Type	Silty Sandy Gravel					
	Classification	Existing					
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion			
	63 mm	100					
	50 mm	100					
	37.5 mm	100					
	28 mm	100					
	20 mm	100					
	14 mm	98					
	5 mm	80					
	2 mm	56					
	0.425 mm	34					
	0.075 mm	19.2					
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		1.90					
Coarse Sand Soil-Mortar (%)		39					
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		42					
Plasticity Index (%)		15					
Linear Shrinkage (%)		7.5					
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m^3)	2006					
	Optimum Moisture Content (%)	8.2					
	Mould Moisture Content (%)	8.1					
A	Relative Compaction (%)	100.0					
	Swell (%)	1.7					
B	Relative Compaction (%)	94.8					
	Swell (%)	2.0					
C	Relative Compaction (%)	92.0					
	Swell (%)	2.2					
CBR	@100% Max Dry Density	14					
	@98% Max Dry Density	10					
	@95% Max Dry Density	6					
	@93% Max Dry Density	4					
	@90% Max Dry Density	2					
Material Condition							
Insitu Moisture Content (%)							
Soil Classification Of The Material Based Only On The Tests Results Above							
COLTO Specification:		Not Classified					
AASHTO System		A-2-7					
Unified System		GM					

87337

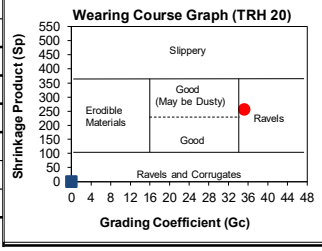








● 87337 ■



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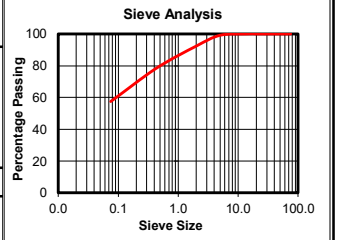
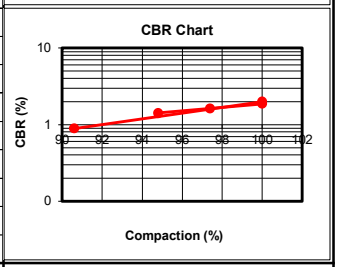
Attention :	Iain Paton	No. of Pages :	6/8

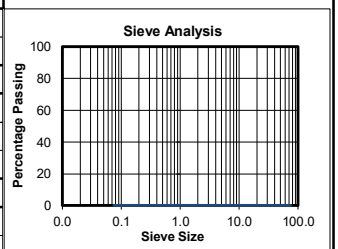
TEST REPORT
CALIFORNIA BEARING RATIO

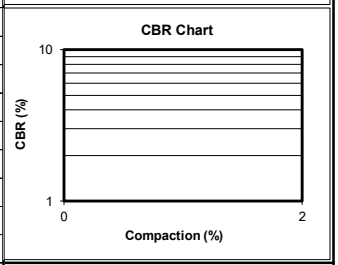
Sample Position (SV)		TP6	COLTO: Not Classified				
Depth (mm)		0-800					
Sample No		87338					
Materials Description	Source	In-situ					
	Colour	Light Brown					
	Soil Type	Silty Sandy Gravel					
	Classification	Existing					
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion			
	63 mm	100					
	50 mm	100					
	37.5 mm	100					
	28 mm	100					
	20 mm	100					
	14 mm	100					
	5 mm	99					
	2 mm	92					
	0.425 mm	78					
	0.075 mm	57.4					
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		0.72					
Coarse Sand Soil-Mortar (%)		15					
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		43					
Plasticity Index (%)		12					
Linear Shrinkage (%)		6.0					
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m^3)	1750					
	Optimum Moisture Content (%)	13.3					
	Mould Moisture Content (%)	13.3					
A	Relative Compaction (%)	100.0					
	Swell (%)	6.0					
B	Relative Compaction (%)	94.8					
	Swell (%)	8.3					
C	Relative Compaction (%)	90.6					
	Swell (%)	9.2					
CBR	@100% Max Dry Density	2					
	@98% Max Dry Density	2					
	@95% Max Dry Density	1					
	@93% Max Dry Density	1					
	@90% Max Dry Density	1					
Material Condition							
Insitu Moisture Content (%)							
Soil Classification Of The Material Based Only On The Tests Results Above							
COLTO Specification:		Not Classified					
AASHTO System		A-7-5					
Unified System		ML					

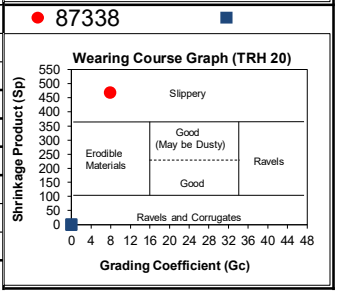
87338











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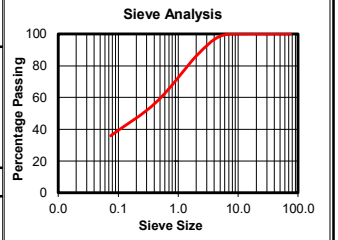
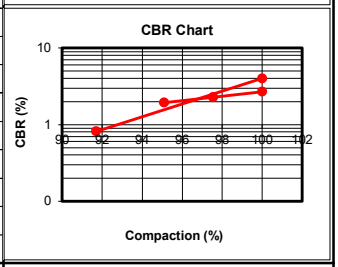
Customer :	Outeniqua Geotechnical Services P O Box 964 Knysna 6570	Project :	Proposed Upgrade of the Thembalethu Bulk Sewer PH3 & 4 - George Municipality
		Date Received :	22/11/2023
		Date Reported :	29/11/2023
		Req. Number :	4102/23
Attention :	Iain Paton	No. of Pages :	7/8

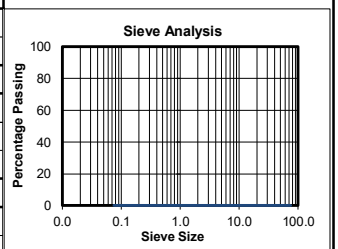
TEST REPORT
CALIFORNIA BEARING RATIO

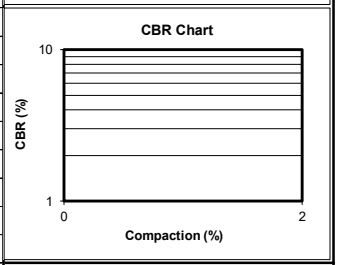
Sample Position (SV)		TP7	COLTO: Not Classified				
Depth (mm)		900-1600					
Sample No		87339					
Materials Description	Source	In-situ					
	Colour	Dark Yellowish Orange Stained Black					
	Soil Type	Silty Sandy Gravel					
	Classification	Existing					
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion			
	63 mm	100					
	50 mm	100					
	37.5 mm	100					
	28 mm	100					
	20 mm	100					
	14 mm	100					
	5 mm	99					
	2 mm	86					
	0.425 mm	57					
	0.075 mm	36.0					
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		1.21					
Coarse Sand Soil-Mortar (%)		34					
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		38					
Plasticity Index (%)		13					
Linear Shrinkage (%)		6.5					
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m^3)	1868					
	Optimum Moisture Content (%)	11.2					
	Mould Moisture Content (%)	11.2					
A	Relative Compaction (%)	100.0					
	Swell (%)	2.9					
B	Relative Compaction (%)	95.1					
	Swell (%)	3.4					
C	Relative Compaction (%)	91.7					
	Swell (%)	3.7					
CBR	@100% Max Dry Density	4					
	@98% Max Dry Density	2					
	@95% Max Dry Density	1					
	@93% Max Dry Density	1					
	@90% Max Dry Density	1					
Material Condition							
Insitu Moisture Content (%)							
Soil Classification Of The Material Based Only On The Tests Results Above							
COLTO Specification:		Not Classified					
AASHTO System		A-6					
Unified System		SM					

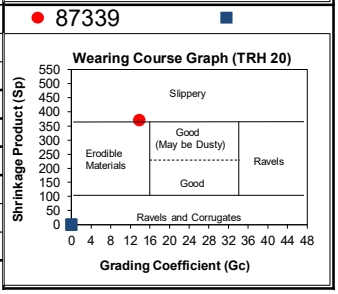
87339











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Ruaan Lesch
Technical Signatory
For Outeniqua Lab (Pty) Ltd.

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OUTENIQUA LAB (Pty) Ltd.

Registration No. 95/07742/07

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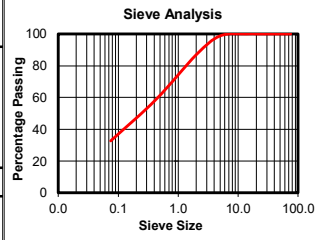
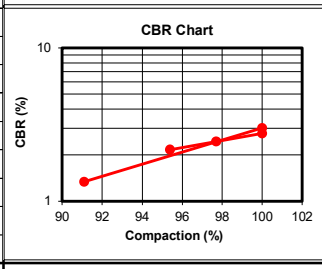
Attention :	Iain Paton	No. of Pages :	8/8

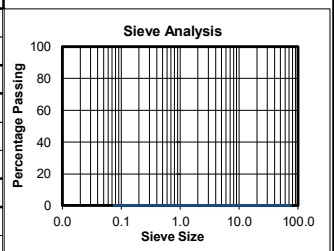
TEST REPORT
CALIFORNIA BEARING RATIO

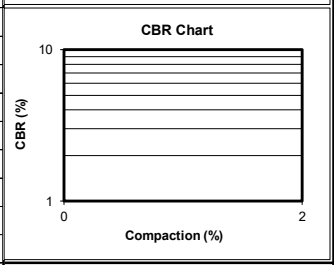
Sample Position (SV)		TP8	COLTO: Not Classified				
Depth (mm)		0-1200					
Sample No		**87340**					
Materials Description	Source	In-situ					
	Colour	Light Brown					
	Soil Type	Silty Sandy Gravel					
	Classification	Existing					
Material Indicators - (SANS 3001 Method GR1)							
Percentage Passing	75 mm	100		Opinion			
	63 mm	100					
	50 mm	100					
	37.5 mm	100					
	28 mm	100					
	20 mm	100					
	14 mm	100					
	5 mm	99					
	2 mm	87					
	0.425 mm	59					
	0.075 mm	32.6					
Material Indicators - (SANS 3001 Method PR5)							
Grading Modulus *		1.22					
Coarse Sand Soil-Mortar (%)		32					
Atterberg Limits - (SANS 3001 Method GR10)							
Liquid Limit (%)		38					
Plasticity Index (%)		12					
Linear Shrinkage (%)		6.0					
Material Strength - (SANS 3001 Method GR30,GR40 - SCALPED)							
MDD	Max Dry Density (kg/m^3)	1978					
	Optimum Moisture Content (%)	8.4					
	Mould Moisture Content (%)	8.2					
A	Relative Compaction (%)	100.0					
	Swell (%)	2.8					
B	Relative Compaction (%)	95.4					
	Swell (%)	3.3					
C	Relative Compaction (%)	91.1					
	Swell (%)	3.8					
CBR	@100% Max Dry Density	3					
	@98% Max Dry Density	3					
	@95% Max Dry Density	2					
	@93% Max Dry Density	2					
	@90% Max Dry Density	1					
Material Condition							
Insitu Moisture Content (%)							
Soil Classification Of The Material Based Only On The Tests Results Above							
COLTO Specification:		Not Classified					
AASHTO System		A-2-6					
Unified System		SM					

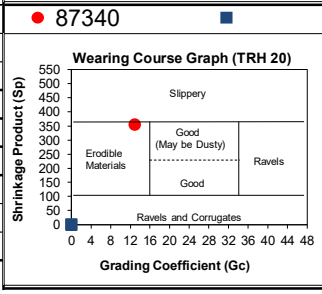
87340











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Appendix 4

DCP test data

Outeniqua Geotechnical Services cc.

Geotechnical Engineering Consultants

Registration No. 1999/062743/23

18 Clyde Street, Knysna : PO Box 964, Knysna, 6570

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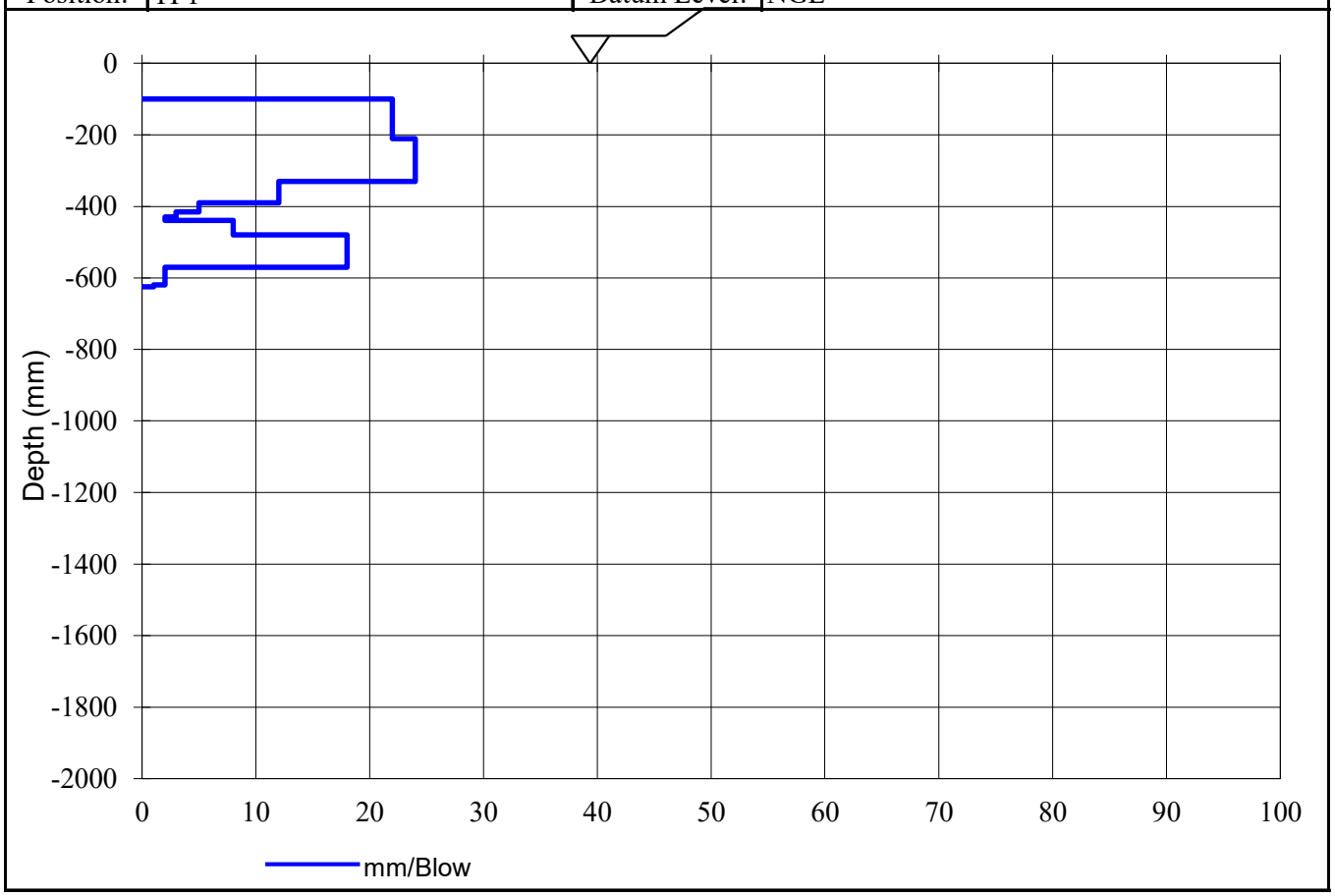
		Date Received :	27.10.2023
		Date Reported :	14.11.2023
		Req. Number :	
Attention :	Koenraad Potgieter	No. of Pages :	1 of 8

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TP1	Datum Level:	NGL



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For Outeniqua Geotech. Services cc.
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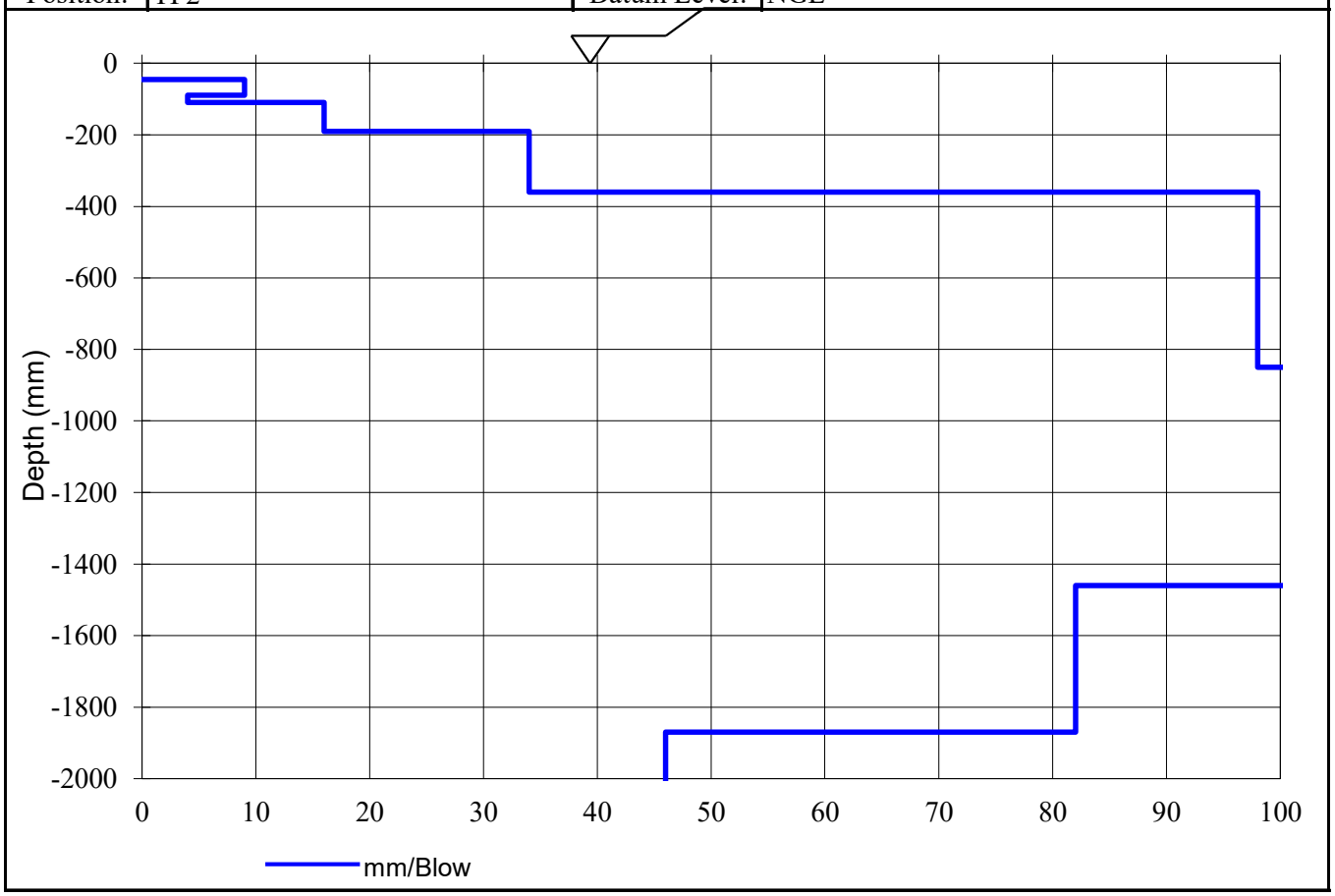
Attention :	Koenraad Potgieter	No. of Pages :	2 of 8

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TP2	Datum Level:	NGL



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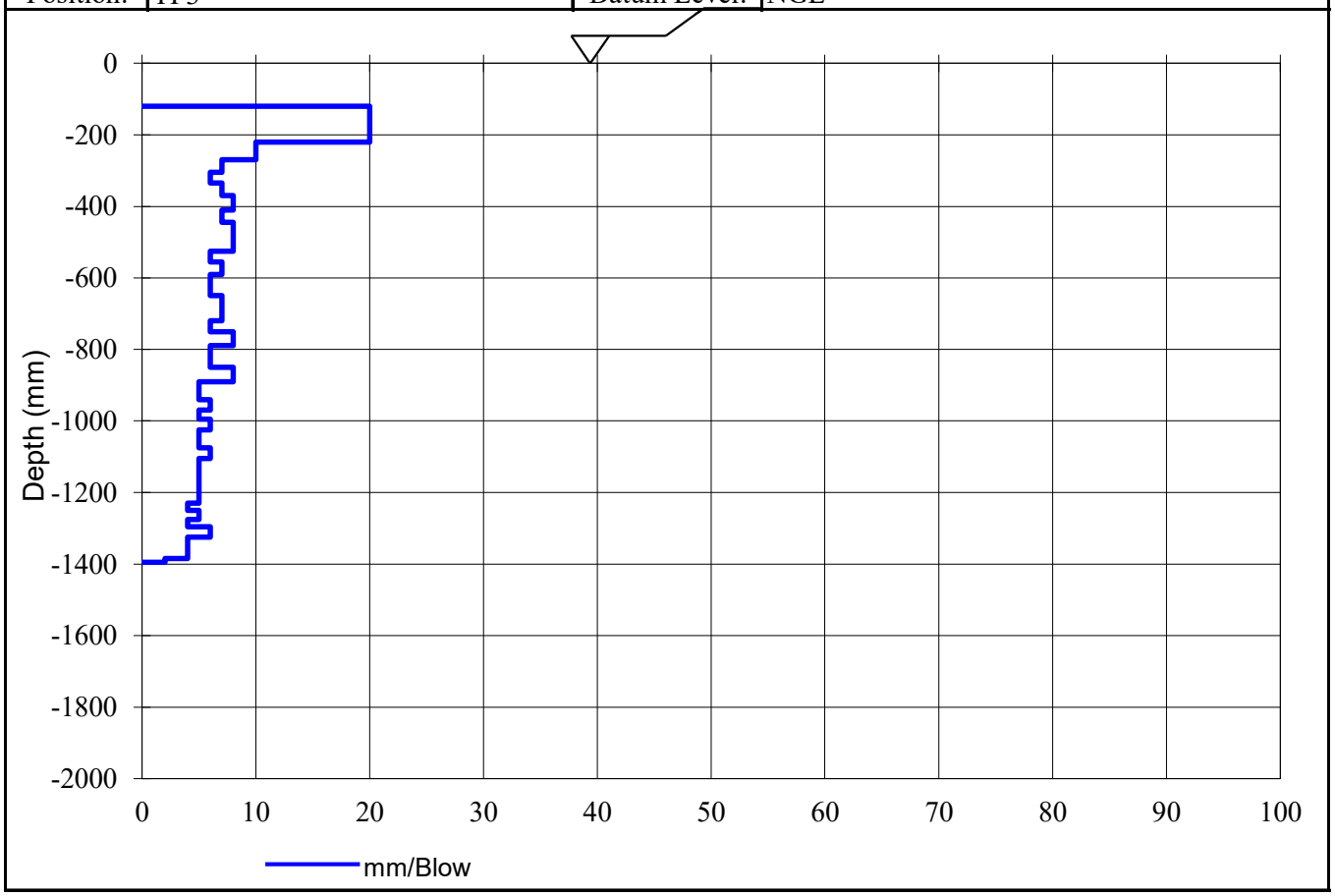
		Date Reported :	14.11.2023
		Req. Number :	
Attention :	Koenraad Potgieter	No. of Pages :	3 of 8

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TP3	Datum Level:	NGL



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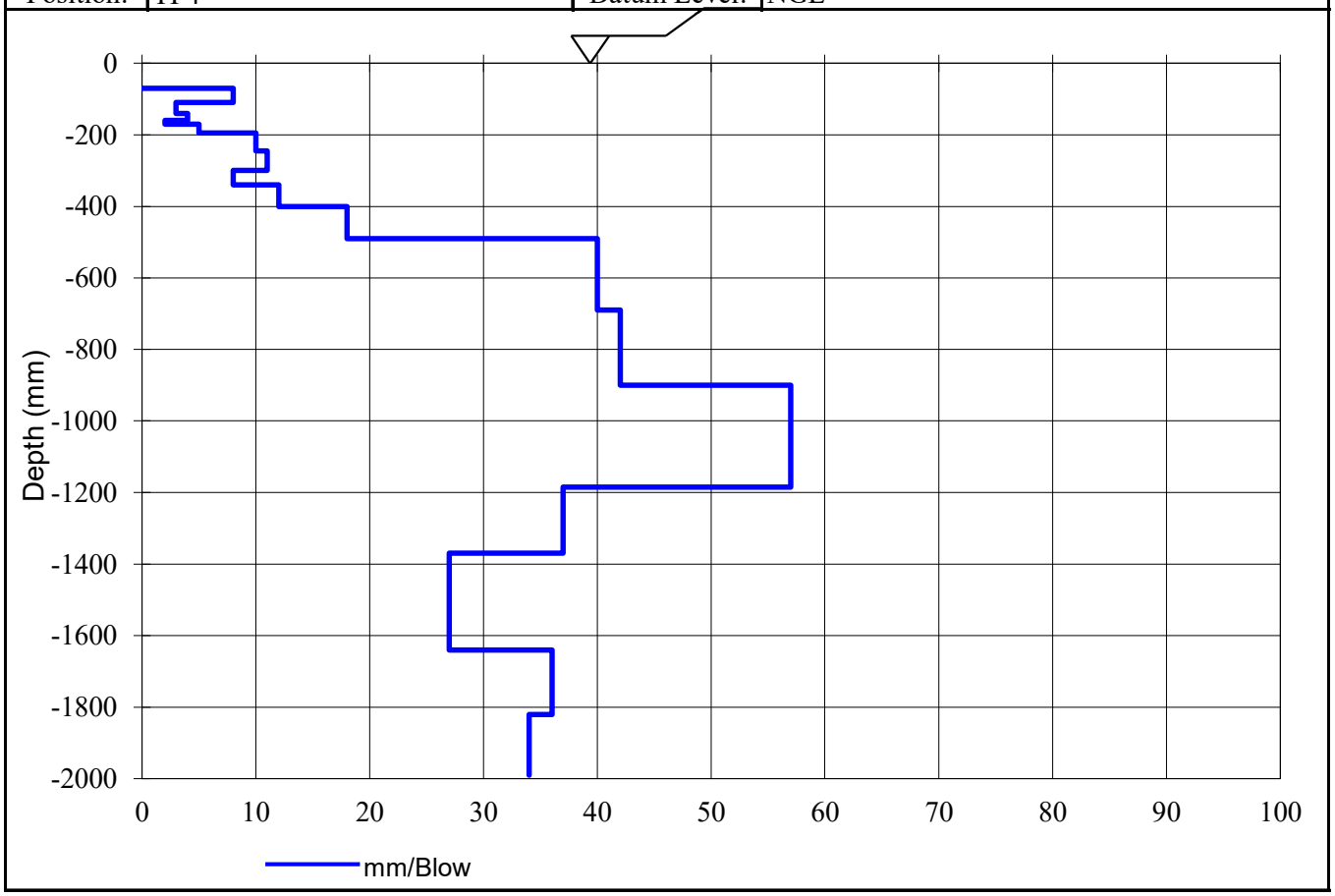
Attention :	Koenraad Potgieter	No. of Pages :	4 of 8

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TP4	Datum Level:	NGL



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		Req. Number :	
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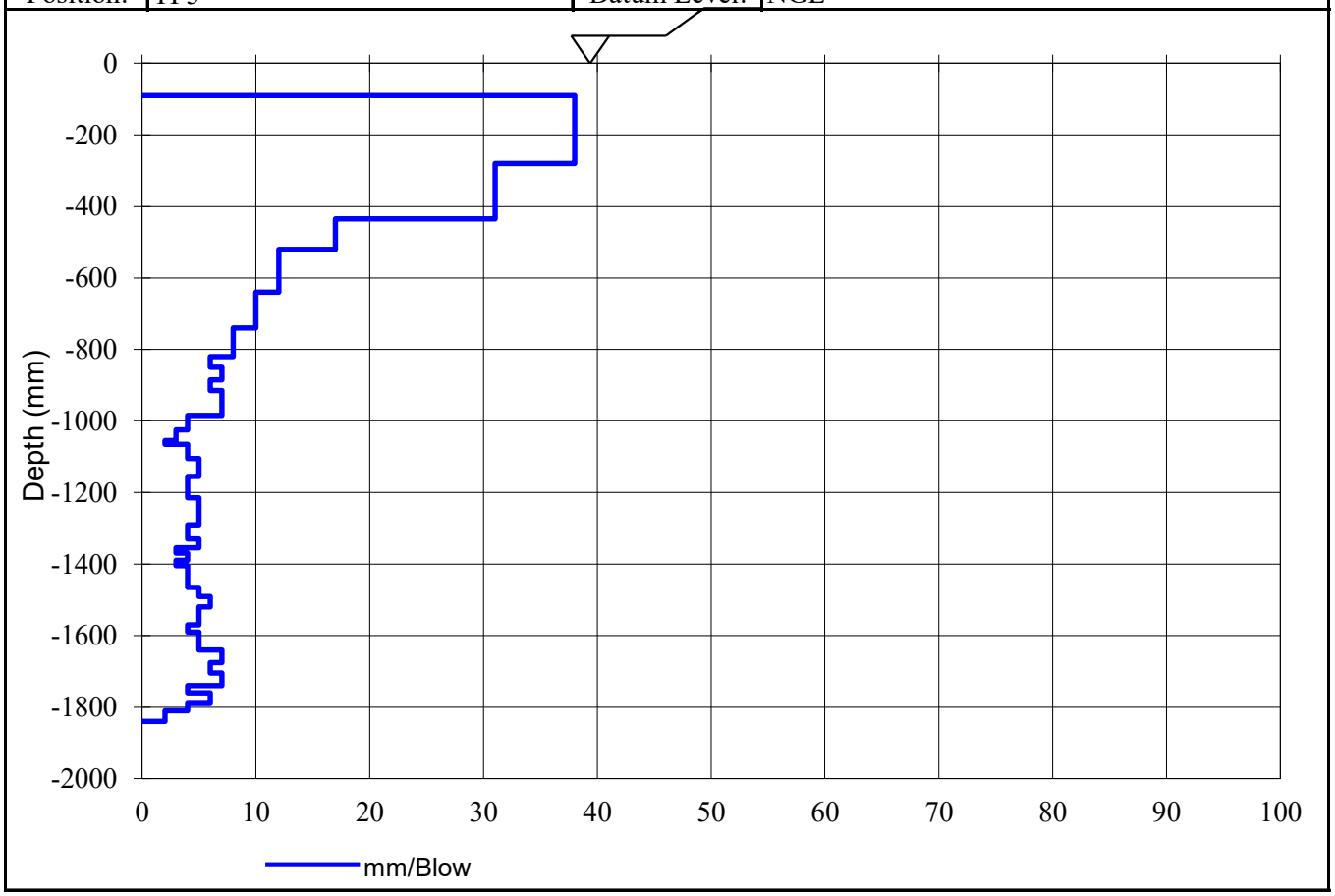
TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TP5	Datum Level:	NGL



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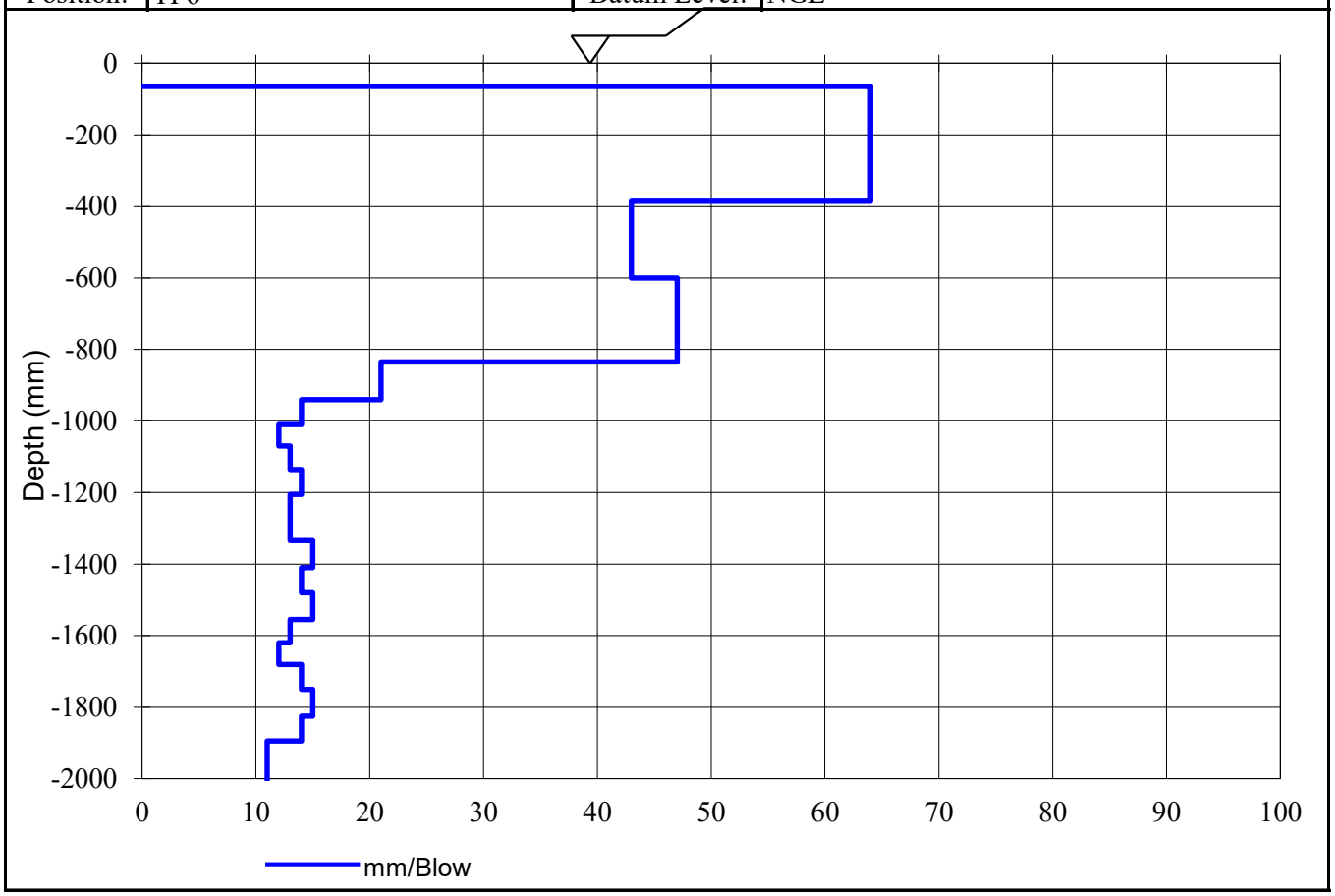
TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position:	TP6	Datum Level:	NGL



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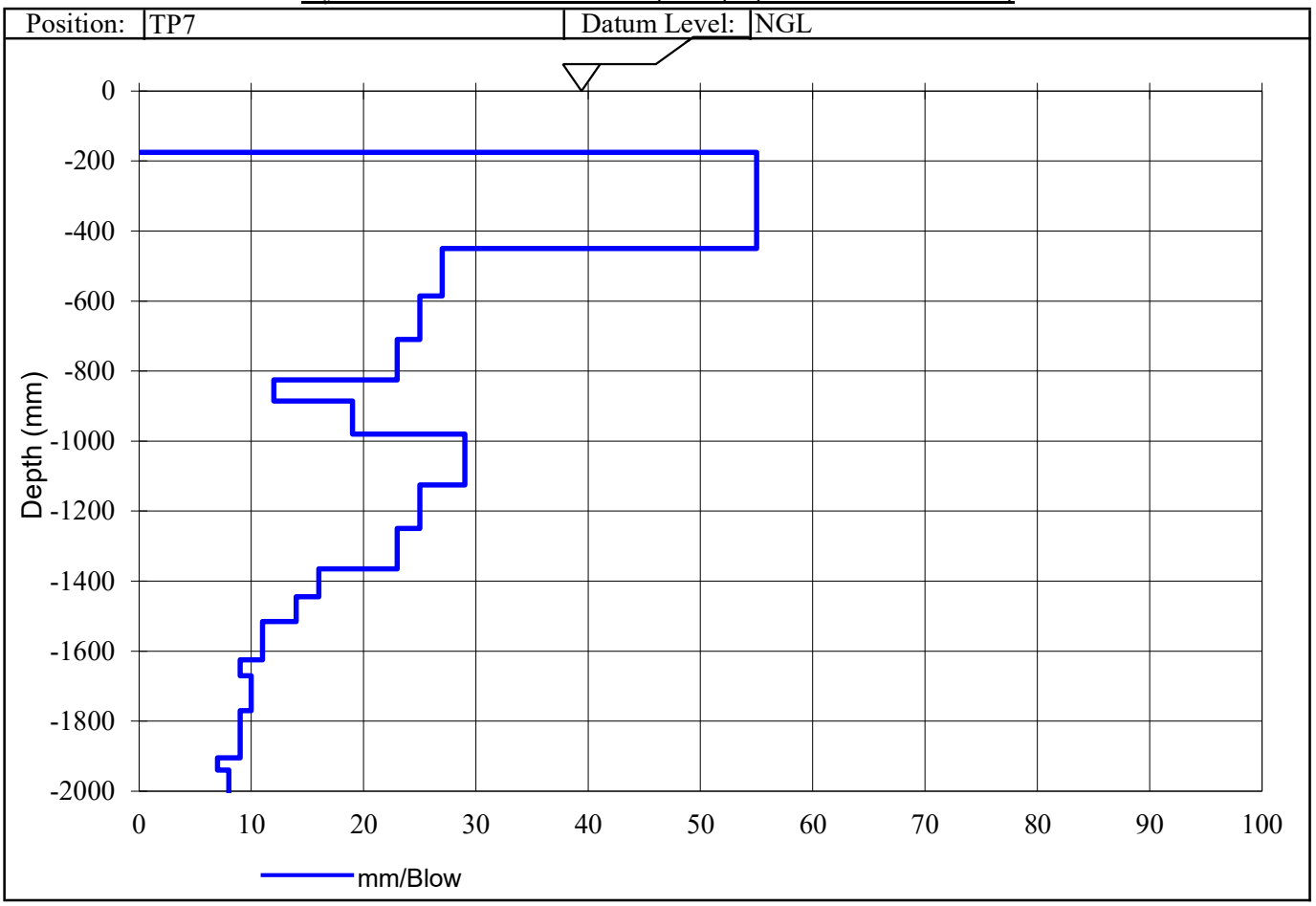
TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: TP7 Datum Level: NGL



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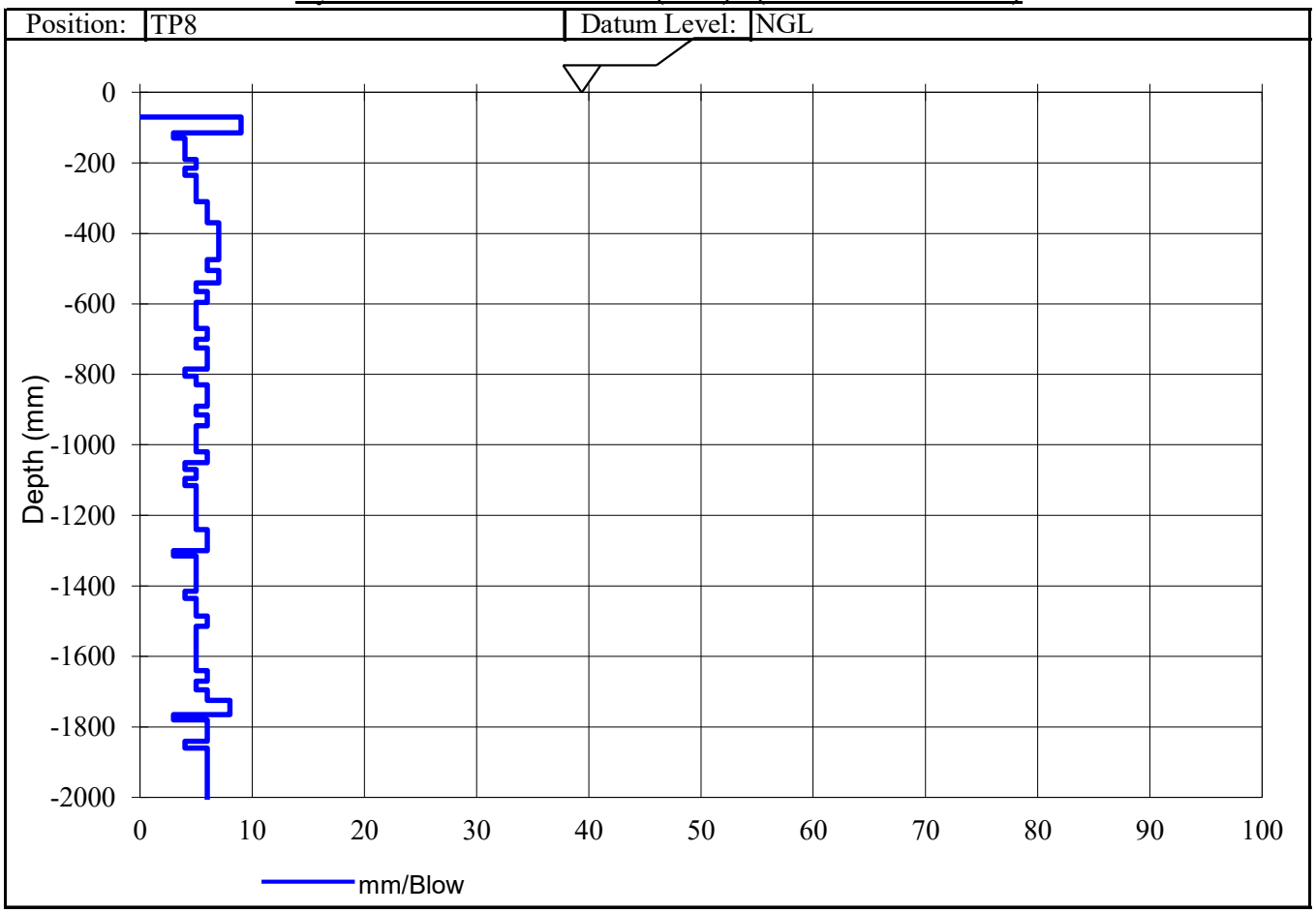
		Date Received :	27.10.2023
		Date Reported :	14.11.2023
		Req. Number :	
Attention :	Koenraad Potgieter	No. of Pages :	8 of 8

TEST REPORT

Dynamic Cone Penetrometer (DCP) - (TMH 6 Method ST6)

Position: TP8 Datum Level: NGL



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ANNEXURE C

SEWER DESIGN FLOWS

DESIGN FLOW CALCULATIONS
(Section K.4 - Red Book 2019 [method (iii) Sewer flow and peak factor method]

FULL DEVELOPMENT (ALL ERVEN)

SEWER FLOW:

	Area ha	density units/ha	Land Use Res.	Unit Hydrograph	Unit Q kl/d/unit	Erven No.	PDDWF kl/day	PF 2	IPDWF kl/day
Old Brick Area	61,9	6,7	Low Cost , High Density	UH4	0,29	412	119,5		239,0
Thembalethu Area 2	5,0	50,3	Low Cost , High Density	UH4	0,29	250	72,5		145,0
Thembalethu Area 5 - 6ab	68,0	13,9	Low Cost , High Density	UH4	0,29	152	44,1		88,2
						814	236,1		472

GROUNDWATER INFILTRATION:

	inf rate L/min/m/mØ	Unit	pipe /erf T K.11	Pipe Length m	Pipe Ø m				INF FLOW kl/day
Old Brick Area	0,03	UH4	10	4120	0,2				35,60
Thembalethu Area 2	0,03	UH4	10	2500	0,2				21,60
Thembalethu Area 5 - 6ab	0,03	UH4	10	1520	0,2				13,13
									70

DESIGN FLOWS:

	IPDWF kl/day	INF FLOW kl/day	TOT kl/day	IPWWF kl/day					IPWWF l/s
Old Brick Area	239,0	35,60	274,6	392,2					4,5
Thembalethu Area 2	145,0	21,60	166,6	238,0					2,8
Thembalethu Area 5 - 6ab	88,2	13,13	101,3	144,7					1,7
	472,1	70,33	542,4	612,8					9,0

PROJECT DATA

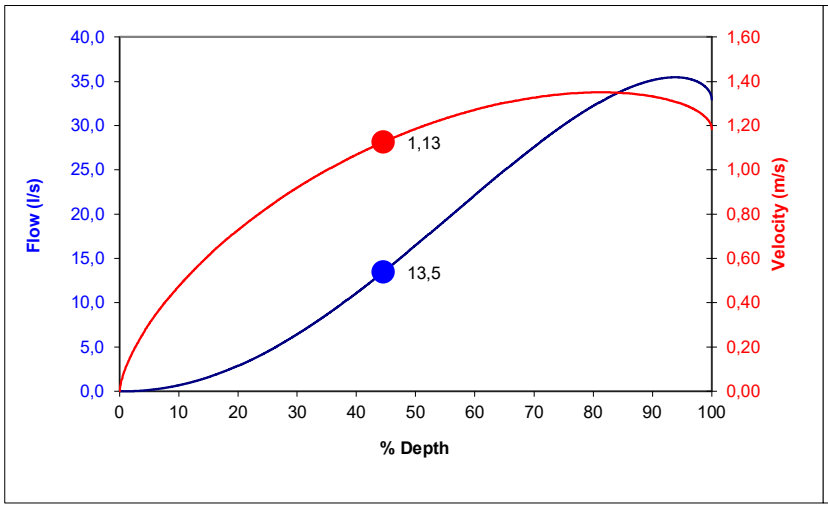
Project Name:	THEMBALETHU BULK SEWER PHASE 3 AND 4 - PORTION 2
Project Number	1762
Pipe Description:	BULK LINE
Analysed By:	Siviwe Kulu
Date:	10-Apr-24
File Path:	P:\GG\1762 Thembalethu Bulk Sewer Phase 3 and 4\04 Design & Drawings\05 Sewer\Design Flows\1762_Circular Partial Pi

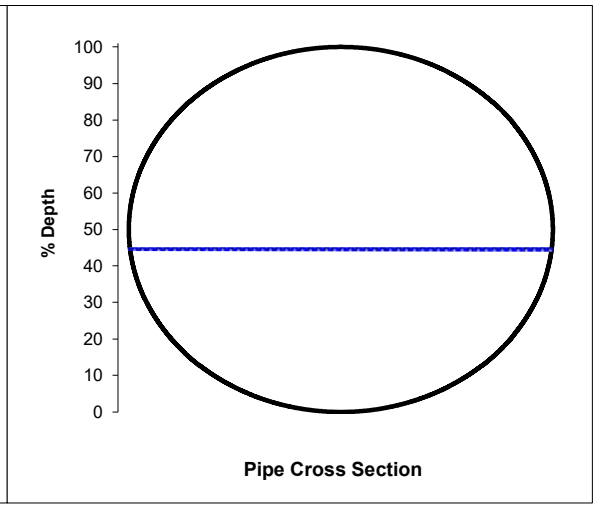
INPUT

Pipe Material:	uPVC	
Pipe Internal Diameter:	188,2	mm
Pipe Slope:	0,67	%
Mannings "n":	0,009	
Required Flow:	13,50	l/s

HYDRAULIC OUTPUT

Required Flow	13,50	l/s	Wetted Perimeter	0,275	m
Calculated Flow	13,49	l/s	Flow Area	0,012	m^2
Velocity	1,126	m/s	Specific Energy	148	mm
Flow Depth	84	mm	Froude Number	1,42	
Flow Depth / Pipe Dia.	45	%	Flow Type	Supercritical	





ANNEXURE D

DRAWINGS

No	APPROVED	AMENDMENTS	DATE
0	KP	ISSUED FOR CONSTRUCTION	30 OCT 2023

SURVEYED	-	-
DRAWN	C MBOMBELA	SEPT 2023
DESIGNED	K POTGIETER, C MBOMBELA	SEPT 2023
CHECKED	K POTGIETER	SEPT 2023
APPROVED	2023/11/03	DATE: 30-10-2023

LUKHOZI

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WEB www.lukhozi.co.za

CLIENT

GEORGE
LOCAL MUNICIPALITY

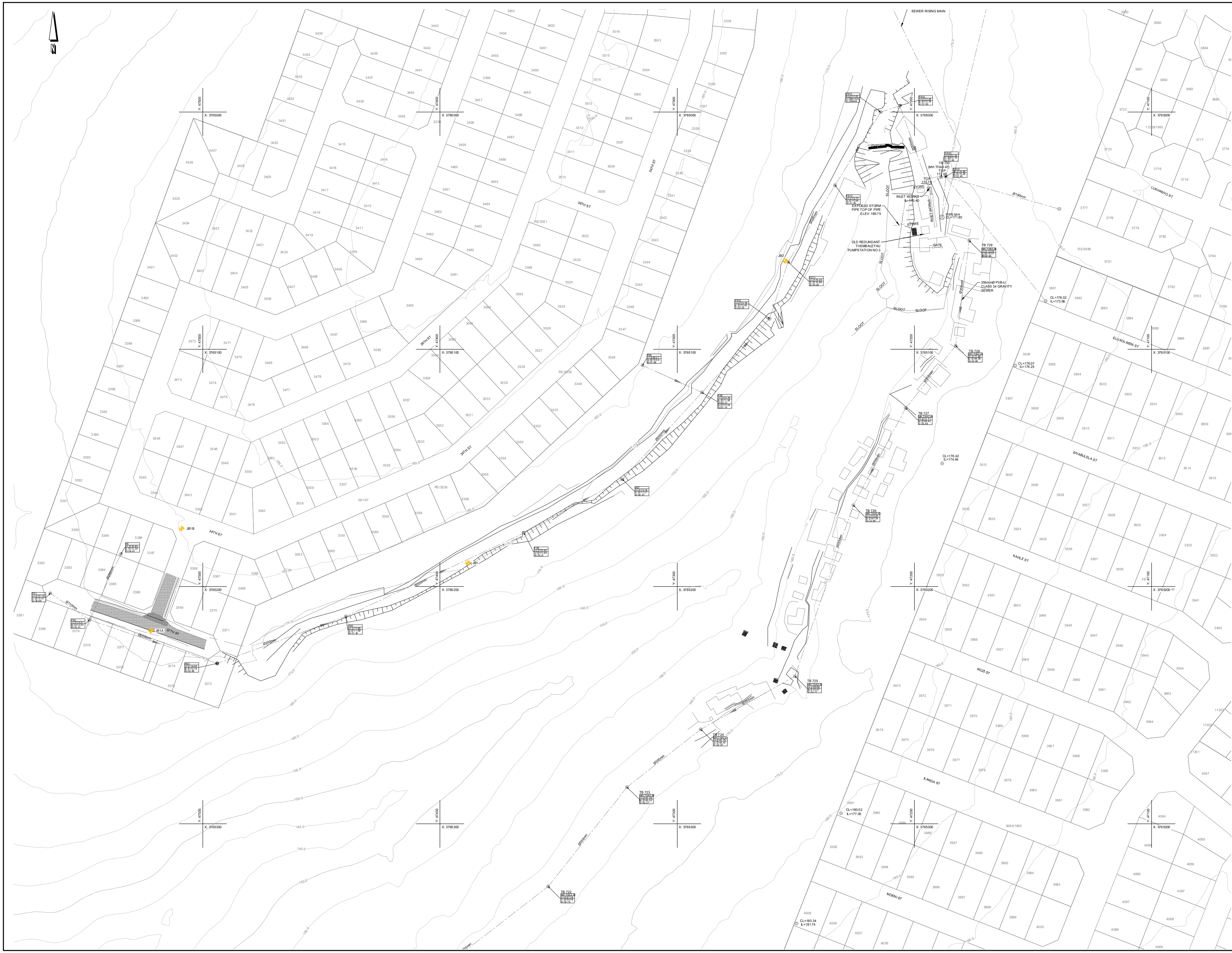
PROJECT TITLE

THEMBALETHU
BULK SEWER PHASE 3&4:
PORTION 1

DRAWING TITLE

PORTION 1
LOCALITY PLAN

SCALE	SHEET SET	SHEET SIZE
1:500	SHEET 1 OF 1 SHEETS	A0
DRAWING No.	1762-GEN-001	REVISION 0



LEGEND

EXISTING SERVICES

- SEWER PIPELINE
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- SLOOT
- BENCHMARK
- PAVED ROAD
- EXISTING ROAD
- GABIONS

2023/11/01 10:04 am

No	APPROVED	AMENDMENTS	DATE
0	KP	ISSUED FOR CONSTRUCTION	30 OCT 2023

SURVEYED	-	-
DRAWN	C MBOMBELA	SEPT 2023
DESIGNED	K POTGIETER, C MBOMBELA	SEPT 2023
CHECKED	K POTGIETER	SEPT 2023
APPROVED	2023/11/03 70064	DATE: 30-10-2023

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CLIENT

GEORGE
LOCAL MUNICIPALITY

PROJECT TITLE

THEMBALETHU
BULK SEWER PHASE 3&4:
PORTION 1

DRAWING TITLE

EXISTING SERVICES
LAYOUT

SCALE	SHEET SET	SHEET SIZE
1:500	SHEET 1 OF 1 SHEETS	A0

DRAWING No.	REVISION
1762-GEN-002	0

P:\GG\1762 Thembalethu Bulk Sewer Phase 3 and 4\04 Design & Drawings\05 Sewer\1762-SEW Thembalethu Phase 1 Layout.dwg

LEGEND

EXISTING SERVICES

- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	201770064	DATE:--2024/05/03

LUKHOZI

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CLIENT

GEORGE LOCAL MUNICIPALITY

PROJECT TITLE

THEMBALETHU BULK SEWER PHASE 3 & 4: PORTION 2

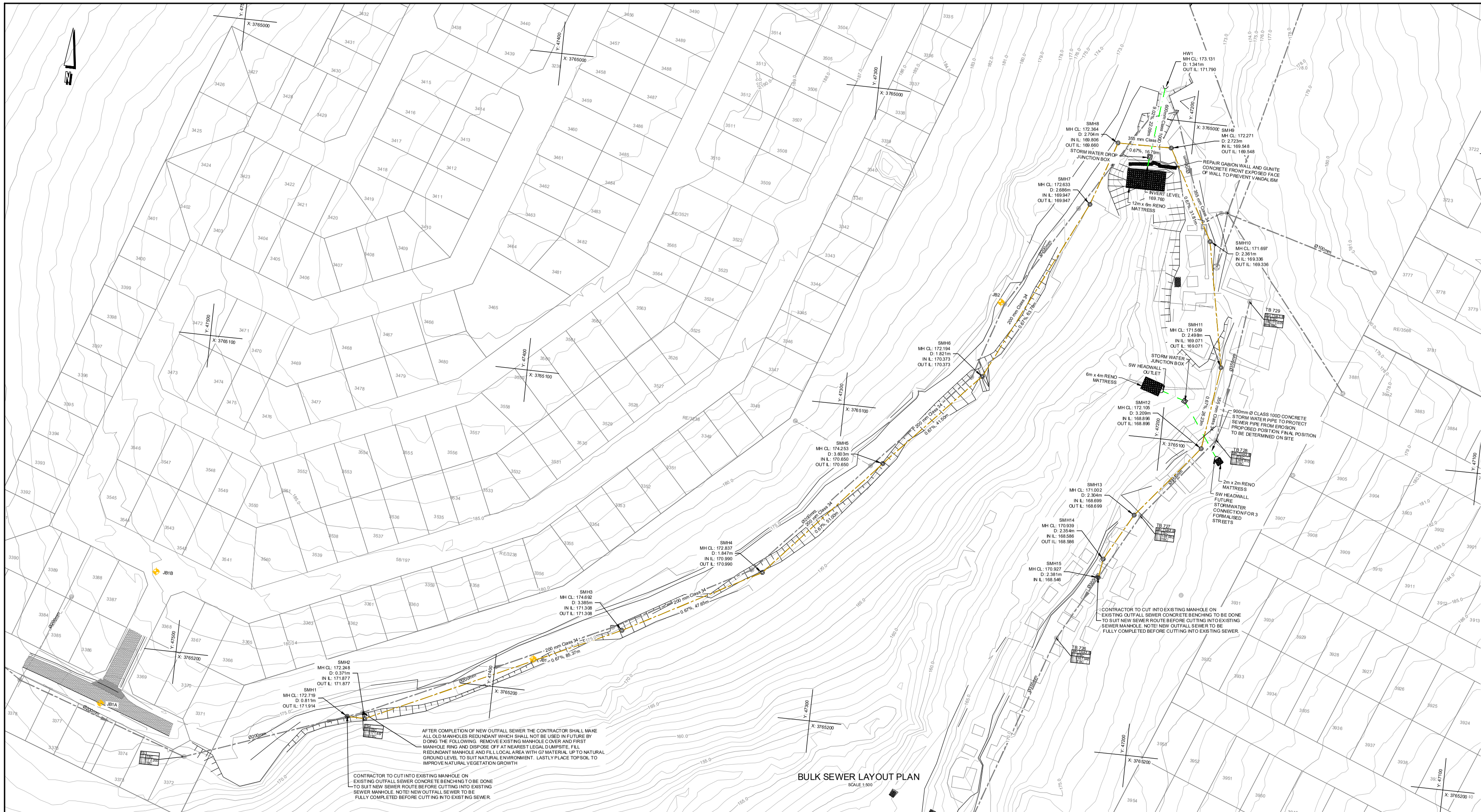
DRAWING TITLE

PORTION 2
EXISTING SERVICES LAYOUT PLAN

SCALE	SHEET SET	SHEET SIZE
1 : 2000	SHEET 1 OF 1 SHEETS	A0
DRAWING No.	1762-GEN-004	REVISION P0

P:\GG\1762 Thembalethu Bulk Sewer Phase 3 and 4\04 Design & Drawings\05 Sewer\1762-SEW-REV0.dwg

2024/02/05 03:46 pm



LEGEND

EXISTING SERVICES

- SEWER PIPELINE
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- SLOOT
- BENCHMARK
- PAVED ROAD
- EXISTING ROAD
- GABIONS AND RENO MATRESSES

PROPOSED SERVICES

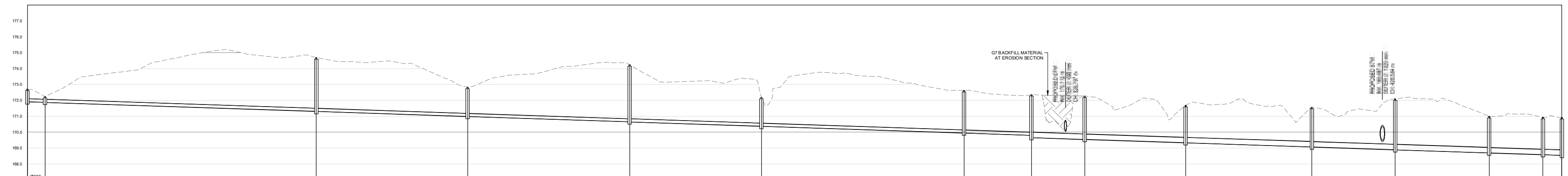
- SEWER PIPELINE
- SEWER MANHOLE
- STORMWATER PIPELINE
- STORMWATER HEADWALL
- GABIONS AND RENO MATRESSES

GENERAL NOTES:

1. SURVEY COORDINATE SYSTEM: LO 23 HARTEBEESTHOEK 94.
2. ALL CONSTRUCTION WORK TO BE IN ACCORDANCE WITH THE RELEVANT SANS 1200 SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION AS AMENDED BY THE SCOPE OF WORKS.
3. ANY CONSTRUCTION DETAILS NOT SHOWN ON THE DRAWINGS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH THE MUNICIPAL STANDARD DETAILS.
4. ALL SEWER CONNECTIONS TO BE Ø110mm uPVC CLASS 34, UNLESS OTHERWISE SHOWN OR REQUIRED.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL LEVELS AND DIMENSIONS ON SITE PRIOR TO COMMENCING WITH ANY EXCAVATIONS.
6. THE EXACT POSITIONS AND LEVELS OF ALL EXISTING SERVICES TO BE DETERMINED BY HAND EXCAVATION OR APPROVED LOCATION DEVICE BEFORE COMMENCING WITH CONSTRUCTION.
7. THE ENGINEER IS TO BE CALLED TO INSPECT ALL TRENCHES PRIOR TO ANY BACKFILL.
8. ALL MATERIAL TESTS FOR ALL CONSTRUCTION WORKS TO BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
9. ANY DISCREPANCIES TO BE BROUGHT TO THE ENGINEER'S ATTENTION IMMEDIATELY.
10. REFER TO DRAWING NO. 1762-GEN-001 FOR THE PHASE LOCALITY PLAN.
11. REFER TO DRAWING NO. 1762-GEN-002 FOR EXISTING SERVICES LAYOUT.
12. REFER TO DRAWING NO. 1762-SEW-010 FOR SEWER TYPICAL DETAILS.
13. ALL SEWER GRAVITY PIPES TO BE 315mm HEAVY DUTY CLASS 34 FOR SEWER BULK COLLECTOR, UNLESS OTHERWISE SHOWN OR REQUIRED.
14. SEWER MANHOLES ARE TO BE CONSTRUCTED USING 1.0m DIAMETER PRECAST RINGS TO DEPTHS IN ACCORDANCE WITH THE DESIGNS & DRAWINGS. MANHOLES DEEPER THAN 1.5m WILL BE REDUCED TO 0.75m WIDTH AT A DEPTH OF 1.5m. FOR DEPTHS GREATER THAN 4.0m TO A MAX. OF 6m DEEP BOTTOM PRECAST RING DIAMETER SHALL BE INCREASED TO 1.25M DIAMETER.
15. FINISHED COVER LEVELS:
   CARRIAGEWAYS - COVER TO BE FLUSHED WITH THE FINISHED ROAD SURFACE
   ROAD RESERVE - COVER TO BE 50mm ABOVE THE FINISHED GROUND LEVEL
   OPEN SPACES - COVER TO BE 500mm ABOVE FINISHED GROUND LEVEL

STRUCTURE LIST-PHASE 1 BULK SEWER NETWORK

STRUCTURE NAME	Y	X	RIM ELEVATION	SUMP ELEVATION SUMP DEPTH	INVERT ELEVATION	MATERIAL
SMH1	47 444.286	3 766 214.253	172.719	171.888 0.811	P14-INV OUT 171.914	[illegible]
SMH2	47 438.841	3 766 214.583	172.248	171.877 0.371	P14-INV IN 171.877 P5-INV OUT 171.877	[illegible]
SMH3	47 361.560	3 765 178.068	174.692	171.308 3.385	P5-INV IN 171.308 P4-INV OUT 171.308	[illegible]
SMH4	47 310.747	3 765 158.246	172.837	170.990 1.847	P4-INV IN 170.990 P6-INV OUT 170.990	[illegible]
SMH5	47 285.864	3 765 117.127	174.253	170.650 3.603	P6-INV IN 170.650 P7-INV OUT 170.650	[illegible]
SMH6	47 257.795	3 765 088.558	172.194	170.373 1.821	P7-INV IN 170.373 P8-INV OUT 170.373	[illegible]
SMH7	47 230.214	3 765 028.142	172.633	169.947 2.686	P8-INV IN 169.947 P8(2)-INV OUT 169.947	[illegible]
SMH8	47 223.330	3 765 009.017	172.364	169.660 2.704	P8(3)-INV IN 169.660 P15-INV OUT 169.660	[illegible]
SMH9	47 206.543	3 765 008.638	172.271	169.548 2.723	P15-INV IN 169.548 P13-INV OUT 169.548	[illegible]
SMH10	47 191.291	3 765 036.717	171.697	169.336 2.361	P13-INV IN 169.336 P13(3)-INV OUT 169.336	[illegible]
SMH11	47 183.580	3 765 079.668	171.569	169.071 2.498	P13(3)-INV IN 169.071 [illegible]	[illegible]
SMH12	47 186.884	3 765 101.675	172.105	168.896 3.209	[illegible]	[illegible]
SMH13	47 205.659	3 765 124.678	171.002	168.699 2.304	[illegible]	[illegible]
SMH14	47 213.810	3 765 136.471	170.939	168.586 2.354	[illegible]	[illegible]
SMH15	47 214.725	3 765 148.378	170.927	168.546 2.381	[illegible]	[illegible]



SCALES:
Horizontal 1:500
Vertical 1:100

DATUM 167.000m MSL

REFERENCE	SMH1	SMH2	SMH3	SMH4	SMH5	SMH6	SMH7	SMH8	SMH9	SMH10	SMH11	SMH12	SMH13	SMH14	SMH15
DISTANCE (m)	0.000	5.546	90.916	138.570	189.572	231.074	294.856	316.062	332.850	364.655	404.302	430.583	460.212	477.106	483.084
GROUND LEVEL	172.721	172.220	174.692	172.828	174.253	172.194	172.633	172.364	172.271	171.697	171.569	172.105	171.002	170.939	170.927
DEPTH TO MH INVERT	0.811	0.371	3.385	1.847	3.603	1.821	2.686	2.704	2.723	2.361	2.498	3.209	2.304	2.354	2.381

Pipes / slope / length (between manholes):

Segment	Pipe	Slope	Length
SMH1–SMH2	Ø200 CLASS 34	0.67% 1:149.9	5.55m
SMH2–SMH3	Ø200 CLASS 34	0.67% 1:149.9	85.37m
SMH3–SMH4	Ø200 CLASS 34	0.67% 1:149.9	47.65m
SMH4–SMH5	Ø200 CLASS 34	0.67% 1:149.9	51.00m
SMH5–SMH6	Ø200 CLASS 34	0.67% 1:149.9	41.50m
SMH6–SMH7	Ø200 CLASS 34	0.67% 1:149.9	63.78m
SMH7–SMH8	Ø200 CLASS 34	0.67% 1:149.9	21.21m
SMH8–SMH9	Ø355 CLASS 34	0.67% 1:149.9	16.79m
SMH9–SMH10	Ø355 CLASS 34	0.67% 1:149.9	31.80m
SMH10–SMH11	Ø355 CLASS 34	0.67% 1:150.0	39.70m
SMH11–SMH12	Ø355 CLASS 34	0.67% 1:149.9	26.23m
SMH12–SMH13	Ø355 CLASS 34	0.67% 1:149.9	29.63m
SMH13–SMH14	Ø355 CLASS 34	0.67% 1:149.9	16.89m
SMH14–SMH15	Ø355 CLASS 34	0.67% 1:149.9	5.98m

LONGSECTION PHASE 1 BULK SEWER NETWORK
FROM 0.000 TO 483.084

No	APPROVED	AMENDMENTS	DATE
0	KP	ISSUED FOR CONSTRUCTION	30 OCT 2023
1	KP	SEWER PIPELINE REVISED, STORMWATER LINE ADDED	23 NOV 2023
2	KP	SEWER PIPELINE REVISED AND STORMWATER INCLUDED	15 JAN 2024

SURVEYED	JOUBERT & BRINK	OCT 2023
DRAWN	S KULU	OCT 2023
DESIGNED	K POTGIETER, S KULU	OCT 2023
CHECKED	K POTGIETER	OCT 2023
APPROVED	2024/01/25	DATE: 23-11-2023

LUKHOZI CONSULTING ENGINEERS (PTY) LTD

CLIENT: GEORGE LOCAL MUNICIPALITY

PROJECT TITLE: THEMBALETHU BULK SEWER PHASE 3 & 4: PORTION 1

DRAWING TITLE: BULK SEWER LAYOUT PLAN

SCALE: AS SHOWN | SHEET SET: SHEET 1 OF 1 SHEETS | SHEET SIZE: A0

DRAWING No: 1762-SEW-001 | REVISION: 2

2024/01/26 12:10 pm

LAYOUT PLAN
SCALE 1:1000

LEGEND

EXISTING SERVICES

- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

PROPOSED SERVICES

- SEWER PIPELINE
- SEWER MANHOLE

2024/05/03 12:42 pm

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU, K POTGIETER	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	201770064	DATE:--2024/05/03

LUKHOZI

LUKHOZI CONSULTING ENGINEERS (PTY) LTD

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DORMEHLSDRIFT, GEORGE

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EMAIL grg@lukhozi.co.za
WEB www.lukhozi.co.za

CLIENT

GEORGE
LOCAL MUNICIPALITY

PROJECT TITLE

THEMBALETHU
BULK SEWER PHASE 3 & 4:
PORTION 2

DRAWING TITLE

PORTION 2 BULK SEWER
KEY PLAN

SCALE	SHEET SET	SHEET SIZE
AS SHOWN	SHEET 1 OF 1 SHEETS	A0
DRAWING No.		REVISION
1762-SEW-002		P0

P:\GG\1762 Thembalethu Bulk Sewer Phase 3 and 4\04 Design & Drawings\05 Sewer\1762-SEW-Thembalethu Portion 2 Layout.dwg

GENERAL NOTES:

1. SURVEY COORDINATE SYSTEM: LO 23 HARTEBEESTHOEK 94.
2. ALL CONSTRUCTION WORK TO BE IN ACCORDANCE WITH THE RELEVANT SANS 1200 SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION AS AMENDED BY THE SCOPE OF WORKS.
3. ANY CONSTRUCTION DETAILS NOT SHOWN ON THE DRAWINGS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH THE MUNICIPAL STANDARD DETAILS.
4. ALL SEWER CONNECTIONS TO BE Ø110mm uPVC CLASS 34, UNLESS OTHERWISE SHOWN OR REQUIRED.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL LEVELS AND DIMENSIONS ON SITE PRIOR TO COMMENCING WITH ANY EXCAVATIONS.
6. THE EXACT POSITIONS AND LEVELS OF ALL EXISTING SERVICES TO BE DETERMINED BY HAND EXCAVATION OR APPROVED LOCATION DEVICE BEFORE COMMENCING WITH CONSTRUCTION.
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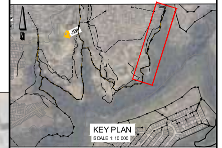
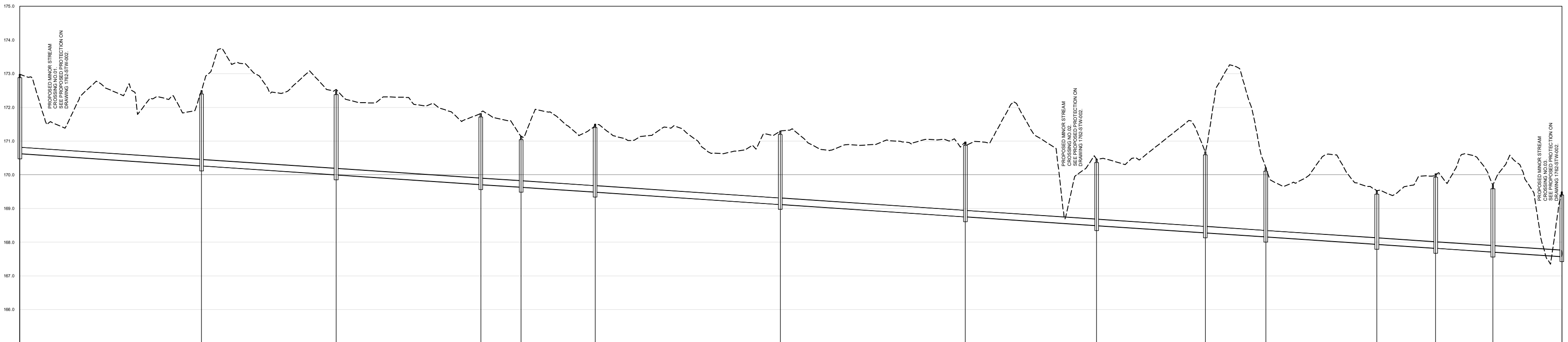
9. ANY DISCREPANCIES TO BE BROUGHT TO THE ENGINEER'S ATTENTION IMMEDIATELY.
10. REFER TO DRAWING NO. 1762-GEN-001 FOR THE PHASE LOCALITY PLAN.
11. REFER TO DRAWING NO. 1762-GEN-002 FOR EXISTING SERVICES LAYOUT.
12. REFER TO DRAWING NO. 1762-SEW-010 FOR SEWER TYPICAL DETAILS.
13. ALL SEWER GRAVITY PIPES TO BE 200mm HEAVY DUTY CLASS 34 FOR SEWER BULK COLLECTOR, UNLESS OTHERWISE SHOWN OR REQUIRED.
14. SEWER MANHOLES ARE TO BE CONSTRUCTED USING 1.0m DIAMETER PRECAST RINGS TO DEPTHS IN ACCORDANCE WITH THE DESIGNS & DRAWINGS. MANHOLES DEEPER THAN 1.5m WILL BE REDUCED TO 0.75m WIDTH AT A DEPTH OF 1.5m. FOR DEPTHS GREATER THAN 4.0m TO A MAX. OF 6m DEEP BOTTOM PRECAST RING DIAMETER SHALL BE INCREASED TO 1.25M DIAMETER.
15. FINISHED COVER LEVELS:
    CARRIAGEWAYS - COVER TO BE FLUSHED WITH THE FINISHED ROAD SURFACE
    ROAD RESERVE - COVER TO BE 50mm ABOVE THE FINISHED GROUND LEVEL
    OPEN SPACES - COVER TO BE 500mm ABOVE FINISHED GROUND LEVEL

LEGEND

EXISTING SERVICES
- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

PROPOSED SERVICES
- SEWER PIPELINE
- SEWER MANHOLE





SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 165.000m MSL

REFERENCE	DISTANCE (m)	GROUND LEVEL	DEPTH TO MH INVERT	PIPE INVERT LEVEL	PIPE	SLOPE / LENGTH
SMH A01	0.000	172.982	2.358	170.625	Ø200 CLASS 34	0.67% 1:150.0 54.00m
SMH A02	54.000	172.500	2.235	170.265 / 170.265	Ø200 CLASS 34	0.67% 1:150.0 40.00m
SMH A03	94.013	172.483	2.485	169.998 / 169.998	Ø200 CLASS 34	0.67% 1:150.0 42.99m
SMH A04	137.000	171.813	2.102	169.711 / 169.711	Ø200 CLASS 34	0.67% 1:150.0 12.00m
SMH A05	149.000	171.146	1.514	169.631 / 169.631	Ø200 CLASS 34	0.67% 1:150.0 22.00m
SMH A06	171.000	171.500	2.015	169.485 / 169.485	Ø200 CLASS 34	0.67% 1:150.0 55.00m
SMH A07	226.000	171.296	2.178	169.118 / 169.118	Ø200 CLASS 34	0.67% 1:150.0 55.00m
SMH A08	281.000	170.972	2.220	168.751 / 168.751	Ø200 CLASS 34	0.67% 1:150.0 39.00m
SMH A09	320.000	170.460	1.969	168.491 / 168.491	Ø200 CLASS 34	0.67% 1:150.0 32.30m
SMH A10	352.303	170.688	2.412	168.276 / 168.276	Ø200 CLASS 34	0.67% 1:150.0 17.97m
SMH A11	370.272	170.207	2.051	168.156 / 168.156	Ø200 CLASS 34	0.67% 1:150.0 33.00m
SMH A12	403.272	169.526	1.589	167.936 / 167.936	Ø200 CLASS 34	0.67% 1:150.0 17.50m
SMH A13	420.772	170.024	2.205	167.820 / 167.820	Ø200 CLASS 34	0.67% 1:150.0 17.00m
SMH A14	437.772	169.689	1.983	167.706 / 167.706	Ø200 CLASS 34	0.67% 1:150.0 20.50m
SMH A15	458.272	169.495	1.926	167.570		

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU, K POTGIETER	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	201770064	DATE: 2024/05/03

LUKHOZI CONSULTING ENGINEERS (PTY) LTD
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TEL 044 050 4154
EMAIL grg@lukhozi.co.za
WEB www.lukhozi.co.za

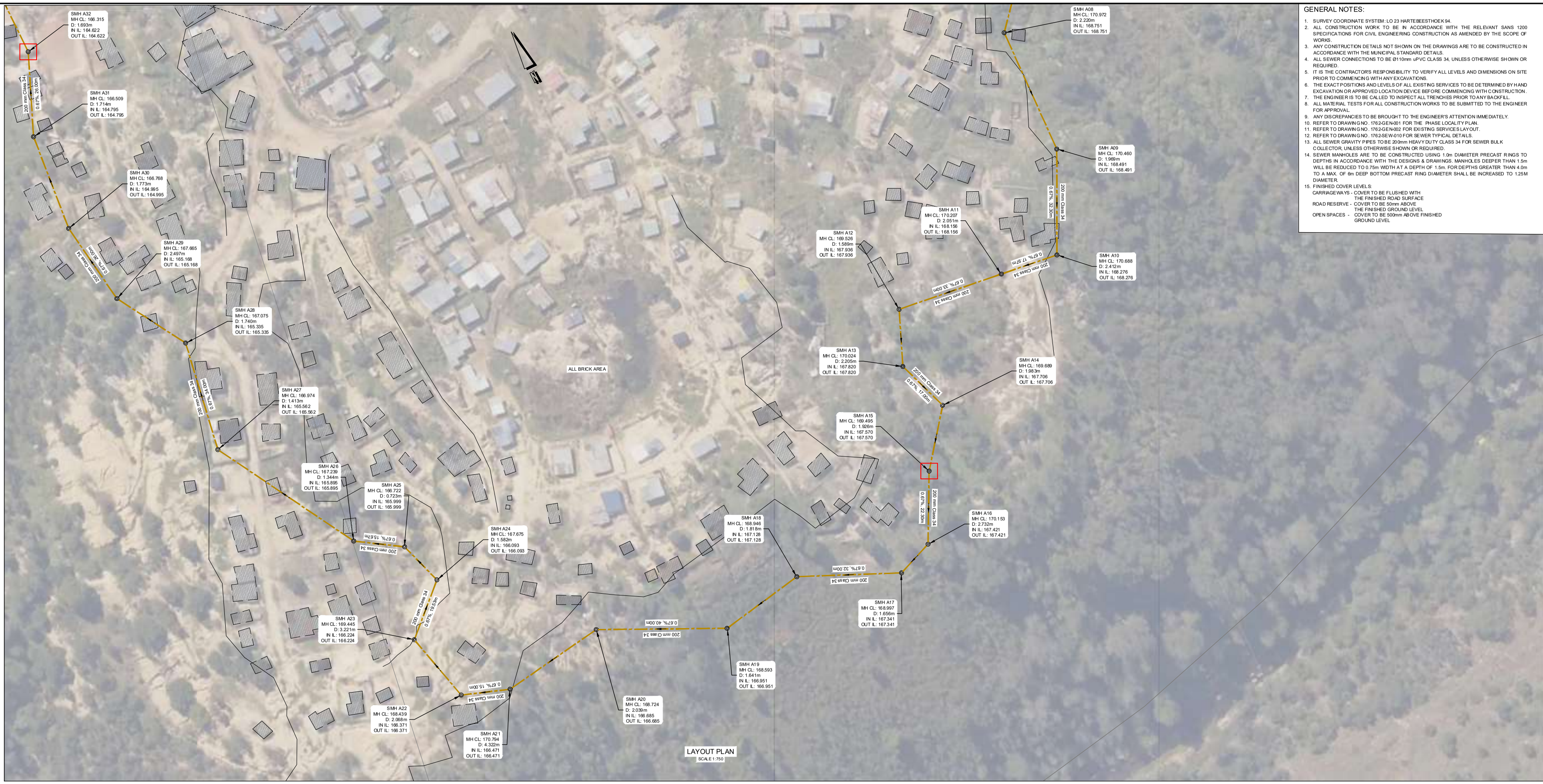
CLIENT
GEORGE LOCAL MUNICIPALITY

PROJECT TITLE
THEMBALETHU BULK SEWER PHASE 3 & 4: PORTION 2

DRAWING TITLE
PORTION 2 BULK SEWER LAYOUT PLAN SMH A01 - SMH A15

SCALE: AS SHOWN | SHEET SET: SHEET 1 OF 7 SHEETS | SHEET SIZE: A0
DRAWING No. 1762-SEW-003 | REVISION P0

P:\GG\1762 Thembalethu Bulk Sewer Phase 3 and 4\04 Design & Drawings\05 Sewer\1762-SEW-Thembalethu Portion 2 Layout.dwg
2024/05/03 12:23 pm



LAYOUT PLAN
SCALE 1:750

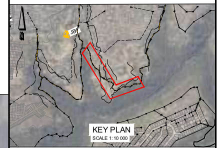
GENERAL NOTES:

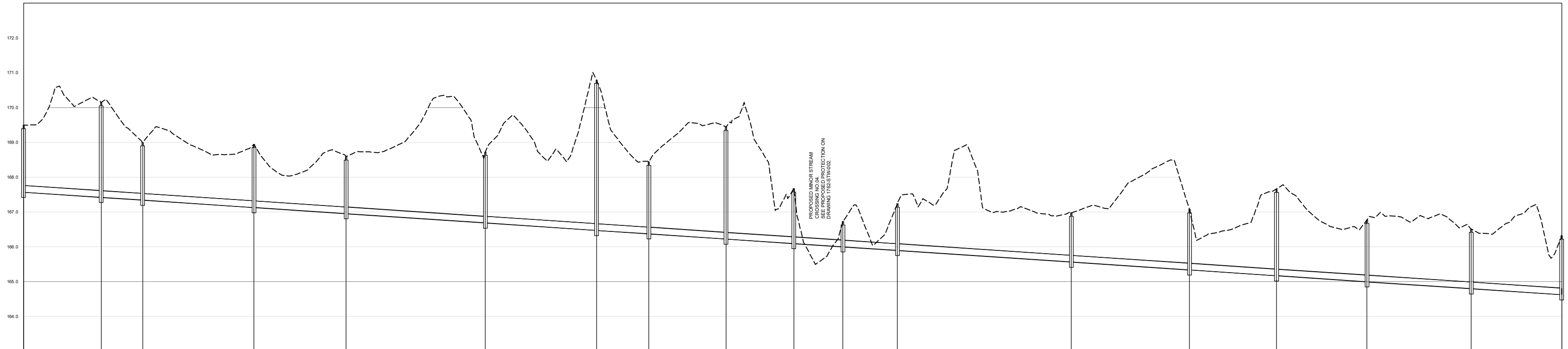
1. SURVEY COORDINATE SYSTEM: LO 23 HARTEBEESTHOEK 94.
2. ALL CONSTRUCTION WORK TO BE IN ACCORDANCE WITH THE RELEVANT SANS 1200 SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION AS AMENDED BY THE SCOPE OF WORKS.
3. ANY CONSTRUCTION DETAILS NOT SHOWN ON THE DRAWINGS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH THE MUNICIPAL STANDARD DETAILS.
4. ALL SEWER CONNECTIONS TO BE Ø110mm uPVC CLASS 34, UNLESS OTHERWISE SHOWN OR REQUIRED.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL LEVELS AND DIMENSIONS ON SITE PRIOR TO COMMENCING WITH ANY EXCAVATIONS.
6. THE EXACT POSITIONS AND LEVELS OF ALL EXISTING SERVICES TO BE DETERMINED BY HAND EXCAVATION OR APPROVED LOCATION DEVICE BEFORE COMMENCING WITH CONSTRUCTION.
7. THE ENGINEER IS TO BE CALLED TO INSPECT ALL TRENCHES PRIOR TO ANY BACKFILL.
8. ALL MATERIAL TESTS FOR ALL CONSTRUCTION WORKS TO BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
9. ANY DISCREPANCIES TO BE BROUGHT TO THE ENGINEER'S ATTENTION IMMEDIATELY.
10. REFER TO DRAWING NO. 1762-GEN-001 FOR THE PHASE LOCALITY PLAN.
11. REFER TO DRAWING NO. 1762-GEN-002 FOR EXISTING SERVICES LAYOUT.
12. REFER TO DRAWING NO. 1762-SEW-010 FOR SEWER TYPICAL DETAILS.
13. ALL SEWER GRAVITY PIPES TO BE 200mm HEAVY DUTY CLASS 34 FOR SEWER BULK COLLECTOR, UNLESS OTHERWISE SHOWN OR REQUIRED.
14. SEWER MANHOLES ARE TO BE CONSTRUCTED USING 1.0m DIAMETER PRECAST RINGS TO DEPTHS IN ACCORDANCE WITH THE DESIGNS & DRAWINGS. MANHOLES DEEPER THAN 1.5m WILL BE REDUCED TO 0.75m WIDTH AT A DEPTH OF 1.5m. FOR DEPTHS GREATER THAN 4.0m TO A MAX. OF 6m DEEP BOTTOM PRECAST RING DIAMETER SHALL BE INCREASED TO 1.25M DIAMETER.
15. FINISHED COVER LEVELS:
    CARRIAGEWAYS - COVER TO BE FLUSHED WITH THE FINISHED ROAD SURFACE
    ROAD RESERVE - COVER TO BE 50mm ABOVE THE FINISHED GROUND LEVEL
    OPEN SPACES - COVER TO BE 500mm ABOVE FINISHED GROUND LEVEL

LEGEND

EXISTING SERVICES
- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

PROPOSED SERVICES
- SEWER PIPELINE
- SEWER MANHOLE





SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 163.000m MSL

REFERENCE	DISTANCE (m)	GROUND LEVEL	DEPTH TO MH INVERT	PIPE INVERT LEVEL
SMH A15	458.272	169.496	1.926	167.570
SMH A16	480.570	170.153	2.732	167.421 / 167.421
SMH A17	492.509	168.997	1.656	167.341 / 167.341
SMH A18	524.509	168.946	1.818	167.128 / 167.128
SMH A19	551.009	168.593	1.641	166.951 / 166.951
SMH A20	591.009	168.724	2.039	166.685 / 166.685
SMH A21	623.009	170.794	4.322	166.471 / 166.471
SMH A22	638.009	168.439	2.068	166.371 / 166.371
SMH A23	660.185	169.445	3.221	166.224 / 166.224
SMH A24	679.713	167.675	1.582	166.093 / 166.093
SMH A25	693.818	166.722	0.723	165.999 / 165.999
SMH A26	709.484	167.239	1.344	165.895 / 165.895
SMH A27	759.484	166.974	1.413	165.562 / 165.562
SMH A28	793.484	167.075	1.740	165.335 / 165.335
SMH A29	818.484	167.665	2.497	165.168 / 165.168
SMH A30	844.484	166.768	1.773	164.995 / 164.995
SMH A31	874.484	166.509	1.714	164.795 / 164.795
SMH A32	900.484	166.315	1.693	164.622

REFERENCE	SLOPE / LENGTH
Ø200 CLASS 34 (SMH A15 – SMH A16)	0.67% 1:150.0 22.30m
Ø200 CLASS 34 (SMH A16 – SMH A17)	0.67% 1:150.0 11.94m
Ø200 CLASS 34 (SMH A17 – SMH A18)	0.67% 1:150.0 32.00m
Ø200 CLASS 34 (SMH A18 – SMH A19)	0.67% 1:150.0 26.50m
Ø200 CLASS 34 (SMH A19 – SMH A20)	0.67% 1:150.0 40.00m
Ø200 CLASS 34 (SMH A20 – SMH A21)	0.67% 1:150.0 32.00m
Ø200 CLASS 34 (SMH A21 – SMH A22)	0.67% 1:150.0 15.00m
Ø200 CLASS 34 (SMH A22 – SMH A23)	0.67% 1:150.0 22.18m
Ø200 CLASS 34 (SMH A23 – SMH A24)	0.67% 1:150.0 19.53m
Ø200 CLASS 34 (SMH A24 – SMH A25)	0.67% 1:150.0 14.11m
Ø200 CLASS 34 (SMH A25 – SMH A26)	0.67% 1:150.0 15.67m
Ø200 CLASS 34 (SMH A26 – SMH A27)	0.67% 1:150.0 50.00m
Ø200 CLASS 34 (SMH A27 – SMH A28)	0.67% 1:150.0 34.00m
Ø200 CLASS 34 (SMH A28 – SMH A29)	0.67% 1:150.0 25.00m
Ø200 CLASS 34 (SMH A29 – SMH A30)	0.67% 1:150.0 26.00m
Ø200 CLASS 34 (SMH A30 – SMH A31)	0.67% 1:150.0 30.00m
Ø200 CLASS 34 (SMH A31 – SMH A32)	0.67% 1:150.0 26.00m

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU, K POTGIETER	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	PR REG No: 201770064	DATE: 2024/05/03

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CLIENT
GEORGE
LOCAL MUNICIPALITY

PROJECT TITLE
THEMBALETHU
BULK SEWER PHASE 3 & 4:
PORTION 2

DRAWING TITLE
PORTION 2 BULK SEWER
LAYOUT PLAN
SMH A15 - SMH A32

SCALE	SHEET SET	SHEET SIZE
AS SHOWN	SHEET 2 OF 7 SHEETS	A0

DRAWING No.	REVISION
1762-SEW-004	P0

GENERAL NOTES:

1. SURVEY COORDINATE SYSTEM: LO 23 HARTEBEESTHOEK 94.
2. ALL CONSTRUCTION WORK TO BE IN ACCORDANCE WITH THE RELEVANT SANS 1200 SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION AS AMENDED BY THE SCOPE OF WORKS.
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4. ALL SEWER CONNECTIONS TO BE Ø110mm uPVC CLASS 34, UNLESS OTHERWISE SHOWN OR REQUIRED.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL LEVELS AND DIMENSIONS ON SITE PRIOR TO COMMENCING WITH ANY EXCAVATIONS.
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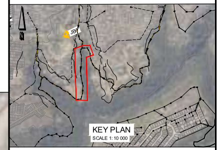
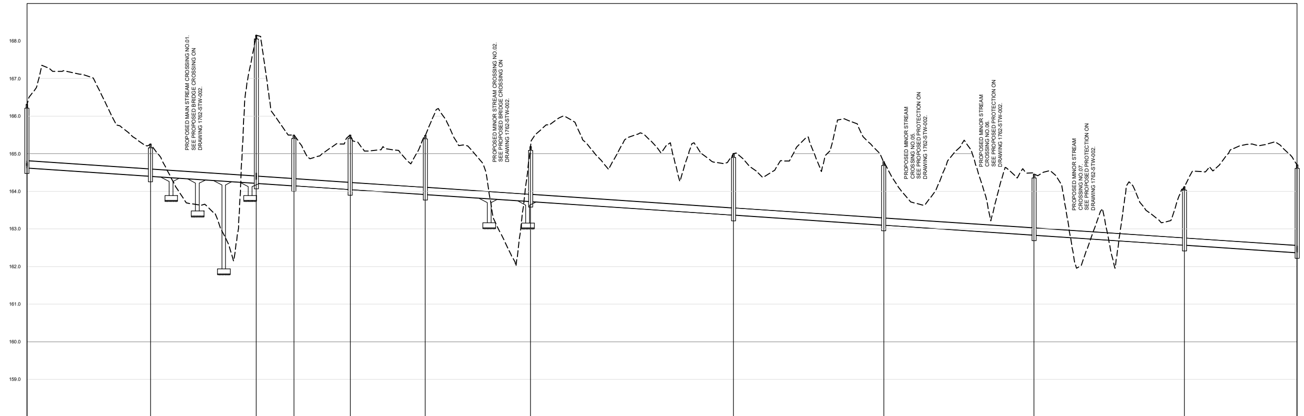
    - ROAD RESERVE - COVER TO BE 50mm ABOVE THE FINISHED GROUND LEVEL
    - OPEN SPACES - COVER TO BE 500mm ABOVE FINISHED GROUND LEVEL

LEGEND

EXISTING SERVICES
- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

PROPOSED SERVICES
- SEWER PIPELINE
- SEWER MANHOLE





SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 158.000m MSL

REFERENCE	DISTANCE (m)	GROUND LEVEL	DEPTH TO MH INVERT	PIPE INVERT LEVEL	SLOPE / LENGTH
SMH A32	900.484	166.315	1.693	164.622	
Ø200 CLASS 34					0.67% 1:150.0 32.90m
SMH A33	933.386	165.258	0.856	164.402 / 164.402	
Ø200 CLASS 34					0.67% 1:150.0 28.14m
SMH A34	961.521	168.153	3.938	164.215 / 164.215	
Ø200 CLASS 34					0.67% 1:150.0 10.00m
SMH A35	971.523	165.500	1.352	164.148 / 164.148	
Ø200 CLASS 34					0.67% 1:150.0 15.00m
SMH A36	986.523	165.500	1.452	164.048 / 164.048	
Ø200 CLASS 34					0.67% 1:150.0 20.00m
SMH A37	1006.523	165.492	1.578	163.915 / 163.915	
Ø200 CLASS 34					0.67% 1:150.0 28.00m
SMH A38	1034.523	165.192	1.464	163.728 / 163.728	
Ø200 CLASS 34					0.67% 1:150.0 54.00m
SMH A39	1088.523	165.000	1.632	163.368 / 163.368	
Ø200 CLASS 34					0.67% 1:150.0 40.00m
SMH A40	1128.523	164.787	1.686	163.101 / 163.101	
Ø200 CLASS 34					0.67% 1:150.0 40.00m
SMH A41	1168.523	164.456	1.621	162.835 / 162.835	
Ø200 CLASS 34					0.67% 1:150.0 40.00m
SMH A42	1208.523	164.129	1.561	162.568 / 162.568	
Ø200 CLASS 34					0.67% 1:150.0 29.99m
SMH A43	1238.517	164.710	2.342	162.368	

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU, K POTGIETER	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	201770064	DATE:-2024/05/03

LUKHOZI CONSULTING ENGINEERS (PTY) LTD
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TEL 044 050 4154
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WEB www.lukhozi.co.za

CLIENT
GEORGE LOCAL MUNICIPALITY

PROJECT TITLE
THEMBALETHU BULK SEWER PHASE 3 & 4: PORTION 2

DRAWING TITLE
PORTION 2 BULK SEWER LAYOUT PLAN SMH A32 - SMH A43

SCALE: AS SHOWN | SHEET SET: SHEET 3 OF 7 SHEETS | SHEET SIZE: A0
DRAWING No.: 1762-SEW-005 | REVISION: P0

2024/05/03 12:33 pm
P:\GG\1762 Thembalethu Bulk Sewer Phase 3 and 4\04 Design & Drawings\05 Sewer\1762-SEW-Thembalethu Portion 2 Layout.dwg

GENERAL NOTES:

1. SURVEY COORDINATE SYSTEM: LO 23 HARTEBEESTHOEK 94.
2. ALL CONSTRUCTION WORK TO BE IN ACCORDANCE WITH THE RELEVANT SANS 1200 SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION AS AMENDED BY THE SCOPE OF WORKS.
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15. FINISHED COVER LEVELS:
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LEGEND

EXISTING SERVICES
- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

PROPOSED SERVICES
- SEWER PIPELINE
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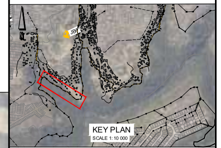

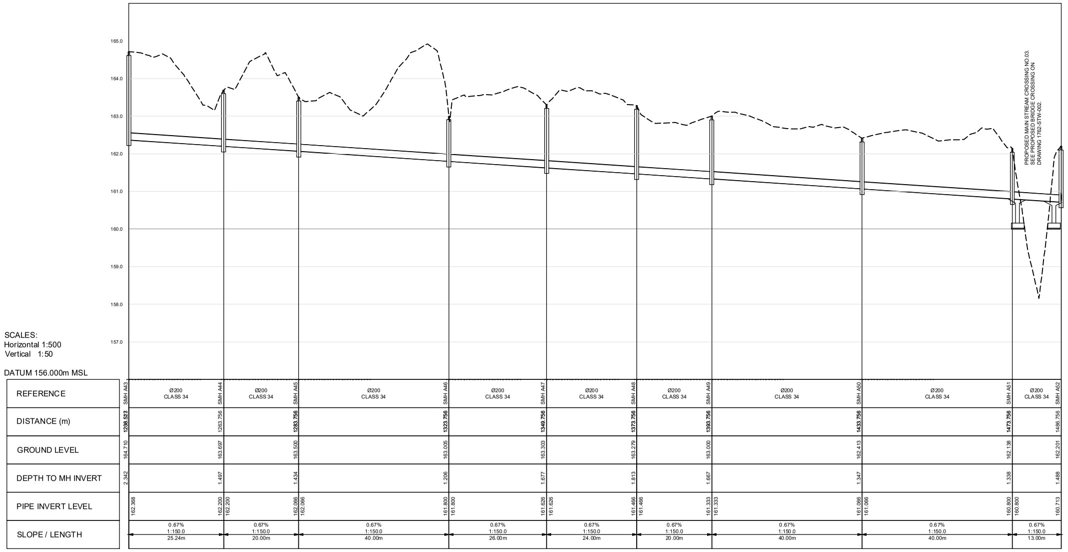

SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 156.000m MSL

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU, K POTGIETER	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	201770064	DATE: 2024/05/03

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PROJECT TITLE
THEMBALETHU BULK SEWER PHASE 3 & 4: PORTION 2

DRAWING TITLE
PORTION 2 BULK SEWER LAYOUT PLAN SMH A42 - SMH A52

SCALE: AS SHOWN | SHEET SET: SHEET 4 OF 7 SHEETS | SHEET SIZE: A0
DRAWING No. 1762-SEW-006 | REVISION P0

P:\GG\1762 Thembalethu Bulk Sewer Phase 3 and 4\04 Design & Drawings\05 Sewer\1762-SEW-Thembalethu Portion 2 Layout.dwg
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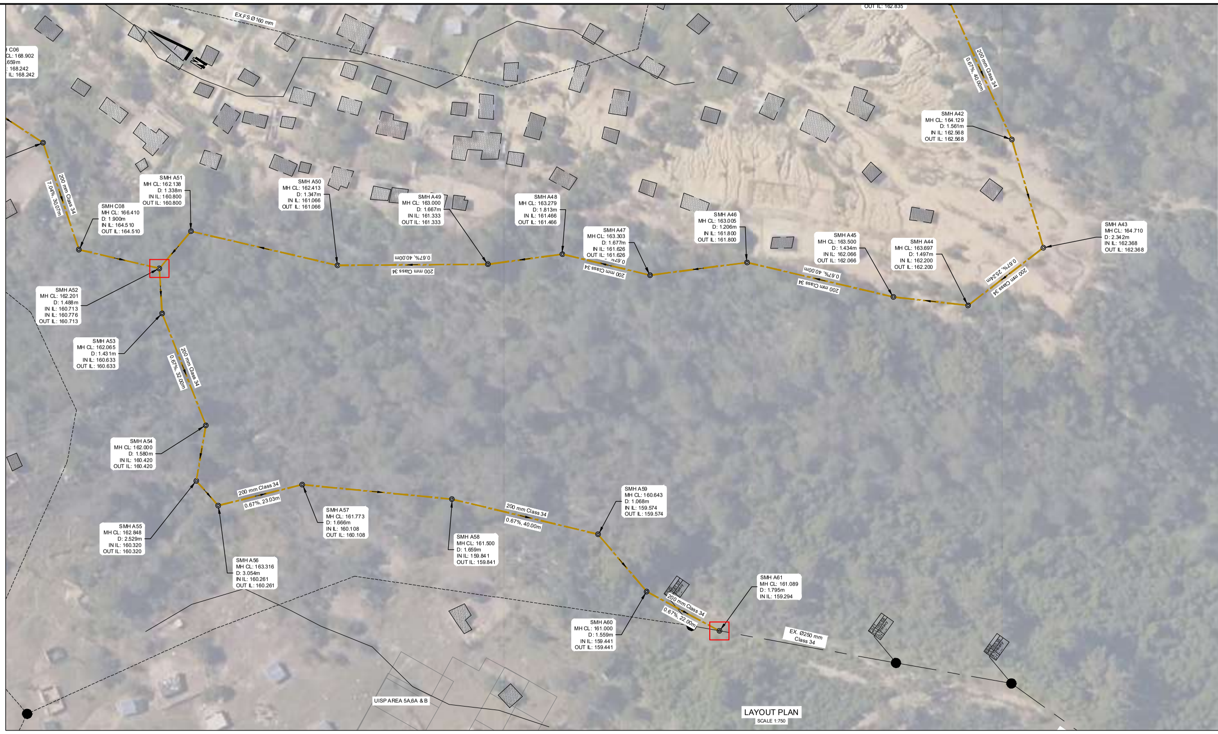

LAYOUT PLAN
SCALE 1:750

GENERAL NOTES:

1. SURVEY COORDINATE SYSTEM: LO 23 HARTEBEESTHOEK 94.
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    OPEN SPACES - COVER TO BE 500mm ABOVE FINISHED GROUND LEVEL

LEGEND

EXISTING SERVICES
- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

PROPOSED SERVICES
- SEWER PIPELINE
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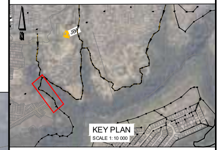
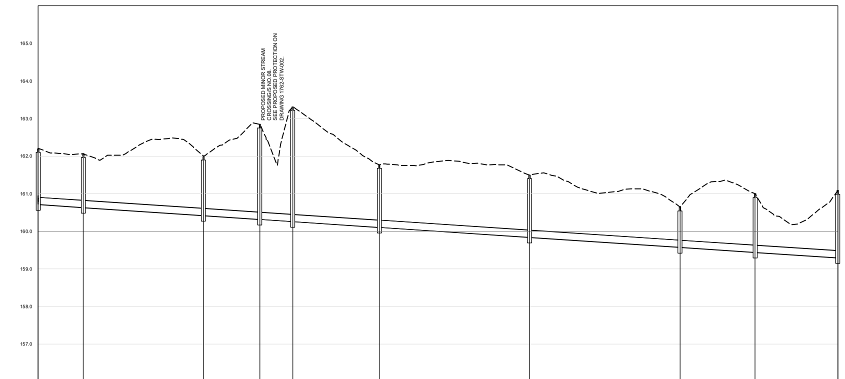

KEY PLAN
SCALE 1: 10 000



SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 156.000m MSL

REFERENCE	DISTANCE (m)	GROUND LEVEL	DEPTH TO MH INVERT	PIPE INVERT LEVEL	SLOPE / LENGTH (to next)
SMH A52	1486.756	162.201	1.488	160.713	Ø200 CLASS 34, 0.67% 1:150.0, 12.00m
SMH A53	1498.756	162.065	1.431	160.633 / 160.633	Ø200 CLASS 34, 0.67% 1:150.0, 32.00m
SMH A54	1530.756	162.000	1.580	160.420 / 160.420	Ø200 CLASS 34, 0.67% 1:150.0, 15.00m
SMH A55	1545.756	162.848	2.529	160.320 / 160.320	Ø200 CLASS 34, 0.67% 1:150.0, 8.76m
SMH A56	1554.518	163.316	3.054	160.261 / 160.261	Ø200 CLASS 34, 0.67% 1:150.0, 23.03m
SMH A57	1577.552	161.773	1.666	160.108 / 160.108	Ø200 CLASS 34, 0.67% 1:150.0, 40.00m
SMH A58	1617.552	161.500	1.659	159.841 / 159.841	Ø200 CLASS 34, 0.67% 1:150.0, 40.00m
SMH A59	1657.552	160.643	1.068	159.574 / 159.574	Ø200 CLASS 34, 0.67% 1:150.0, 20.00m
SMH A60	1677.552	161.000	1.559	159.441 / 159.441	Ø200 CLASS 34, 0.67% 1:150.0, 22.00m
SMH A61	1699.552	161.089	1.795	159.294	

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU, K POTGIETER	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	201770064	DATE: 2024/05/03

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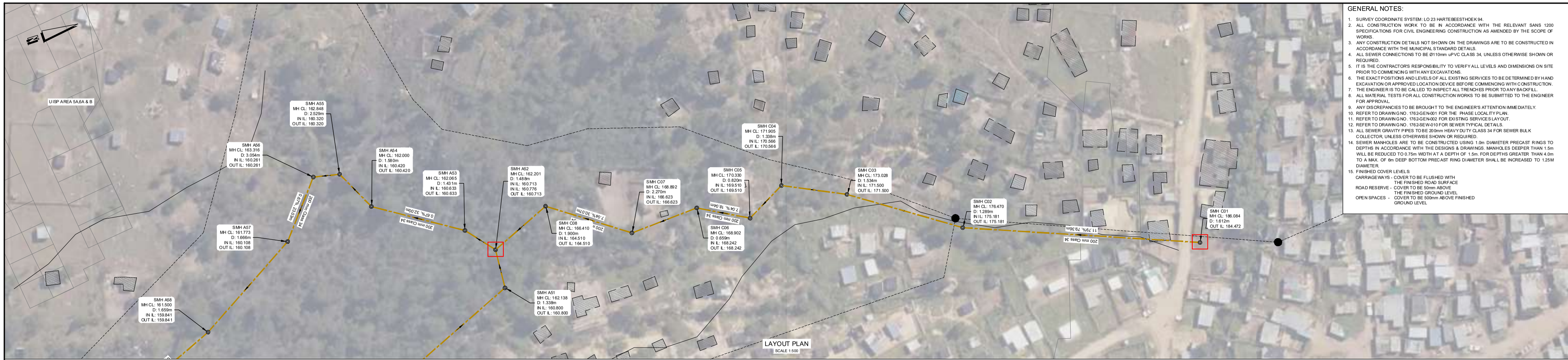
CLIENT
GEORGE LOCAL MUNICIPALITY

PROJECT TITLE
THEMBALETHU BULK SEWER PHASE 3 & 4: PORTION 2

DRAWING TITLE
PORTION 2 BULK SEWER LAYOUT PLAN SMH A52 - SMH A61

SCALE: AS SHOWN | SHEET SET: SHEET 5 OF 7 SHEETS | SHEET SIZE: A0
DRAWING No. 1762-SEW-007 | REVISION P0



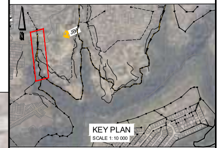
GENERAL NOTES:

1. SURVEY COORDINATE SYSTEM: LO 23 HARTEBEESTHOEK 94.
2. ALL CONSTRUCTION WORK TO BE IN ACCORDANCE WITH THE RELEVANT SANS 1200 SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION AS AMENDED BY THE SCOPE OF WORKS.
3. ANY CONSTRUCTION DETAILS NOT SHOWN ON THE DRAWINGS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH THE MUNICIPAL STANDARD DETAILS.
4. ALL SEWER CONNECTIONS TO BE Ø110mm uPVC CLASS 34, UNLESS OTHERWISE SHOWN OR REQUIRED.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL LEVELS AND DIMENSIONS ON SITE PRIOR TO COMMENCING WITH ANY EXCAVATIONS.
6. THE EXACT POSITIONS AND LEVELS OF ALL EXISTING SERVICES TO BE DETERMINED BY HAND EXCAVATION OR APPROVED LOCATION DEVICE BEFORE COMMENCING WITH CONSTRUCTION.
7. THE ENGINEER IS TO BE CALLED TO INSPECT ALL TRENCHES PRIOR TO ANY BACKFILL.
8. ALL MATERIAL TESTS FOR ALL CONSTRUCTION WORKS TO BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
9. ANY DISCREPANCIES TO BE BROUGHT TO THE ENGINEER'S ATTENTION IMMEDIATELY.
10. REFER TO DRAWING NO. 1762-GEN-001 FOR THE PHASE LOCALITY PLAN.
11. REFER TO DRAWING NO. 1762-GEN-002 FOR EXISTING SERVICES LAYOUT.
12. REFER TO DRAWING NO. 1762-SEW-010 FOR SEWER TYPICAL DETAILS.
13. ALL SEWER GRAVITY PIPES TO BE 200mm HEAVY DUTY CLASS 34 FOR SEWER BULK COLLECTOR, UNLESS OTHERWISE SHOWN OR REQUIRED.
14. SEWER MANHOLES ARE TO BE CONSTRUCTED USING 1.0m DIAMETER PRECAST RINGS TO DEPTHS IN ACCORDANCE WITH THE DESIGNS & DRAWINGS. MANHOLES DEEPER THAN 1.5m WILL BE REDUCED TO 0.75m WIDTH AT A DEPTH OF 1.5m. FOR DEPTHS GREATER THAN 4.0m TO A MAX. OF 6m DEEP BOTTOM PRECAST RING DIAMETER SHALL BE INCREASED TO 1.25M DIAMETER.
15. FINISHED COVER LEVELS:
    CARRIAGEWAYS - COVER TO BE FLUSHED WITH THE FINISHED ROAD SURFACE
    ROAD RESERVE - COVER TO BE 50mm ABOVE THE FINISHED GROUND LEVEL
    OPEN SPACES - COVER TO BE 500mm ABOVE FINISHED GROUND LEVEL

LEGEND

EXISTING SERVICES
- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

PROPOSED SERVICES
- SEWER PIPELINE
- SEWER MANHOLE



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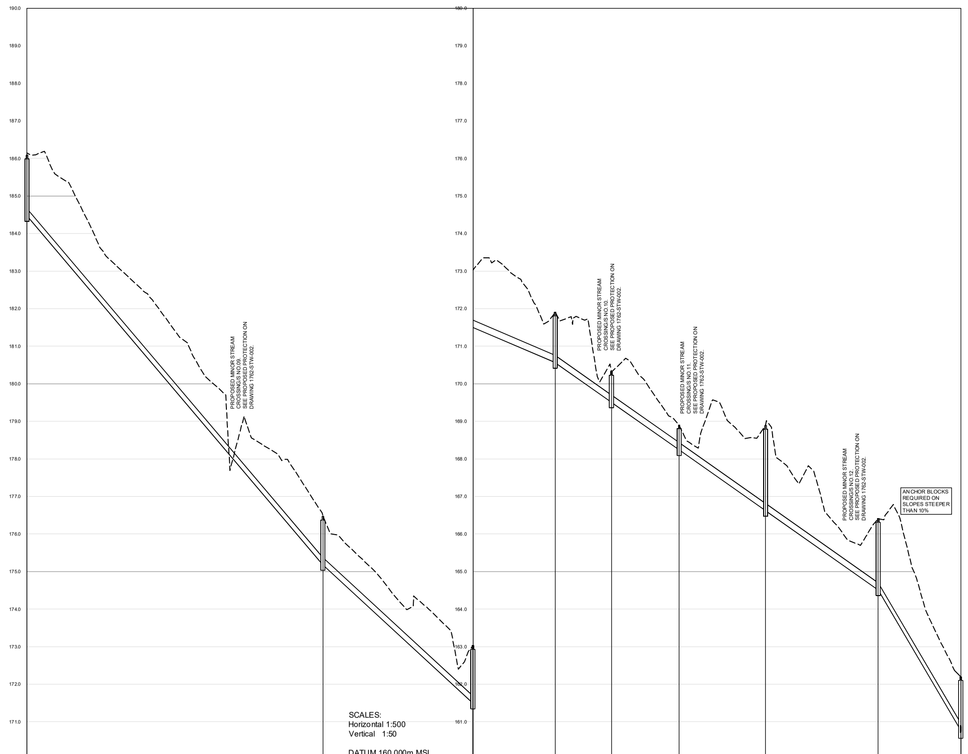

SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 170.000m MSL

SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 160.000m MSL

REFERENCE	SMH C01	Ø200 CLASS 34	SMH C02	Ø200 CLASS 34	SMH C03	Ø200 CLASS 34	SMH C04	Ø200 CLASS 34	SMH C05	Ø200 CLASS 34	SMH C06	Ø200 CLASS 34	SMH C07	Ø200 CLASS 34	SMH C08	Ø200 CLASS 34	SMH A52
DISTANCE (m)	0.000		78.815		118.734		140.642		155.642		173.642		196.642		226.642		248.642
GROUND LEVEL	186.143		176.470		173.028		171.905		170.330		168.902		168.892		166.410		162.201
DEPTH TO MH INVERT	1.612		1.289		1.534		1.338		0.820		0.659		2.270		1.900		1.488
PIPE INVERT LEVEL	184.472		175.181 175.181		171.500 171.500		170.566 170.566		169.510 169.510		168.242 168.242		166.623 166.623		164.510 164.510		160.776
SLOPE / LENGTH		11.79% 1:8.5 78.82m		9.22% 1:10.8 39.92m		4.26% 1:23.5 21.91m		7.04% 1:14.2 15.00m		7.04% 1:14.2 18.00m		7.04% 1:14.2 23.00m		7.04% 1:14.2 30.00m		16.97% 1:5.9 22.00m	

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU, K POTGIETER	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	201770064	DATE: 2024/05/03

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WEB www.lukhozi.co.za

CLIENT
GEORGE
LOCAL MUNICIPALITY

PROJECT TITLE
THEMBALETHU
BULK SEWER PHASE 3 & 4:
PORTION 2

DRAWING TITLE
PORTION 2 BULK SEWER
LAYOUT PLAN
LINE C

SCALE	SHEET SET	SHEET SIZE
AS SHOWN	SHEET 6 OF 7 SHEETS	A0
DRAWING No.	1762-SEW-008	REVISION P0

P:\GG\1762 Thembalethu Bulk Sewer Phase 3 and 4\04 Design & Drawings\05 Sewer\1762-SEW-Thembalethu Portion 2 Layout.dwg

GENERAL NOTES:

1. SURVEY COORDINATE SYSTEM: LO 23 HARTEBEESTHOEK 94.
2. ALL CONSTRUCTION WORK TO BE IN ACCORDANCE WITH THE RELEVANT SANS 1200 SPECIFICATIONS FOR CIVIL ENGINEERING CONSTRUCTION AS AMENDED BY THE SCOPE OF WORKS.
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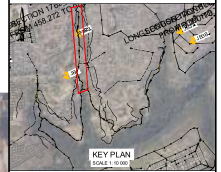
    - ROAD RESERVE - COVER TO BE 50mm ABOVE THE FINISHED GROUND LEVEL
    - OPEN SPACES - COVER TO BE 500mm ABOVE FINISHED GROUND LEVEL

LEGEND

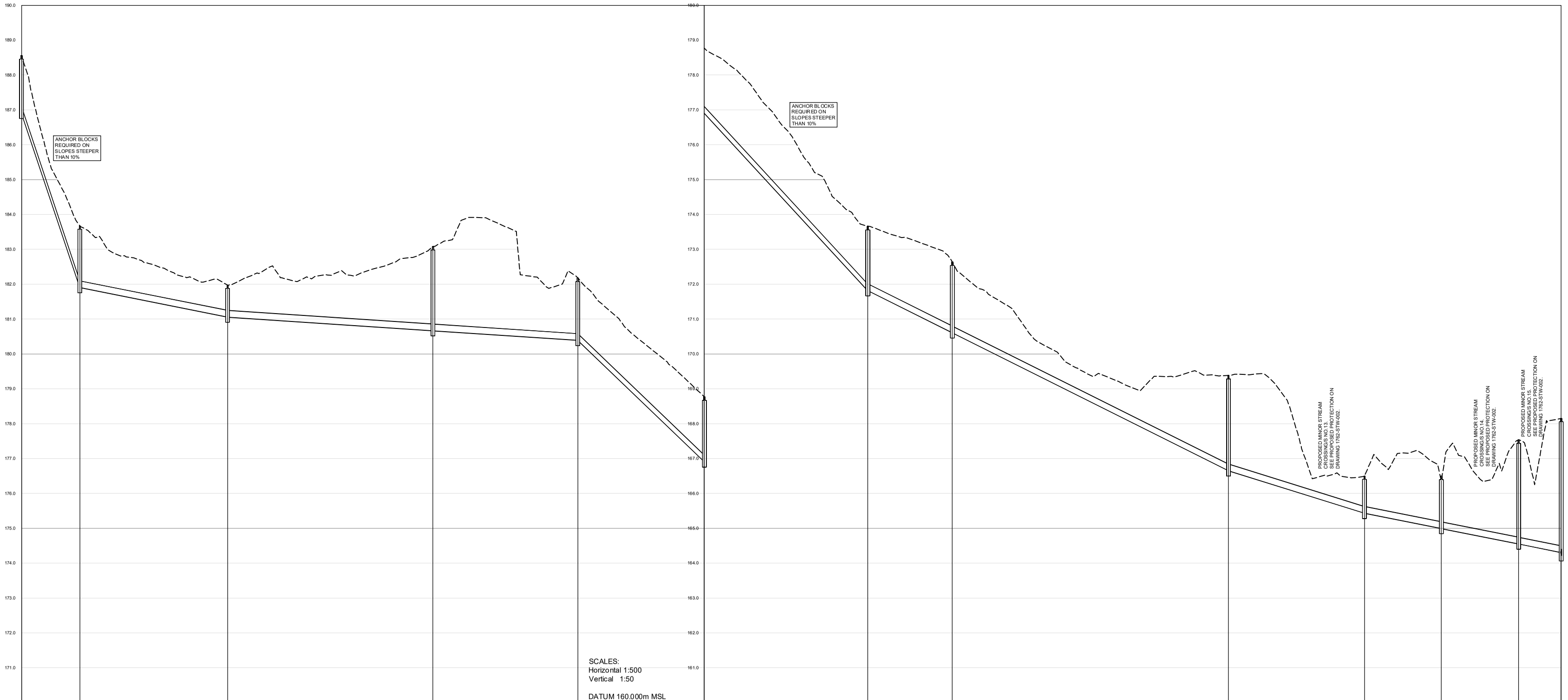
EXISTING SERVICES
- TOP OF BANK
- SEWER PIPELINE
- SEWER PIPELINE FROM GEORGE GIS
- STORMWATER PIPELINE
- SEWER MANHOLE
- FENCE LINE
- GATE
- BENCHMARK
- TEMPORARY HOUSING

PROPOSED SERVICES
- SEWER PIPELINE
- SEWER MANHOLE

LAYOUT PLAN
SCALE 1:500



KEY PLAN
SCALE 1:10 000



SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 170.000m MSL

SCALES:
Horizontal 1:500
Vertical 1:50

DATUM 160.000m MSL

REFERENCE	DISTANCE (m)	GROUND LEVEL	DEPTH TO MH INVERT	PIPE INVERT LEVEL (IN)	PIPE INVERT LEVEL (OUT)
SMH B01	0.000	188.554	1.648		186.906
SMH B02	16.727	183.672	1.766	181.906	181.906
SMH B03	59.065	181.977	0.918	181.059	181.059
SMH B04	117.894	183.078	2.412	180.667	180.667
SMH B05	159.365	182.177	1.787	180.390	180.390
SMH B06	195.660	178.768	1.863	176.906	176.906
SMH B07	242.468	173.665	1.842	171.818	171.818
SMH B08	266.689	172.634	2.028	170.607	170.607
SMH B09	345.788	169.382	2.736	166.652	166.652
SMH B10	384.783	166.500	1.066	165.434	165.434
SMH B11	406.783	166.369	1.506	164.994	164.994
SMH B12	428.921	167.535	2.983	164.551	164.551
SMH A34	441.138	168.153	3.938	164.307	

FROM	TO	PIPE	SLOPE	LENGTH
SMH B01	SMH B02	Ø200 CLASS 34	29.89% 1:3.3	16.73m
SMH B02	SMH B03	Ø200 CLASS 34	2.00% 1:50.0	42.34m
SMH B03	SMH B04	Ø200 CLASS 34	0.67% 1:150.0	58.83m
SMH B04	SMH B05	Ø200 CLASS 34	0.67% 1:150.0	41.47m
SMH B05	SMH B06	Ø200 CLASS 34	9.60% 1:10.4	36.29m
SMH B06	SMH B07	Ø200 CLASS 34	10.87% 1:9.2	46.81m
SMH B07	SMH B08	Ø200 CLASS 34	5.00% 1:20.0	24.22m
SMH B08	SMH B09	Ø200 CLASS 34	5.00% 1:20.0	79.10m
SMH B09	SMH B10	Ø200 CLASS 34	3.12% 1:32.0	39.00m
SMH B10	SMH B11	Ø200 CLASS 34	2.00% 1:50.0	22.00m
SMH B11	SMH B12	Ø200 CLASS 34	2.00% 1:50.0	22.14m
SMH B12	SMH A34	Ø200 CLASS 34	2.00% 1:50.0	12.22m

No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	S KULU	NOV 2023
DESIGNED	S KULU, K POTGIETER	NOV 2023
CHECKED	K POTGIETER	NOV 2023
APPROVED	PR ENG REG NO. 201770064	DATE: 2024/05/03

LUKHOZI
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WEB www.lukhozi.co.za

CLIENT
GEORGE
LOCAL MUNICIPALITY

PROJECT TITLE
THEMBALETHU
BULK SEWER PHASE 3 & 4:
PORTION 2

DRAWING TITLE
PORTION 2 BULK SEWER
LAYOUT PLAN
LINE B

SCALE	SHEET SET	SHEET SIZE
AS SHOWN	SHEET 7 OF 7 SHEETS	A0

DRAWING No.	REVISION
1762-SEW-009	P0

2024/05/03 01:16 pm
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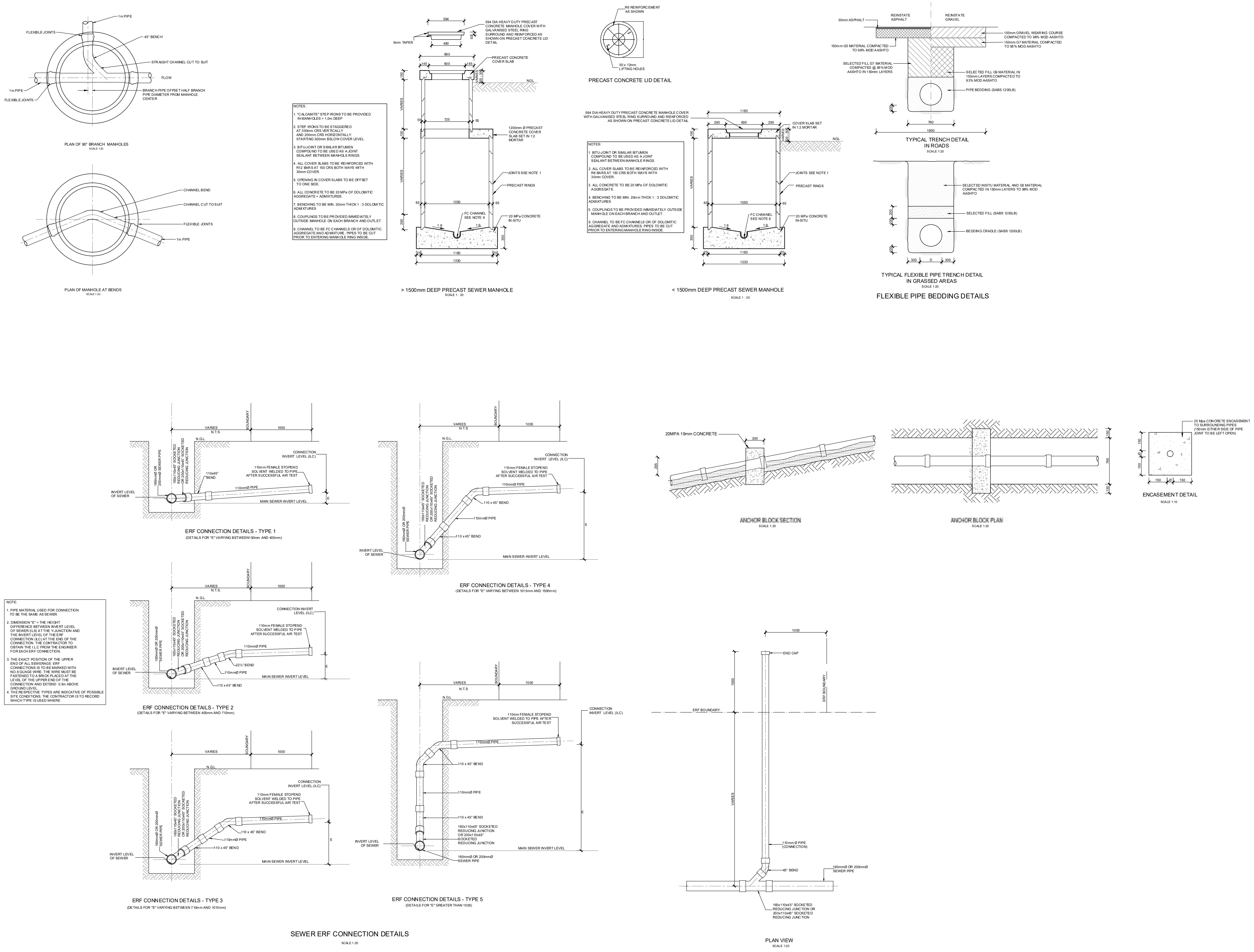

NOTES (> 1500mm DEEP PRECAST SEWER MANHOLE):

1. "CALCAMITE" STEP IRONS TO BE PROVIDED IN MANHOLES > 1,0m DEEP
2. STEP IRONS TO BE STAGGERED AT 300mm CRS VERTICALLY AND 200mm CRS HORIZONTALLY. STARTING 500mm BELOW COVER LEVEL.
3. BITU-JOINT OR SIMILAR BITUMEN COMPOUND TO BE USED AS A JOINT SEALANT BETWEEN MANHOLE RINGS.
4. ALL COVER SLABS TO BE REINFORCED WITH R12 BARS AT 150 CRS BOTH WAYS WITH 30mm COVER.
5. OPENING IN COVER SLABS TO BE OFFSET TO ONE SIDE.
6. ALL CONCRETE TO BE 20 MPa OF DOLOMITIC AGGREGATE + ADMIXTURES.
7. BENCHING TO BE MIN. 20mm THICK 1 : 3 DOLOMITIC ADMIXTURES
8. COUPLINGS TO BE PROVIDED IMMEDIATELY OUTSIDE MANHOLE ON EACH BRANCH AND OUTLET.
9. CHANNEL TO BE FC CHANNELS OR OF DOLOMITIC AGGREGATE AND ADMIXTURE. PIPES TO BE CUT PRIOR TO ENTERING MANHOLE RING INSIDE.

594 DIA HEAVY DUTY PRECAST CONCRETE MANHOLE COVER WITH GALVANISED STEEL RING SURROUND AND REINFORCED AS SHOWN ON PRECAST CONCRETE LID DETAIL

NOTES (< 1500mm DEEP PRECAST SEWER MANHOLE):

1. BITU-JOINT OR SIMILAR BITUMEN COMPOUND TO BE USED AS A JOINT SEALANT BETWEEN MANHOLE RINGS.
2. ALL COVER SLABS TO BE REINFORCED WITH R6 BARS AT 150 CRS BOTH WAYS WITH 30mm COVER.
3. ALL CONCRETE TO BE 20 MPa OF DOLOMITIC AGGREGATE.
4. BENCHING TO BE MIN. 20mm THICK 1 : 3 DOLOMITIC ADMIXTURES
5. COUPLINGS TO BE PROVIDED IMMEDIATELY OUTSIDE MANHOLE ON EACH BRANCH AND OUTLET.
6. CHANNEL TO BE FC CHANNELS OR OF DOLOMITIC AGGREGATE AND ADMIXTURES. PIPES TO BE CUT PRIOR TO ENTERING MANHOLE RING INSIDE.

NOTE (SEWER ERF CONNECTION DETAILS):

1. PIPE MATERIAL USED FOR CONNECTION TO BE THE SAME AS SEWER.
2. DIMENSION "E" = THE HEIGHT DIFFERENCE BETWEEN INVERT LEVEL OF SEWER (ILS) AT THE Y-JUNCTION AND THE INVERT LEVEL OF THE ERF CONNECTION (ILC) AT THE END OF THE CONNECTION. THE CONTRACTOR TO OBTAIN THE I.L.C FROM THE ENGINEER FOR EACH ERF CONNECTION.
3. THE EXACT POSITION OF THE UPPER END OF ALL SEWERAGE ERF CONNECTIONS IS TO BE MARKED WITH NO.8 GUAGE WIRE. THE WIRE MUST BE FASTENED TO A BRICK PLACED AT THE LEVEL OF THE UPPER END OF THE CONNECTION AND EXTEND 0.5m ABOVE GROUND LEVEL.
4. THE RESPECTIVE TYPES ARE INDICATIVE OF POSSIBLE SITE CONDITIONS. THE CONTRACTOR IS TO RECORD WHICH TYPE IS USED WHERE

No	APPROVED	AMENDMENTS	DATE
P1	KP	ISSUED FOR INFORMATION	APR 2024
P0	KP	ISSUED FOR INFORMATION	NOV 2023

SURVEYED	-	-
DRAWN	C MBOMBELA	OCT 2023
DESIGNED	K POTGIETER, C MBOMBELA	OCT 2023
CHECKED	K POTGIETER	OCT 2023
APPROVED	[illegible]0064 DATE: 30-10-2023	

LUKHOZI

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EMAIL grg@lukhozi.co.za
WEB www.lukhozi.co.za

CLIENT

GEORGE
LOCAL MUNICIPALITY

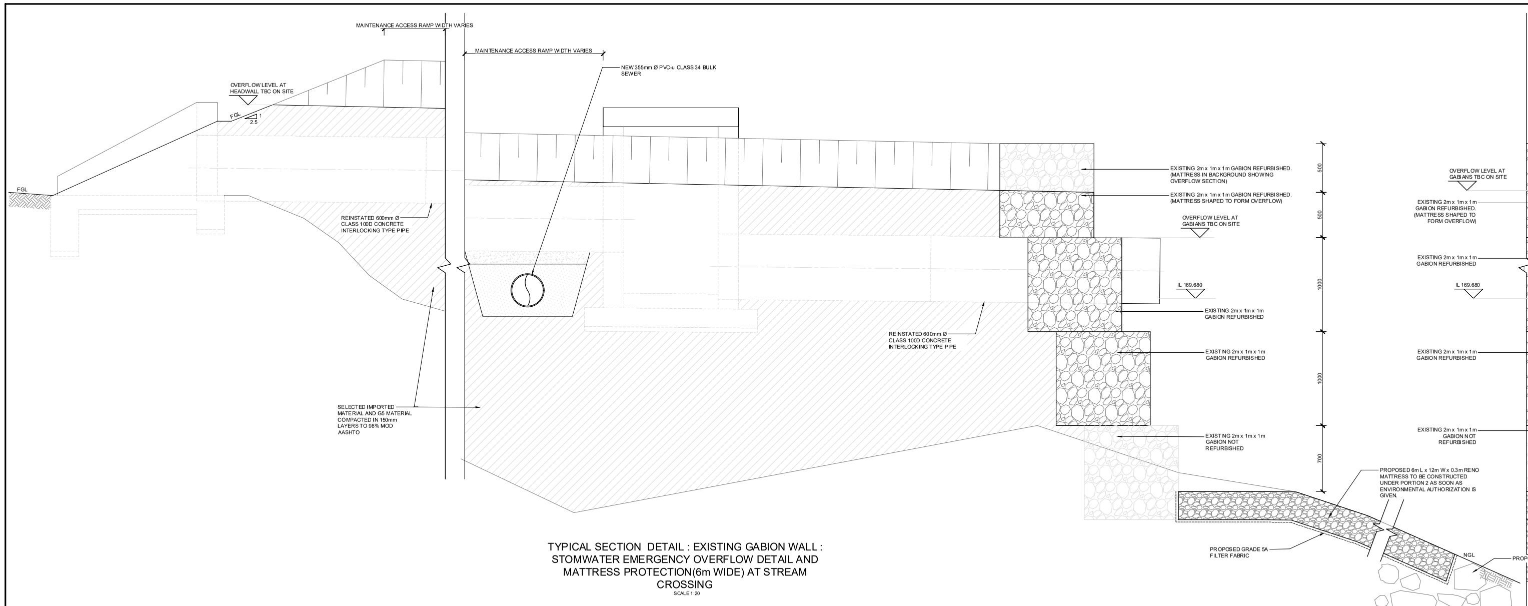
PROJECT TITLE

THEMBALETHU
BULK SEWER PHASE 3&4:
PORTION 1

DRAWING TITLE

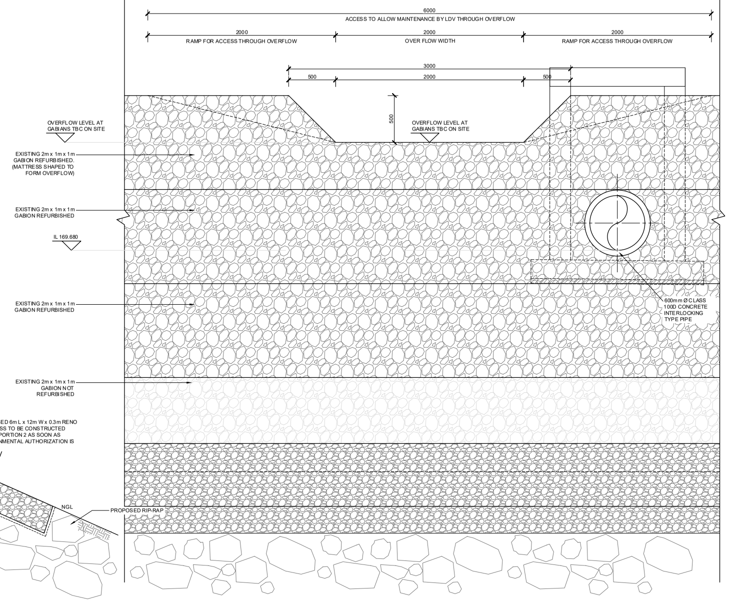
TYPICAL SEWER DETAILS

SCALE	SHEET SET	SHEET SIZE
AS SHOWN	SHEET 1 OF 1 SHEETS	A0
DRAWING No. 1762-SEW-010		REVISION P1



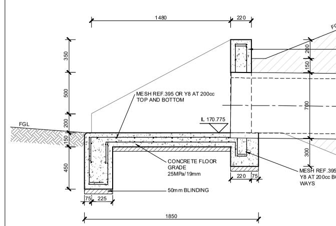
TYPICAL SECTION DETAIL : EXISTING GABION WALL : STOMWATER EMERGENCY OVERFLOW DETAIL AND MATTRESS PROTECTION(6m WIDE) AT STREAM CROSSING

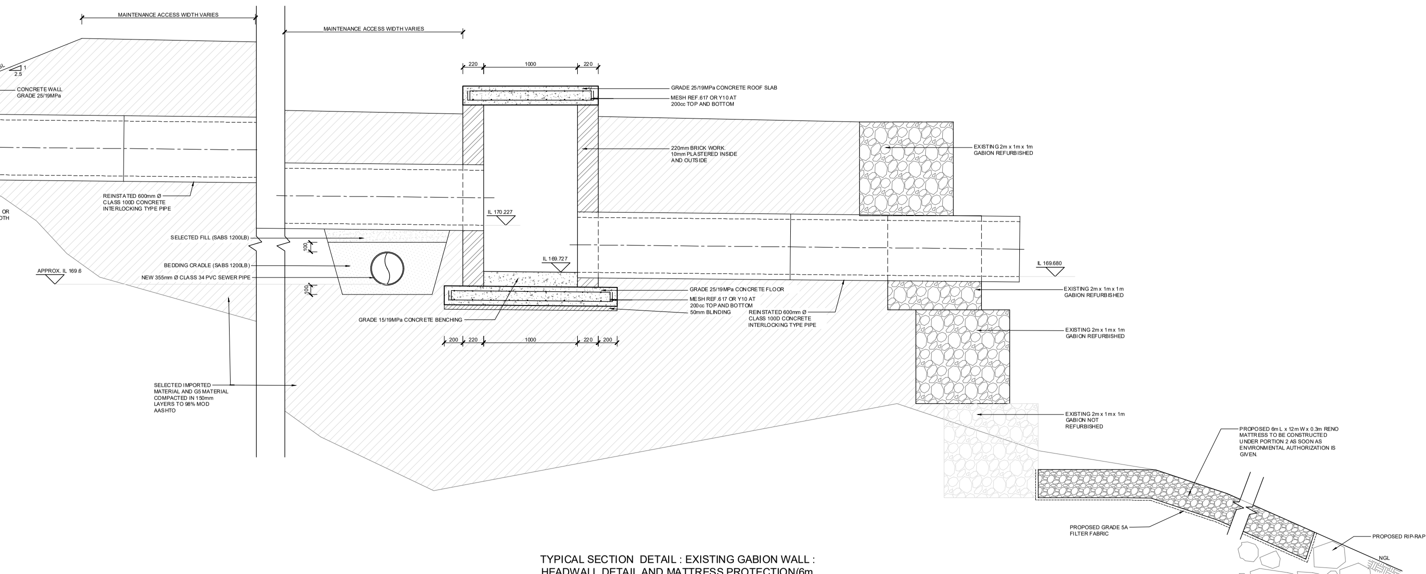
SCALE 1:20



TYPICAL FRONT ELEVATION : EXISTING GABION WALL : STOMWATER EMERGENCY OVERFLOW DETAIL AND MATTRESS PROTECTION(6m WIDE) AT STREAM CROSSING

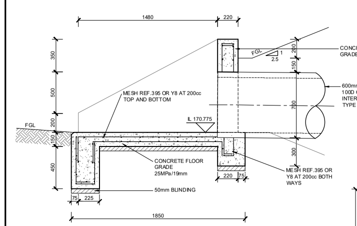
SCALE 1:20





TYPICAL SECTION DETAIL : EXISTING GABION WALL : HEADWALL DETAIL AND MATTRESS PROTECTION(6m WIDE) AT STREAM CROSSING

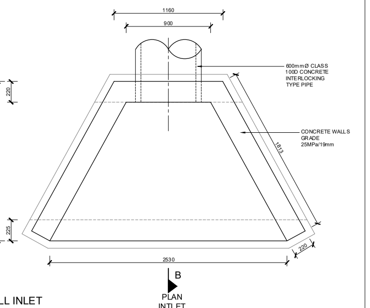
SCALE 1:20



SECTION B - B
INLET

NOTES:

1. FLOORS AND WALLS ARE CONSTRUCTED OF CONCRETE GRADE 25MPa/19mm.
2. REINFORCEMENT TO WALLS AND FLOOR MESH REF. 395 BEND ON SITE OR Y8 @ 200C/C BEND, CUT, SHAPED AND FIXED ON SITE.



PLAN
INTLET

STOMWATER HEADWALL INLET

SCALE 1:20

No	APPROVED	AMENDMENTS	DATE
0	KP	ISSUED FOR CONSTRUCTION	03 MAY 2024

SURVEYED	-	-
DRAWN	T MOSIA	APRIL 2024
DESIGNED	K POTGIETER	APRIL 2024
CHECKED	K POTGIETER	APRIL 2024
APPROVED	REGISTRATION NO: 201770064	DATE: 2024/05/03

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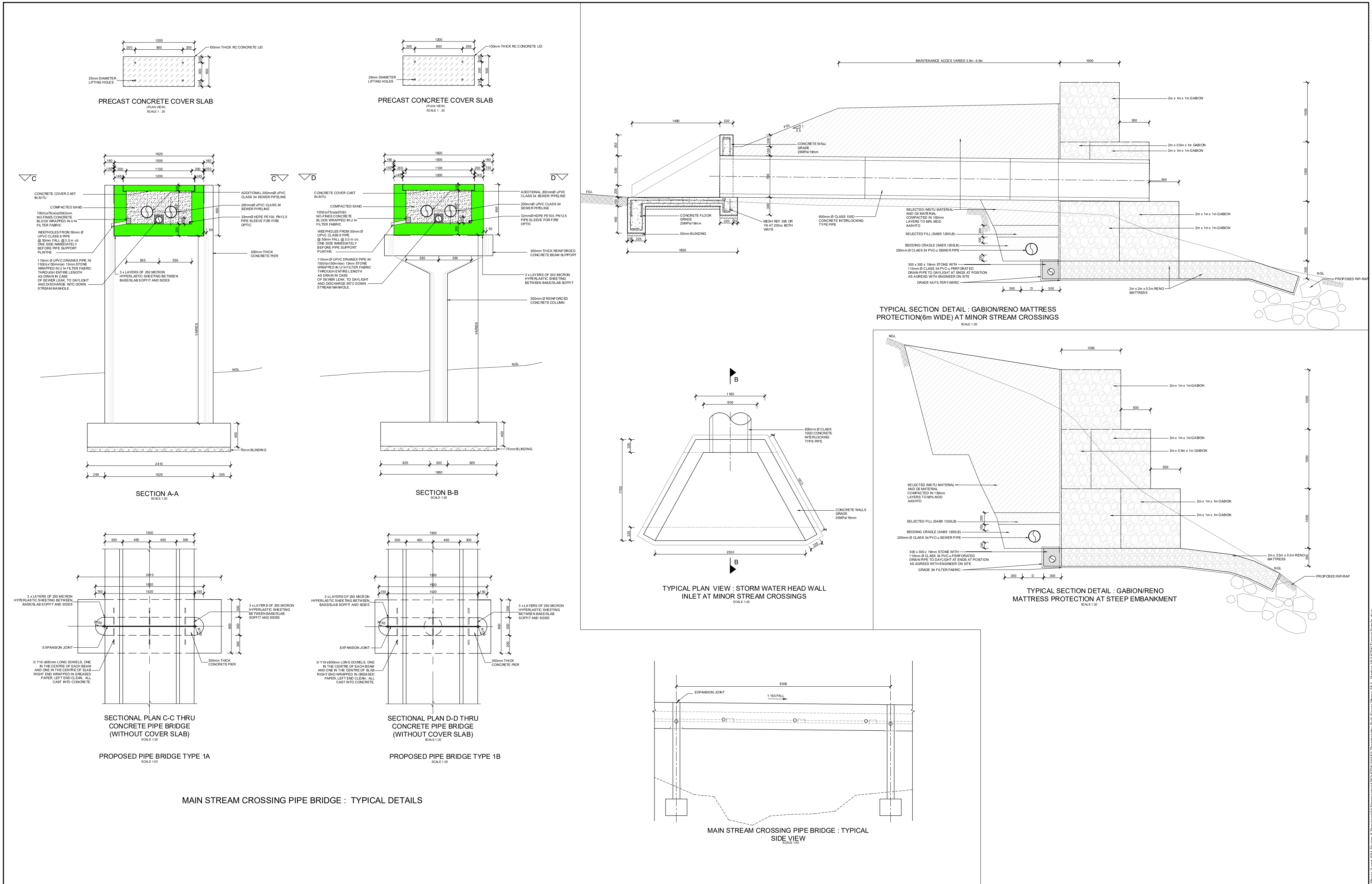
WEB www.lukhozi.co.za

CLIENT: GEORGE LOCAL MUNICIPALITY

PROJECT TITLE: THEMBALETHU BULK SEWER PHASE 3&4 PORTION 1

DRAWING TITLE: PORTION 1 : STREAM CROSSING, STORMWATER OVERFLOW AND STORMWATER DETAILS

SCALE: 1 : 20
SHEET SET: SHEET 1 OF 1 SHEETS
SHEET SIZE: A0
DRAWING No.: 1762-STW-001
REVISION: 0



No	APPROVED	AMENDMENTS	DATE
P0	KP	ISSUED FOR INFORMATION	09 APRIL 2024

SURVEYED	-	-
DRAWN	T MOSIA	APRIL 2024
DESIGNED	K POTGIETER	APRIL 2024
CHECKED	K POTGIETER	APRIL 2024
APPROVED	201770064	DATE: 2024/05/03

LUKHOZI CONSULTING ENGINEERS (PTY) LTD

CLIENT: GEORGE LOCAL MUNICIPALITY

PROJECT TITLE: THEMBALETHU BULK SEWER PHASE 3&4 PORTION 2

DRAWING TITLE: POTION 2 : STREAM CROSSINGS AND STORMWATER DETAILS

SCALE: 1 : 20 | SHEET SET: SHEET 1 OF 1 SHEETS | SHEET SIZE: A0

DRAWING No.: 1762-STW-002 | REVISION: P0

2024/05/03 01:00 pm

DOCUMENT CONTROL SHEET

CLIENT: George Municipality

JOB NO: 1762

PROJECT: Thembalethu Bulk Sewer Phase 3 and 4

TITLE: Concept & Viability Design Report

	Prepared By	Reviewed By	Approved By
ORIGINAL	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE
REVISION 1	NAME S Kulu	NAME G Tucker	NAME K Potgieter
DATE 2024/05/03	SIGNATURE 2024/05/03	SIGNATURE 08/05/2024	SIGNATURE 2024/05/03
REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE
REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE