February 2026

BASIC ASSESSMNET REPORT

PROPOSED UPGRADE OF NATIONAL ROAD R30 SECTION 8 FROM KLERKSDORP (KM 0.0) TO BUFFELSVALLEI (KM 37.0) AND ASSOCIATED BORROW PITS WITHIN DR KENNETH KAUNDA DISTRICT MUNICIPALITY IN THE NORTH WEST PROVINCE.

DFFE REFERENCE: Not yet Issued

PREPARED BY:	**PREPARED FOR**
Independent Environmental Consultancy: Earthlink Environmental Services Contact Person: Kgakile Mapoulo Contact Number: 071 878 8295 Contact Email: kgakile@earthlinkenvironmental.co.za Address: 572, 24th Road, Withok Estates, Brakpan 1541	Applicant: South African National Roads Agency SOC Limited (SANRAL) Contact Person: Naailah Mia Contact Number: 062 292 0965 Contact Email: mian@nra.co.za Address: 38 Ida Street, Menlo Park, Pretoria
Earthlink Environmental Services	SANRAL SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD

TABLE OF CONTENTS

1 INTRODUCTION 1
1.1 Project Locality 1
2 PROJECT DESCRIPTION 3
3 POLICY AND LEGISLATIVE FRAMEWORK 6
3.1 Environmental Legislation 6
3.1.1 National Environmental Management Act, EIA Regulations (2014) 6
3.1.2 National Water Act (1998) 8
3.2 Other Legislation 9
4 NEED AND DESIRABILITY 13
4.1 Need for the Project 13
4.2 Desirability of the Project 13
5 ALTERNATIVES CONSIDERED 15
5.1 Project alternatives 15
5.2 Site Alternatives 15
5.3 No- Go Alternative 15
6 PUBLIC PARTICIPATION 17
6.1 Public comment periods 17
6.1.1 Site Notices 17
6.1.2 Newspaper advertisement and I&AP email Notification 17
6.1.3 Availability of Basic Assessment 17
6.1.4 Public Meeting 17
6.1.5 Raised Issues 17
7 DESCRIPTION OF THE RECEIVING ENVIRONMENT 18
7.1 Climate 18
7.1.1 Rainfall 18
7.1.2 Temperature 18
7.2 Site Geology and Soils 18
7.3 Topography 18
7.4 Surface Hydrology 18
7.4.1 Wetland features 22
7.4.2 Soil wetness and soil form indicator 25
7.4.3 Vegetation indicator 25
7.4.4 Wetland Delineation. 26
7.4.5 Freshwater Aquatic Specialists 28

7.5 Terrestrial Biodiversity (Floral and Faunal) 29
7.5.1 Gh 10 Vaal-Vet Sandy Grassland's Conservation Status 32
7.5.2 2015 North West Biodiversity Sector Plan 32
7.5.3 Flora Species of Special Concern 34
7.5.4 Faunal Diversity 35
7.6 Socio Economic 37
7.6.1 Regional Context 37
7.6.2 Population Demographics 37
7.6.3 Economic Profile 37
7.6.4 Employment and Income 38
7.6.5 Infrastructure and Services 38
7.6.6 Social Dynamics 38
7.7 Heritage 39
7.7.1 Social And/or Religious Intangible Heritage 39
7.7.2 Historical Period and Built Environment 39
7.7.3 Graves 39
7.7.4 Iron Age 40
7.7.5 Stone Age 41
7.8 Palaeontology 41
7.9 Geotechnical Assessment 42
7.10 Traffic Engineering Assessment 43
8 ENVIRONEMNTAL SENSITIVITY 43
8.1 DFFE Screening Tool Site Sensitivity 43
9 IMPACT ASSESSMENT METHODOLOGY 46
10 ENVIRONEMNTAL IMPACT ASSESSMENT 48
10.1 Construction Phase 48
10.1.1 Topography 48
10.1.2 Terrestrial Biodiversity 49
10.1.3 Aquatic 50
10.1.4 Visual 53
10.1.5 Noise 56
10.1.6 Social Aspect 57
10.1.7 Heritage 59
10.1.8 Palaeontology 60
10.1.9 Soil/Agriculture 60

10.2 Operational Phase 62
10.2.1 Terrestrial biodiversity 62
10.2.2 Aquatic 64
10.2.3 ASSESSMENT OF THE NO-GO ALTERNATIVE 67
10.3 Decommissioning Phase 68
10.4 Impact Statement 69
10.5 Impact Mitigation and Monitoring 69
11 CONCLUSION AND RECOMMENDATIONS 70
12 REFERENCES 71

ACRONYMS AND ABBREVIATIONS:

BA	Basic Assessment
BAR	Basic Assessment Report
CA	Competent Authority
CR	Critically Endangered
DFFE	Department of Forestry, Fisheries & Environment
DMRE	Department of Mineral Resource and Energy
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment
EMF	Environmental Management Framework
EMPR	Environmental Management Programme
EN	Endangered
GPS	Global Positioning System
Ha	Hectare
HIA	Heritage Impact Assessment
I&AP	Interested and/or Affected Party
IPPs	Independent Power Producers
IRP	Integrated Resource Plan
IUCN	International Union for Conservation of Nature (IUCN)
LEDET	Limpopo Economic Development, Environment and Tourism
LIHRA	Limpopo Provincial Heritage Resources Authority
MAE	Mean Annual Evaporation
MAMSL	Metres Above Mean Sea Level
MAP	Mean Average Precipitation
NDP	National Development Plan
NEMA	National Environmental Management Act (1998)
NEMWA	National Environmental Management: Waste Act (2008)
NWA	National Water Act (1998)
REDZ	Renewable Energy Development Zones
REIPPPP	Renewable Energy Independent Power Producer Procurement
VU	Vulnerable
WEPS	Wholesale Electricity Pricing System
WUL	Water Use Licence
WULA	Water Use Licence Application

LIST OF FIGURES

Figure 1: Regional Locality map 2
Figure 2: Layout Map 5
Figure 3: Surface Water Map 1 20
Figure 4: Surface Water Map 2. 21
Figure 5: Map of the wetland and watercourses within 500m of the R30 Section 8 23
Figure 6: Watercourse and Wetland observed within 500m of the road (A-C Represents the watercourse and D represents the wetland (Dam) 24
Figure 7: Soil Observed within one the watercourses 25
Figure 8: Phragmite species observed onsite 26
Figure 9: Wetland delineation Map 27
Figure 10: Typical Freshwater Habitat onsite 28
Figure 11: Vegetation Map-Road R30 Section 8 31
Figure 12 : The R30 Section 8 in relation to the 2015 North West Biodiversity Sector Plan 33
Figure 13: Eucalyptus tree observed onsite 35
Figure 14: Grazing Cattle observed on a property next to the road 35
Figure 15: Ostriches observed outside of the borrow pit R30 S8-10, which is located next to the road servitude 36
Figure 16: View of Graveyard. GPS: S26° 29' 14.1" E26° 39' 35.1" 39
Figure 17: View of Graveyard. GPS: S26° 31' 02.7" E26° 38' 26.6" 40
Figure 18: View of Marker. GPS: S26° 22' 18.4" E26° 46' 31.6" 40
Figure 19: SAHRIS paleo sensitivity map for the site for the proposed R30 Section 8 road improvement. 41

LIST OF TABLES

Table 1: The affected property coordinates 3
Table 2: Improvement Strategy for Major Structures 4
Table 3: Applicable listed activities (EIA Regulations 2014, as amended) 6
Table 4: Other applicable legislation 9
Table 5: Potential impacts that may be associated with the no-go option 15
Table 6: The taxa associated with the dominant vegetation units are summarized below. 29
Table 7: Site Sensitivity as per DFFE Screening Report 45
Table 8: Potential impacts in terms of topography, soils, geology and hydrology 48
Table 9: Impact 1: Degradation and / or destruction of Freshwater habitats (Watercourses and the wetland). 50
Table 10: Impact 2: Loss of indigenous fauna and flora diversity associated with watercourses. 52
Table 11: Visual Impacts significance rating 54
Table 12: Noise Impacts Significance 56
Table 13: Potential Socio-Economic impacts 57
Table 14: Heritage impact Rating 59
Table 15: Impact Assessment 60

CONTACT DETAILS

Environmental Impact Assessment Practitioner	Earthlink Environmental Services
Project Team	Ms. Prudence Chuene- EAP Ms. Kgakile Mapoulo – Project Manager
Email	kgakile@earthlinkenvironmental.co.za terrence@earthlinkenvironmental.co.za
Cell	071 878 8295 and 082 047 7295
Physical Address	572, 24th Road, Withok Estates, Brakpan 1541
Expertise of the EAP	EAP Experience: 6 years' experience Affiliation: EAPASA Registered Qualifications: PhD in Atmospheric Composition – University of Pretoria - Current MSc of Geography- University of Limpopo BSc Environmental and Resource Studies - University of Limpopo

EAP CV attached as Appendix 1

Applicant	South African National Roads Agency SOC Limited (SANRAL)
Contact Person	Naailah Mia
Tel.	062 292 0965
Email	mian@nra.co.za

1 INTRODUCTION

Earthlink Environmental Services (Pty) Ltd has been appointed by the South African National Roads Agency Limited (SANRAL) to facilitate the application process for an environmental authorization required for the proposed improvement of National Road R30, Section 8. This improvement will extend from km 36.800 to Ventersdorp km 68.646 within the jurisdiction of the Dr. Kenneth Kaunda District Municipality in the North West Province.

The proposed project aims to improve the road infrastructure to support regional development, enhance transportation efficiency, and ensure compliance with road safety standards. The project will involve various activities, including widening of the existing road, widening of river bridges and some major and minor culverts, demolishing and construction of new river bridges, re-alignments of road curves and re-entry into 5 potential borrow pits. These activities will be conducted in adherence to environmental regulations to minimize potential impacts on the surrounding environment.

This Environmental Impact Assessment (EIA) report has been compiled to present a detailed analysis of the potential environmental impacts associated with the proposed project. The report outlines the scope of the project, identifies environmental sensitivities, and assesses the implications of the planned activities. It further provides mitigation measures to ensure sustainable development while balancing the need for infrastructure enhancement with environmental preservation.

The technical data, project details, and other relevant information presented in this report have been sourced directly from the Applicant's project team. The information provided forms the basis for the environmental assessment and aligns with the applicable legislative and regulatory frameworks.

1.1 Project Locality

The improvement of National Road R30, Section 8, spans a distance of approximately 31.8 kilometres, beginning at km 36.800 and extending to Ventersdorp km 68.646. This route traverses agricultural areas within the jurisdiction of the Dr. Kenneth Kaunda District Municipality in the North West Province.

These areas consist of agricultural, residential, and natural zones that may be environmentally sensitive, requiring thorough assessment and mitigation measures.

This improvement seeks to improve regional transportation safety, efficiency, and accessibility, benefiting local communities and industries. The project will be conducted in accordance with environmental regulations, ensuring a sustainable approach to infrastructure development.

Figure 1 below show the regional locality of the road

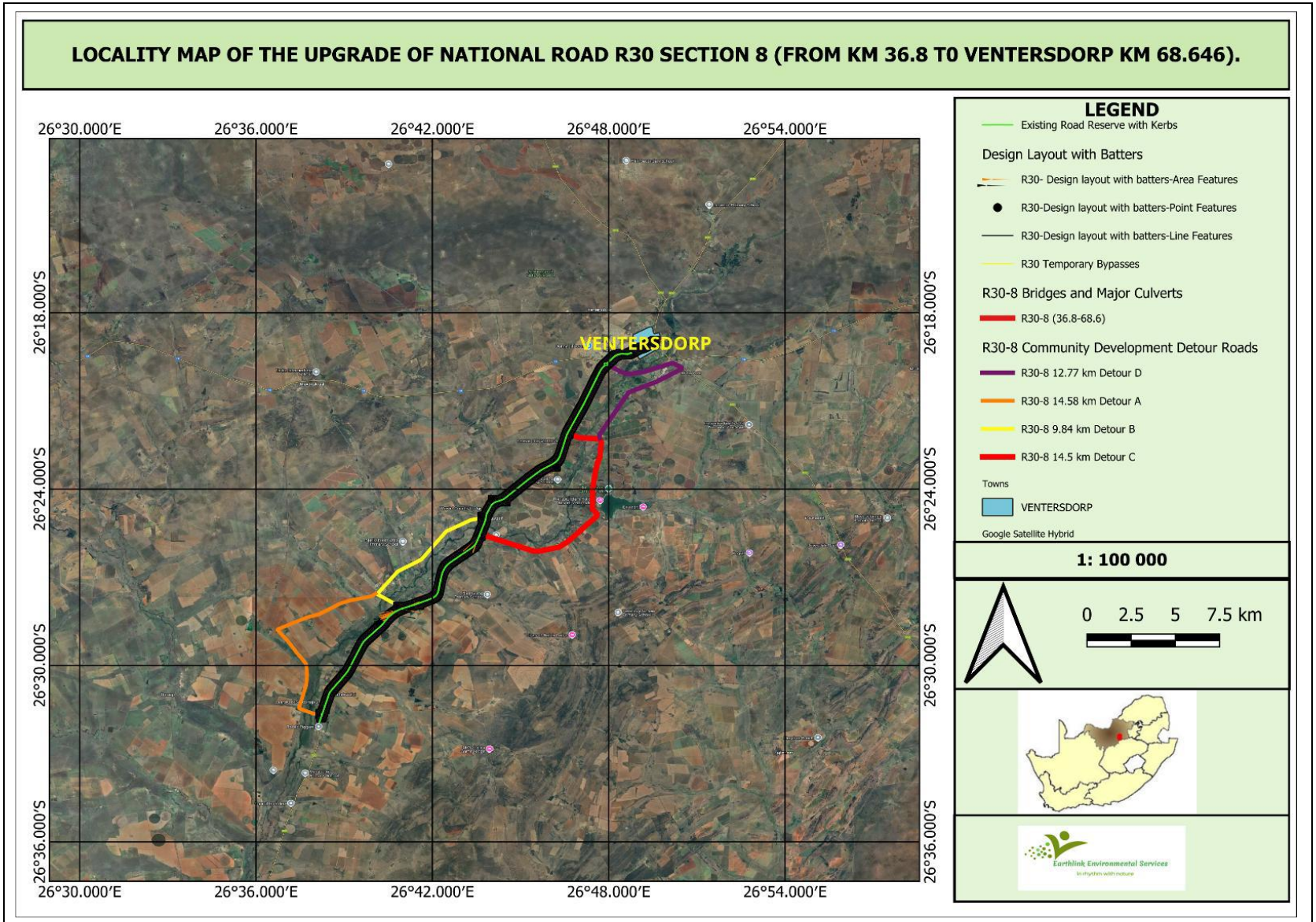


Figure 1: Regional Locality map

2 PROJECT DESCRIPTION

South African National Road Agency SOC Limited (SANRAL) proposes to improve Road R30 section 8, from km 36.800 to Ventersdorp km 68.646 within Dr Kenneth Kaunda District Municipality in the Northwest Province. The project is aimed at improving the road geometry by adding surfaced shoulders and rehabilitating the existing pavement structure to enable it to carry a 20-year design traffic load.

The major aspects of this project include the following:

- No increase of the road reserve width is anticipated,
- Improvement of the existing pavement structure,
- Strengthening the existing pavement,
- general widening of the existing road cross section to 3.7m lanes and 2.5m (high fill) – 3.0m(normal conditions) surfaced shoulders,
- Isolated vertical and horizontal geometric improvements,
- widening of river bridges and some major and minor culverts,
- Demolishing and construction of new river bridges
- horizontal re-alignment of the road at curves:
    - from KM 46.9 to KM 47.7
    - from KM 53.9 to KM 55
    - from KM60.2 to KM60.7
- possible 6.5m wide temporary deviation to accommodate two-way traffic during construction.
- Possible Opening of one hard-rock quarry and re-entry into 5 potential borrow pits
- Stockpile areas and vegetation clearance outside road reserve in excess of one hectare.
- Possible utilisation of four detours/bypasses during construction, these are provincial/municipal roads, both gravel and/or surfaced.
-

Table 1: The affected property coordinates	
Affected Property	Elandskuil 208
Road coordinates:	**Start Point:** 26°31'56.56″S 26°38'9.19″E **Middle point:** 26°25'55.21″S 26°43'36.24″E **End point:** 26°18'54.98″S 26°49'38.86″E
SGID Code:	T0IP00000000020800191

Figure 2 below show the layout map of the proposed activity and associated infrastructure.

MAJOR STRUCTURES

The major cross drainage structures along the route are in a fair to good condition, noting minimal structural damage or construction defects with the general structure. The eight (5) major culverts and (5) the bridges to be widened were assessed against the current road. The table below summarises the major structures.

Table 2: Improvement Strategy for Major Structures

C0403	1.8m X1.2m	26°30'16.74"S 26°38'59.37"E
C4411	1.8m X 1.45m	26°29'21.11"S 26°39'34.71"E
C0411	1.7m X 0.975m	26°28'11.85"S 26°40'39.97"E
C0414	1.8m x 1.23m	26°27'39.01"S 26°41'59.43"E
C0418	3.525m X 3.5m	26°19'27.92"S 26°48'08.96"E
B1018	26.58m	26°27'24.88"S 26°42'13.29"E
B1845	40.75m	26°25'14.88"S 26°43'44.07"E
B4039	53.21m	26°24'26.13"S 26°44'12.83"E
B1167	20.09m	26°21'16.11"S 26°47'04.05"E
B2181	18.45m	26°20'12.44"S 26°47'35.69"E

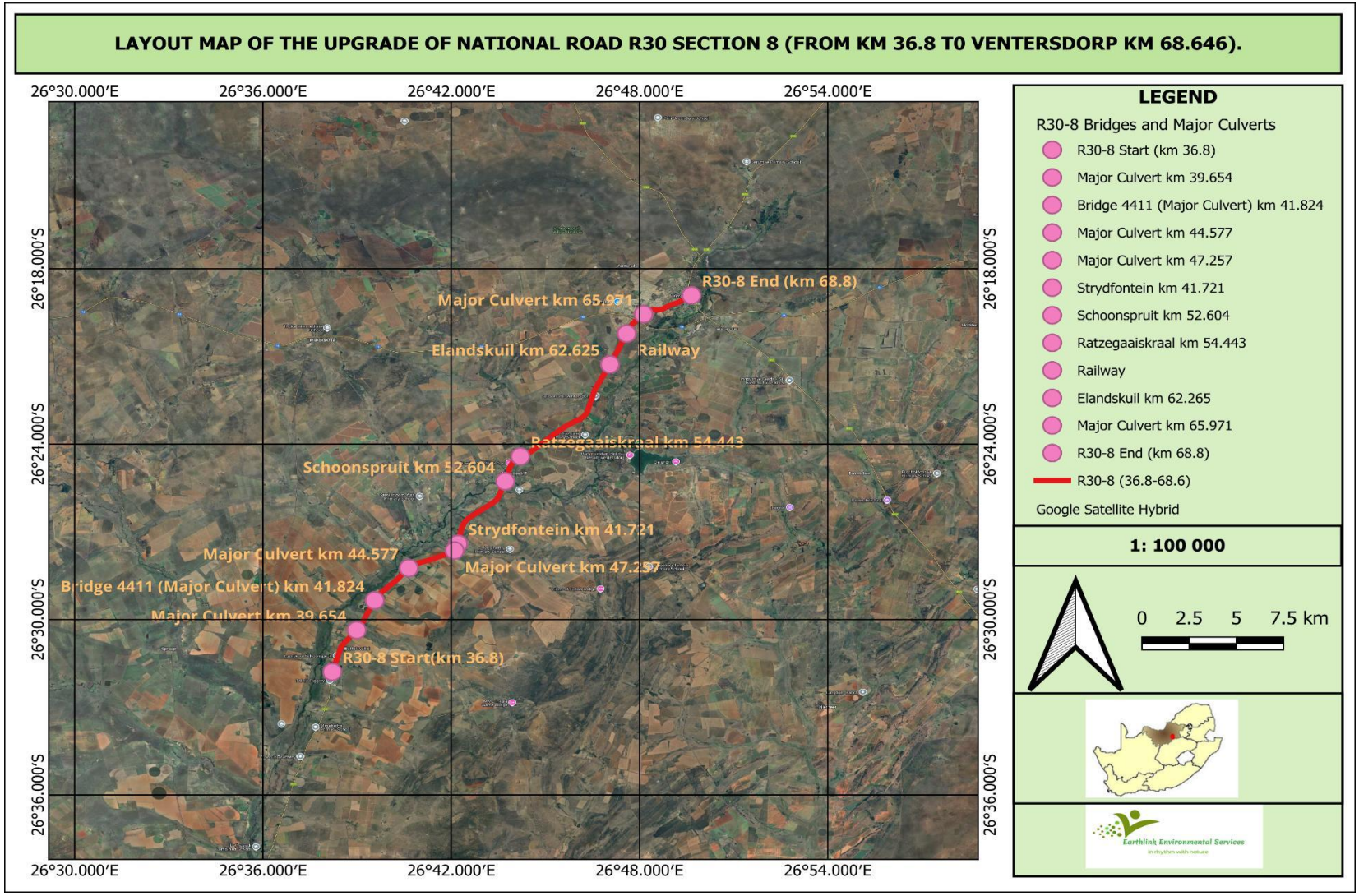


Figure 2: Layout Map

3 POLICY AND LEGISLATIVE FRAMEWORK

This Chapter provides an overview of the policy and legislative context within which the upgrade of R30 road Section 8 is applicable.

3.1 Environmental Legislation

The National Environmental Management Act (NEMA), 1998 (Act 107 of 1998, as amended) is South Africa's overarching environmental legislation, and contains a comprehensive legal framework to give effect to the environmental rights contained in section 24 of The Constitution. Section 2 of NEMA contains environmental principles that form the legislated foundation for sustainable environmental management in South Africa.

3.1.1 National Environmental Management Act, EIA Regulations (2014)

Environmental Authorisation (EA) is required in terms of the EIA Regulations (2014, as amended 2017), published in terms of section 24(5) read with section 44 of the National Environmental Management Act (NEMA, Act No. 107 of 1998), as certain of the listed activities are triggered, as indicated in Table 3 below.

Table 3: Applicable listed activities (EIA Regulations 2014, as amended)

Activity No(s):	Relevant **Basic Assessment Activity(ies)** as set out in **Listing Notice 1** of the EIA Regulations, 2014 as amended	Reasons for triggering
19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles, or rock of more than 10 cubic metres from a watercourse.	The proposed road improvement involves the widening of river bridges and some major and minor culverts, demolishing and construction of new river bridges within watercourses and it is estimated that about 30m3 or more of material will be excavated and deposited within the water course
27	The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation.	The road improvement will require stockpile areas and vegetation clearance outside road reserve and about 1 hectare or more for stockpiling.
56	The widening of a road by more than 6 meters, or the lengthening of a road by more than 1 kilometre –	The road improvement will require about 6.5m widening of the road to accommodate

Activity No(s):	Relevant **Basic Assessment Activity(ies)** as set out in **Listing Notice 1** of the EIA Regulations, 2014 as amended	Reasons for triggering
	(i) where the existing reserve is wider than 13,5 meters	two-way traffic during construction.
Activity No(s):	Provide the relevant **Basic Assessment Activity(ies)** as set out in **Listing Notice 3** of the EIA Regulations, 2014 as amended	Describe the portion of the proposed project to which the applicable listed activity relates. Ensure to include thresholds/area/footprint applicable.
12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. h. North-West i. World Heritage Sites; core of biosphere reserve; or sites or areas identified in terms of an international convention; ii. A protected area including municipal or provincial nature reserves as contemplated by NEMPAA or other legislation; iii. All Heritage Sites proclaimed in terms of National Heritage Resources Act, 1999 (Act No. 25 of 1999); iv. Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority; v. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; or vi. Areas within a watercourse or wetland, or within 100 metres from the edge of a watercourse or wetland.	Clearance of over 300m^2 of indigenous vegetation within CBA 1 will be required.
14	The development of—	The project include structure of more than 10 square meters

Activity No(s):	Relevant **Basic Assessment Activity(ies)** as set out in **Listing Notice 1** of the EIA Regulations, 2014 as amended	Reasons for triggering
	(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or **(ii) infrastructure or structures with a physical footprint of 10 square metres or more;** where such development occurs— (a) within a watercourse; h. North West iv. Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority;	(bridges and culverts) within the critical biodiversity (CBA 1).

The proposed development requires that a Basic Assessment process be undertaken and the Department of Forestry, Fisheries and the Environment are the Competent Authorities (CA).

3.1.2 National Water Act (1998)

In order to ensure sustainable water, use for the benefit of all water users, the National Water Act (NWA), 1998 (Act 36 of 1998) aims to manage the nation's water resources. In order to achieve this, integrated resource management and the preservation of water resource quality are essential.

3.1.2.1 Water Use Licence

In terms of the National Water Act, Act No. 36 of 1998 (NWA) a water use licence is required for:

(a) taking water from a water resource;
(b) storing water;
(c) impeding or diverting the flow of water in a watercourse;
(d) engaging in a stream flow reduction activity contemplated in section 36;
(e) engaging in a controlled activity identified as such in section 37 (1) or declared under section 38 (1);
(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
(g) disposing of waste in a manner which may detrimentally impact on a water resource;

(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
(i) altering the bed, banks, course or characteristics of a watercourse;
(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
(k) using water for recreational purposes.

The proposed upgrade is expected to require a water use authorization, likely under a General Authorisation, as the project's activities within watercourses trigger Section 21(c) and (i) of the National Water Act. A separate application for this authorization will be submitted to the Department of Water and Sanitation (DWS).
Other provisions of the NWA have been considered, specifically relating to Part 4 (Section 19), which deals with pollution prevention, in particular situations where pollution of a water resource occurs or might occur as a result of activities on land.

3.2 Other Legislation

The following table outlines other legislation which will or may be applicable to the project, but do not require any permits or licences.

Table 4: Other applicable legislation

LEGISLATION	PERTAINS TO
The Constitution Act (No 108 of 1996)	Section 24 of the Constitution pertains specifically to the environment. It states that everyone has the right to an environment that is not harmful to their health or well-being, and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development. The Constitution outlines the need to promote social and economic development. Section 24 of the Constitution therefore requires that development be conducted in such a manner that it does not infringe on an individual's environmental rights, health, or well-being. This is especially significant for previously disadvantaged individuals who are most at risk to environmental impacts. The undertaking of an EIA process for the proposed project in terms of the requirements of the EIA Regulations, 2014 (as amended) aims to minimise any impacts on the natural and social environment.
National Environmental Management Act (No. 107 of 1998) (NEMA)	This piece of legislation is South Africa's key piece of environmental legislation and sets the framework for environmental management in South Africa. NEMA is founded on the principle that everyone has

LEGISLATION	PERTAINS TO
	the right to an environment that is not harmful to their health or well-being as contained within the Bill of Rights. The national environmental management principles state that the social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment. The need for responsible and informed decision-making by government on the acceptability of environmental impacts is therefore enshrined within NEMA.
Conservation of Agricultural Resources Act (1983)	As per the Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983), Conservation is defined as: "*in relation to the natural agricultural resources, includes the protection, recovery and reclamation of those resources*;" The objectives of the CARA, as stated in section 2 of the Act, entitled "Objects of Act", are: "*The objects of this Act are to provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants*."
National Environmental Management: Air Quality Act (No 39 of 2004)	Air Quality Management in South Africa is primarily regulated through the National Environmental Air Quality Act (NEMAQA) {Act 39 of 2004, as amended}. The object of this Act is: (a) to protect the environment by providing reasonable measures for— (i) the protection and enhancement of the quality of air in the Republic; (ii) the prevention of air pollution and ecological degradation; and (iii) securing ecologically sustainable development while promoting justifiable economic and social development; and (b) generally, to give effect to section 24(b) of the Constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and well-being of people.
National Environmental Management: Biodiversity Act (No 10 of 2004)	The National Environmental Management: Biodiversity Act (Act 10 Of 2004) (NEMBA) is the primary legislation governing biodiversity management in South Africa. Section 2: "Objectives of the Act", states the following:

LEGISLATION	PERTAINS TO
	2. The objectives of this Act are- a) within the framework of the National Environmental Management Act, to provide for- i. the management and conservation of biological diversity within the Republic and of the components of such biological diversity. ii. the use of indigenous biological resources in a sustainable manner; and iii. the fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources; b) to give effect to ratified international agreements relating to biodiversity which are binding on the Republic; c) to provide for co-operative governance in biodiversity management and conservation; and to provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.
National Environmental Management: Waste Amendment Act (No 26 of 2014)	Waste management activities
	Licensing of waste management activities
	Institutional and planning matters
	Compliance and enforcement
National Heritage Resources Act (No 25 of 1999)	The NHRA aims to promote good management of the national estate, and to enable and encourage communities to nurture and conserve their legacy so that it may be bequeathed to future generations. a) The Act protects as cultural heritage resources such as: Archaeological artefacts, rock structures, structures and sites older than 100 years; b) Ethnographic art objects (e.g. prehistoric rock art) and ethnography; c) Objects of decorative and visual arts; d) Military objects, structures and sites older than 75 years; e) Historical objects, structures and sites older than 60 years; f) Proclaimed heritage sites; g) Graveyards and graves older than 60 years; h) Meteorites and fossils; and i) Objects, structures and sites or scientific or technological value.
National Forests Act (No 84 of 1998), as amended by the Forestry Laws Amendment Act (No 35 of 2005)	Various tree species that are protected per Government Notice No. 1012 under section 12(I)(d) of the National Forests Act, 1998 (Act No. 84 of 1998). In terms of section1 5(1) of the National Forests Act, 1998 "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate

LEGISLATION	PERTAINS TO
	or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated)". These include camel and grey camel thorn for example. Permits from the department of forestry will be required for the removal thereof.
Noise Regulations	The Noise Control Regulations (R 154 GG 13717 of 10 January 1992) promulgated in terms of ECA, defines: • Nuisance noise, as "any sound which disturbs or impairs or may disturb or impair the convenience or peace of any person" • Disturbing noise, as "any noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more". Regulation 4 states 'No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof.'
Occupational Health and Safety Act (No 85 of 1993)	General duties of employers to their employees
	General duties of employers and self-employed persons to persons other than their employees

4 NEED AND DESIRABILITY

The proposed upgrade of Road R30 Section 8 is both necessary and desirable, as it addresses critical infrastructure needs, promotes economic growth, and ensures improved safety and accessibility for communities in the Dr. Kenneth Kaunda District Municipality. By implementing the project with environmental considerations and compliance, it will contribute to sustainable development in the North West Province.

The subsection below gives in detail the need and desirability of the project.

4.1 Need for the Project

The proposed upgrade of Road R30 Section 8 from Klerksdorp (km 0.0) to Buffelsvallei (km 37.0) addresses critical infrastructure requirements to improve transportation efficiency and safety in the region. The need for this project can be summarised as follows:

- **Increased Traffic Demand:** The existing road infrastructure is insufficient to handle the current and projected traffic volumes, particularly with increased heavy vehicle traffic due to economic activities in the area.
- **Road Safety Concerns:** The current road geometry and narrow carriageway width contribute to safety risks for road users. Enhancements, such as improved cross-sections and widened shoulders, will reduce accident rates and provide a safer travel experience.
- **Pavement Deterioration:** The existing pavement structure is nearing the end of its design life and is no longer capable of handling current traffic loads. Strengthening the pavement will ensure the road can carry a 20-year design traffic load.
- **Regional Connectivity:** Road R30 serves as a critical corridor linking Klerksdorp and Buffelsvallei and facilitates access to surrounding towns and agricultural areas. Upgrading this route will support economic growth and enhance regional integration.
- **Drainage and Flooding Issues:** Inadequate drainage infrastructure contributes to localized flooding and road damage during heavy rains. Improved drainage systems, including the widening and replacement of culverts and bridges, are necessary to mitigate these issues.

4.2 Desirability of the Project

The desirability of the project is aligned with social, economic, and environmental benefits for the region and beyond:

- **Economic Growth and Development**: Improved Road infrastructure will enhance access for goods and services, promote regional trade, and support economic activities, including agriculture, mining, and tourism.
- **Improved Accessibility**: Upgrading the road will improve mobility for communities along the route, providing better access to essential services such as education, healthcare, and markets.

- **Reduction in Travel Time and Costs**: Enhanced Road geometry and improved traffic flow will result in reduced travel times, lower fuel consumption, and minimized vehicle maintenance costs for road users.
- **Sustainability and Compliance:** The project will incorporate measures to minimize environmental impacts, such as adherence to water use license requirements and implementing mitigation measures for vegetation clearance and biodiversity protection.
- **Alignment with Strategic Plans**: The upgrade aligns with national and provincial strategic objectives, including those outlined in SANRAL's road infrastructure plans and the North West Provincial Growth and Development Strategy, which emphasize infrastructure development as a catalyst for economic and social growth.
- **Improved Safety Standards**: Upgraded intersections, widened shoulders, and adherence to SANRAL design standards will create a safer roadway for all users, including pedestrians and cyclists.

5 ALTERNATIVES CONSIDERED

5.1 Project alternatives

No project alternatives were investigated within the ambit of this EIA. The project proposal, viz. road, major culverts and bridge upgrades are in line with surrounding land use and development trends. The Applicant, SANRAL through their regional site inspections that form part of their normal business practices, it has been found that a new surface and upgrade of infrastructure on road-R30 section 8 to improve its grade and safety for the affected communities who uses the roads.

5.2 Site Alternatives

No layout alternatives have been investigated as the proposed layout goes in line with the need for the upgrade of road R30 section 8 and associated bridge and culverts.

5.3 No- Go Alternative

The 'no-go' alternative refers to the scenario in which the proposed activity does not take place, and the site remains as it is.

If the no-go alternative is taken, the impacts that can be anticipated to be associated with the proposed road upgrade would not come to pass and the conditions and trends on the property can be expected to remain as per the status quo. Impacts that can be expected to be experienced in case of the no-go alternative being selected include the following:

Table 5: Potential impacts that may be associated with the no-go option

Potential Impact	Status	Extent	Magnitude	Likelihood	Significance
Bio-physical aspects					
No construction-phase increase in soil erosion and sedimentation of watercourses	Neutral	Local	Medium	Highly probable	Low
Long-term levels and trends of erosion and of sedimentation of drainage lines remain unchanged	Neutral	Local	Low	Highly probable	Low
No habitat destruction and/or fragmentation	Neutral	Local	Medium	Definite	Low-Medium

Potential Impact	Status	Extent	Magnitude	Likelihood	Significance
No removal of protected plant species	Neutral	Local	Low	Highly probable	Very low
No faunal fatalities resulting from construction-related activities	Neutral	Local	Low	Definite	Low
No disruption of the activities of fauna on and around the site due to e.g. noise	Neutral	Local	Low	Highly probable	Low
No trapping / hunting / killing fauna by labourers out of fear or for food	Neutral	Local	Low	Highly probable	Low
No roadkilll within t he development	Neutral	Local	Low	Definite	Low
Socio-economic aspects					
No disturbance of archaeological material	Neutral	Local	Unknown	Definite	Unknown
No creation of employment or sustaining of jobs in construction-related fields	Neutral	Local	Medium-High	Definite	Medium-High
No supporting local businesses through local procurement of materials, equipment & services	Neutral	Local to Sub-regional	Medium-High	Highly probable	Medium-High
No increase in criminal activity and/or rowdiness	Neutral	Local	Unknown	Highly probable	Low-Medium
No job creation (long term)	Neutral	Local	Low-Medium	Highly probable	Low-Medium
No decrease in shortage of electricity	Neutral	Local	Medium-high	Highly probable	Medium-high
No visual impacts of construction activities	Neutral	Local	Medium-High	Definite	Medium
No visual impact of the development	Neutral	Local	Medium-High	Definite	Medium
No noise associated with increased traffic (heavy vehicles) during construction	Neutral	Local	Low	Definite	Low
No noise associated with construction activities	Neutral	Local	Low--medium	Definite	Low
Long-term ambient noise level remains unchanged		Local	Low	Highly probable	Very low

6 PUBLIC PARTICIPATION

Public participation is an essential and regulatory requirement for an environmental authorisation process and is guided by Regulations 41 to 44 of the EIA Regulations 2014 (GN R326) (as amended). The purpose of public participation is clearly outlined in Regulation 40 of the EIA Regulations 2014 (GN R326) (as amended) and is being followed for this proposed project.

6.1 Public comment periods

6.1.1 Site Notices

The commencement of the Basic Assessment process was advertised on site notices placed on site (see Appendix 5).

6.1.2 Newspaper advertisement and I&AP email Notification

The commencement and availability of the Basic Assessment report was advertised in the newspaper and the registered I&APs were notified by email. Please see Appendix 5.

6.1.3 Availability of Basic Assessment

The draft Basic Assessment report was emailed to the registered I&Aps for the 30-days commenting period from **20 February 2026 to 3 April 2026.** This is a draft report, and no comments have been received so far. Comments to be received within the 30 days comment period will be sent to DFFE with the Final Basic Assessment report.

6.1.4 Public Meeting

No public meeting was conducted as no objections were anticipated, given that the project pertains to service delivery. Any comments received during the 30-days comment period will be forwarded to DFFE along with the Final Basic Assessment Report.

6.1.5 Raised Issues

This is a draft report, and no comments have been received yet. Any comments submitted during the 30-day comment period will be forwarded to DFFE along with the Final Basic Assessment Report.

7 DESCRIPTION OF THE RECEIVING ENVIRONMENT

7.1 Climate

7.1.1 Rainfall

The region predominantly experiences rainfall during the summer months, often in the form of afternoon thunderstorms. Average annual rainfall ranges between 400 mm and 600 mm, with December and January being the wettest months. In contrast, the winter months are dry, with minimal to no precipitation.

7.1.2 Temperature

Summers (October to March) are typically warm to hot, with daytime temperatures ranging from 28°C to 35°C. Heatwaves frequently occur during the peak summer months. Winters (May to August) are mild to cool, with daytime temperatures ranging between 15°C and 22°C. Nighttime temperatures during winter can occasionally drop below freezing in colder periods.

7.2 Site Geology and Soils

The area consists of aeolian and colluvial sand overlying sandstone, mudstone and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba.

7.3 Topography

The topography along the R30 section 8, from Klerksdorp to Buffelsvallei, within the Dr Kenneth Kaunda District Municipality, is characterized by gently undulating terrain typical of the North West Province. The landscape features broad plains interspersed with low hills and occasional ridges. The elevation changes are gradual, allowing for relatively consistent slopes along the road alignment. Soil conditions in the region vary, with a mix of sandy and clay-rich soils, which may influence drainage and pavement performance. The area's open grasslands and scattered vegetation contribute to minimal natural obstructions, making it conducive to the planned road geometry improvements.

7.4 Surface Hydrology

The aquatic sensitivity of the proposed site is classified as VERY HIGH in the Screening Report, which was confirmed to be "High" due to the watercourses within 500m of the road upgrade. The National Freshwater Ecosystems Priority Areas (NFEPA) identifies important wetlands in South Africa (Figure 3). The National Freshwater Ecosystems Priority Areas (NFEPA) identifies important wetlands in South Africa. The study site falls

under the Middle Vaal Water Management Area (WMA). The road is spread between the quaternary catchments C24E, C24G and C24H. Figure 3 and Figure 4 is a specific representation of the watercourses/wetlands that are found along section 8 of the road R30.

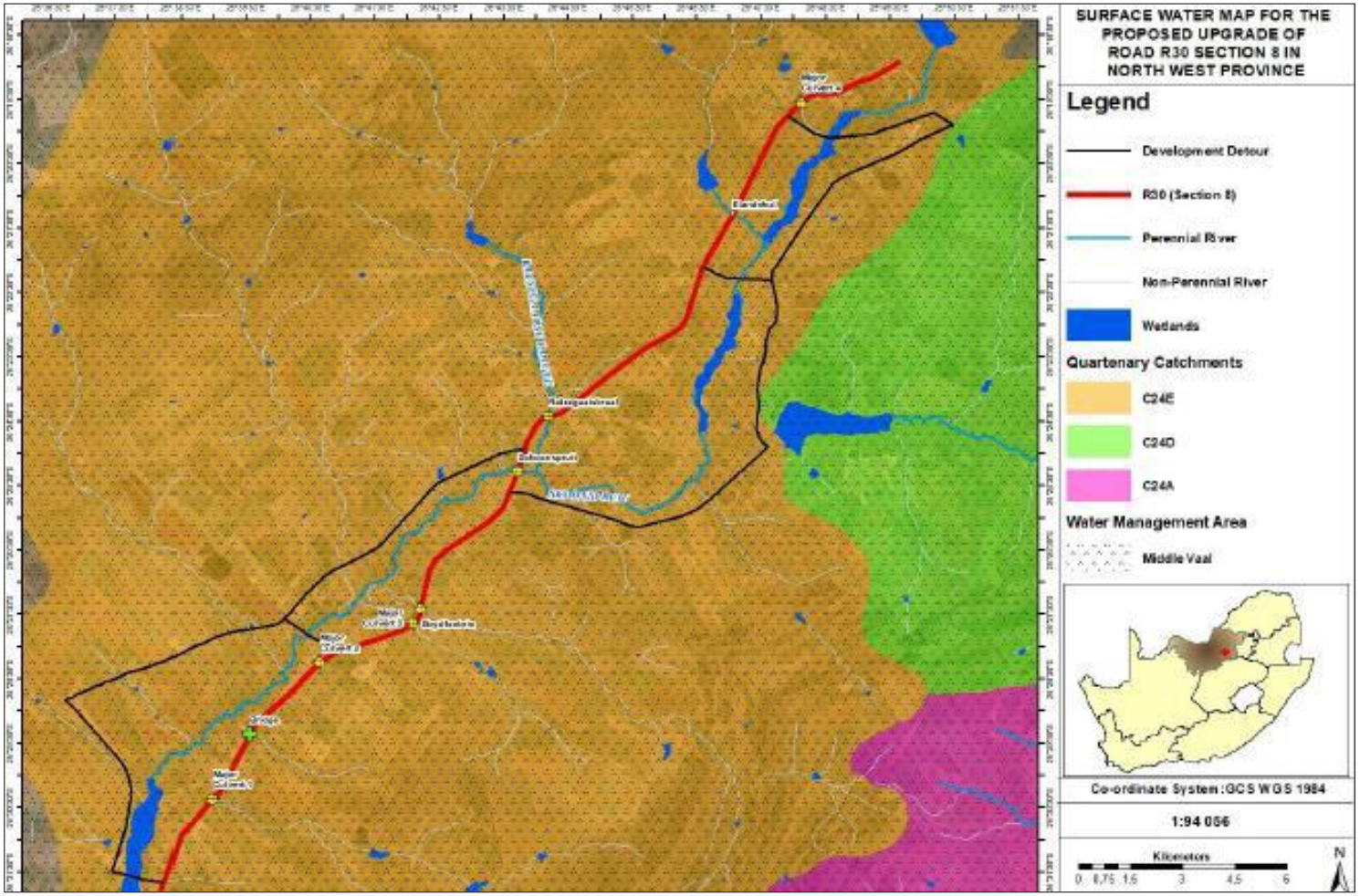


Figure 3: Surface Water Map 1

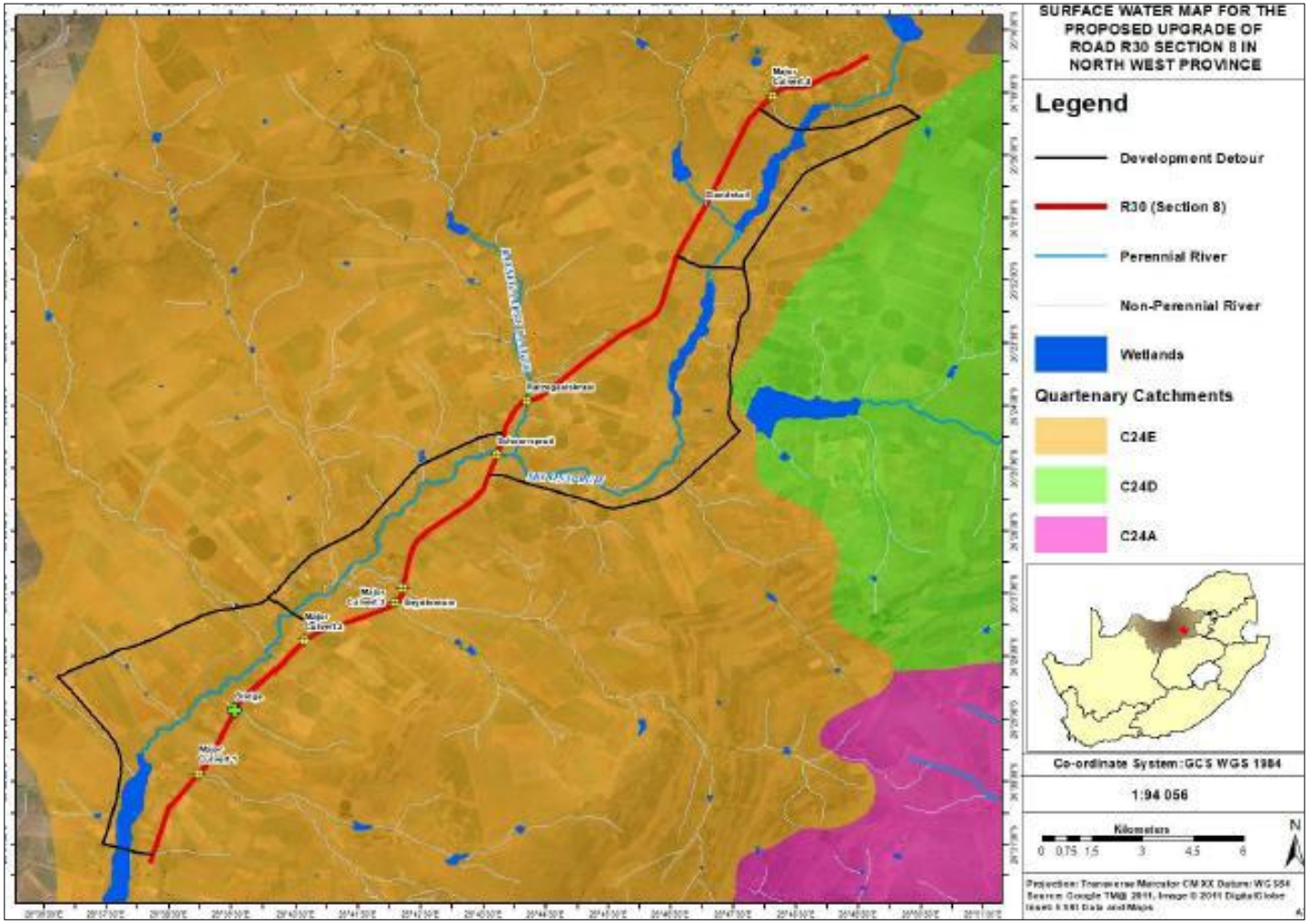


Figure 4: Surface Water Map 2.

7.4.1 Wetland features

R30 Road Section 8 traverses a regulated area encompassing multiple watercourses, each falling within the 500-meter buffer zone stipulated by the National Water Act (Act No. 36 of 1998) for aquatic ecosystem protection. These features are illustrated in figure 5. The most significant watercourse was identified along the northern segment of the alignment during the site inspection (refer to Figure 5).

Hydrological observations indicate the presence of seasonal and possibly perennial wetland features exhibiting saturated soils and standing water indicative of palustrine systems. Vegetation within these systems includes dominant hydrophytic species such as Phragmites australis (common reed), confirmed in Figure 6. This species plays a critical role in stabilizing wetland margins, enhancing water quality through sediment filtration, and providing nesting and roosting habitat for a range of avifaunal species, including wetland-dependent birds.

The ecological function of these riparian habitats must be carefully considered in route planning and environmental compliance, particularly in relation to Section 21(c) and (i) water use authorizations. Mitigation measures, including buffer demarcation, erosion control, and avoidance of construction within critical ecological zones, are recommended to preserve the integrity of the aquatic ecosystem.

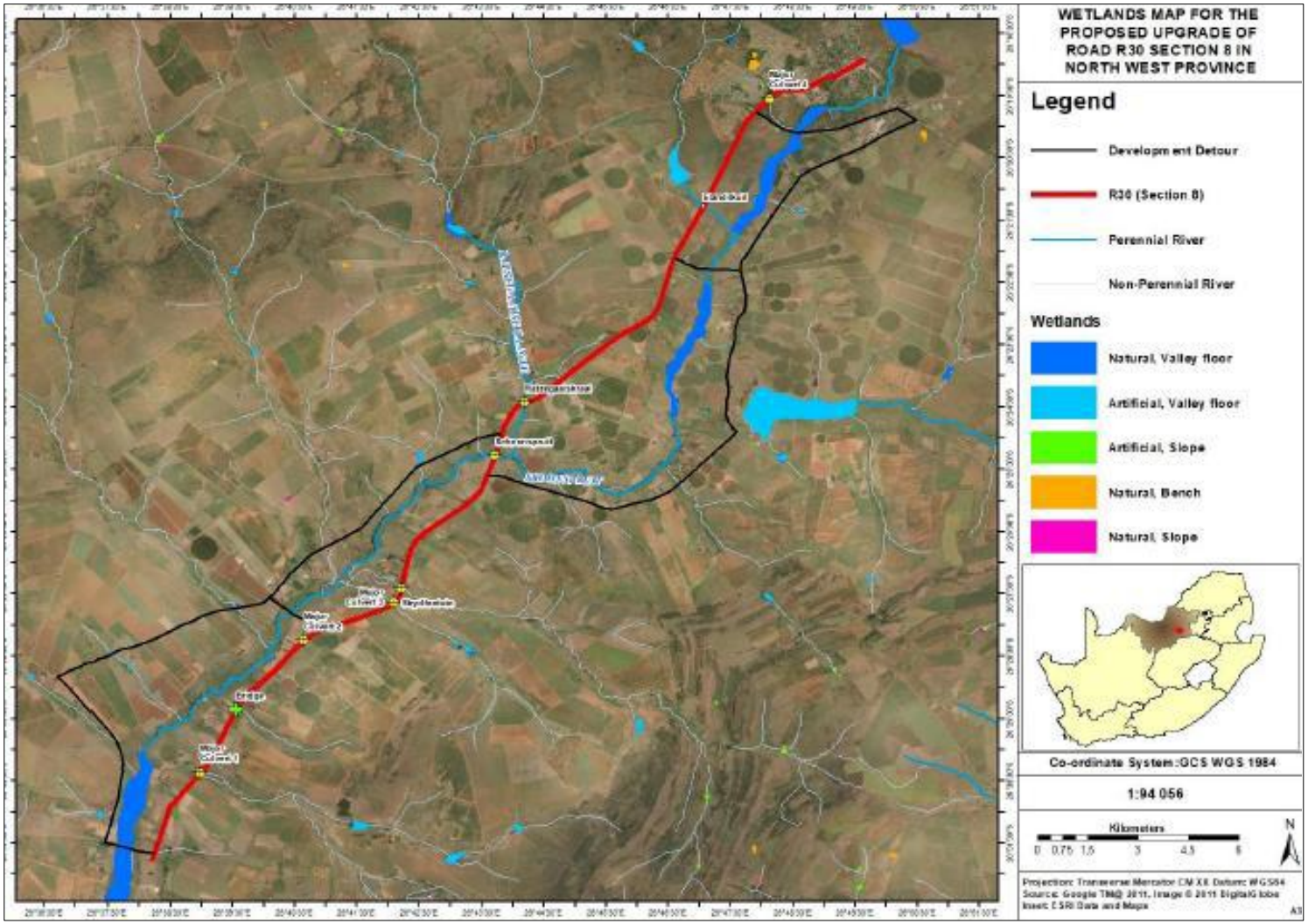


Figure 5: Map of the wetland and watercourses within 500m of the R30 Section 8



Figure 6: Watercourse and Wetland observed within 500m of the road (A-C Represents the watercourse and D represents the wetland (Dam)

7.4.2 Soil wetness and soil form indicator

The watercourses onsite have water and support a host of hydrophytes and terestrial plant species. Wetland areas were identified and mainly delineated according to the presence of hydric (wetland) soil types. Hydric soils are defined as those which show characteristics (redoximorphic features). The watercourses consist mainly of clay soils (figure 7).



Figure 7: Soil Observed within one the watercourses.

7.4.3 Vegetation indicator

According to DWAF (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act, Act 36 of 1998. However, using vegetation as a primary wetland indicator requires an undisturbed condition (DWAF, 2005). Major disturbances were however noted in the wetland systems making it difficult to rely solely on vegetation as a wetland indicator. Disturbances included the presence of agricultural activities, servitude of the road and powerlines along the R30 National Road. There was evidence of hydrophytes as reeds (Phragmites australis) (figure 8).



Figure 8: Phragmite species observed onsite

7.4.4 Wetland Delineation.

Any wetlands identified on the site were categorised according to the National Wetland Classification System for South Africa (Ollis et al., 2013). The wetland area was classified as a hydrogeomorphic (HGM) unit. An HGM unit is a recognisable physiographic wetland-unit based on the geomorphic setting, water source of the wetland and the water flow patterns (MacFarlane et al., 2009). The proposed project is located within 500m of the Taalbosspruit and its tributaries, the Rietgatsspruit and two artificial wetlands (Figure 9).

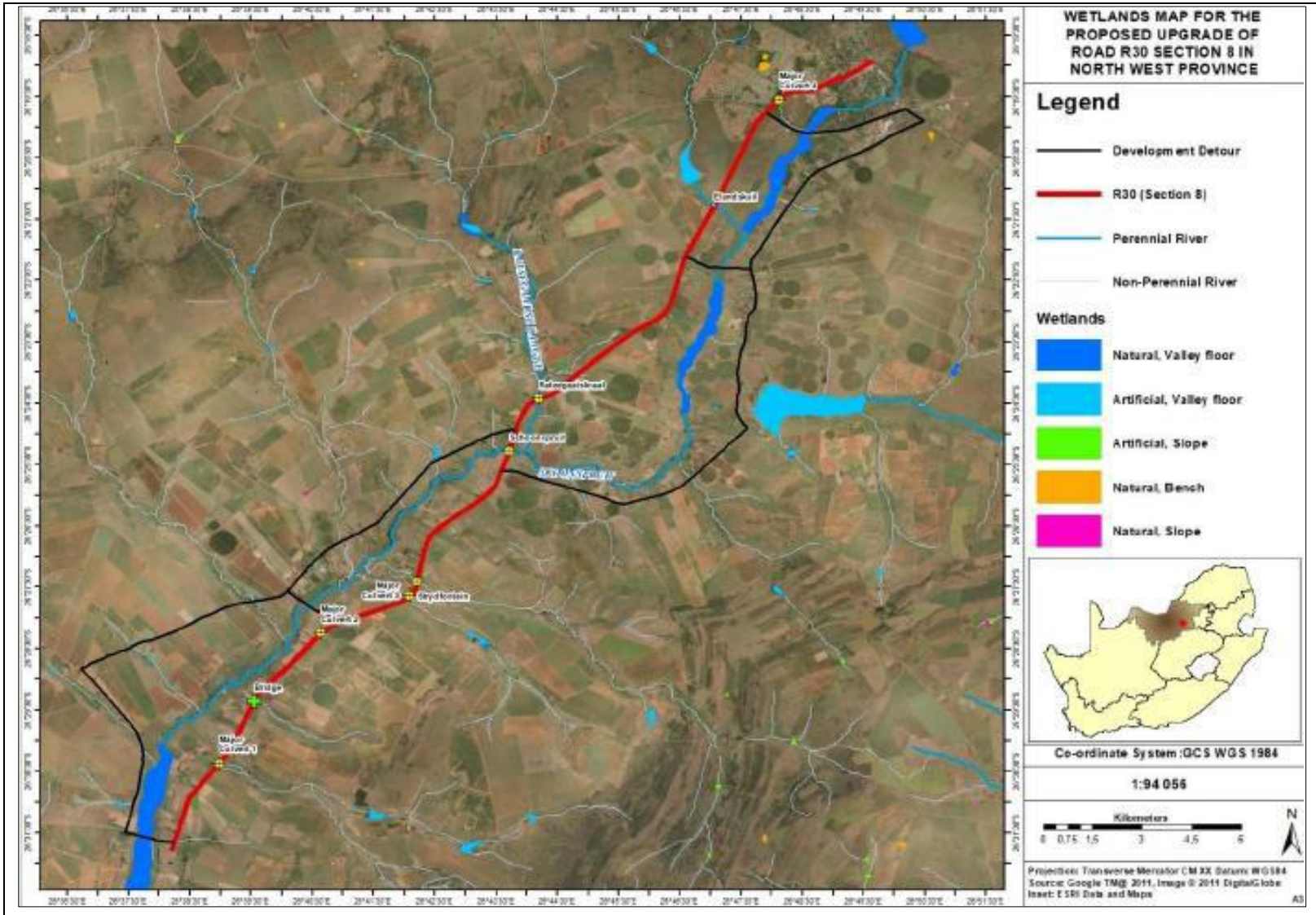


Figure 9: Wetland delineation Map

7.4.5 Freshwater Aquatic Specialists

The freshwater habitats onsite, as illustrated in Figure 10, predominantly consist of aquatic plant species such as algae, water lilies (Nymphaea spp.), and green algae. These taxa play an essential ecological role by enhancing water quality—utilizing their root systems to filter out pollutants and excess nutrients, thereby supporting nutrient cycling, and maintaining aquatic ecosystem health.

During the site inspection, several unnamed tributary watercourses were found to be dry, indicating a seasonal or ephemeral hydrological regime, which limits their capacity to support ichthyofaunal (fish) populations. In contrast, major rivers exhibited signs of aquatic fauna presence, with one instance involving a deceased fish observed within the channel (Figure 8-10), suggesting intermittent aquatic activity.

Additionally, these freshwater habitats provide suitable ecological conditions for avifaunal species, serving as functional nesting, roosting, and foraging grounds for birds adapted to riparian and wetland environments. Their presence also contributes to supporting onsite agricultural activities, likely through water retention, soil moisture regulation, and habitat diversification—further underscoring the ongoing ecological value of these habitats despite variable water availability.



Figure 10: Typical Freshwater Habitat onsite

7.5 Terrestrial Biodiversity (Floral and Faunal)

The road R30-S8 is located within the Vaal-Vet Sandy Grassland (Gh 10) vegetation unit (Figure 11.). This vegetation unit is found in plain-dominated landscapes with some scattered, slightly irregular undulating plains and hills. The vegetation unit consist of low-tussock grasslands with an abundant karroid element. The vegetation unit is dominated by Themeda triandra which is an important feature of this vegetation unit. Locally low cover of T. triandra and the associated increase in Elionurus muticus, Cymbopogon pospischilii and Aristida congesta is attributed to heavy grazing and/or erratic rainfall.

The Vaal-Vet Sandy Grassland (Gh 10) is distributed in the North-West and Free State Provinces, South of Lichtenburg, and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. This vegetation unit is found in altitudes ranging between 1 220 and 1 560 m, it is generally found in 1 260– 1 360 m.

The taxa associated with the dominant vegetation units are summarized on **Table 6** below.

Table 6: The taxa associated with the dominant vegetation units are summarized below.

Important Taxa within the Vaal-Vet Sandy Grassland (Mucina and Rutherford 2006).

PLANT FORM	SPECIES
Gh 10 Vaal-Vet Sandy Grassland	
Graminoids:	*Anthephora pubescens (d), Aristida congesta (d), Chloris virgata (d), Cymbopogon caesius (d), Cynodon dactylon (d), Digitaria argyrograpta (d), Elionurus muticus (d), Eragrostis chloromelas (d), E. lehmanniana (d), E. plana (d), E. trichophora (d), Heteropogon contortus (d), Panicum gilvum (d), Setaria sphacelata (d), Themeda triandra (d), Tragus berteronianus (d), Brachiaria serrata, Cymbopogon pospischilii, Digitaria eriantha, Eragrostis curvula, E. obtusa, E. superba, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides.*
Herbs	*Stachys spathulata (d), Barleria macrostegia, Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Geigeria aspera var. aspera, Helichrysum caespititium, Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Vernonia oligocephala..*
Geophytic Herbs	*Bulbine narcissifolia, Ledebouria marginata*
Succulent	*Tripteris aghillana var. integrifolia*

Table 6: The taxa associated with the dominant vegetation units are summarized below.

Important Taxa within the Vaal-Vet Sandy Grassland (Mucina and Rutherford 2006).

PLANT FORM	SPECIES
Herb	
Low Shrubs	*Felicia muricata (d), Pentzia globosa (d), Anthospermum rigidum subsp. pumilum, Helichrysum dregeanum, H. paronychioides, Ziziphus zeyheriana.*
	AZa 5 Highveld Alluvial Vegetation
Riparian thickets	*Small Trees: Acacia karroo (d), Salix mucronata subsp. mucronata (d), S. mucronata subsp. woodii (d, within subescarpment grasslands of KwaZulu-Natal), Ziziphus mucronata (d), Celtis africana, Rhus lancea. Tall Shrubs: Gymnosporia buxifolia (d), Rhus pyroides (d), Diospyros lyci¬o¬ides, Ehretia rigida, Grewia flava. Low Shrubs: Asparagus laricinus (d), A. suaveolens (d). Woody Climber: Clematis brachiata. Succulent Shrub: Lycium hirsutum (d). Graminoids: Setaria verticillata (d), Panicum maximum. Herb: Pollichia campestris.*
Reed beds Megagraminoid	*Phragmites australis (d). Flooded grasslands & herblands Low Shrubs: Gomphocarpus fruticosus (d), Felicia muricata. Succulent Shrub: Salsola rabieana. Graminoids: Agrostis lachnantha (d), Andropogon eucomus (d), Chloris virgata (d), Cynodon dactylon (d), Eragrostis plana (d), Hemarthria altissima (d), Imperata cylindrica (d), Ischaemum fasciculatum (d), Miscanthus junceus (d), Paspalum distichum (d), Andropogon appendiculatus, Brachiaria marlothii, Cyperus denudatus, C. longus, Echinochloa holubii, Eragrostis obtusa, E. porosa, Fimbristylis ferruginea, Panicum coloratum, Pycreus mundii, Sporobolus africanus, S. fimbriatus, Themeda triandra, Urochloa panicoides. Herbs: Persicaria lapathifolia (d), Alternanthera sessilis, Barleria macrostegia, Corchorus asplenifolius, Equisetum ramosissimum, Galium capense, Hibiscus pusillus, Lobelia angolensis, Nidorella resedifolia, Persicaria amphibia, P. hystricula, Pseudognaphalium oligandrum, Pulicaria scabra, Rorippa fluviatilis var. fluviatilis, Senecio inornatus, Stachys hyssopoides, Vahlia capensis. Geophytic Herbs: Crinum bulbispermum, Haplocarpha lyrata. Open water Aquatic Herb: Myriophyllum spicatum.*

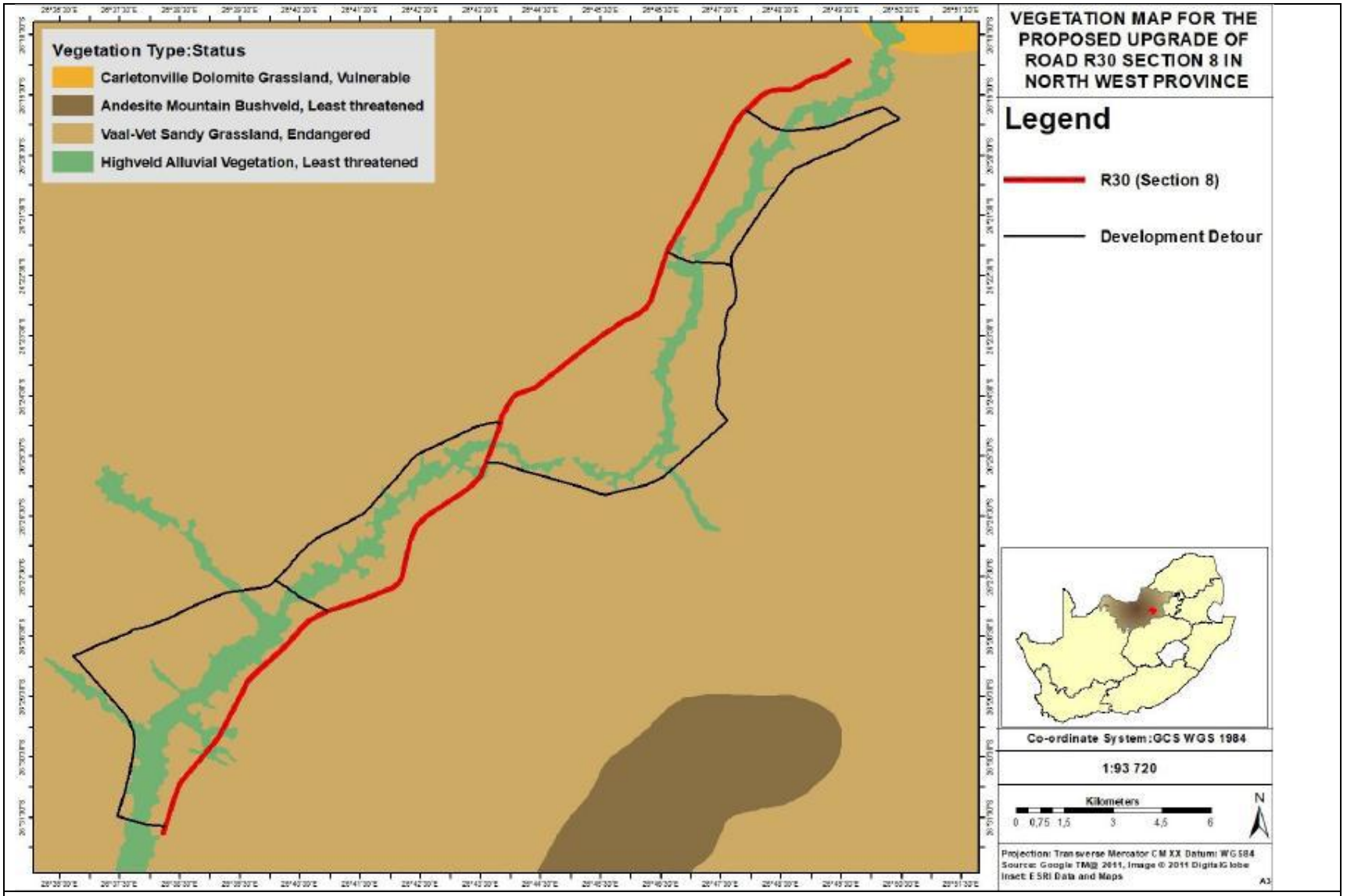


Figure 11: Vegetation Map-Road R30 Section 8

7.5.1 Gh 10 Vaal-Vet Sandy Grassland's Conservation Status

The Gh 10 Vaal-Vet Sandy Grassland is classified as **Endangered**. A conservation target of 24% has been set. Only 0.3% is statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. Erosion is very low (85.3%) and low (11%).

The AZa 5 Highveld Alluvial Vegetation is classified as Least threatened. A conservation target of 31% has been set with nearly 10% statutorily conserved in the Barberspan (a Ramsar site), Bloemhof Dam, Christiana, Faan Meintjes, Sandveld, Schoonspruit, Soetdoring and Wolwespruit Nature Reserves. More than a quarter has been transformed for cultivation and by building of dams (Bloemhof, Erfenis, Krugersdrif, Mockes and Vaalharts Dams). The highveld alluvia are prone to invasion by a number of weeds, obviously encouraged by the high nutrient status of soils and ample water supply. Woody plants such as Salix babylonica, Schinus molle, Melia azedarach, Celtis sinensis, Morus alba, Populus x canescens, Nicotiana glauca and N. longiflora and forbs such as Argemone ochroleuca, Chenopodium strictum, Conyza canadensis, Datura stramonium, Melilotus alba, Oenothera indecora, Paspalum dilatatum, P. urvillei, Pennisetum clandestinum, Tagetes minuta, Verbena bonariensis, Xanthium strumarium agg. and Zinnia peruviana (see Cilliers et al. 1998, Malan et al. 2001a, b, L. Mucina, unpublished data) often dominate either the riverine thickets or grasslands or form ruderal communities in disturbed habitats. The undergrowth of the alluvial riparian thickets and the accompanying grasslands suffer from heavy overgrazing in many places.

7.5.2 2015 North West Biodiversity Sector Plan

According to the 2015 North West Biodiversity Sector Plan, the proposed Upgrade of section 8 of the road R30 are located within the following:

- Critical Biodiversity Area 1 and 2
- Ecological Support Area 1.

Refer to figure 12 below for the Sensitivity map.

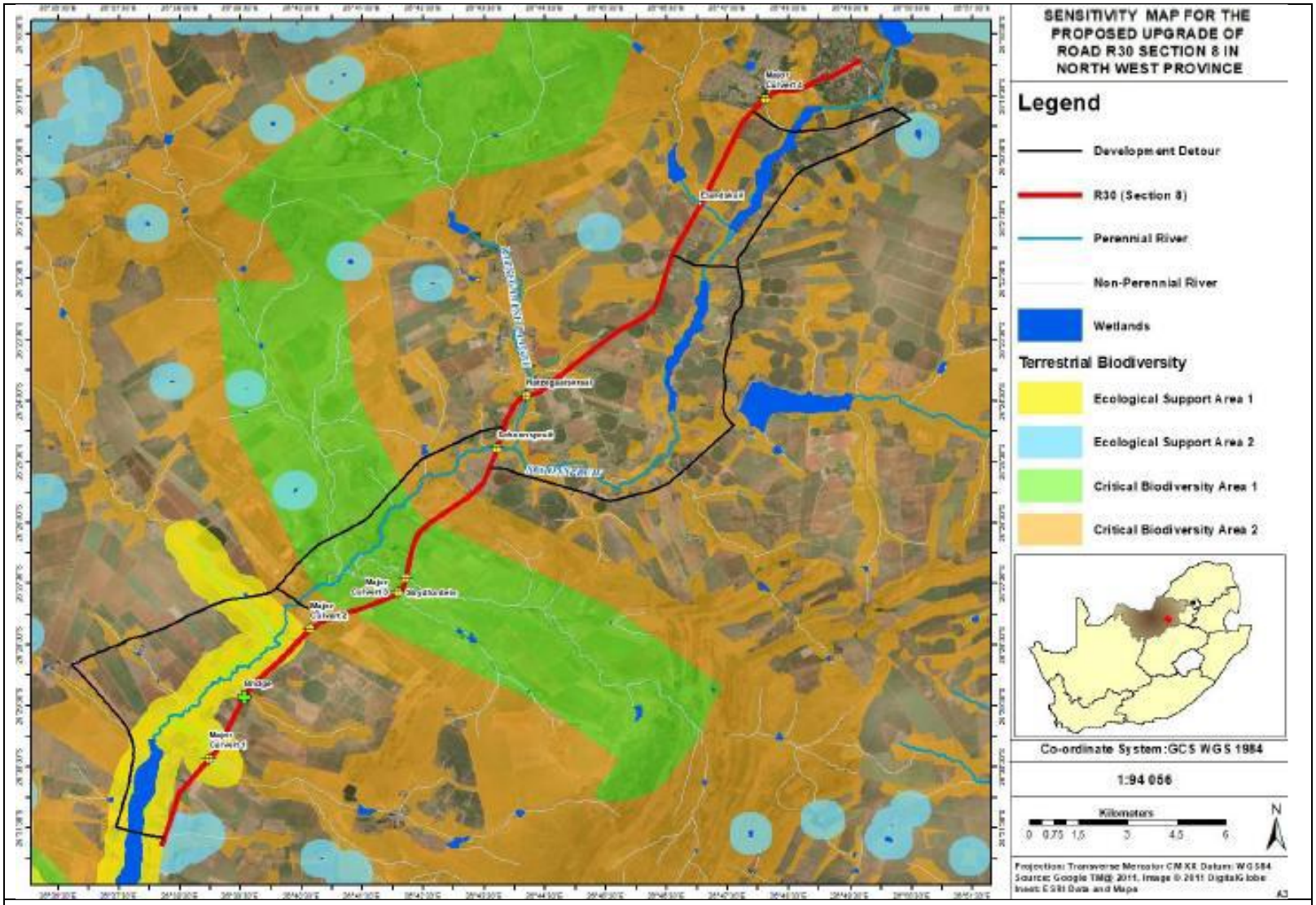


Figure 12 : The R30 Section 8 in relation to the 2015 North West Biodiversity Sector Plan

7.5.3 Flora Species of Special Concern

During the field investigation no floral SCCs were found and the chances that the species above re-establish themselves on the site is medium to low. Should any floral SCC be encountered during any phase of the proposed development, these species should be rescued and relocated by a suitably qualified specialist and either relocated to suitable habitat within the study area outside of the development footprint, utilised within the landscaping plan of the project, or moved to registered nurseries such as the Agricultural Research Council (ARC) or the South African National Biodiversity Institute (SANBI).

7.5.3.1 Ethnobotanical plant species

Ethnobotany/ Ethnoecology is a branch of botany that focuses on the use of plants for medicines, cultural and recreational purposes. The overexploitation of indigenous plants for ethnobotanical purposes can be detrimental to populations of those particular plant species, and the other species that depend on its existence for their survival.

During the site inspection, no medical plants were encountered along the road servitude.

7.5.3.2 Alien Invasive Species Present on Site

The Invasive Species that were observed onsite are listed below:

- Eucalyptus camaldulensis (Commonly known as Gumtree)

The genus Eucalyptus, with about 800 species, belongs to the myrtle family, Myrtaceae, and is almost entirely native to Australia. The Eucalypts are best known for their commercial use as timber trees and windbreaks. They are also cultivated for ornament, shade, firewood and honey production.

Eucalyptus species are invasive and pose a threat to the natural resources of the country. Most invasion occurs along watercourses but also on forest margins, in gaps within native forest and plantations as well as into Fynbos and grassland. Eucalypts are well known for their ability to use large volumes of water, and this increases with increasing availability of water such as along watercourses.



Figure 13: Eucalyptus tree observed onsite

7.5.4 Faunal Diversity

7.5.4.1 Mammals

According to the desktop study conducted, the species of the terrestrial biodiversity compliance statement attached under Appendix 5.1, were identified as being possible to occur within the study area or the immediate vicinity of the proposed construction area. It must be noted that some of these species are very sensitive to habitat and in some instances the likeliness for them to occur is minimal. There are six (6) sensitive mammal species that have a HIGH chance of occurring in the study area, namely roan antelope, Vaal rhebok, plains zebra, brown hyena, African clawless otter, and southern sable antelope. None of the sensitive mammals which were expected were spotted on site except for grazing cattle.



Figure 14: Grazing Cattle observed on a property next to the road.

7.5.4.2 Reptile

None of the expected reptiles were observed on site during the site visit. Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Large areas surrounding the site have resulted in increased habitat modification and transformation as well as increased human presence and associated disturbances (illegal reptile collecting, indiscriminate killing of all snake species, fires) surrounding the site coupled with increased habitat destruction and disturbances on the neighbouring properties are all causal factors in the alteration and disappearance of reptile diversity in the area. A list of the reptile species that can be expected onsite are of the terrestrial biodiversity compliance statement attached under Appendix 5.1.

7.5.4.3 Avifauna

Birds are generally regarded as good ecological indicators, because their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological conditions are directly linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land cover is directly linked to habitats within the study area. The diversity of these habitats should give rise to many different species.

A few avifauna species were observed along the road servitudes especially near the watercourse.



Figure 15: Ostriches observed outside of the borrow pit R30 S8-10, which is located next to the road servitude.

7.5.4.4 Invertebrates

A list of butterflies that are likely to be observed on the study site and the surrounding areas are summarised in Table 11-3 of the terrestrial biodiversity compliance statement attached under Appendix 5.1.

7.6 Socio Economic

7.6.1 Regional Context

The Dr. Kenneth Kaunda District Municipality comprises four local municipalities:

- City of Matlosana
- Maquassi Hills
- JB Marks (which includes Ventersdorp following the 2016 municipal merger with Tlokwe).

Within the JB Marks Municipality, Ventersdorp plays an important role as a local service town for surrounding rural communities. The area along the R30 Section 8 road improvement is predominantly rural, with agriculture forming the backbone of local livelihoods. Crop production (particularly maize and sunflower) and livestock farming are widely practiced, supporting both subsistence and commercial activities.

The proposed improvement of the R30 is expected to improve accessibility, mobility, and economic linkages for Ventersdorp and surrounding villages, strengthening access to markets, social services, and employment opportunities within the broader district.

7.6.2 Population Demographics

- Population Size and Density: The Dr. Kenneth Kaunda District Municipality has an estimated population of about 742,800 people, with an average population density of approximately 50 people per km². Within the JB Marks Local Municipality, which includes Ventersdorp, the population is more dispersed, particularly in rural farming settlements along the R30 route. Ventersdorp town itself functions as a local service centre with a relatively small population compared to the larger district towns.

- Age Distribution: The population across the district is generally youthful, with the majority under the age of 35 years. This reflects a growing demand for employment, training, and economic opportunities, particularly for young people in rural communities.

- Education Levels: Educational attainment in the project area is varied. While literacy levels are generally moderate, many rural residents have limited access to post-secondary education and skills development opportunities. This contrasts with urban nodes, where higher levels of formal education and skills are more common.

7.6.3 Economic Profile

The district's economy is diversified, with key sectors including:

- Mining: Gold and uranium mining are prominent in Klerksdorp, contributing significantly to employment and regional GDP.

- Agriculture: The area surrounding Ventersdorp is strongly agricultural, with widespread crop production (notably maize, sunflower, and sorghum) and livestock farming. These activities are central to both subsistence and commercial

livelihoods and are expected to benefit from improved road infrastructure that enhances access to markets.

- Retail and Services: Ventersdorp town functions as a local commercial and service hub for surrounding villages and farming communities, providing retail trade, healthcare, and education services. Improved connectivity along the R30 is expected to strengthen these socio-economic linkages.

7.6.4 Employment and Income

- Employment Levels: Unemployment in the Dr. Kenneth Kaunda District is relatively high and remains above the national average, with rural areas such as Ventersdorp being the most affected. Limited formal job opportunities contribute to widespread dependency on seasonal agricultural work and informal trading. The proposed road improvement is expected to create temporary construction-related employment and stimulate indirect economic opportunities for local communities.

- Income Levels: The district reflects notable income disparities, with urban residents earning higher and more stable wages compared to those in rural areas. In Ventersdorp and surrounding villages, many households rely on social grants, small-scale farming, or informal sector activities as their primary sources of income. Improved road access may help reduce transport costs and enhance access to economic opportunities and markets.

7.6.5 Infrastructure and Services

- Road Infrastructure: The current condition of National Road R30 is a key factor affecting regional connectivity. The upgrade is expected to improve access to markets, health facilities, and educational institutions.
- Health and Education Services: While urban centers have relatively well-equipped facilities, rural areas often lack adequate health and educational services. Improved road infrastructure can facilitate better service delivery.

7.6.6 Social Dynamics

- Community Characteristics: The region is home to a mix of cultures and languages, with Setswana being the predominant language.

- Land Use: The route passes through a combination of urban, peri-urban, and rural landscapes, impacting agricultural lands, residential areas, and undeveloped spaces.

- Social Challenges: The area faces challenges such as poverty, inequality, and limited access to basic services, particularly in rural communities.

7.7 Heritage

7.7.1 Social And/or Religious Intangible Heritage

The section of the R30 traverses predominately active farmlands before entering the town of Klerksdorp. No active social or religious areas were recorded along the route.

7.7.2 Historical Period and Built Environment

Historical maps from UCT digital collections were perused for information pertaining to the R30. A map from 1900, clearly shows that what is now the R30 existed at that time. Cognisance should be taken of this fact, as the road in various forms has connected Klerksdorp and Rustenburg for well over a century. However, as population increase occurred the road would have undergone many upgrades over more than 120 years.

7.7.3 Graves

The area contains several memorial sites and graveyards of cultural and historical significance. Three graves and one roadside marker are present, typically memorializing loved ones lost in motor vehicle accidents.



Figure 16: View of Graveyard. GPS: S26° 29' 14.1" E26° 39' 35.1"



Figure 17: View of Graveyard. GPS: S26° 31' 02.7" E26° 38' 26.6"



Figure 18: View of Marker. GPS: S26° 22' 18.4" E26° 46' 31.6"

7.7.4 Iron Age

According to the most recent archaeological cultural distribution sequences by Huffman (2007), this area falls within the distribution area of various cultural groupings originating out of the Urewe Tradition. The facies that may be present are:

Urewe Tradition: Blackburn branch- Ntsuanatsatsi facies AD 1450 - 1650

Uitkomst facies AD 1650- 1820

Olifantspoort facies AD 1500- 1700

Buispoort facies AD 1700- 1840

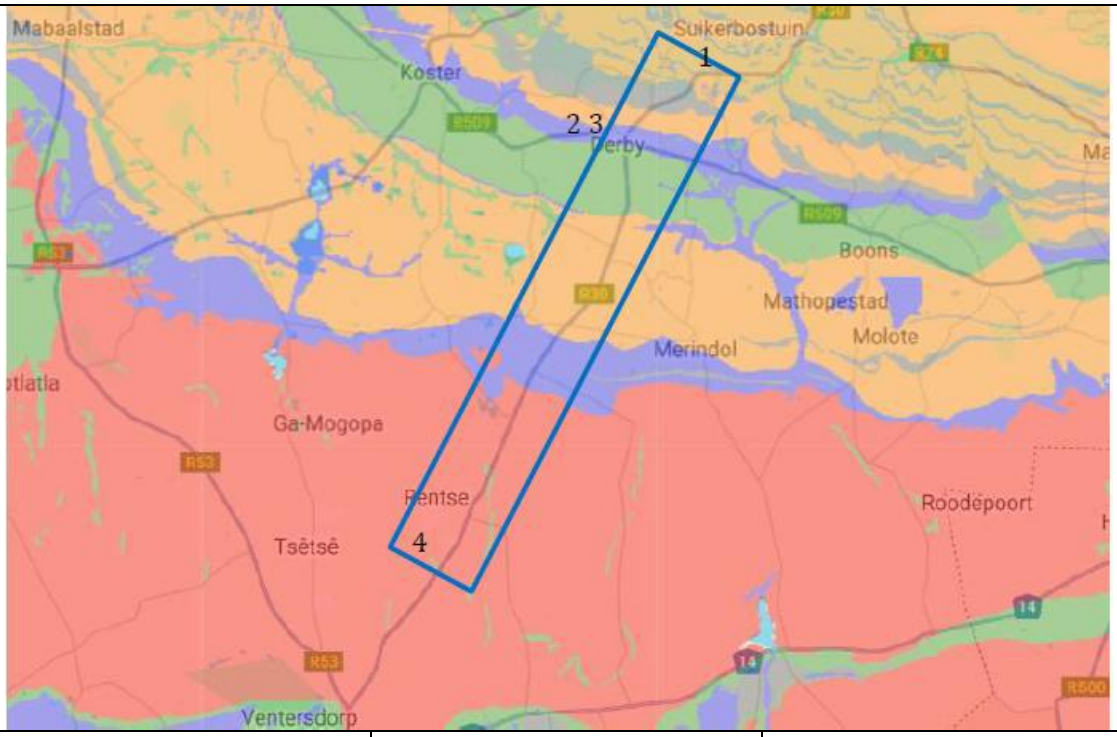
No remains from the Iron Age were recorded.

7.7.5 Stone Age

No remains from the Iron Age were recorded.

7.8 Palaeontology

The project lies in the Transvaal Basin where the rocks of the Paleoproterozoic Transvaal Supergroup are exposed. The southern section is on potentially very highly sensitive rocks of the Malmani Subgroup while the northern section is on highly sensitive rocks of the lower Pretoria Group, all members of the Transvaal Supergroup. The road currently does not have any fossils present on the surface.



Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/ YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No paleontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No paleontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 19: SAHRIS paleo sensitivity map for the site for the proposed R30 Section 8 road improvement.

7.9 Geotechnical Assessment

Ndodana Consulting Engineers (Pty) Ltd (NCE) were appointed by The South African National Roads Agency SOC Ltd (SANRAL), for the Consulting Engineering Services for the Assessment, Detailed Design, Contract Documentation, and Monitoring of the Partial Reconstruction of National Road R30 Section 8 from km 36.8 to Ventersdorp (km 68.646) with a total length of 31.846 km. SANRAL approved the reclassification of the project to an Improvement Scope in 2020. C2C Consulting Engineers cc (C2C) were selected as the New Entrant (Targeted Enterprise) for this project. C2C will be responsible for the design of the bridges and major culverts related works under the Improvement scope. NCE contracted Southern Geotechnical Engineering (SGE) to oversee the geotechnical investigation, log boreholes, profile test pits, and compiled the geotechnical investigation report.

The geotechnical investigation was conducted for the planned widening of bridge and culvert structures along National Road R30, Section 8, from km 36.8 to km 68.646. The project includes the Strydfontein, Schoonspruit, Ratzegaai, and Elandskuil River bridges, as well as five major culverts. The route is underlain by granite, gneiss, sedimentary, and volcanic formations, with alluvium deposits common at stream and wetland crossings. Near-surface soils are cohesive, fine-grained, and clayey, with varying expansiveness and compressibility.

Soil classifications include CL, SC, SC-SM, and CH, with AASHTO classifications ranging from A-2-6 to A-7-6. Soil samples show varying percentages of gravel, sand, silt, and clay, with grading modulus values ranging from 0.29 to 1.37. Liquid Limit (LL) ranges from 17% to 73%, Plasticity Index (PI) from 6% to 40%, and Linear Shrinkage (LS) from 3% to 26%.
Seven primary geo-material groups were identified, including granite rock, diabase intrusions, and amygdaloidal lava rock. Uniaxial Compressive Strength (UCS) values range from 0.7 MPa to 253.6 MPa, with failure modes influenced by rock type, density, and discontinuities.
Rotary core borehole drilling, Dynamic Probe Super Heavy (DPSH) testing, and test pitting were conducted. DPSH tests showed varying soil densities and resistance, with refusal depths ranging from 2.50 m to 6.60 m due to high blow counts. Laboratory tests included foundation indicator, consolidation, swell pressure, and UCS tests.
Shallow groundwater conditions were observed, with seepage encountered in most test pits and boreholes. Piezometers recorded standing water levels between 0.03 and 0.71 mbgl. Soft excavation conditions are expected in transported alluvium soils, which are fine-grained and have low shear strength. Excavations may require shoring or lateral support due to instability and shallow groundwater levels.

Bridge structures: Recommended foundation system is temporary or permanent cased auger piles or Continuous Flight Auger (CFA) piles. Culvert structures: Recommended foundation system is spread footings with remedial measures, including removal of soft alluvium and replacement with rockfill and compacted G5 material.
Possible flooding during construction near watercourses.
Deeply fractured and discontinuous granite rock profiles may require careful pile design and rock socket evaluation. Implement remedial measures for culvert foundations to address excessive consolidation settlements. Design foundations using Limit State Design

methodology (SANS codes based on Eurocode 7). Monitor piezometers to assess seasonal groundwater variations. Ensure safety measures during construction to mitigate flooding risks. Geological and geotechnical conditions may vary during construction, requiring reassessment of recommendations. No additional geotechnical investigations are anticipated during the construction phase, but the piling contractor may conduct exploratory auger holes.

The Geotechnical Investigation report is attached as Appendix 5 of this BAR.

7.10 Traffic Engineering Assessment

Merchelles Collective (Pty) Ltd is appointed by Ndodana Consulting Engineers (Pty) Ltd to render Professional Traffic Engineering services for the improvement of National Road R30 Section 8 from KM 36.8 to Ventersdorp KM 68.65. The objective of the traffic assessment is to investigate prevailing traffic conditions and identify feasible road infrastructure capacity improvements. The aim of undertaking a traffic assessment for the improvement of R30 Section 8 (R30-8) is to investigate prevailing traffic conditions and identify feasible infrastructure capacity improvements where warranted.

Future Traffic Volumes: Projected traffic volumes for 2045 remain within the capacity of a two-lane single carriageway under medium growth scenarios.
N14/R30: Fails under peak hour traffic due to high turning volumes. Recommended improvement: Diamond interchange. R30/Loccatie St: Western approach operates at LOS F during PM peak hour. Recommended improvement: Dual-lane traffic circle.
R30/Voortrekker St: May require upgrades if planned land use development materializes.
Universal Access Design: Tactile paving, kerb ramps, reduced kerb radius, and non-slip surfaces. Pedestrian Sidewalks: Minimum width of 2m on both sides of the road.
Pedestrian Crossings: Full crossings at 5 priority intersections and raised crossing near Toevlug Primary School. Public Transport Lay-bys: Proposed near R30/Loccatie St and R30/Steen St intersections. On-Street Parking: Improved signage and speed control measures (limit to 50 km/h in urban areas).
The road performs at acceptable levels of service for existing and proposed conditions. Tshing Extension 10 development will significantly impact traffic and necessitate intersection upgrades. Recommended improvements include a diamond interchange at N14/R30 and a dual-lane traffic circle at R30/Loccatie St. NMT and public transport facilities should be enhanced to improve safety and accessibility in the urban section.

The Traffic Engineering Assessment report is attached as Appendix 5 of this BAR.

8 ENVIRONEMNTAL SENSITIVITY

8.1 DFFE Screening Tool Site Sensitivity

The National Department of Forestry, Fisheries and the Environment (DFFE) has developed a national screening tool that identifies potentially environmentally sensitive areas in and around the proposed site. It is now a requirement that any application for environmental authorisation is accompanied by such a screening report.

The screening tool identified specialist studies that may be applicable to the proposed development based on the site's classification, and the identified environmental sensitivities of the proposed development footprint.

The full screening reports and site verification reports can be found as appendix 4 to this report. The environmental sensitives identified by the screening tool for the proposed infrastructures are shown in **Table 7** below.

Table 7: Site Sensitivity as per DFFE Screening Report

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity	Confirmation of the specialist and site sensitivity by EAP	Site sensitivity after Site Verification
Agriculture Theme	**X**				Agricultural Compliance – **See Appendix 5.5**	Low
Animal Species Theme		**X**			Terrestrial Biodiversity Compliance- **See Appendix 5.1**	Low
Aquatic Biodiversity Theme	**X**				Aquatic Biodiversity Compliance – **See Appendix 5.2**	Low
Archaeological and Cultural Heritage Theme				**X**	Heritage Impact Assessment - **See Appendix 5.3**	Low
Civil Aviation Theme		**X**			No assessment to be undertaken (Refer to site verification report attached under Appendix 6)	Very Low
Defence Theme				**X**	No assessment to be undertaken (Refer to site verification report attached under Appendix 6)	Very Low
Palaeontology Theme			**X**		Paleontological Assessment – **See Appendix 5.4**	Low
Plant Species Theme			**X**		Terrestrial Biodiversity Compliance- **See Appendix 5.1**	Low
Terrestrial Biodiversity Theme (including Animal and Plant Specialist Theme)	**X**				Terrestrial Biodiversity Compliance - **Appendix 5.1**	Low

9 IMPACT ASSESSMENT METHODOLOGY

Impacts – whether anticipated– were scored on the following basis:

- **Status:**
  - *Positive* – the proposed project will have a positive impact in terms of the particular parameter;
  - *Negative* – the proposed project will have a negative impact in terms of the particular parameter;
  - *Neutral* – the proposed project will have neither a positive nor a negative impact in terms of the particular parameter.

- **Extent:**
  - *Site-bound* – the impact will be felt only on the site itself;
  - *Local* – the impact is to be felt on the site and in its immediate surroundings, up to a radius of 50km from the site);
  - *Sub-regional* – the impact is to be felt at a distance of up to 100km from the site;
  - *Regional* – the impact is to be felt in the KwaZulu Natal Province; - *National* – the impact is to be felt across provincial boundaries.

- **Duration:**

Refers to the period of time over which impacts can be expected to be experienced.

  - *Short term* – 0 to 5 years;
  - *Medium term* – more than 5 years, up to 15 years;
  - *Long term* – more than 15 years;
  - *Permanent* – the impact is irreversible.

- **Magnitude:**

Refers to the intensity of the potential impact, if it is experienced.

  - *Negligible* – the impact will barely be felt, if at all. No mitigation required;
  - *Low* – the parameter will only be affected to a small extent by the proposed project. No mitigation required, but monitoring is recommended;
  - *Medium* – the parameter will be affected by the proposed project, but functions in terms of the parameter can still continue. Mitigation and

monitoring required;

- *High* – functioning in terms of the parameter will be significantly affected by the impact. Extensive mitigation and long-term monitoring required.

- **Likelihood:**

  - *Improbable* – it is unlikely that the impact will be experienced;

  - *Possible* – the impact may be experienced. Monitoring required; mitigation may also be required based on the type of impact and its significance;

  - *Highly probable* – the impact will most likely be experienced. Monitoring and mitigation required based on the type of impact and its significance in order to reduce the probability of the impact occurring and/or to reduce the magnitude of the impact;

  - *Definite* – the impact will be experienced or has already been experienced. Monitoring and mitigation required based on the type of impact and its significance in order to reduce the probability of the impact occurring and/or to reduce the magnitude of the impact.

- **Significance:**

Significance is based on a consolidation of the anticipated extent, duration, magnitude and likelihood of the potential impact.

- *Negligible* – The impact will barely be felt, if at all. No mitigation required;

- *Low* – The parameter will only be affected to a small extent by the proposed project. No mitigation required, but monitoring is recommended;

- *Medium* – The parameter will be affected by the proposed project, but functions in terms of the parameter can still continue. Mitigation and monitoring required;

- *High* – Functioning in terms of the parameter will be significantly affected by the impact. Extensive mitigation and long-term monitoring required.

10 ENVIRONEMNTAL IMPACT ASSESSMENT

10.1 Construction Phase

10.1.1 Topography

Topography and soils

Potential impacts that may be associated with alteration of the local topography is the increased erosion because of site clearing and earth works (Construction phase) and increased proportion of hard surfaces leading to concentrated peak storm water flow (operational phase).

Geology and Geo-hydrology

The project is not anticipated to impact on the geology or geo-hydrology of the area.

Potential impacts that may be associated with topography, soils, geology are summarised in **Table 8** below.

Table 8: Potential impacts in terms of topography, soils, geology and hydrology

Potential impact	Status	Extent	Duration	Magnitude	Likelihood	Significance without mitigation	Significance with mitigation
Increased soil erosion and concomitant sedimentation of watercourses	Negative	Local	Short term	Medium	Possible	Medium	Low
Soil compaction / trampling of vegetation within watercourses or riparian areas	Negative	Local	Short term	Low-Medium	Possible	Medium	Low

10.1.2 Terrestrial Biodiversity

A terrestrial biodiversity compliance statement was undertaken by the Ntumbuluko Consulting to assess the associated impacts. The full report is attached as Appendix 5.1

10.1.2.1 Potential Impacts

The majority of the project area has historically been modified to accommodate agricultural practices and as such remain in a transformed state. The project area does, however, contain unique habitat features such as the wetland systems. The negative expected environmental impacts that will stem from the development activities include:

- The loss and fragmentation of vegetation communities.
- The unsafe movement of faunal species; and
- The direct and indirect loss and disturbance of floral and faunal species and communities.

Completion of the terrestrial biodiversity assessment led to disputing of classification for the terrestrial biodiversity theme sensitivity as allocated by the National Environmental Screening Tool. The majority of the project area has instead been assigned a Very Low to Low sensitivity, because of the high levels of environmental disturbance that have taken place along the road servitude and the fact that no SCC were observed - or are very likely to occur. It is noted that one area have been assigned higher sensitivity, mainly the wetland system which have been allocated a 'Medium' sensitivity. The wetland areas remain in a moderately natural condition as it has been predominantly excluded from direct historic anthropogenic activities and as such still provides habitat to support indigenous vegetation and common faunal species.

10.1.2.2 Mitigation measures

The R30 S8 road servitude is classified as having a sensitivity rating of 'Very low', is likely to face minimal further impacts from any development activities, and as such the proposed activities may proceed within these areas.

10.1.3 Aquatic

A wetland delineation and impact assessment were undertaken by the Ntumbuluko Consulting (Pty) Ltd to assess the associated impacts as per the DFFE screening tool specialist protocols. The full report is attached as Appendix 5.2.

10.1.3.1 Potential Impacts

The following impact assessment is supplied, the assessment was conducted only for existing degradation of the study site by the existing R30 National Road section 8 site with the focus on wetland habitats. From the assessments it is clear that impacts can be expected from the proposed activities (**Table 9**).

Table 9: Impact 1: Degradation and / or destruction of Freshwater habitats (Watercourses and the wetland).

Impact Name	**Degradation and/or destruction of wetland habitats.**				
Alternative	**Proposal**				
Phase	**All phases**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	1	1
Extent of Impact	1	1	Reversibility of Impact	2	1
Duration of Impact	2	1	Probability	3	2
Environmental Risk (Pre-mitigation)					-4.50
Mitigation Measures					

Impact Name	Degradation and/or destruction of wetland habitats.

In terms of section 19 of the NWA (1998), owners / managers / people occupying land on which any activity orprocess

undertaken which causes or is likely to cause pollution or degradation of a water resource must take all reasonable measures to prevent any such disturbance from occurring, continuing or recurring. These measures may include measures to (inter alia):

- Cease, modify, or control any act or process causing the pollution/degradation.
- Comply with any prescribed waste standard or management practice.
- Contain or prevent the movement of pollutants or the source of degradation.
- Remedy the effects of pollution/degradation.
- Remedy the effects of any disturbance to the bed and banks of a watercourse/wetland.

According to the NWA (1998) part of the definition of pollution of water resources states that any physical alterations to a water resource, for example the excavation of a wetland / stream or changes to the morphology of such a water resource may be considered to be pollution. Activities which cause an alteration to the biological properties of a wetland, i.e. the fauna and flora contained within and supported by that water resource are therefore also considered to be a form of pollution.

Any construction activities in or within a delineated buffer zone of a water resource may only take place after the necessary water use license has been obtained.

Where wetlands may be encroached upon by proposed activities, the edge of the wetland must be clearly demarcated in the field with pegs or poles that will last for the duration of the construction phase, color-coded as follows:

- RED – Indicating the edge of the wetland (Note: This includes the permanent, seasonal and temporal zones of wetlands, or parts thereof; and no vehicles or building materials are allowed in this zone). These should be put along the entire length of the site.
- ORANGE – Indicating the edge of the buffer zone

Construction machinery and associated vehicles may not be allowed to enter wetlands. Strictly no re-fueling of vehicles or machinery should be allowed to take place in any area close to a wetland.

During and after construction areas of exposed soil can easily erode and subsequently end up in the wetlands. A well-designed storm water system must be put in place to avoid erosion into wetlands. Natural runoff from the natural terrestrial habitat surrounding the wetlands should, however, not be restricted unnecessarily.

Impact Name	Degradation and/or destruction of wetland habitats.
The use of potential pollutants (painting, chemicals, etc.) during construction and operational phases must be strictly controlled and a high quality of management and supervision concerning such materials must be enforced, especially close to wetland buffer zone areas. Sanitary facilities must be made available to construction workers to prevent urine and human waste entering the wetlands. If at any point construction activities encroach on wetlands, it is strongly advised that a wetland/aquatic specialist is appointed during all phases to monitor impacts and related mitigation measures regarding wetland habitats.	
Environmental Risk (Post-mitigation)	-2.00
Degree of confidence in impact prediction:	High
Impact Prioritization	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result *in spatial and temporal cumulative change.*	
Degree of potential irreplaceable loss of resources	1
The impact is unlikely to result in irreplaceable loss of resources.	
Prioritisation Factor	1.17
Final Significance	-2.33

Table 10: Impact 2: Loss of indigenous fauna and flora diversity associated with watercourses.

Impact Name	Loss of indigenous fauna and flora diversity associated with wetlands.				
Alternative	**Proposal**				
Phase	**All phases**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	1	Reversibility of Impact	4	2
Duration of Impact	2	2	Probability	2	1

Environmental Risk (Pre-mitigation)	-5.00
Mitigation Measures	
Destruction of natural wetland vegetation must be avoided at all costs. Special attention should be paid to alien and invasive control within the whole study area. Alien and invasive vegetation control should take place throughout all development phases to prevent loss of habitat of indigenous fauna and flora. Movement of vehicles and construction workers in wetlands and buffer zones should be strictly prohibited. No harvesting of plants or animals should be allowed. Any specimens of protected plant species known to occur in the wetlands and the delineated buffer zone and may potentially be impacted by the construction activities, are to be fenced off for the duration of the activity. Conservation of these species and their natural habitat must be a high priority. If at any point construction activities encroach on wetlands, it is strongly advised that a wetland/aquatic specialist is appointed during all phases to monitor impacts and related mitigation measures regarding wetland habitats. Red Data listed and protected species as well as sensitive habitats related to wetlands should be strictly monitored. Any conservation recommendations and measures that aim to mitigate the impacts of this development must also be monitored by such a specialist during the construction, operational and decommissioning phases.	
Environmental Risk (Post-mitigation)	-1.50
Degree of confidence in impact prediction:	High
Impact Prioritization	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result *in spatial and temporal cumulative change.*	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value(services and/or functions) of these *resources is limited.*	
Prioritization Factor	1.33
Final Significance	-2.00

10.1.4 Visual

10.1.4.1 Potential Impacts

The following visual impacts are anticipated during the construction phase of the project:

- Site Preparation and Vegetation Clearance: Removing vegetation exposes bare soil, altering the natural landscape and diminishing the scenic quality of the area.
- Excavation and Earthworks: Large-scale earthmoving operations create mounds of soil and debris, which can be unsightly and visually intrusive.
- Temporary Bypass Roads: Construction of bypass roads introduces artificial elements into the landscape, disrupting its natural character.
- Storage of Materials and Machinery: Construction sites can appear cluttered and untidy due to the storage of materials, machinery, and equipment.
- Construction of Structures (Bridges, Culvert: erection of structures like bridges and culverts introduces temporary scaffolding, machinery, and construction materials, creating visual intrusions.
- Dust and Airborne Particles: Dust from construction activities reduces air clarity, making the surrounding landscape appear hazy and less visually appealing.

10.1.4.2 Impacts significance

The table below summarizes the significance of impacts both with and without mitigation. With the implementation of mitigation measures, these impacts are of low significance.

Table 11: Visual Impacts significance rating

Activity	Status	Extent	Duration	Magnitude	Likelihood	Significance Without Mitigation	Significance With Mitigation
Site Preparation and Vegetation Clearance	Negative	Local	Short term	Medium	Definite	Medium	Low
Excavation and Earthworks	Negative	Local	Short term	Medium	Highly probable	Medium	Low
Temporary Bypass Roads	Negative	Local	Short term	Medium	Highly probable	Medium	Low
Storage of Materials and Machinery	Negative	Site-bound	Short term	Medium	Definite	Medium	Low

Activity	Status	Extent	Duration	Magnitude	Likelihood	Significance Without Mitigation	Significance With Mitigation
Construction of Structures (Bridges, Culverts)	Negative	Local	Short term	Medium	Definite	Medium	Low
Dust and Airborne Particles	Negative	Local	Short term	Medium	Highly probable	Medium	Low
Night-time Construction Lighting	Negative	Local	Short term	Medium	Possible	Medium	Low

10.1.4.3 Mitigation Measures

By implementing these mitigation measures, the visual impacts of construction activities can be significantly reduced, maintaining the aesthetic integrity of the surrounding landscape.

- Site Preparation and Vegetation Clearance:
  - Clearly demarcate construction areas to avoid unnecessary vegetation clearance.
  - Rehabilitate cleared areas promptly after construction activities.
- Excavation and Earthworks:
  - Limit the size of exposed areas at any given time.
  - Use visually neutral or natural-colored tarps to cover stockpiles.
- Temporary Bypass Roads:
  - Design bypass roads to minimize disruption to scenic areas.
  - Rehabilitate temporary routes promptly after construction.
- Storage of Materials and Machinery:
  - Store materials in designated, screened areas away from public view.
  - Ensure regular organization and maintenance of storage areas.
- Construction of Structures (Bridges, Culverts):
  - Use temporary visual barriers (e.g., hoardings or screens) around construction zones.
  - Incorporate aesthetic design features into permanent structures.
- Dust and Airborne Particles:
  - Regularly water dusty areas to suppress dust emissions.
  - Cover vehicles and material loads during transportation.

10.1.5 Noise

10.1.5.1 Potential Impacts

The folloing noise impacts are expected during construction phase:

- Site Clearing and Preparation: Use of equipment like bulldozers and chainsaws generates intermittent and moderately loud noise.
- Excavation and Earthworks: Excavators, backhoes, and other heavy machinery produce sustained high noise levels.
- Material Transportation: Movement of construction materials via trucks increases traffic noise, particularly along access roads.

10.1.5.2 Impacts significance

The following noise impacts are expected to range from medium to low with mitigation measures.

Table 12: Noise Impacts Significance

Activity	Status	Extent	Duration	Magnitude	Likelihood	Significance Without Mitigation	Significance With Mitigation
Site Clearing and Preparation	Negative	Local	Short term	Medium	Highly probable	Medium	Low
Excavation and Earthworks	Negative	Local	Short term	High	Definite	High	Medium
Material Transportation	Negative	Local	Short term	Medium	Highly probable	Medium	Low

10.1.5.3 Mitigation meausres

- Site Clearing and Preparation:
    - Use modern, quieter equipment and limit operations to daytime hours.
    - Avoid simultaneous operation of multiple noisy machines.
- Excavation and Earthworks:
    - Install noise barriers or screens around high-noise activity zones.
    - Maintain machinery to reduce noise emissions.
- Material Transportation:
    - Schedule transportation during off-peak hours.

- Use designated haul routes away from sensitive receptors.

- General Construction Activities:
  - Conduct regular maintenance of equipment to reduce noise.
  - Educate construction crews on noise minimization practices

10.1.6 Social Aspect

10.1.6.1 Potential Impacts

The following socio impacts are anticipated:

- Job Creation: The construction phase provides temporary employment opportunities for local workers, improving household income and reducing unemployment.
- Increased Local Business Activity: Local businesses may experience increased demand for goods and services, such as food, accommodation, and equipment.
- Disruption to Daily Activities: Construction activities, such as noise, dust, and road closures, can disrupt the daily lives of nearby residents.
- Traffic Delays and Diversions: Construction work and temporary bypass roads may cause travel delays, reducing efficiency and accessibility.
- Noise and Dust Impacts on Communities: Noise and airborne dust from construction activities can affect the quality of life of nearby residents.
- Pressure on Local Infrastructure: Construction activities may increase the use of local roads and utilities, leading to wear and strain on existing infrastructure.
- Social Tensions: There may be disagreements or competition over employment opportunities, especially if local hiring is perceived as insufficient.
- Improved Road Safety (Long Term Benefit): The upgraded road infrastructure will lead to safer and more efficient travel for local communities and regional users.

10.1.6.2 Impacts Significance

Table 13: Potential Socio-Economic impacts

Activity	Status	Extent	Duration	Magnitude	Likelihood	Significance Without Mitigation	Significance With Mitigation
Job Creation	Positive	Local	Short term	Medium	Definite	Medium	High
Increased Local Business Activity	Positive	Local	Short term	Medium	Highly probable	Medium	High
Disruption to Daily Activities	Negative	Local	Short term	Medium	Definite	Medium	Low
Traffic Delays and Diversions	Negative	Local	Short term	Medium	Highly probable	Medium	Low
Noise and Dust Impacts	Negative	Local	Short term	Medium	Highly probable	Medium	Low

Activity	Status	Extent	Duration	Magnitude	Likelihood	Significance Without Mitigation	Significance With Mitigation
on Communities							
Pressure on Local Infrastructure	Negative	Local	Short term	Low	Possible	Low	Negligible
Social Tensions	Negative	Local	Short term	Medium	Possible	Medium	Low
Improved Road Safety (Long Term Benefit)	Positive	Local	Long term	High	Definite	High	High

10.1.6.3 Mitigation Measures

By implementing these measures, socio-economic impacts can be managed effectively, ensuring that the benefits of the project outweigh its temporary inconveniences.

- Job Creation:
  - Prioritize hiring locally where possible.
  - Offer skills development programs to increase employability for long-term opportunities.
- Increased Local Business Activity:
  - Encourage contractors to source goods and services locally.
  - Facilitate partnerships with local businesses to maximize benefits.
- Disruption to Daily Activities:
  - Schedule noisy or disruptive activities during less intrusive times of the day.
  - Provide advance communication to affected communities about construction timelines and impacts.
- Traffic Delays and Diversions:
  - Implement traffic management plans to minimize disruptions.
  - Use signage to provide clear directions and reduce commuter inconvenience.
- Noise and Dust Impacts on Communities:
  - Suppress dust with regular watering of construction areas.
  - Restrict noisy activities to daytime hours and provide noise barriers if necessary.
- Pressure on Local Infrastructure:
  - Plan for construction activities to minimize strain on existing infrastructure.
  - Coordinate with local authorities to address potential issues proactively.
- Social Tensions:
  - Ensure transparent hiring practices and equitable distribution of benefits.

- Engage with communities to address grievances and promote inclusivity.

- Improved Road Safety:
  - Incorporate community feedback into road design to address local safety concerns.
  - Enhance safety awareness through signage and education during the construction phase.

10.1.7 Heritage

Shasa Heritage consulting was appointed to undertake heritage assessment for the proposed project. The full report is attached under Appendix 5.3.

10.1.7.1 Impact Ratings

Table 14: Heritage impact Rating

Impact	Rating
Nature	Road upgrade- R30 S8
Topographical effect	1- limited to site
Reversibility	2
Permanent loss of heritage resources	1
Cumulative effect	1
Duration	3
Magnitude	1
Probability	2
Significance S= (E+D+M) P	1+3+1 x2 =10 The area is considered of low significance
Mitigation	Monitoring on site

10.1.7.2 Recommendation

- Monitoring is recommended.
- The contractor should be apprised of the procedures to follow should any heritage materials be unearthed during construction.
- Contractors to be apprised of working with care near the graveyards
- Contractors should be apprised of the protocol to follow for paleontological chance finds.
- The markers should be locally advertised to establish the family wishes regarding memorial markers, either moving the side of the road, once reestablished or moved to a local cemetery.

10.1.8 Palaeontology

Table 15: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	-
	L	Soils do not preserve fossils; so far there are no records from the Malmani Subgroup of trace fossils in this region, so it is very unlikely that fossils occur on the site. The impact would be negligible
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
PART B: Assessment		
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be trace fossils in the dolomites, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the loose soils and sands that cover the area or in the diabase that will be quarried. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. Since there is a small chance that trace fossils from the Malmani Subgroup Formation may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is low.

10.1.9 Soil/Agriculture

Agricultural Compliance Statement has been undertaken by EnterpreBiz (Pty) Ltd. Full report attached under Appendix 5.4

Some of the activities which are likely to affect the soil and the land capability of the area are:

- Erosion of the fertile topsoil due to clearing of vegetation
- Loss of potential agricultural soils
- Soil compaction due to increased movement of construction machinery and vehicles
- Accumulation of construction debris and waste, which may contaminate soils and hinder plant growth
- Introduction of invasive plant species through movement of equipment and materials, impacting farm area and soil fertility
- Changes in soil pH or nutrient balance due to accidental chemical spills or improper disposal of construction materials.

10.2 Operational Phase

10.2.1 Terrestrial biodiversity

Increased sedimentation may occur as a result of the runoff from the road improvement. This has the potential to change habitat structure within the receiving environment, and this will in turn result in changes in ecosystem function. Changes in habitat structure due to sedimentation would result in changes in the species composition.

Water quality impairment has the potential to change ecosystem function, change community structure as species sensitive to water quality impairment are eliminated and tolerant species increase in number, this results in a loss of biodiversity of sensitive species.

Invasive alien plants have far-reaching detrimental effects on native biota and has been widely accepted as being a leading cause of biodiversity loss. They typically have rapid reproductive turnover and are able to outcompete native species for environmental resources, alter soil stability, and promote erosion, change litter accumulation, and soil properties. In addition, certain alien plants exacerbate soil erosion whilst others contribute to a reduction in stream flow thereby potentially increasing sediment inputs and altering natural hydrology of receiving watercourses. These impacts negatively affect areas that are largely natural (with low

existing weed levels) greater than for areas already characterised by dense infestations of alien plants with low indigenous plant diversity (Macfarlane et al., 2014).

10.2.1.1 Sedimentation and soil erosion

Soil erosion will result in the deposition of sediment into the freshwater system, posing a risk to the downstream catchment geomorphological/functional integrity. Subsequent impacts that are likely to result are:

- sedimentation of the watercourse that will be destructive to many faunal species affecting their habitat; breeding and feeding cycles.

Local site factors such as soil erodibility, vegetation cover, gradient of local slopes and regional rainfall/runoff intensity will affect the probability and intensity of erosion impacts (Macfarlane *et al.*, 2014). Typical results of erosion & sedimentation of water resources may include:

- Localised scouring at stormwater discharge points into watercourses
- Deposition of large masses of sediment downstream causing localised channel braiding, instability of the riverbanks and alterations in water distribution.

10.2.1.2 Pollution of water resources and soil

Changes to the water quality will result in changes to the ecosystem structure and function as well as a potential loss of biodiversity. Water quality pollution leads to modification of the species composition where sensitive species are lost and organisms tolerant to environmental changes dominate the community structure. Any substances entering and polluting watercourses will directly impact downstream ecology through surface runoff during rainfall events, or subsurface water movement, particularly during the wetter summer months.

Contaminants such as hydrocarbons, solids, pathogens and hazardous materials may enter watercourses (examples include petrol/diesel, oil/grease, paint, cement/concrete and other hazardous substances). These contaminants negatively affect aquatic ecosystems including

sensitive or intolerant species of flora and fauna. Where significant changes in water quality occur, this will ultimately result in a shift in aquatic species composition, favouring more tolerant species, and potentially resulting in the localised exclusion of sensitive species. Water quality monitoring must be implemented to ensure sustainable management of water sources within that area. Suddenly drastic changes in water quality can also have chronic effects on aquatic biota leading to localised extinctions. Deterioration in water quality will also affect its suitability for human domestic/agricultural use and have far reaching impacts for local communities who may rely on rivers as water supply (Macfarlane et al., 2014).

10.2.1.3 Alien Invasive Species.

There are alien invasive plant species currently present along the Road. Any ground disturbance provides an opportunity for alien invasive plant species to spread and for new species to establish themselves in the areas. Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs (Zedler & Kercher, 2004). Such changes on the ecology of the riparian habitat have/will have a detrimental impact on its ability to maintain both floral and faunal biodiversity. Invasive alien plant species, particularly woody species, have much increased water usage compared with indigenous vegetation. Many alien invasive plant species are particularly found in riparian ecosystems and their invasion results in the destruction of indigenous species; increased inflammable biomass (high fire intensity); erosion; clogging of waterways such as small streams and drainage channels causing decreased river flows and incision of river beds and banks. This results in an overall impact on the hydrological functioning of the system.

10.2.1.4 Mitigation.

The proposed upgrading of the road will have negative effects on the environment. The following mitigation measures may reduce the severity of impacts:

- Rehabilitation of the disturbed areas;
- Minimising pollutants entering the watercourse;
- Implement a programme for the clearing/eradication of alien species including long term control of such species;
- Wetland monitoring and biomonitoring must take place bi-annually.

10.2.1.4.1 Sedimentation and soil erosion

Mitigation Measures

- Do not allow surface water or stormwater to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place.
- Exposed soils must be rehabilitated as soon as practically possible to limit the risk of erosion. Erosion control measures must be employed where required.
- Riparian vegetation bordering on drainage lines, wetlands and rivers will be considered environmentally sensitive and impacts on these habitats should be avoided.
- If erosion has taken place, rehabilitation will commence as soon as possible.

10.2.1.4.2 Pollution of water resources and soil.

Mitigation Measures

- Demarcate wetland areas to avoid unauthorised access.
- No washing of any equipment in close proximity to a watercourse is permitted.
- No releases of any substances that could be toxic to fauna or faunal habitats within the channels or any watercourses is permitted.
- Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil must be removed, and the affected area rehabilitated immediately.
- Education of workers is key to establishing good pollution prevention practices. Training programs must provide information on material handling and spill prevention and response, to better prepare employees in case of an emergency.
- Signs should also be placed at appropriate locations to remind workers of good housekeeping practices including litter and pollution control.
- The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be ensured. All employees handling fuels and other hazardous materials are to be properly trained. Storage containers must be regularly inspected so as to prevent leaks.
- All contractors and employees should undergo induction which is to include a component of environmental awareness.

10.2.1.4.3 Alien Invasive Species.

Mitigation Measures

- Ongoing alien plant control must be undertaken, particularly in the disturbed areas as these areas will quickly be colonised by invasive alien species, especially in the riparian zone, which is particularly sensitive to AIP infestation.
- Herbicides must be carefully applied, in order to prevent any chemicals from entering the river. Spraying of herbicides within or near to the wetland areas is strictly forbidden.
- Re-instate indigenous vegetation (grasses and indigenous trees) in disturbed areas.
- After rehabilitation, re-vegetate any exposed surfaces and mulch re-vegetated areas.
- Select appropriate species for wetland and terrestrial areas and ensure species diversity is enhanced, with species commonly found in the natural wetland area.

10.2.2 Aquatic

Increased sedimentation may occur as a result from the runoff from the road upgrade. This has the potential to change habitat structure within the receiving environment and this will in turn result in changes in ecosystem function. Changes in habitat structure due to sedimentation would result in changes in the species composition.

Water quality impairment has the potential to change ecosystem function, change community structure as species sensitive to water quality impairment are eliminated and tolerant species increase in number, this results in a loss of biodiversity of sensitive species.

Invasive alien plants have far-reaching detrimental effects on native biota and has been widely accepted as being a leading cause of biodiversity loss. They typically have rapid reproductive turnover and are able to outcompete native species for environmental resources, alter soil stability, and promote erosion, change litter accumulation and soil properties. In addition, certain alien plants exacerbate soil erosion whilst others contribute to a reduction in stream flow thereby potentially increasing sediment inputs and altering natural hydrology of receiving watercourses. These impacts negatively affect areas that are largely natural (with low

existing weed levels) greater than for areas already characterised by dense infestations of alien plants with low indigenous plant diversity (Macfarlane *et al.*, 2014).

10.2.2.1 Sedimentation and soil erosion

Soil erosion will result in the deposition of sediment into the freshwater system, posing a risk to the downstream catchment geomorphological/functional integrity. Subsequent impacts that are likely to result are:

- sedimentation of the watercourse that will be destructive to many faunal species affecting their habitat; breeding and feeding cycles.

Local site factors such as soil erodibility, vegetation cover, gradient of local slopes and regional rainfall/runoff intensity will affect the probability and intensity of erosion impacts (Macfarlane *et al.*, 2014). Typical results of erosion & sedimentation of water resources may include:

- Localised scouring at stormwater discharge points into watercourses
- Deposition of large masses of sediment downstream causing localised channel braiding, instability of the riverbanks and alterations in water distribution.

10.2.2.2 Pollution of water resources and soil

Changes to the water quality will result in changes to the ecosystem structure and function as well as a potential loss of biodiversity. Water quality pollution leads to modification of the species composition where sensitive species are lost and organisms tolerant to environmental changes dominate the community structure. Any substances entering and polluting watercourses will directly impact downstream ecology through surface runoff during rainfall events, or subsurface water movement, particularly during the wetter summer months.

Contaminants such as hydrocarbons, solids, pathogens and hazardous materials may enter watercourses (examples include petrol/diesel, oil/grease, paint, cement/concrete and other hazardous substances). These contaminants negatively affect aquatic ecosystems including sensitive or intolerant species of flora and fauna. Where significant changes in water quality occur, this will ultimately result in a shift in aquatic species composition, favouring more tolerant species, and potentially resulting in the localised exclusion of sensitive species. Water quality monitoring must be implemented to ensure sustainable management of water sources within that area. Suddenly drastic changes in water quality can also have chronic effects on aquatic biota leading to localised extinctions. Deterioration in water quality will also affect its suitability for human domestic/agricultural use and have far reaching impacts for local communities who

may rely on rivers as water supply (Macfarlane et al., 2014).

10.2.2.3 Alien Invasive Species

There are alien invasive plant species currently present along the Road. Any ground disturbance provides an opportunity for alien invasive plant species to spread and for new species to establish themselves in the areas. Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs (Zedler & Kercher, 2004). Such changes on the ecology of the riparian habitat have/will have a detrimental impact on its ability to maintain both floral and faunal biodiversity. Invasive alien plant species, particularly woody species, have much increased water usage compared with indigenous vegetation. Many alien invasive plant species are particularly found in riparian ecosystems and their invasion results in the destruction of indigenous species; increased inflammable biomass (high fire intensity); erosion; clogging of waterways such as small streams and drainage channels causing decreased river flows and incision of riverbeds and banks. This results in an overall impact on the hydrological functioning of the system.

10.2.2.4 Mitigation.

The proposed upgrading of the road will have negative effects on the environment. The following mitigation measures may reduce the severity of impacts:

- Rehabilitation of the disturbed areas;
- Minimising pollutants entering the watercourse;
- Implement a programme for the clearing/eradication of alien species including long term control of such species;
- Wetland monitoring and biomonitoring must take place bi-annually.

10.2.2.4.1 Sedimentation and soil erosion.

Mitigation Measures

- Do not allow surface water or stormwater to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place.
- Exposed soils must be rehabilitated as soon as practically possible to limit the risk of erosion. Erosion control measures must be employed where required.
- Riparian vegetation bordering on drainage lines, wetlands and rivers will be considered environmentally sensitive and impacts on these habitats should be avoided.
- If erosion has taken place, rehabilitation will commence as soon as possible.

10.2.2.4.2 Pollution of water resources and soil.

Mitigation Measures

- Demarcate wetland areas to avoid unauthorised access.
- No washing of any equipment in close proximity to a watercourse is permitted.

- No releases of any substances that could be toxic to fauna or faunal habitats within the channels or any watercourses is permitted.
- Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil must be removed, and the affected area rehabilitated immediately.
- Education of workers is key to establishing good pollution prevention practices. Training programs must provide information on material handling and spill prevention and response, to better prepare employees in case of an emergency.
- Signs should also be placed at appropriate locations to remind workers of good housekeeping practices including litter and pollution control.
- The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be ensured. All employees handling fuels and other hazardous materials are to be properly trained. Storage containers must be regularly inspected so as to prevent leaks.
- All contractors and employees should undergo induction which is to include a component of environmental awareness.

10.2.2.4.3 Alien Invasive Species

Mitigation Measures

- Ongoing alien plant control must be undertaken, particularly in the disturbed areas as these areas will quickly be colonised by invasive alien species, especially in the riparian zone, which is particularly sensitive to AIP infestation.
- Herbicides must be carefully applied, in order to prevent any chemicals from entering the river. Spraying of herbicides within or near to the wetland areas is strictly forbidden.
- Re-instate indigenous vegetation (grasses and indigenous trees) in disturbed areas.
- After rehabilitation, re-vegetate any exposed surfaces and mulch re-vegetated areas.
- Select appropriate species for wetland and terrestrial areas and ensure species diversity is enhanced, with species commonly found in the natural wetland area.

10.2.3 ASSESSMENT OF THE NO-GO ALTERNATIVE

Currently there is no proposal from a wetland point of view of a no-go alternative Since the road is already in existence.

10.3 Decommissioning Phase

The R30 road is not anticipated to be decommissioned, as it is intended to remain in use for an indefinite operational lifespan, potentially serving the region for several decades or more. This long-term functionality aligns with its strategic importance for transportation and economic activities in the area.

However, in the unlikely event that the road is decommissioned, the impacts associated with such activities would likely mirror those experienced during the construction phase. This is because decommissioning would involve similar processes, such as the use of heavy machinery, the removal of infrastructure, and the rehabilitation of disturbed areas. Potential impacts could include:

- Soil Disturbance and Erosion: The removal of road materials and associated infrastructure could lead to soil exposure, increasing the risk of erosion and sedimentation in nearby watercourses.
- Dust and Air Pollution: Dust generation and emissions from machinery during decommissioning activities could temporarily affect air quality.
- Noise Pollution: The operation of equipment and the dismantling of structures would generate noise, potentially disturbing nearby communities and wildlife.
- Vegetation and Habitat Disturbance: If areas surrounding the road are disturbed during decommissioning, local flora and fauna may be temporarily affected.
- Waste Management Challenges: The disposal of materials, including asphalt, concrete, and debris, would need to be managed carefully to prevent environmental contamination.

Despite these potential impacts, the application of mitigation measures similar to those implemented during the construction phase would help minimize environmental and social disruptions. These measures would include erosion control, dust suppression, noise mitigation, and proper waste disposal practices.

10.4 Impact Statement

From a review of the relevant policy and planning framework, it was concluded that the project is well aligned with the policy framework, and a clear need for the project is seen from a policy perspective at a local, provincial and National level.

The impact assessment and the specialist findings from the EIA studies undertaken have indicated that there are no identified fatal flaws associated with the upgrade of R30 road section 8 and associated infrastructure. The mitigation measures have been recommended by the specialist for any sensitivity that occurs within the project site. The impacts that are expected to remain after the avoidance of the sensitive areas have been reduced through the recommendation of specific mitigation measures by the specialists. The minimization of the significance of the impacts is in line with tier 2 of the mitigation hierarchy

Therefore, by putting the recommended mitigation or enhancement strategies into practice, impacts can be reduced to levels that are acceptable or increased. Both positive and negative effects are anticipated from a societal perspective.

It can be inferred from the development's assessment that upgrading road R30 Section 8 and the associated bridges and culverts won't have any detrimental impacts on the environment (subject to the implementation of the recommended mitigation measures).

10.5 Impact Mitigation and Monitoring

Please refer to the attached EMPR, which contains measures for the prevention, mitigation and/or monitoring of impacts related to the project.

11 CONCLUSION AND RECOMMENDATIONS

It is recommended that Environmental Authorisation be granted to the applicant, SANRAL, for the Proposed Upgrade of National Road R30 Section 8 From Klerksdorp (Km 0.0) To Buffelsvallei (KM 37.0) And Associated Borrow Pits Within Dr Kenneth Kaunda District Municipality in The North West Province, as described in this report.

It is recommended that the following conditions be included in the authorisation:

- Should any deviations from the current layout be contemplated, such changes must be communicated to DFFE, and it must be determined whether the changes are allowable in terms of the EA or if amendment of the EA must be applied for first;
- No additional activities triggering the listed activities contained in the EIA Regulations may take place, unless EA is obtained first.
- The impact mitigation measures contained in the EMPR accompanying this report must be implemented to minimize and/or mitigate environmental impacts henceforth.
- Conditions that may be set by DFFE in terms of the EA must be adhered to. If it is found that it will not be possible to adhere to certain conditions, this must be communicated to DFFE ahead of time to prevent a non-compliant situation.
- Should any additional activities listed in terms of the EIA Regulations be planned on the site, the appropriate application(s) for authorisation must be lodged with the relevant authority.

12 REFERENCES

1. Dr. Kenneth Kauda District Municipality, Integrated Development Plan 2022-2027.
2. EnterpreBiz (Pty) Ltd. 2025. For The Improvement Of National Road R30 Section 8 From Km 36.8 To Ventersdorp Km 68.646, In The Province Of North West And The District Municipalities Of City Matlosana And JB Marks.
3. Mucina, L. and Rutherford, M.C. (eds) 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
4. Ntumbuliko Consulting (Pty) Ltd, 2024. *T*errestrial Biodiversity Compliance Statement: For The Proposed Upgrade Of National Road R30 Section 8 From Klerksdorp (Km 0.0) To Buffelsvallei (Km 37.0) Within Dr Kenneth Kaunda District Municipality In The Northwest Province.
5. Ntumbuluko Consulting (Pty) Ltd, 2024. *Wetland Delineation and Impact Assessment Report Of The Proposed Upgrade Of National Road R30 Section 8 From Klerksdorp (Km 0.0) To Buffelsvallei (Km 37.0)* Within Dr Kenneth Kaunda District Municipality In The Northwest Province.
6. Shasa Heritage Consulting, 2024. *Heritage Scoping Report for Proposed Upgrading of Section 8 Of The R30, Buffelsvlei To Klerksdorp*, North West Province.
7. Shasa Heritage Consulting, 2024. *Palaeontological Impact Assessment for the proposed upgrade of the R30 from Klerksdorp to Buffelsvallei, Section 8, North West Province*.

APPENDIX 1: PROJECT MAPS

APPENDIX 2: SITE PHOTOS

APPENDIX 3: PROOF OF PUBLIC PARTICIPATION

APPENDIX 4: SCREENING REPORT

APPENDIX 5.1: TERRESTRIAL COMPLIANCE STATEMENT

APPENDIX 5.2: WETLAND DELINEATION AND IMPACT ASSESSMENT REPORT

APPENDIX 5.3: HERITAGE IMPACT ASSESSMENT

APPENDIX 5.4: PALEONTOLOGICAL REPORT

APPENDIX 5.5: AGRICULTURAL COMPLIANCE STATEMENT

APPENDIX 5.6: Geotechnical Report signed

APPENDIX 6: SITE SENSITIVITY VERIFICATION REPORT

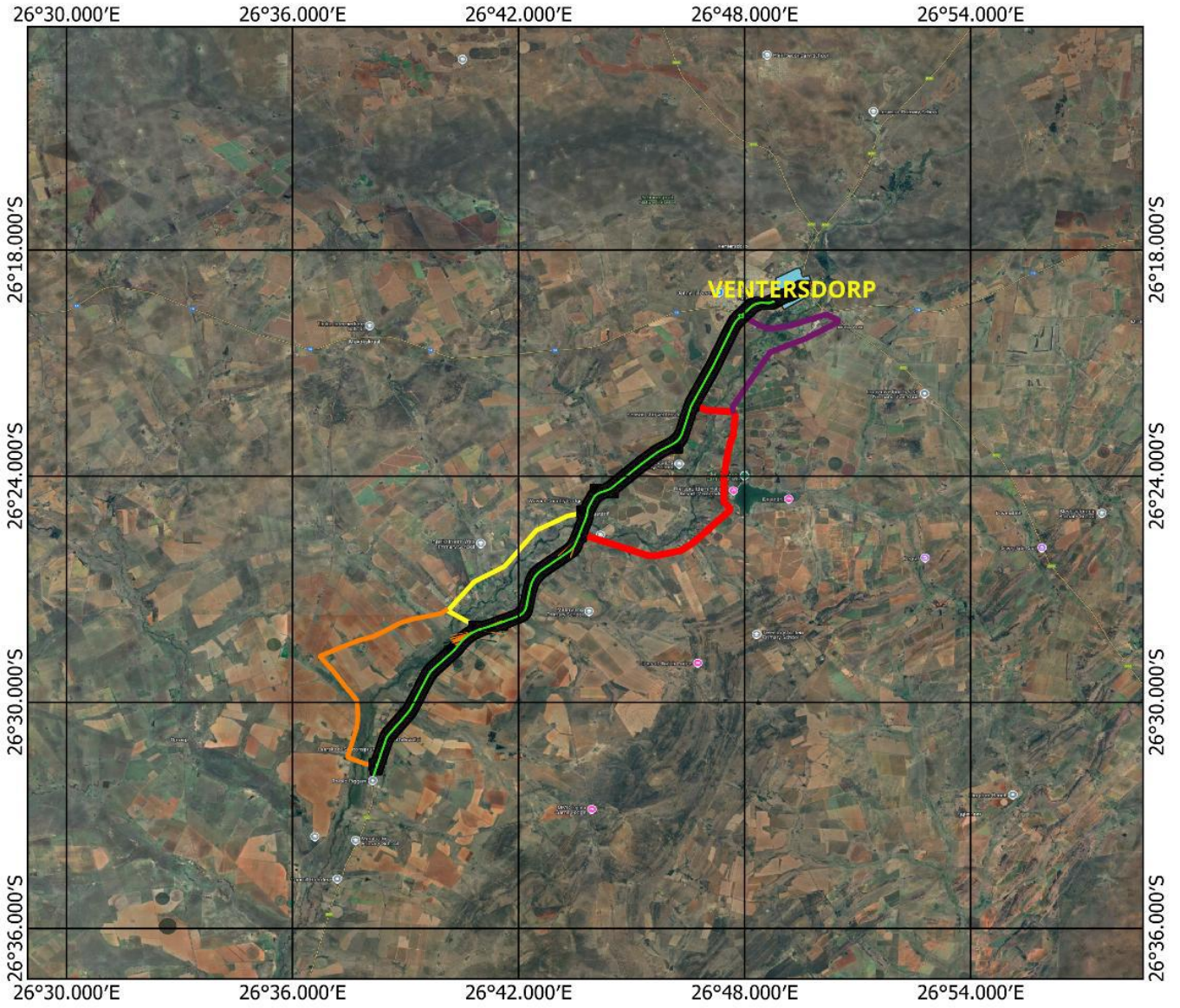
APPENDIX 7: ENVIRONEMNTAL MANAGEMENT PROGRAMME REPORT (EMPR)

APPENDIX 8 – SPECIALIST DECLARATION

APPENDIX 9 – EAP CV

APPENDIX 1: PROJECT MAPS

LOCALITY MAP OF THE UPGRADE OF NATIONAL ROAD R30 SECTION 8 (FROM KM 36.8 T0 VENTERSDORP KM 68.646).



LEGEND

- Existing Road Reserve with Kerbs

Design Layout with Batters

- R30- Design layout with batters-Area Features
- R30-Design layout with batters-Point Features
- R30-Design layout with batters-Line Features
- R30 Temporary Bypasses

R30-8 Bridges and Major Culverts

- R30-8 (36.8-68.6)

R30-8 Community Development Detour Roads

- R30-8 12.77 km Detour D
- R30-8 14.58 km Detour A
- R30-8 9.84 km Detour B
- R30-8 14.5 km Detour C

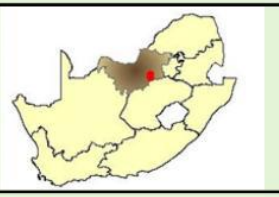
Towns

- VENTERSDORP

Google Satellite Hybrid

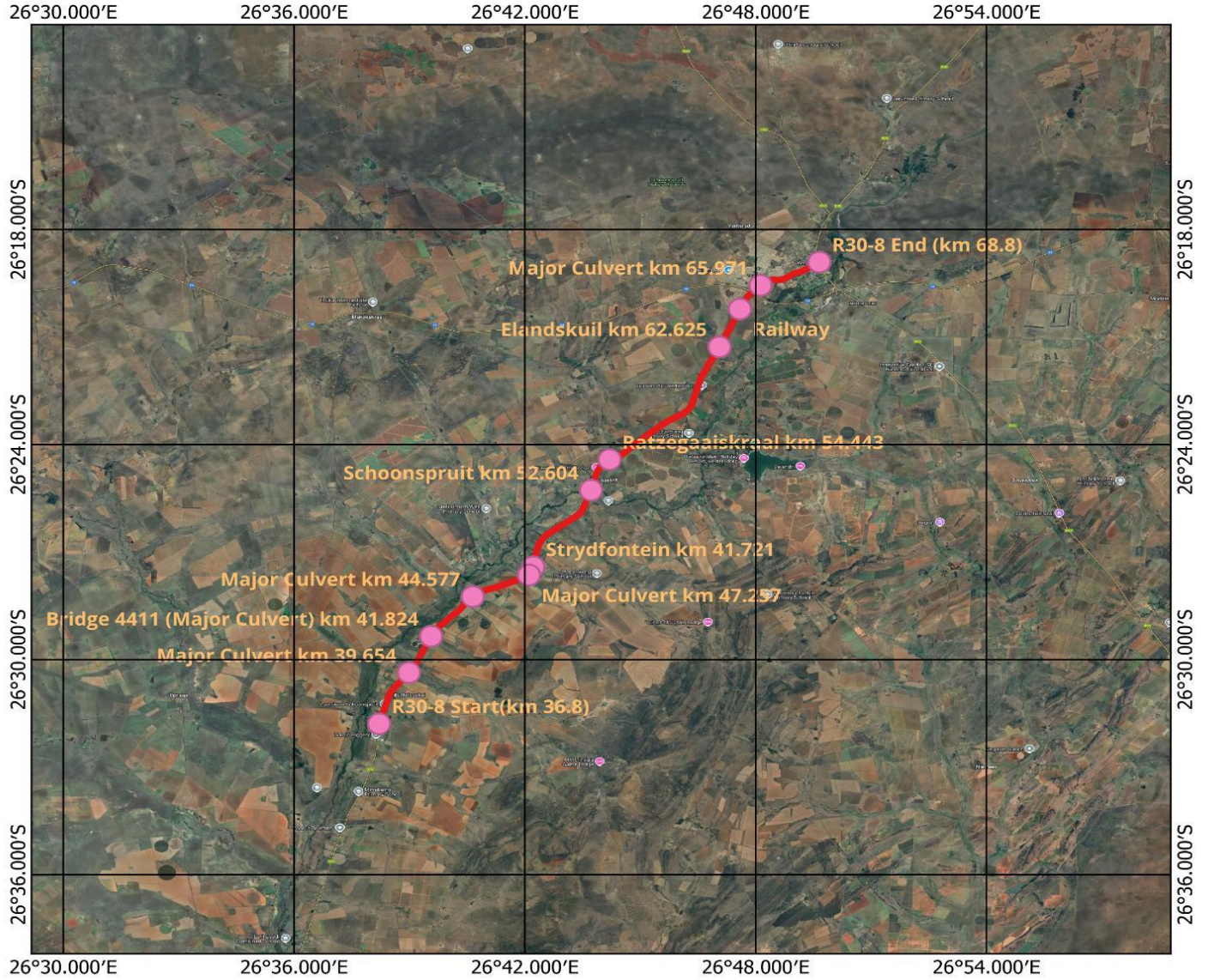
1: 100 000

0 2.5 5 7.5 km



Earthlink Environmental Services
In rhythm with nature

LAYOUT MAP OF THE UPGRADE OF NATIONAL ROAD R30 SECTION 8 (FROM KM 36.8 T0 VENTERSDORP KM 68.646).



LEGEND

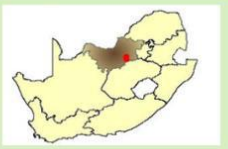
R30-8 Bridges and Major Culverts

- R30-8 Start (km 36.8)
- Major Culvert km 39.654
- Bridge 4411 (Major Culvert) km 41.824
- Major Culvert km 44.577
- Major Culvert km 47.257
- Strydfontein km 41.721
- Schoonspruit km 52.604
- Ratzegaaiskraal km 54.443
- Railway
- Elandskuil km 62.265
- Major Culvert km 65.971
- R30-8 End (km 68.8)
- R30-8 (36.8-68.6)

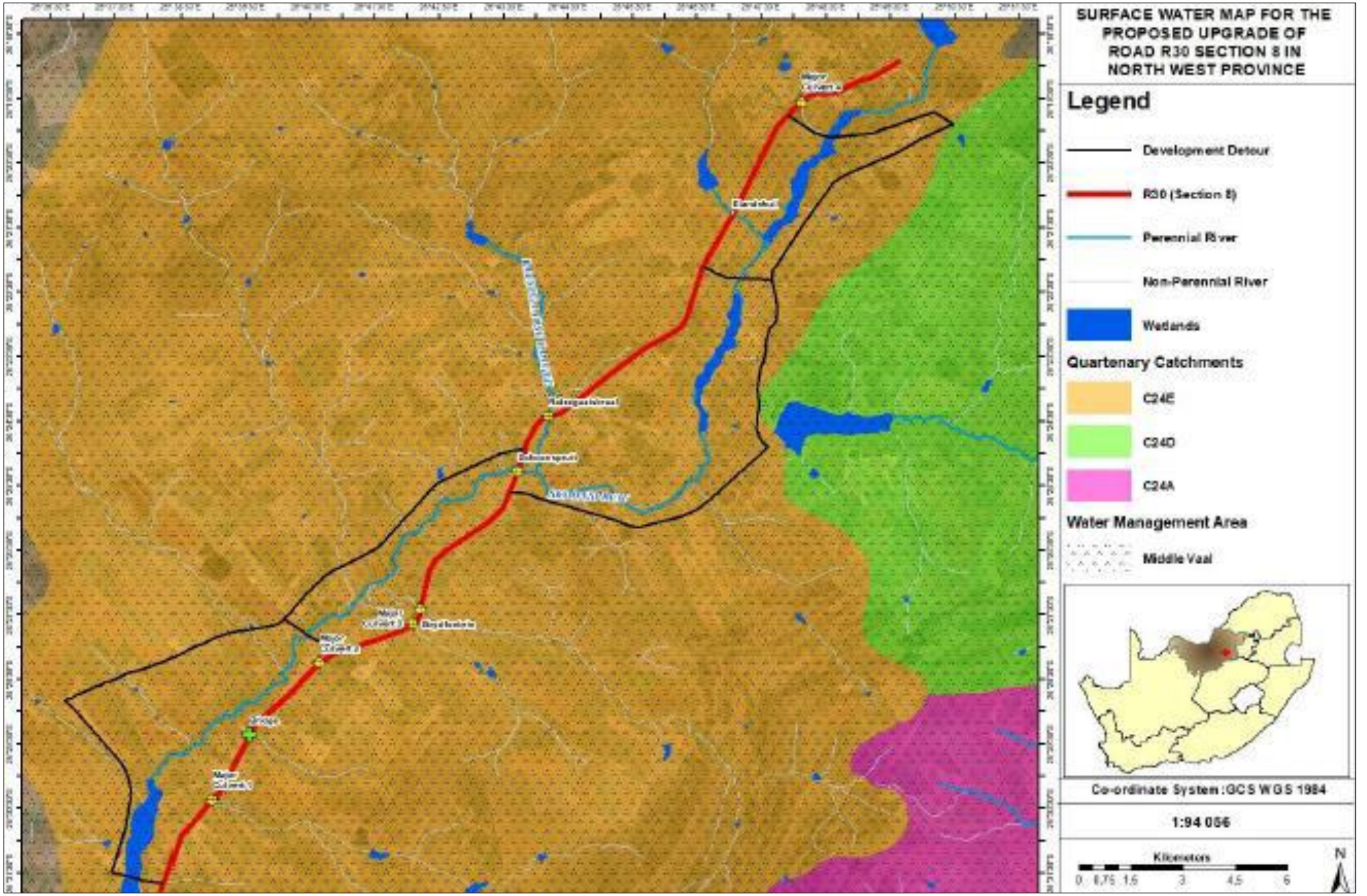
Google Satellite Hybrid

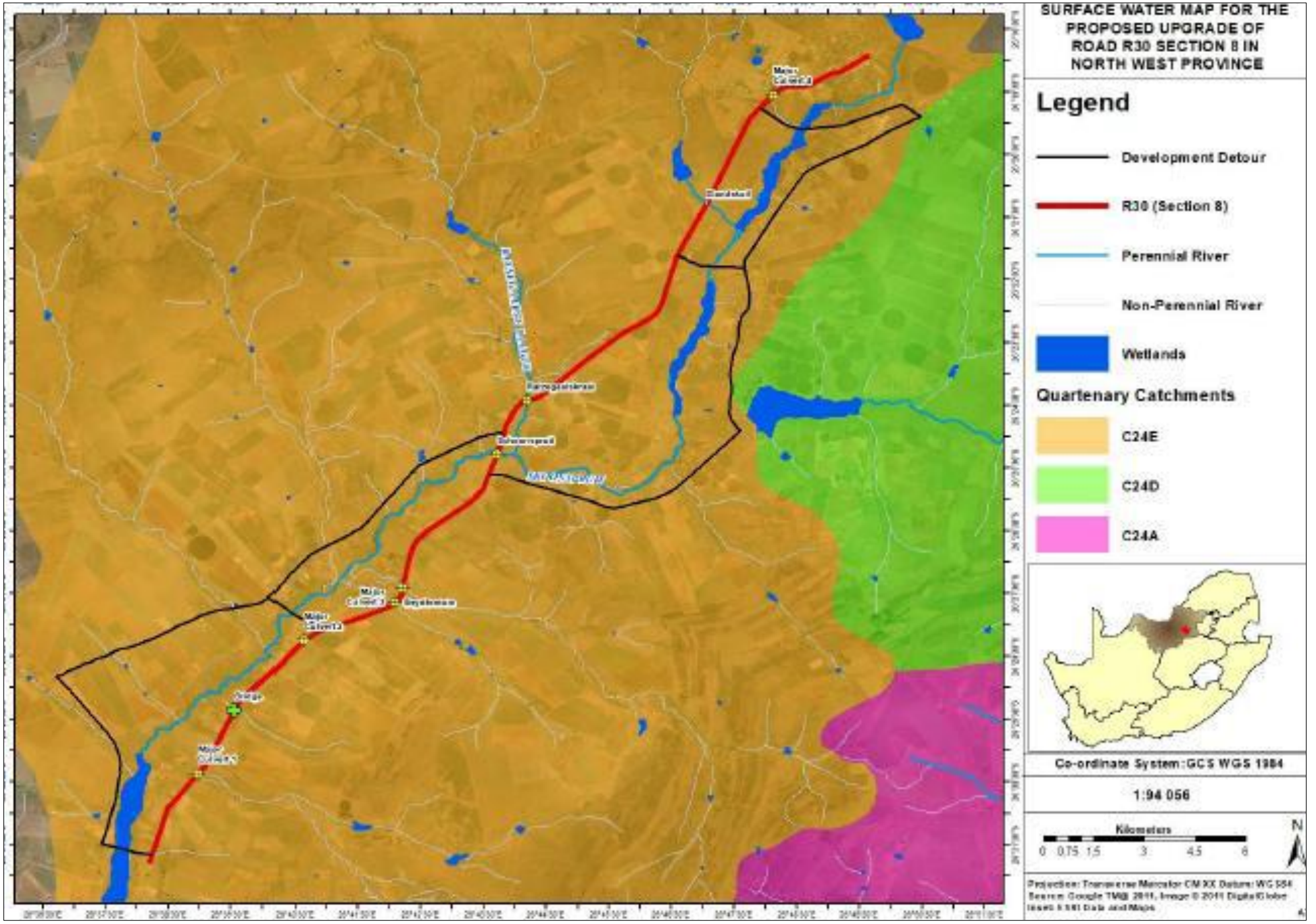
1: 100 000

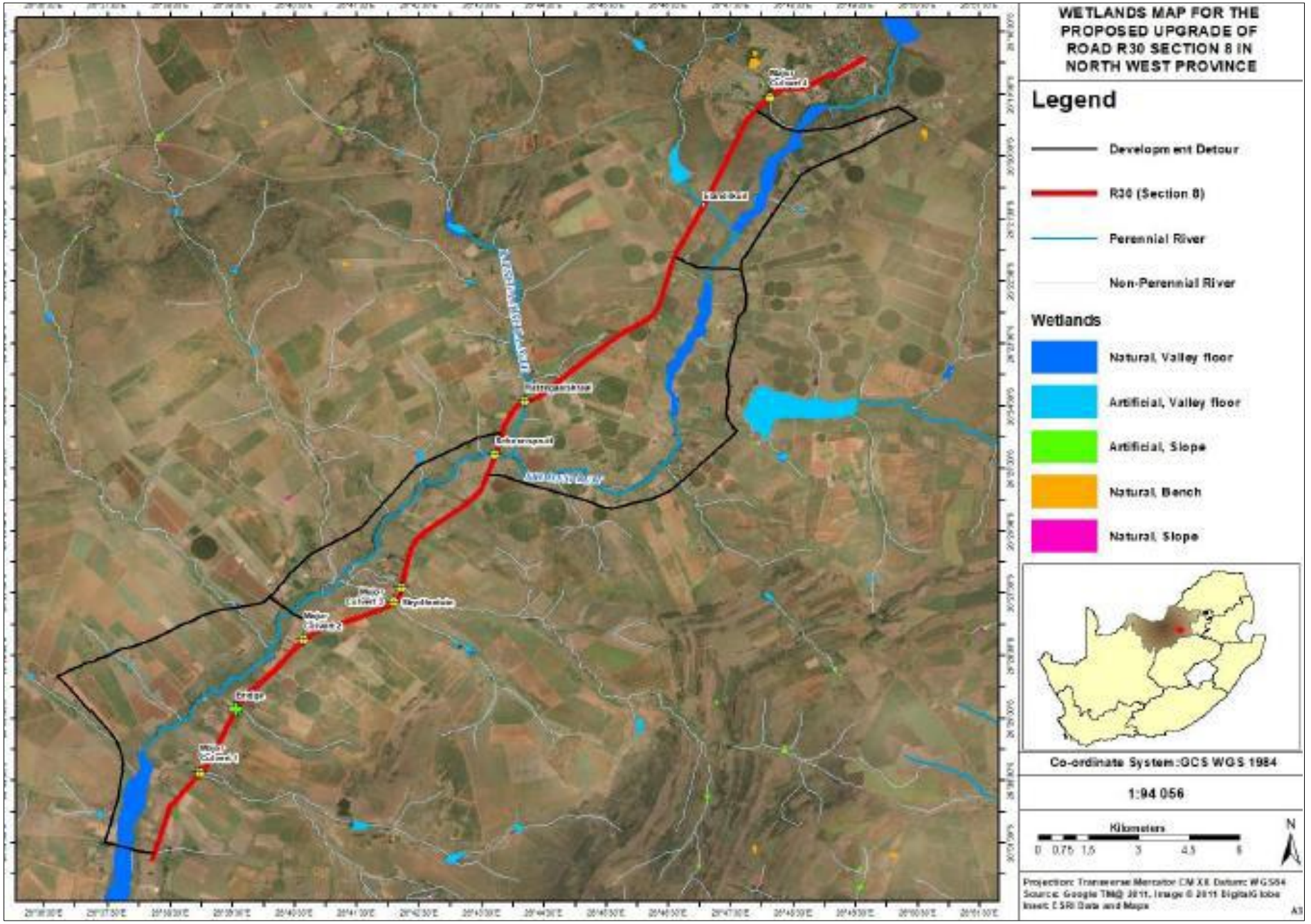
0 2.5 5 7.5 km

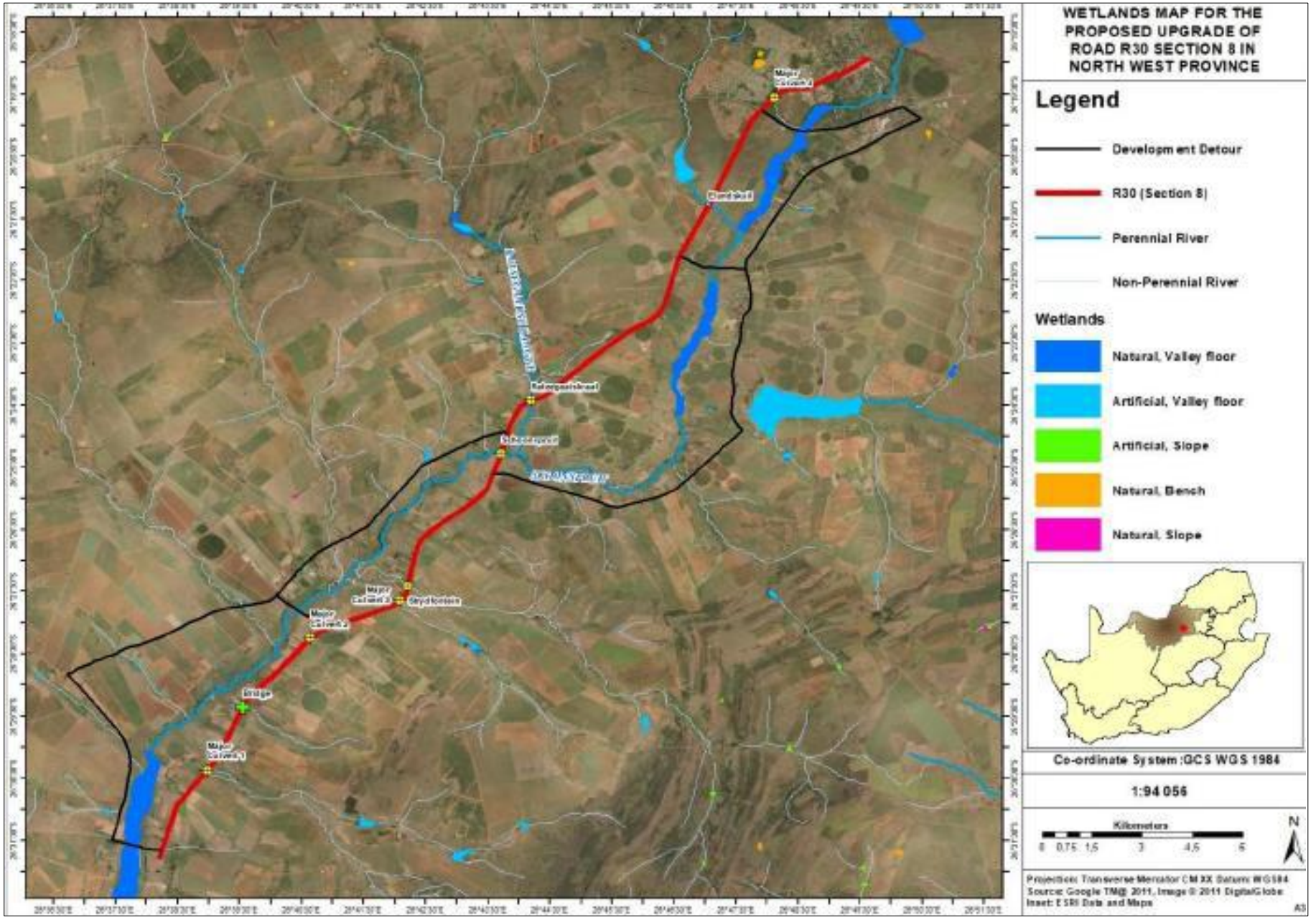


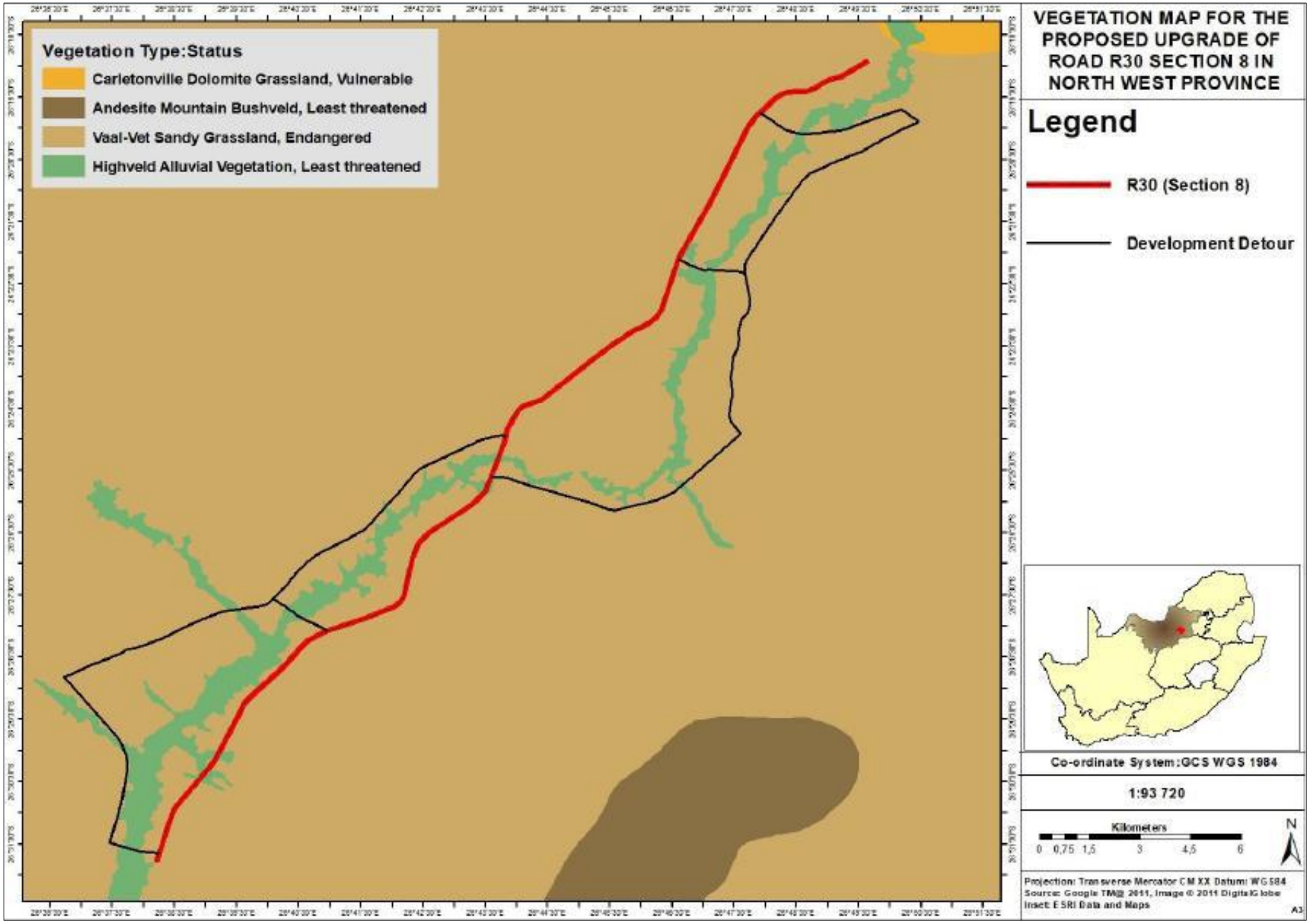
Earthlink Environmental Services
In rhythm with nature

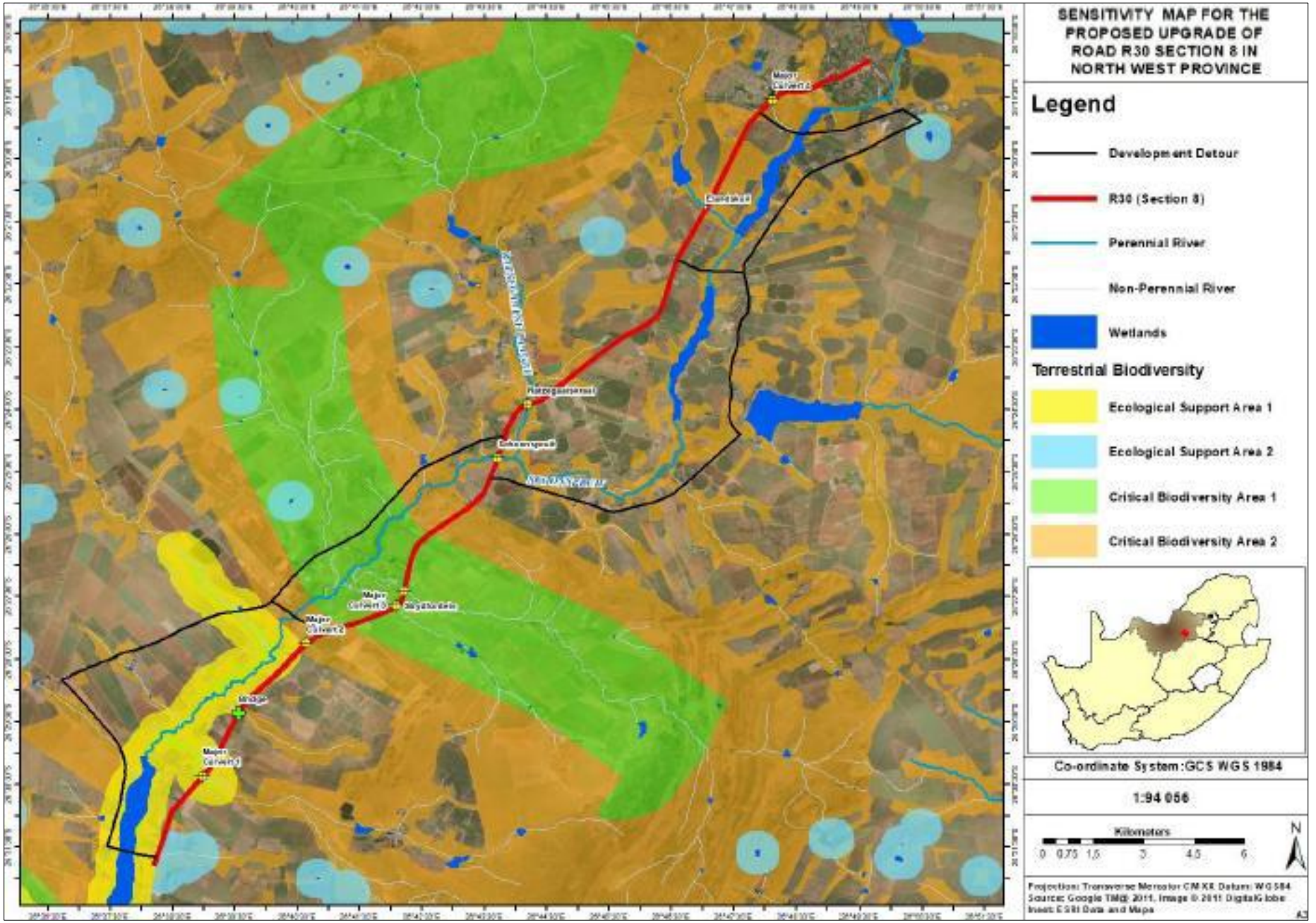

SURFACE WATER MAP FOR THE PROPOSED UPGRADE OF ROAD R30 SECTION 8 IN NORTH WEST PROVINCE
Legend
Development Detour
R30 (Section 8)
Perennial River
Non-Perennial River
Wetlands
Quartenary Catchments
C24E
C24D
C24A
Water Management Area
Middle Vaal
Co-ordinate System: GCS WGS 1984
1:94 056
Kilometers
0 0.75 1.5 3 4.5 6
N


SURFACE WATER MAP FOR THE PROPOSED UPGRADE OF ROAD R30 SECTION 8 IN NORTH WEST PROVINCE
Legend
Development Detour
R30 (Section 8)
Perennial River
Non-Perennial River
Wetlands
Quartenary Catchments
C24E
C24D
C24A
Co-ordinate System:GCS WGS 1984
1:94 056
Kilometers
0 0.75 1.5 3 4.5 6
N


WETLANDS MAP FOR THE PROPOSED UPGRADE OF ROAD R30 SECTION 8 IN NORTH WEST PROVINCE
Legend
Development Detour
R30 (Section 8)
Perennial River
Non-Perennial River
Wetlands
Natural, Valley floor
Artificial, Valley floor
Artificial, Slope
Natural, Bench
Natural, Slope
Co-ordinate System:GCS WGS 1984
1:94 056
Kilometers
0 0.75 1.5 3 4.5 6
N
Projection: Transverse Mercator CM 26 Datum: WGS84
Source: Google TM© 2011, Image © 2011 DigitalGlobe
Insert: ESRI Data and Maps
A3


WETLANDS MAP FOR THE PROPOSED UPGRADE OF ROAD R30 SECTION 8 IN NORTH WEST PROVINCE
Legend
Development Detour
R30 (Section 8)
Perennial River
Non-Perennial River
Wetlands
Natural, Valley floor
Artificial, Valley floor
Artificial, Slope
Natural, Bench
Natural, Slope
Co-ordinate System :GCS WGS 1984
1:94 056
Kilometers
0 0.75 1.5 3 4.5 6
N
Projection: Transverse Mercator CM 27 Datum: WGS84
Source: Google TM@ 2011, Image © 2011 DigitalGlobe
Inset: E SRI Data and Maps
A3


Vegetation Type:Status
Carletonville Dolomite Grassland, Vulnerable
Andesite Mountain Bushveld, Least threatened
Vaal-Vet Sandy Grassland, Endangered
Highveld Alluvial Vegetation, Least threatened
VEGETATION MAP FOR THE PROPOSED UPGRADE OF ROAD R30 SECTION 8 IN NORTH WEST PROVINCE
Legend
R30 (Section 8)
Development Detour
Co-ordinate System:GCS WGS 1984
1:93 720
Kilometers
0 0,75 1,5 3 4,5 6
N
Projection: Transverse Mercator CM XX Datum: WGS84
Source: Google TM@ 2011, Image © 2011 DigitalGlobe
Inset: ESRI Data and Maps
A3


SENSITIVITY MAP FOR THE PROPOSED UPGRADE OF ROAD R30 SECTION 8 IN NORTH WEST PROVINCE
Legend
Development Detour
R30 (Section 8)
Perennial River
Non-Perennial River
Wetlands
Terrestrial Biodiversity
Ecological Support Area 1
Ecological Support Area 2
Critical Biodiversity Area 1
Critical Biodiversity Area 2
Co-ordinate System:GCS WGS 1984
1:94 056
Kilometers
0 0,75 1,5 3 4,5 6
N
Projection: Transverse Mercator CM XX Datum: WGS84
Source: Google TM© 2011, Image © 2011 DigitalGlobe
Insets: ESRI Data and Maps
A3

APPENDIX 2: SITE PHOTOS

PHOTOGRAPHS OF THE PROPOSED NATIONAL ROAD R30 DEVELOPMENT



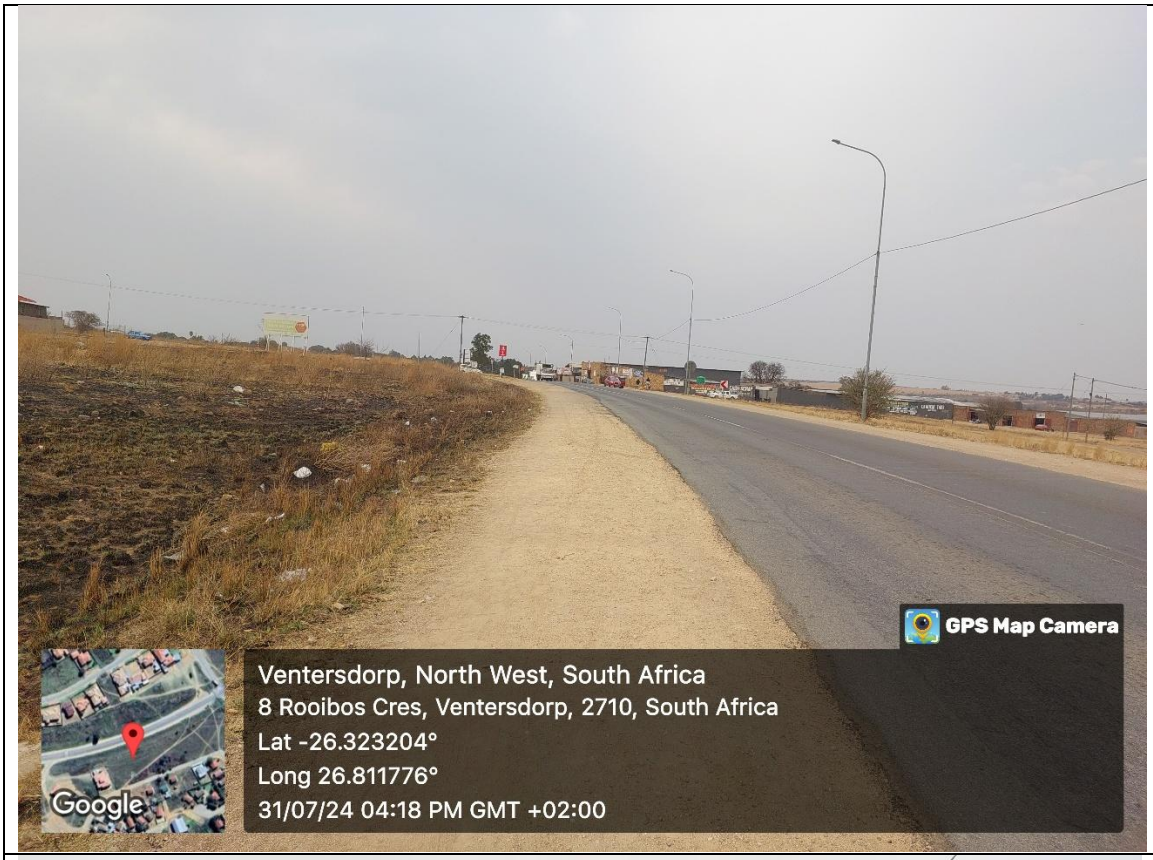


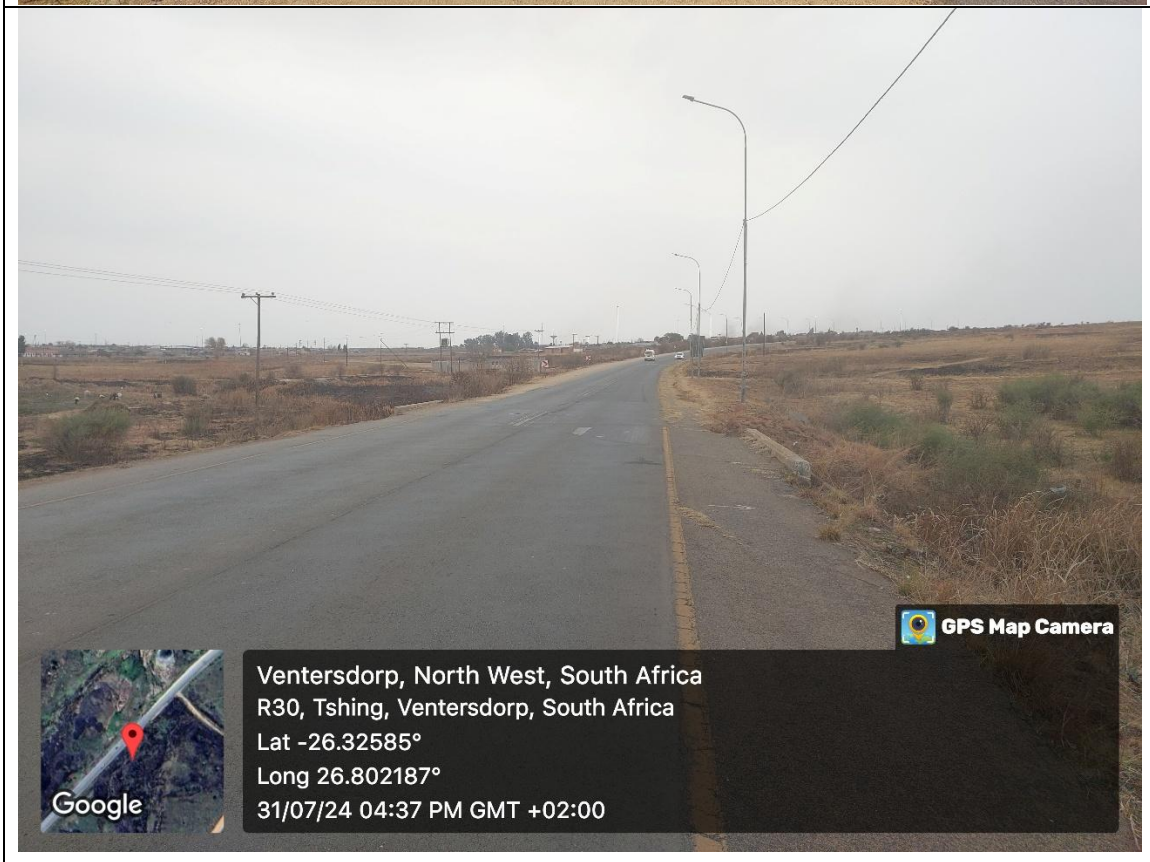

31.07.2024 16:45
-26.37185, 26.77544
Farm Elandskuil, Ventersdorp, 2710


31.07.2024 16:45
-26.37184, 26.77542
Farm Elandskuil, Ventersdorp, 2710


31.07.2024 16:18
-26.32311, 26.81173
Ventersdorp, Ventersdorp, 2710


31.07.2024 16:18
-26.32311, 26.81173
Ventersdorp, Ventersdorp, 2710


GPS Map Camera
Google
Ventersdorp, North West, South Africa
8 Rooibos Cres, Ventersdorp, 2710, South Africa
Lat -26.323204°
Long 26.811776°
31/07/24 04:18 PM GMT +02:00


GPS Map Camera
Google
Ventersdorp, North West, South Africa
R30, Tshing, Ventersdorp, South Africa
Lat -26.32585°
Long 26.802187°
31/07/24 04:37 PM GMT +02:00

APPENDIX 3: PROOF OF PUBLIC PARTICIPATION

Public Notice

BASIC ASSESSMENT PROCESS AND A GENERAL AUTHORIZATION PROCESS FOR THE UPGRADE OF NATIONAL ROAD R30 SECTION 8 FROM KM 36.8 TO VENTERSDORP KM 68.646, IN THE PROVINCE OF NORTH WEST AND IN THE DISTRICT MUNICIPALITIES OF CITY MATLOSANA AND JB MARKS.

Notice is hereby given that the South African National Roads Agency (SANRAL) SOC Limited is proposing to undertake the Basic Assessment and General Authorisation process for the above-mentioned project in terms of:

- Chapter 5 of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), as amended and the associated NEMA Environment Impact Assessment (EIA) Regulations, 2014, as amended;
- Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) the General Authorisation for Section 21(c) or section 21(i) activities; and

ROAD PROJECT LOCATION:

This project falls within the City Matlosana and JB Marks Local Municipalities and is situated within the Dr Kenneth Kaunda District Municipality in the North West province, with Ventersdorp the closest town.

ROAD PROJECT COORDINATES:

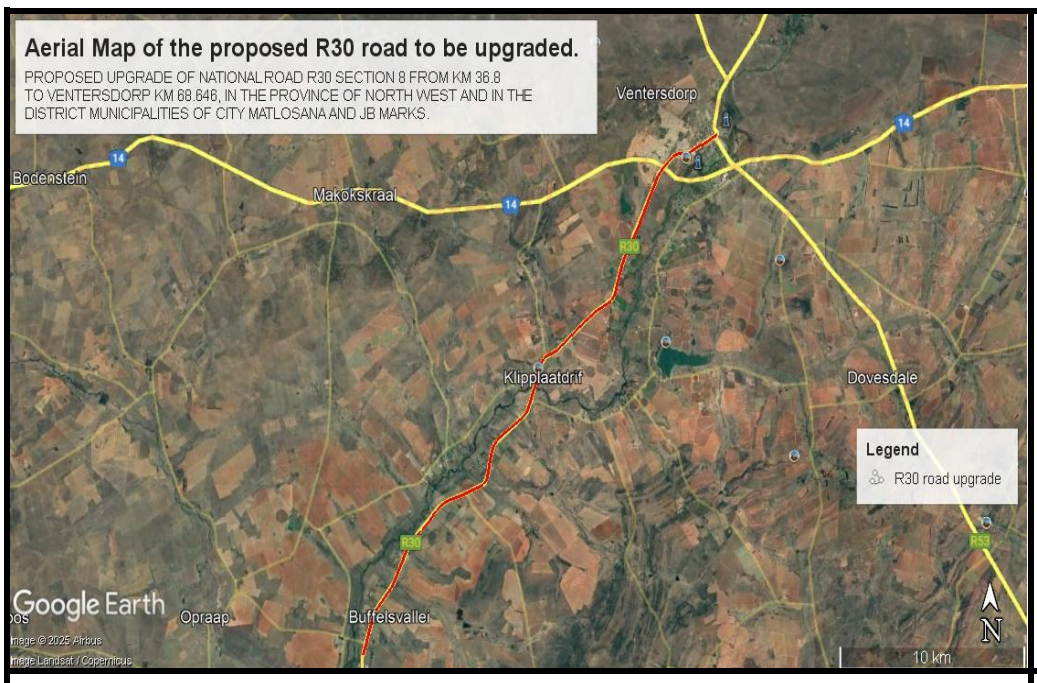
Start Point:	Middle Point:	End Point:
26°31'56.56"S; 26°38'9.19"E	**26°26'11.29"S; 26°43'3.50"E**	**26°18'54.98"S; 26°49'38.86"E**

LISTED ACTIVITIES:

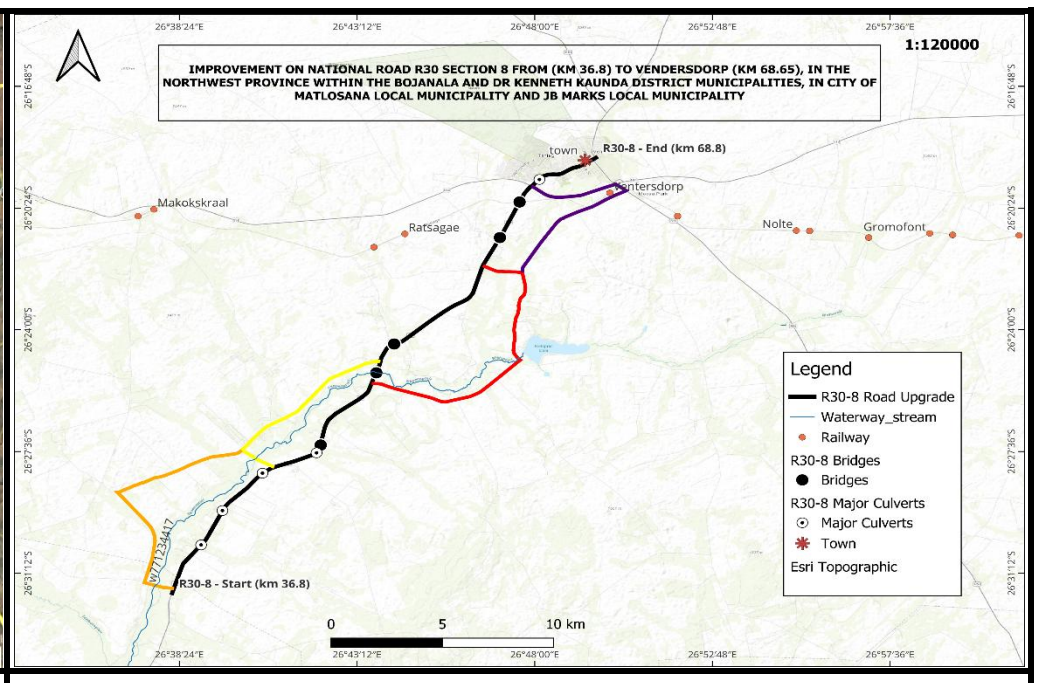
The R30 section 8 road project triggers the following EIA activities: Activity 19, 27 and 56 of Listing notice 1 and Activity 4, 12 and 18 under Listing Notice 3.

The South Africa National Road Agency Soc Limited (SANRAL) have appointed Earthlink Environmental Services as an independent Environmental Assessment Practitioner (EAP), to undertake Environmental Authorisation (EA) for the upgrade of the road and General Authorisation (GA) Application processes. The EA for road upgrade will be submitted to the Department of Forestry, Fisheries and the Environment (DFFE) and the GA application will be submitted to the Department of Water and Sanitation (DWS) respectively.

The Draft Basic Assessment Report (BAR) for the abovementioned project is available for public review and comments from 20th February 2026 to 20th March 2026 on Earthlink Environmental Services website: www.earthlinkenvironmental.co.za, and at Ventersdorp Public Library. Address: Mc Gregor St, Venterspos, Westonaria,1779



Aerial image showing proposed road upgrade project in context.



Locality Map of the proposed road upgrade.

Should you wish to register as an Interested and Affected Party on the project or to make suggestions and/or comments on this proposal, kindly provide these together with your name, contact details (preferred method of communication, e.g., e-mail, cellphone number), and an indication of any interest which you (or the organization you represent) have in the application to:

Contact Person : Chauke Hlahla
Tel : 010 634 2349
Cell : 0733776890
E-mail: terrence@earthlinkenvironmental.co.za/chauke@earthlinkenvironmental.co.za

PLEASE REGISTER YOUR INTEREST IN THE PROJECT FOR THIS FIRST ROUND OF THE PUBLIC PARTICIPATION PROCESS BY NO LATER THAN 20 MARCH 2026.

SANRAL SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD

Earthlink Environmental Services
In rhythm with nature

Earthlink

APPENDIX 4: SCREENING REPORT

SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE ENVIRONMENTAL SENSITIVITY

EIA Reference number:

Project name: Upgrade of National Road R30 Section 8 from Km 36.8 to Ventersdorp Km 68.646

Project title: Upgrade of National Road R30 Section 8 from Km 36.8 to Ventersdorp Km 68.646

Date screening report generated: 24/01/2025 08:00:20

Applicant: The South African National Road SOC Ltd (SANRAL)

Compiler: Chauke Wisdom from Earthlink Environmental Service

Compiler signature:

.....

Application Category: Transformation of land|Indigenous vegetation

OFFICIAL

Table of Contents

Proposed Project Location 3

Orientation map 1: General location 3

Map of proposed site and relevant area(s) 4

Cadastral details of the proposed site 4

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area 10

Environmental Management Frameworks relevant to the application 10

Environmental screening results and assessment outcomes 10

Relevant development incentives, restrictions, exclusions or prohibitions 10

Proposed Development Area Environmental Sensitivity 11

Specialist assessments identified 11

Results of the environmental sensitivity of the proposed area. 13

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY 13

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY 14

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY 15

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY 16

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY 17

MAP OF RELATIVE DEFENCE THEME SENSITIVITY 18

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY 19

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY 20

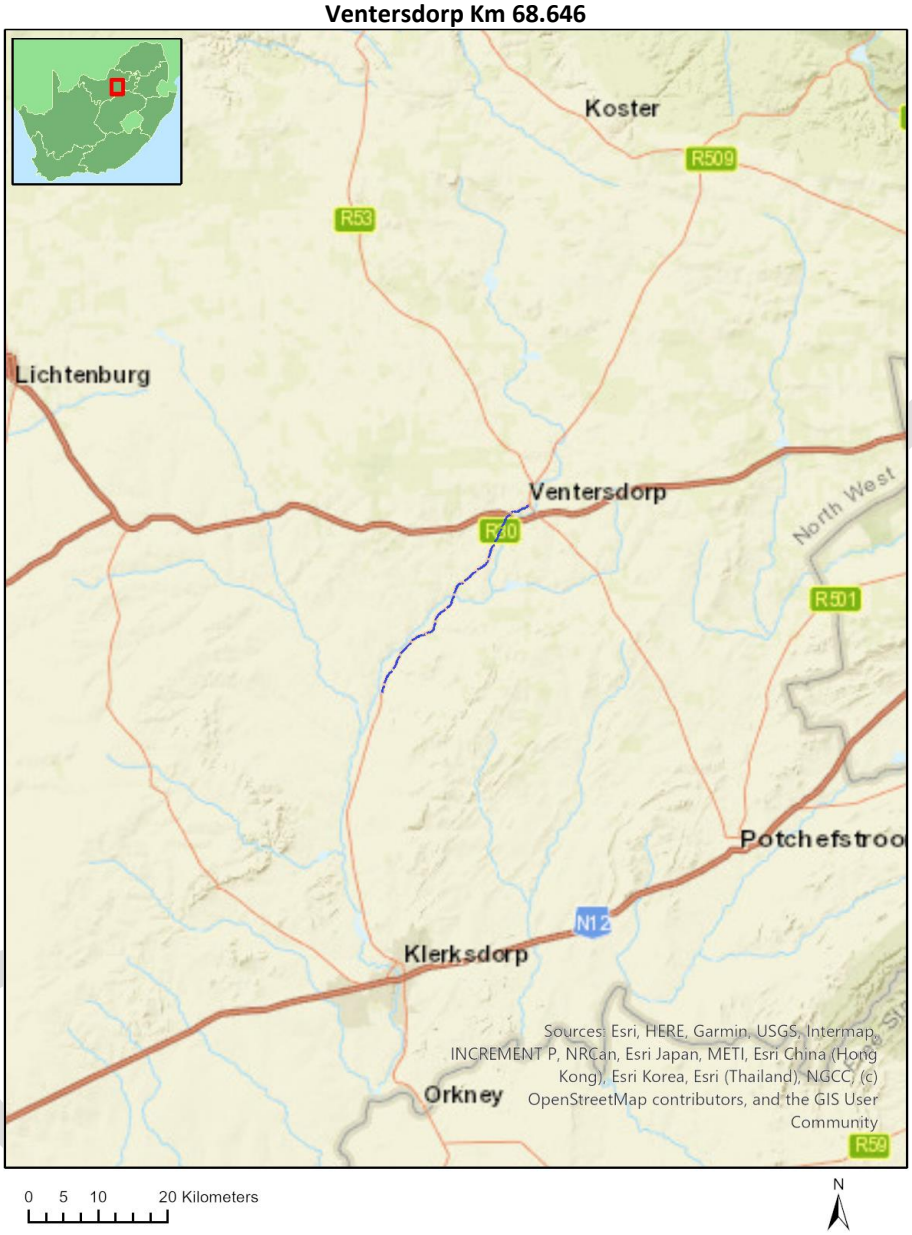
MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY 21

OFFICIAL

Proposed Project Location

Orientation map 1: General location

General Orientation: Upgrade of National Road R30 Section 8 from Km 36.8 to Ventersdorp Km 68.646



Disclaimer applies

Map of proposed site and relevant area(s)



Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	TOEVLUG	14	0	26°19'25.16S	26°48'40.95E	Erven
2	VENTERSDORP	101	39	26°19'8.45S	26°49'16.82E	Erven
3	VENTERSDORP	101	24	26°19'8.84S	26°49'16.11E	Erven
4	VENTERSDORP	101	26	26°19'11.22S	26°49'11.86E	Erven
5	VENTERSDORP	101	30	26°19'10.96S	26°49'12.32E	Erven
6	VENTERSDORP	101	69	26°19'10.11S	26°49'13.84E	Erven
7	VENTERSDORP	101	66	26°19'10.56S	26°49'13.04E	Erven
8	VENTERSDORP	101	43	26°19'9.66S	26°49'14.64E	Erven
9	VENTERSDORP	101	70	26°19'9.97S	26°49'15.4E	Erven
10	VENTERSDORP	102	1	26°19'6.24S	26°49'24.29E	Erven
11	VENTERSDORP	102	14	26°19'7.55S	26°49'18.08E	Erven
12	VENTERSDORP	102	0	26°19'6.96S	26°49'21.52E	Erven
13	VENTERSDORP	103	2	26°19'2.98S	26°49'30.11E	Erven
14	VENTERSDORP	103	0	26°19'4.44S	26°49'27.37E	Erven
15	VENTERSDORP	106	0	26°18'57.34S	26°49'37.71E	Erven
16	VENTERSDORP	106	34	26°18'56.12S	26°49'38.56E	Erven
17	VENTERSDORP	108	16	26°19'0.44S	26°49'31.12E	Erven
18	VENTERSDORP	108	2	26°19'1.47S	26°49'30.47E	Erven
19	VENTERSDORP	114	0	26°19'3.01S	26°49'21.63E	Erven
20	VENTERSDORP	115	1	26°19'3.92S	26°49'20.9E	Erven
21	VENTERSDORP	120	0	26°19'7.11S	26°49'15.37E	Erven
22	VENTERSDORP	122	0	26°19'8.24S	26°49'13.34E	Erven
23	VENTERSDORP	197	0	26°18'54.58S	26°49'37.8E	Erven
24	VENTERSDORP	198	0	26°18'55.11S	26°49'36.83E	Erven
25	VENTERSDORP	288	3	26°19'18.86S	26°48'53.88E	Erven
26	VENTERSDORP	288	0	26°19'18.56S	26°48'52.76E	Erven
27	VENTERSDORP	290	0	26°19'18.22S	26°48'51.27E	Erven

Disclaimer applies

28	VENTERSDORP	290	4	26°19'18.22S	26°48'50.54E	Erven
29	VENTERSDORP	290	3	26°19'18.87S	26°48'49.4E	Erven
30	VENTERSDORP	291	5	26°19'19.51S	26°48'48.24E	Erven
31	VENTERSDORP	291	4	26°19'20.15S	26°48'47.09E	Erven
32	VENTERSDORP	291	0	26°19'20.73S	26°48'46.76E	Erven
33	VENTERSDORP	414	1	26°18'58.91S	26°49'34.9E	Erven
34	VENTERSDORP	419	0	26°19'8.74S	26°49'12.47E	Erven
35	VENTERSDORP	419	1	26°19'9.27S	26°49'11.5E	Erven
36	VENTERSDORP	421	16	26°19'14.84S	26°48'55.89E	Erven
37	VENTERSDORP	421	12	26°19'16.22S	26°48'53.69E	Erven
38	VENTERSDORP	421	13	26°19'16.67S	26°48'52.89E	Erven
39	VENTERSDORP	421	14	26°19'17.08S	26°48'52.13E	Erven
40	VENTERSDORP	421	0	26°19'16.98S	26°48'51.03E	Erven
41	VENTERSDORP	422	0	26°19'19.87S	26°48'49.28E	Erven
42	VENTERSDORP	422	0	26°19'20.93S	26°48'50.79E	Erven
43	VENTERSDORP	422	2	26°19'21.57S	26°48'49.64E	Erven
44	VENTERSDORP	422	1	26°19'22.22S	26°48'48.5E	Erven
45	VENTERSDORP	422	4	26°19'20.3S	26°48'51.94E	Erven
46	VENTERSDORP	424	9	26°18'59.08S	26°49'29.82E	Erven
47	VENTERSDORP	424	12	26°18'58.78S	26°49'28.83E	Erven
48	VENTERSDORP	424	8	26°18'59.76S	26°49'29.07E	Erven
49	VENTERSDORP	424	10	26°18'58.66S	26°49'30.42E	Erven
50	VENTERSDORP	424	13	26°18'58.94S	26°49'30.96E	Erven
51	VENTERSDORP	424	22	26°19'1.25S	26°49'24.79E	Erven
52	VENTERSDORP	424	15	26°19'0.57S	26°49'27.07E	Erven
53	VENTERSDORP	424	7	26°19'1.16S	26°49'26.1E	Erven
54	VENTERSDORP	424	0	26°18'57.93S	26°49'28.04E	Erven
55	VENTERSDORP	424	3	26°19'2.65S	26°49'23.57E	Erven
56	VENTERSDORP	424	14	26°19'3.09S	26°49'23.51E	Erven
57	VENTERSDORP	424	4	26°19'2.24S	26°49'24.17E	Erven
58	VENTERSDORP	494	0	26°19'10.55S	26°49'3.77E	Erven
59	VENTERSDORP	919	0	26°19'12.08S	26°49'10.47E	Erven
60	VENTERSDORP	807	0	26°19'4.36S	26°49'19.22E	Erven
61	VENTERSDORP	809	0	26°19'5.71S	26°49'16.81E	Erven
62	VENTERSDORP	810	0	26°19'5.17S	26°49'17.77E	Erven
63	VENTERSDORP	812	2	26°19'14.1S	26°49'4.52E	Erven
64	VENTERSDORP	812	1	26°19'14.62S	26°49'2.91E	Erven
65	VENTERSDORP	819	0	26°18'56.3S	26°49'33.64E	Erven
66	VENTERSDORP	842	0	26°18'58.15S	26°49'36.12E	Erven
67	VENTERSDORP	906	0	26°19'7.71S	26°49'14.31E	Erven
68	VENTERSDORP	908	0	26°18'59.71S	26°49'33.48E	Erven
69	VENTERSDORP	909	0	26°19'12.56S	26°48'58.95E	Erven
70	VENTERSDORP	910	0	26°19'11.42S	26°49'2.02E	Erven
71	VENTERSDORP	912	0	26°19'9.88S	26°49'9.09E	Erven
72	VENTERSDORP	920	0	26°19'18.54S	26°49'0.54E	Erven
73	TSHING	3055	0	26°19'22.79S	26°48'33.13E	Erven
74	TSHING	3056	0	26°19'22.81S	26°48'33.76E	Erven
75	TSHING	3057	0	26°19'22.84S	26°48'34.43E	Erven
76	ELANDSKUIL	205	0	26°19'51.71S	26°47'36.01E	Farm
77	ELANDSKUIL	208	0	26°22'39.65S	26°46'56.59E	Farm
78	ELANDSKUIL	508	0	26°20'32.01S	26°47'8.42E	Farm
79	PALMIETFONTEIN	343	0	26°33'56.73S	26°39'0.9E	Farm
80	ELANDSKUIL	206	0	26°19'44.16S	26°48'23.45E	Farm
81	ROODEPOORT	191	0	26°17'39.92S	26°50'5.85E	Farm
82	BUFFELSVALLEI	222	0	26°29'6.98S	26°38'23.48E	Farm
83	KLIPPLAATDRIFT	214	0	26°25'31.31S	26°45'4.14E	Farm
84	ELANDSKUIL	509	0	26°21'47.21S	26°47'7.46E	Farm
85	DOORNPAN	193	0	26°16'42.55S	26°46'21.86E	Farm
86	STERKSTROOM	216	0	26°27'9.44S	26°41'42.3E	Farm
87	ELANDSKUIL	208	219	26°22'52.16S	26°46'20.43E	Farm Portion

Disclaimer applies

88	ELANDSKUIL	208	220	26°22'54.71S	26°46'19.27E	Farm Portion
89	ELANDSKUIL	208	221	26°22'57.59S	26°46'17.82E	Farm Portion
90	ELANDSKUIL	208	222	26°23'3.66S	26°46'12.83E	Farm Portion
91	ELANDSKUIL	208	223	26°23'1.61S	26°46'15.11E	Farm Portion
92	ELANDSKUIL	208	224	26°23'12.42S	26°45'58.7E	Farm Portion
93	ELANDSKUIL	208	225	26°23'26.08S	26°45'35.25E	Farm Portion
94	ELANDSKUIL	208	226	26°23'34.22S	26°45'24.18E	Farm Portion
95	ELANDSKUIL	208	215	26°22'40.65S	26°46'24.16E	Farm Portion
96	ELANDSKUIL	208	216	26°22'43.66S	26°46'23.15E	Farm Portion
97	ELANDSKUIL	208	217	26°22'46.2S	26°46'22.48E	Farm Portion
98	ELANDSKUIL	208	218	26°22'48.86S	26°46'21.59E	Farm Portion
99	ELANDSKUIL	208	214	26°22'35.82S	26°46'25.69E	Farm Portion
100	ELANDSKUIL	208	213	26°22'30.16S	26°46'27.66E	Farm Portion
101	ELANDSKUIL	208	212	26°22'24.6S	26°46'29.41E	Farm Portion
102	ELANDSKUIL	208	194	26°22'33.19S	26°46'46.58E	Farm Portion
103	ELANDSKUIL	208	86	26°22'33.93S	26°46'32.46E	Farm Portion
104	ELANDSKUIL	208	211	26°21'5.76S	26°47'9.54E	Farm Portion
105	ELANDSKUIL	208	210	26°21'32.46S	26°46'54.98E	Farm Portion
106	ELANDSKUIL	208	209	26°21'49.76S	26°46'45.06E	Farm Portion
107	ELANDSKUIL	208	208	26°21'53.27S	26°46'43.11E	Farm Portion
108	ELANDSKUIL	208	207	26°21'58.13S	26°46'40.41E	Farm Portion
109	ELANDSKUIL	208	206	26°22'4.05S	26°46'37.13E	Farm Portion
110	ELANDSKUIL	208	205	26°22'10.23S	26°46'34.02E	Farm Portion
111	ELANDSKUIL	208	204	26°22'13.34S	26°46'33.03E	Farm Portion
112	ELANDSKUIL	208	203	26°22'18.13S	26°46'31.65E	Farm Portion
113	ELANDSKUIL	206	0	26°19'30.37S	26°48'20E	Farm Portion
114	ELANDSKUIL	205	12	26°20'22S	26°47'33.38E	Farm Portion
115	ELANDSKUIL	205	11	26°20'2.42S	26°47'48.95E	Farm Portion
116	ELANDSKUIL	205	10	26°19'50.22S	26°47'17.87E	Farm Portion
117	ELANDSKUIL	205	0	26°20'6.94S	26°48'12.16E	Farm Portion
118	ELANDSKUIL	205	5	26°19'41.79S	26°47'48.05E	Farm Portion
119	ELANDSKUIL	205	3	26°19'46.82S	26°47'28.99E	Farm Portion
120	ELANDSKUIL	205	7	26°19'42.18S	26°47'57.79E	Farm Portion
121	ELANDSKUIL	205	6	26°19'58.92S	26°47'42.68E	Farm Portion
122	ELANDSKUIL	208	84	26°23'14.15S	26°46'30.15E	Farm Portion
123	ELANDSKUIL	208	71	26°23'13.68S	26°45'18.79E	Farm Portion
124	ELANDSKUIL	208	74	26°21'28.68S	26°45'42.66E	Farm Portion
125	ELANDSKUIL	208	182	26°23'26.13S	26°45'27.98E	Farm Portion
126	ELANDSKUIL	208	76	26°20'18.39S	26°45'14.63E	Farm Portion
127	DOORNPAN	193	13	26°19'24.15S	26°48'25.69E	Farm Portion
128	DOORNPAN	193	3	26°18'21.65S	26°47'16.71E	Farm Portion
129	ROODEPOORT	191	224	26°19'23.96S	26°48'42.53E	Farm Portion
130	ROODEPOORT	191	61	26°18'55.86S	26°49'40.5E	Farm Portion
131	ROODEPOORT	191	62	26°18'53.78S	26°49'39.22E	Farm Portion
132	ROODEPOORT	191	25	26°18'37.24S	26°48'44.31E	Farm Portion
133	ROODEPOORT	191	222	26°19'24.55S	26°48'36.46E	Farm Portion
134	ROODEPOORT	191	223	26°19'23.26S	26°48'42.57E	Farm Portion
135	ELANDSKUIL	208	77	26°20'7.68S	26°46'17.3E	Farm Portion
136	ELANDSKUIL	208	75	26°21'7.94S	26°45'55.46E	Farm Portion
137	KLIPPLAATDRIFT	214	183	26°25'51.39S	26°43'28.49E	Farm Portion
138	ELANDSKUIL	208	147	26°23'8.93S	26°46'36.16E	Farm Portion
139	ELANDSKUIL	208	159	26°23'1.86S	26°46'41.86E	Farm Portion
140	ELANDSKUIL	208	164	26°23'9.41S	26°45'36.04E	Farm Portion
141	STERKSTROOM	216	154	26°27'20.97S	26°42'12.93E	Farm Portion
142	STERKSTROOM	216	155	26°27'22.5S	26°42'12.59E	Farm Portion
143	STERKSTROOM	216	145	26°26'9.38S	26°43'6.54E	Farm Portion
144	STERKSTROOM	216	159	26°28'13.81S	26°40'38.89E	Farm Portion
145	STERKSTROOM	216	158	26°28'6.45S	26°40'51.98E	Farm Portion
146	STERKSTROOM	216	160	26°28'16.66S	26°40'36.09E	Farm Portion
147	STERKSTROOM	216	157	26°27'59.83S	26°41'11.38E	Farm Portion

Disclaimer applies

148	STERKSTROOM	216	53	26°27'1.62S	26°42'59.51E	Farm Portion
149	STERKSTROOM	216	54	26°27'6.54S	26°42'50.97E	Farm Portion
150	ELANDSKUIL	208	121	26°22'51.66S	26°46'43.29E	Farm Portion
151	ELANDSKUIL	208	119	26°22'55.15S	26°46'43.08E	Farm Portion
152	ELANDSKUIL	208	195	26°22'46.64S	26°45'39.54E	Farm Portion
153	ELANDSKUIL	208	88	26°23'31.87S	26°45'12.84E	Farm Portion
154	ELANDSKUIL	208	83	26°23'12.85S	26°46'32.17E	Farm Portion
155	STERKSTROOM	216	1	26°27'0.34S	26°41'55.36E	Farm Portion
156	ELANDSKUIL	208	181	26°22'8.38S	26°45'43.46E	Farm Portion
157	ELANDSKUIL	208	80	26°21'5.93S	26°47'27.2E	Farm Portion
158	ELANDSKUIL	208	168	26°22'58.26S	26°46'4.19E	Farm Portion
159	ELANDSKUIL	208	172	26°22'47.17S	26°46'46.04E	Farm Portion
160	ELANDSKUIL	208	176	26°22'30.6S	26°45'14.61E	Farm Portion
161	ELANDSKUIL	208	127	26°22'58.76S	26°46'43.13E	Farm Portion
162	ELANDSKUIL	208	133	26°23'6.61S	26°46'37.87E	Farm Portion
163	ELANDSKUIL	208	140	26°22'20.76S	26°46'51.11E	Farm Portion
164	ELANDSKUIL	208	196	26°22'25.98S	26°46'49.27E	Farm Portion
165	ELANDSKUIL	208	191	26°21'57.74S	26°46'58.54E	Farm Portion
166	ELANDSKUIL	208	139	26°21'50.63S	26°46'51.33E	Farm Portion
167	ELANDSKUIL	208	70	26°22'5.02S	26°46'33.41E	Farm Portion
168	ELANDSKUIL	208	184	26°22'3.61S	26°46'58.53E	Farm Portion
169	ELANDSKUIL	208	155	26°21'41.88S	26°47'14.91E	Farm Portion
170	KLIPPLAATDRIFT	214	186	26°23'53.06S	26°44'35.39E	Farm Portion
171	KLIPPLAATDRIFT	214	165	26°23'46.44S	26°45'8.79E	Farm Portion
172	KLIPPLAATDRIFT	214	166	26°23'54.18S	26°44'59.18E	Farm Portion
173	KLIPPLAATDRIFT	214	167	26°23'57.73S	26°44'54.79E	Farm Portion
174	KLIPPLAATDRIFT	214	168	26°23'45.7S	26°45'8.86E	Farm Portion
175	KLIPPLAATDRIFT	214	169	26°23'58.33S	26°44'52.95E	Farm Portion
176	KLIPPLAATDRIFT	214	170	26°24'3.49S	26°44'47.02E	Farm Portion
177	KLIPPLAATDRIFT	214	171	26°24'23.43S	26°44'17.79E	Farm Portion
178	KLIPPLAATDRIFT	214	172	26°24'20.69S	26°44'24.14E	Farm Portion
179	KLIPPLAATDRIFT	214	173	26°24'35S	26°43'59.16E	Farm Portion
180	KLIPPLAATDRIFT	214	174	26°24'39.71S	26°43'56.54E	Farm Portion
181	KLIPPLAATDRIFT	214	175	26°24'43.08S	26°43'54.73E	Farm Portion
182	KLIPPLAATDRIFT	214	176	26°24'46.07S	26°43'53.07E	Farm Portion
183	KLIPPLAATDRIFT	214	177	26°24'50.03S	26°43'51.15E	Farm Portion
184	KLIPPLAATDRIFT	214	178	26°24'54.9S	26°43'49.73E	Farm Portion
185	KLIPPLAATDRIFT	214	180	26°25'7.05S	26°43'46.93E	Farm Portion
186	KLIPPLAATDRIFT	214	179	26°24'58.61S	26°43'49.19E	Farm Portion
187	KLIPPLAATDRIFT	214	181	26°25'15.15S	26°43'43.69E	Farm Portion
188	KLIPPLAATDRIFT	214	182	26°25'35.34S	26°43'35.79E	Farm Portion
189	KLIPPLAATDRIFT	214	99	26°24'4.59S	26°45'40.19E	Farm Portion
190	KLIPPLAATDRIFT	214	11	26°26'39.55S	26°44'29.64E	Farm Portion
191	KLIPPLAATDRIFT	214	59	26°24'45.05S	26°43'13.41E	Farm Portion
192	BUFFELSVALLEI	222	89	26°29'34.94S	26°39'4.27E	Farm Portion
193	BUFFELSVALLEI	222	79	26°29'25.59S	26°39'7.69E	Farm Portion
194	BUFFELSVALLEI	222	67	26°29'27.13S	26°38'54.8E	Farm Portion
195	BUFFELSVALLEI	222	80	26°29'31.02S	26°39'6.68E	Farm Portion
196	BUFFELSVALLEI	222	102	26°29'12.99S	26°40'22.18E	Farm Portion
197	KLIPPLAATDRIFT	214	135	26°24'42.34S	26°43'43.21E	Farm Portion
198	KLIPPLAATDRIFT	214	1	26°26'22.04S	26°43'51.36E	Farm Portion
199	KLIPPLAATDRIFT	214	57	26°24'34.37S	26°43'57.42E	Farm Portion
200	KLIPPLAATDRIFT	214	58	26°24'49.4S	26°43'38.96E	Farm Portion
201	KLIPPLAATDRIFT	214	188	26°24'45.48S	26°44'16.65E	Farm Portion
202	KLIPPLAATDRIFT	214	101	26°23'56.61S	26°45'49.57E	Farm Portion
203	KLIPPLAATDRIFT	214	136	26°24'45.23S	26°43'38.71E	Farm Portion
204	KLIPPLAATDRIFT	214	29	26°24'14.63S	26°44'10.58E	Farm Portion
205	KLIPPLAATDRIFT	214	13	26°24'16.95S	26°45'56.09E	Farm Portion
206	BUFFELSVALLEI	222	108	26°28'35.19S	26°38'49.35E	Farm Portion
207	KLIPPLAATDRIFT	214	103	26°23'42.32S	26°44'56.14E	Farm Portion

Disclaimer applies

208	KLIPPLAATDRIFT	214	60	26°25'1.54S	26°43'45.79E	Farm Portion
209	KLIPPLAATDRIFT	214	61	26°24'53.09S	26°43'16.59E	Farm Portion
210	KLIPPLAATDRIFT	214	187	26°24'24.61S	26°43'40.01E	Farm Portion
211	KLIPPLAATDRIFT	214	189	26°24'25.49S	26°44'45.14E	Farm Portion
212	STERKSTROOM	216	144	26°26'1.49S	26°43'17.26E	Farm Portion
213	STERKSTROOM	216	156	26°27'53.03S	26°41'31.74E	Farm Portion
214	STERKSTROOM	216	146	26°26'8.63S	26°43'6.73E	Farm Portion
215	STERKSTROOM	216	148	26°26'37.76S	26°42'27.43E	Farm Portion
216	STERKSTROOM	216	149	26°26'44.43S	26°42'23.27E	Farm Portion
217	STERKSTROOM	216	150	26°26'48.58S	26°42'21.97E	Farm Portion
218	STERKSTROOM	216	151	26°26'56.51S	26°42'18.91E	Farm Portion
219	STERKSTROOM	216	152	26°27'4.18S	26°42'16.89E	Farm Portion
220	STERKSTROOM	216	153	26°27'33.31S	26°42'10.25E	Farm Portion
221	BUFFELSVALLEI	222	127	26°29'33.01S	26°39'27.59E	Farm Portion
222	BUFFELSVALLEI	222	128	26°29'43.53S	26°39'21.97E	Farm Portion
223	BUFFELSVALLEI	222	118	26°28'47.15S	26°40'5.28E	Farm Portion
224	BUFFELSVALLEI	222	117	26°28'43.08S	26°40'10.08E	Farm Portion
225	BUFFELSVALLEI	222	119	26°28'57.04S	26°39'54.93E	Farm Portion
226	BUFFELSVALLEI	222	120	26°29'3.78S	26°39'46.66E	Farm Portion
227	BUFFELSVALLEI	222	121	26°29'5.64S	26°39'45.28E	Farm Portion
228	BUFFELSVALLEI	222	122	26°29'9.92S	26°39'41.35E	Farm Portion
229	BUFFELSVALLEI	222	123	26°29'19.71S	26°39'34.67E	Farm Portion
230	BUFFELSVALLEI	222	130	26°29'59.89S	26°39'13.56E	Farm Portion
231	BUFFELSVALLEI	222	132	26°30'9.52S	26°39'8.51E	Farm Portion
232	BUFFELSVALLEI	222	133	26°30'12.64S	26°39'6.38E	Farm Portion
233	BUFFELSVALLEI	222	134	26°30'15.27S	26°39'4.48E	Farm Portion
234	BUFFELSVALLEI	222	135	26°30'19.43S	26°39'0.9E	Farm Portion
235	BUFFELSVALLEI	222	136	26°30'21.52S	26°38'59.09E	Farm Portion
236	STERKSTROOM	216	10	26°26'29.14S	26°42'14.28E	Farm Portion
237	STERKSTROOM	216	139	26°27'46.26S	26°42'5.5E	Farm Portion
238	STERKSTROOM	216	44	26°26'54.34S	26°42'2.12E	Farm Portion
239	STERKSTROOM	216	45	26°27'10.03S	26°42'1.94E	Farm Portion
240	STERKSTROOM	216	47	26°26'47S	26°42'24.97E	Farm Portion
241	STERKSTROOM	216	50	26°25'52.25S	26°43'4.95E	Farm Portion
242	STERKSTROOM	216	43	26°26'52.53S	26°42'2.41E	Farm Portion
243	STERKSTROOM	216	62	26°28'4.97S	26°40'42.49E	Farm Portion
244	STERKSTROOM	216	66	26°28'33.37S	26°41'36.69E	Farm Portion
245	STERKSTROOM	216	61	26°27'56.78S	26°41'0.82E	Farm Portion
246	STERKSTROOM	216	2	26°26'56.81S	26°42'1.62E	Farm Portion
247	BUFFELSVALLEI	222	137	26°30'25.3S	26°38'55.79E	Farm Portion
248	BUFFELSVALLEI	222	138	26°30'32.13S	26°38'50.12E	Farm Portion
249	STERKSTROOM	216	142	26°26'24.68S	26°42'19.98E	Farm Portion
250	STERKSTROOM	216	14	26°26'5.11S	26°42'54.65E	Farm Portion
251	STERKSTROOM	216	119	26°27'11.83S	26°42'40.1E	Farm Portion
252	STERKSTROOM	216	56	26°27'44.74S	26°43'4.12E	Farm Portion
253	STERKSTROOM	216	64	26°28'9.09S	26°40'27.83E	Farm Portion
254	STERKSTROOM	216	37	26°27'11.17S	26°41'53.97E	Farm Portion
255	STERKSTROOM	216	65	26°28'21.09S	26°40'46.46E	Farm Portion
256	STERKSTROOM	216	67	26°26'36.97S	26°42'3.42E	Farm Portion
257	STERKSTROOM	216	8	26°26'31.41S	26°42'7.28E	Farm Portion
258	STERKSTROOM	216	51	26°26'43.24S	26°43'27.04E	Farm Portion
259	STERKSTROOM	216	52	26°26'56.83S	26°43'6.7E	Farm Portion
260	BUFFELSVALLEI	222	112	26°28'22.96S	26°40'29.13E	Farm Portion
261	BUFFELSVALLEI	222	113	26°28'30.49S	26°40'22.9E	Farm Portion
262	BUFFELSVALLEI	222	114	26°28'38.85S	26°40'15.38E	Farm Portion
263	BUFFELSVALLEI	222	115	26°28'42.31S	26°40'10.95E	Farm Portion
264	BUFFELSVALLEI	222	116	26°28'48S	26°40'5.07E	Farm Portion
265	BUFFELSVALLEI	222	124	26°29'20.83S	26°39'33.4E	Farm Portion
266	BUFFELSVALLEI	222	129	26°29'52.65S	26°39'17.32E	Farm Portion
267	BUFFELSVALLEI	222	125	26°29'22.64S	26°39'32.47E	Farm Portion

Disclaimer applies

268	BUFFELSVALLEI	222	126	26°29'27.99S	26°39'29.68E	Farm Portion
269	PALMIETFONTEIN	343	35	26°31'47.87S	26°37'54.64E	Farm Portion
270	PALMIETFONTEIN	343	0	26°31'31.81S	26°38'7.71E	Farm Portion
271	PALMIETFONTEIN	343	88	26°31'31.26S	26°38'17.28E	Farm Portion
272	PALMIETFONTEIN	343	89	26°31'44.5S	26°38'12.97E	Farm Portion
273	PALMIETFONTEIN	343	90	26°31'50.76S	26°38'10.62E	Farm Portion
274	PALMIETFONTEIN	343	91	26°32'0.9S	26°38'7.91E	Farm Portion
275	PALMIETFONTEIN	343	84	26°31'25.27S	26°38'19.45E	Farm Portion
276	PALMIETFONTEIN	343	85	26°31'23.18S	26°38'20.08E	Farm Portion
277	PALMIETFONTEIN	343	86	26°31'23.86S	26°38'19.76E	Farm Portion
278	PALMIETFONTEIN	343	87	26°31'24.26S	26°38'20.53E	Farm Portion
279	PALMIETFONTEIN	343	130	26°31'52.32S	26°38'45.77E	Farm Portion
280	PALMIETFONTEIN	343	131	26°31'51.06S	26°38'28.77E	Farm Portion
281	PALMIETFONTEIN	343	8	26°31'23.78S	26°38'22.53E	Farm Portion
282	PALMIETFONTEIN	343	34	26°32'8.29S	26°38'40.6E	Farm Portion
283	ELANDSKUIL	508	0	26°20'38.18S	26°47'8.41E	Farm Portion
284	ELANDSKUIL	508	2	26°20'31.57S	26°47'26.54E	Farm Portion
285	ELANDSKUIL	508	1	26°21'31.24S	26°46'54.94E	Farm Portion
286	ELANDSKUIL	509	0	26°21'47.21S	26°47'7.46E	Farm Portion
287	ELANDSKUIL	509	1	26°21'40.6S	26°46'50.01E	Farm Portion
288		598	0	26°19'48.97S	26°48'21.79E	Farm Portion
289	BUFFELSVALLEI	222	139	26°30'43.01S	26°38'40.29E	Farm Portion
290	BUFFELSVALLEI	222	140	26°30'53.26S	26°38'31.62E	Farm Portion
291	BUFFELSVALLEI	222	141	26°31'2.61S	26°38'27.47E	Farm Portion
292	BUFFELSVALLEI	222	142	26°31'19.54S	26°38'21.63E	Farm Portion
293	BUFFELSVALLEI	222	50	26°29'2.62S	26°39'34.6E	Farm Portion
294	BUFFELSVALLEI	222	53	26°28'53.04S	26°39'46.94E	Farm Portion
295	BUFFELSVALLEI	222	29	26°29'53.5S	26°38'44.79E	Farm Portion
296	BUFFELSVALLEI	222	22	26°29'49.21S	26°38'33.95E	Farm Portion
297	BUFFELSVALLEI	222	5	26°29'50.18S	26°38'43.18E	Farm Portion
298	BUFFELSVALLEI	222	61	26°29'38.58S	26°39'2.33E	Farm Portion
299	BUFFELSVALLEI	222	103	26°29'27.07S	26°40'11.88E	Farm Portion
300	BUFFELSVALLEI	222	57	26°29'21.2S	26°39'12.08E	Farm Portion
301	BUFFELSVALLEI	222	54	26°28'12.47S	26°40'13.27E	Farm Portion
302	BUFFELSVALLEI	222	64	26°29'17.55S	26°39'16.7E	Farm Portion
303	BUFFELSVALLEI	222	65	26°29'15.59S	26°39'25.58E	Farm Portion
304	BUFFELSVALLEI	222	111	26°31'18.7S	26°38'29.48E	Farm Portion
305	BUFFELSVALLEI	222	55	26°28'56.03S	26°40'55.31E	Farm Portion
306	BUFFELSVALLEI	222	101	26°28'44.46S	26°39'56.08E	Farm Portion
307	BUFFELSVALLEI	222	51	26°28'30.73S	26°40'1.94E	Farm Portion
308	BUFFELSVALLEI	222	107	26°31'25.55S	26°39'0.88E	Farm Portion
309	BUFFELSVALLEI	222	25	26°31'13.35S	26°39'13.87E	Farm Portion
310	BUFFELSVALLEI	222	26	26°30'53.08S	26°39'20.84E	Farm Portion
311	BUFFELSVALLEI	222	56	26°28'39.77S	26°40'1.18E	Farm Portion
312	BUFFELSVALLEI	222	85	26°29'1.69S	26°40'28.25E	Farm Portion
313	BUFFELSVALLEI	222	94	26°28'34.44S	26°40'28.91E	Farm Portion
314	BUFFELSVALLEI	222	91	26°29'59.2S	26°39'53.6E	Farm Portion
315	BUFFELSVALLEI	222	68	26°30'36.85S	26°39'20.18E	Farm Portion
316	BUFFELSVALLEI	222	28	26°30'33.43S	26°39'23.94E	Farm Portion
317	BUFFELSVALLEI	222	41	26°30'24.64S	26°39'31.06E	Farm Portion
318	BUFFELSVALLEI	222	131	26°30'5.99S	26°39'10.52E	Farm Portion
319	BUFFELSVALLEI	222	90	26°30'9.33S	26°39'48.5E	Farm Portion
320	BUFFELSVALLEI	222	42	26°30'16.25S	26°38'53.81E	Farm Portion
321	BUFFELSVALLEI	222	44	26°30'9.8S	26°39'2.56E	Farm Portion
322	TSHING	1639	0	26°19'32.06S	26°48'3.62E	Public Place
323	TSHING	1640	0	26°19'25.8S	26°48'10.78E	Public Place
324	TOEVLUG	351	0	26°19'24.19S	26°48'43.78E	Public Place
325	TSHING	3125	0	26°19'23.45S	26°48'34.46E	Public Place
326	TOEVLUG	352	0	26°19'25.86S	26°48'37.38E	Public Place

Disclaimer applies

Development footprint[1] vertices:
No development footprint(s) specified.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	14/12/16/3/3/2/2386	Solar PV	Approved	19.8
2	14/12/16/3/3/1/2549	Solar PV	Approved	23.2
3	14/12/16/3/3/2/2257	Solar PV	Approved	28
4	14/12/16/3/3/2/2258	Solar PV	Approved	28
5	14/12/16/3/3/1/2692	Solar PV	Approved	17.6
6	14/12/16/3/3/1/2548	Solar PV	Approved	23.2
7	14/12/16/3/3/2/2184	Solar PV	Approved	6.1

Environmental Management Frameworks relevant to the application

No intersections with EMF areas found.

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is: **Transformation of land|Indigenous vegetation**.

Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

Incentive, restriction or prohibition	Implication
Strategic Transmission Corridor-Northern corridor	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Combined_EGI.pdf
Strategic Transmission Corridor-Central corridor	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Combined_EGI.pdf
South African Protected Areas	https://screening.environment.gov.za/ScreeningDownloads/Developmen

[1] "development footprint", means the area within the site on which the development will take place and incudes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

	tZones/SAPAD_OR_2024_Q3_Metadata.pdf
South African Conservation Areas	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/SACAD_OR_2024_Q3_Metadata.pdf

Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme	X			
Animal Species Theme		X		
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme	X			
Civil Aviation Theme		X		
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme			X	
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the known impacts associated with the proposed development, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

No	Specialist assessment	Assessment Protocol
1	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
2	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
5	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
6	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_P

OFFICIAL

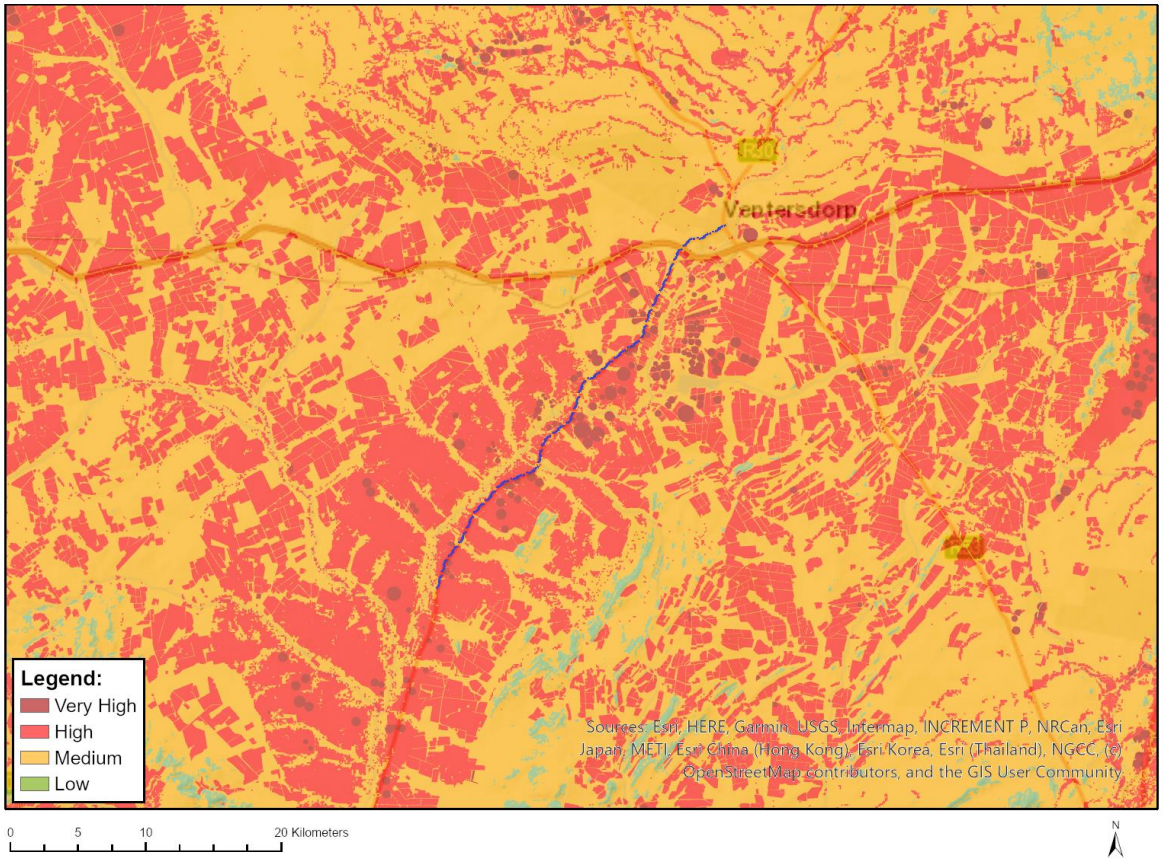
		rotocols.pdf
7	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
8	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

OFFICIAL

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY



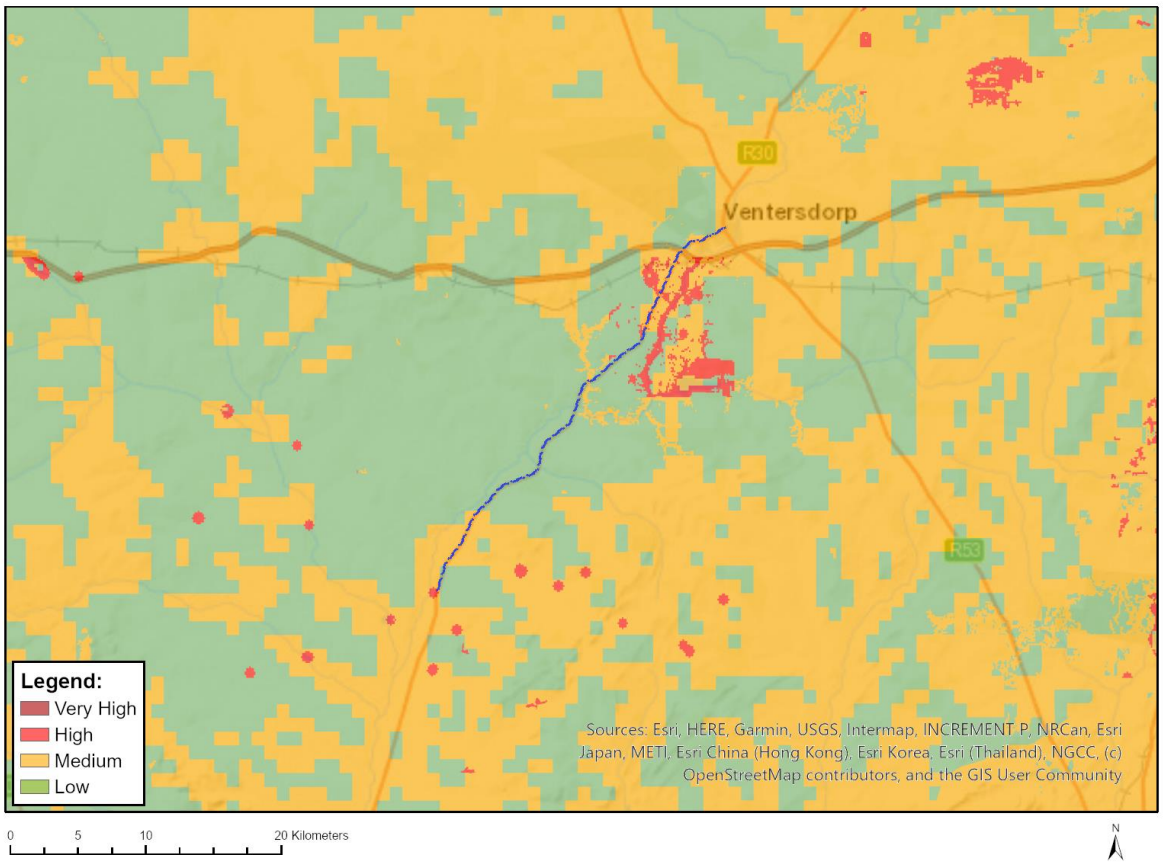
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
High	Land capability;09. Moderate-High/10. Moderate-High
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;09. Moderate-High/10. Moderate-High
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
High	Small Holdings;Land capability;09. Moderate-High/10. Moderate-High
High	Small Holdings;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Low	Land capability;01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Very High	Pivot Irrigation;Land capability;09. Moderate-High/10. Moderate-High

Very High	Pivot Irrigation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



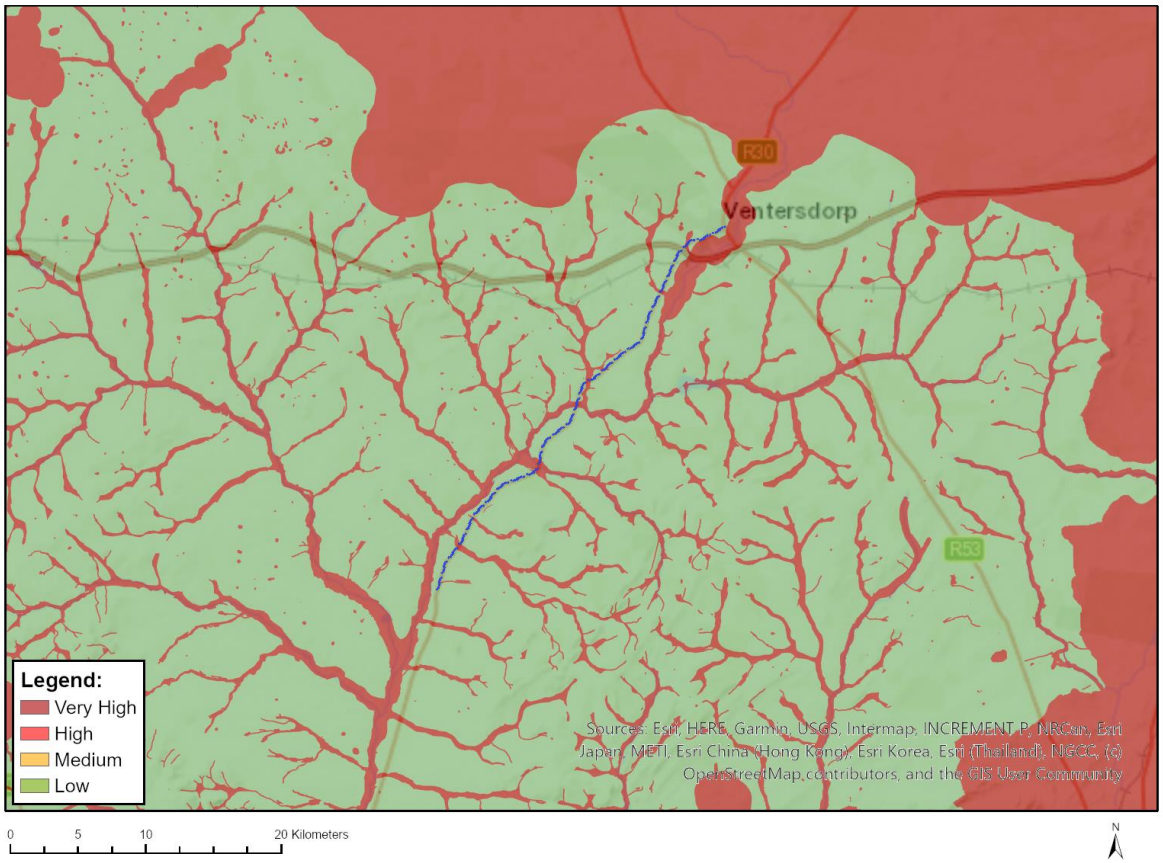
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Tyto capensis
High	Aves-Mycteria ibis
Low	Subject to confirmation
Medium	Aves-Tyto capensis
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Hydrictis maculicollis

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

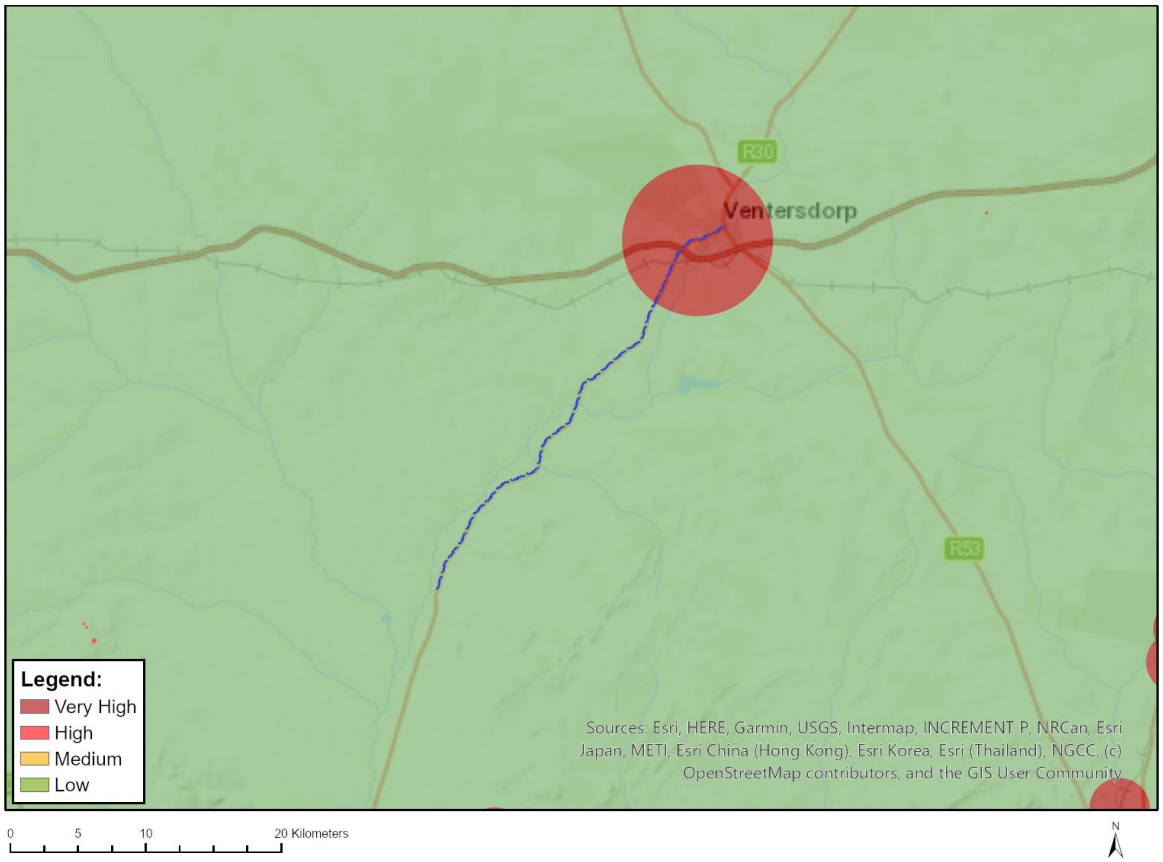
Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	ESA 1
Very High	ESA 2
Very High	Rivers_C
Very High	Rivers_Z
Very High	Wetlands_Dry Highveld Grassland Bioregion (Depression)
Very High	Wetlands_Dry Highveld Grassland Bioregion (Floodplain)
Very High	Wetlands_Dry Highveld Grassland Bioregion (Seep)

OFFICIAL

Disclaimer applies

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

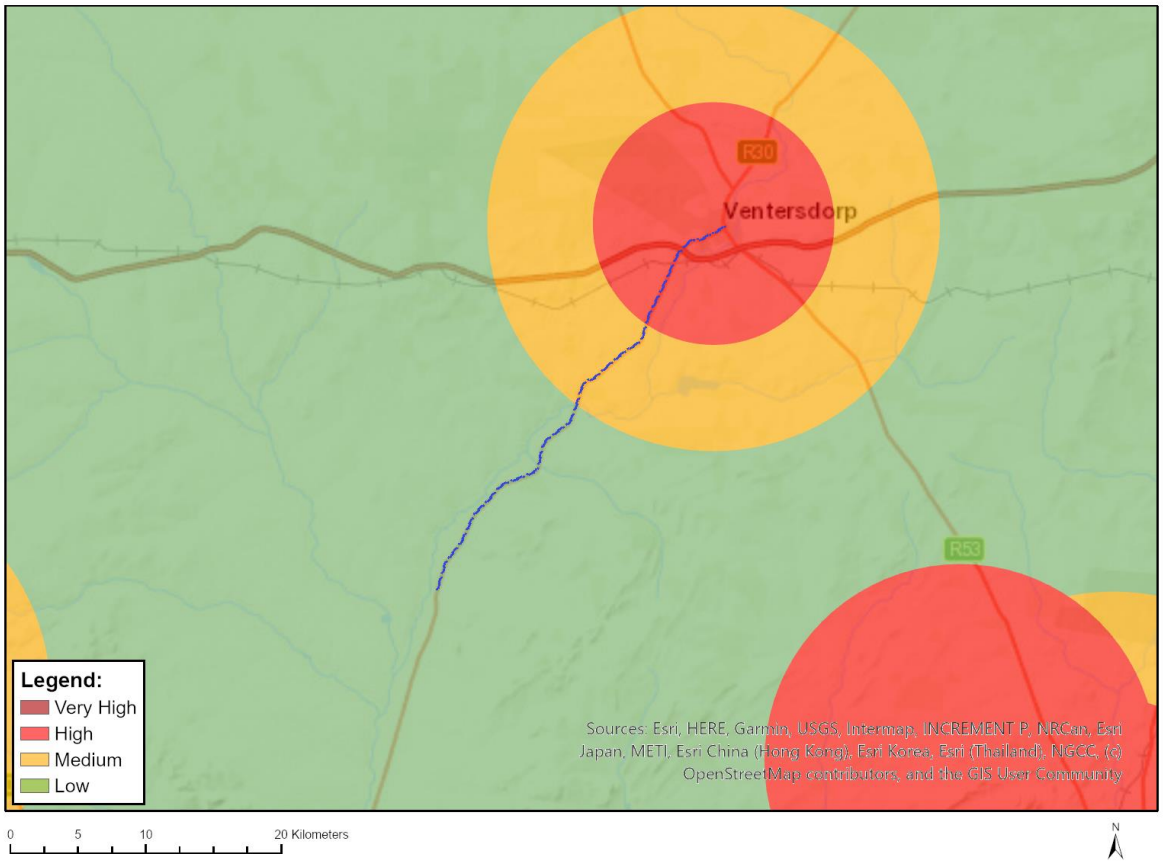


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Within 5km of a Grade I Heritage site

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

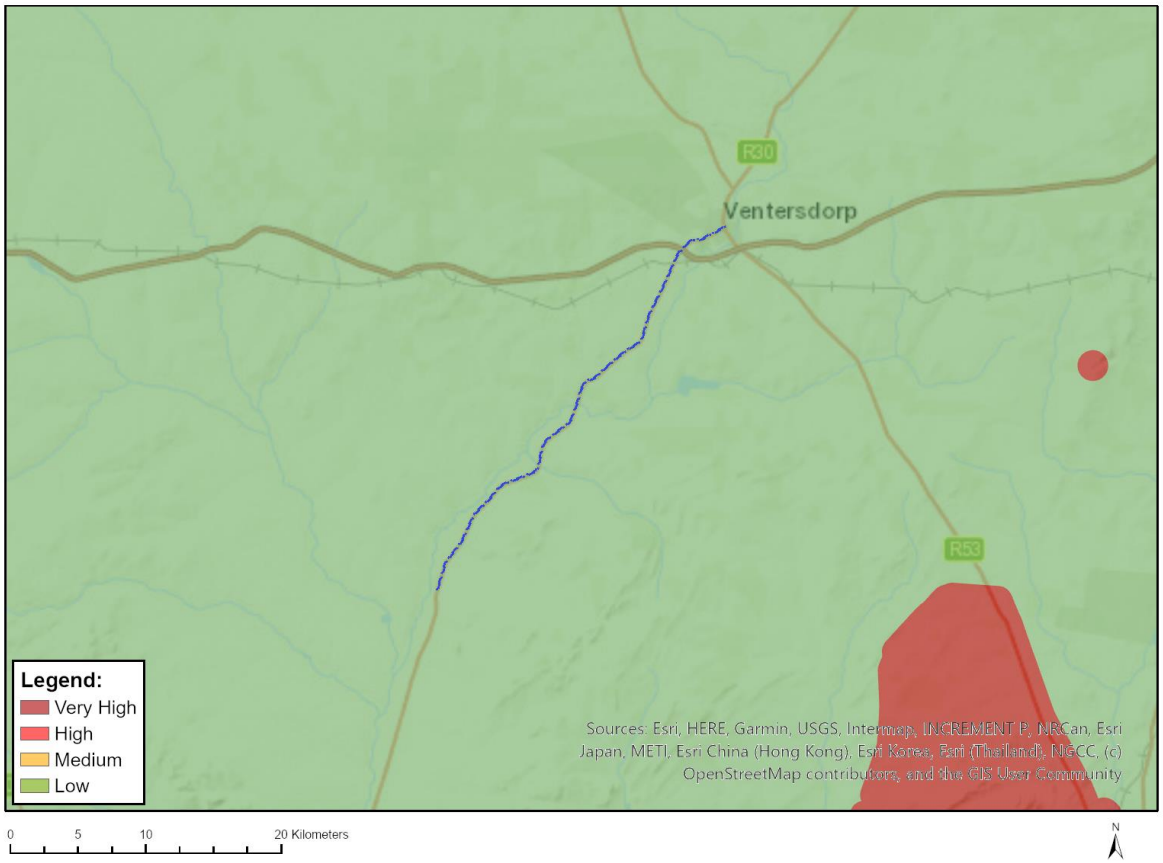


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 8 km of other civil aviation aerodrome
Low	Low sensitivity
Medium	Between 8 and 15 km of other civil aviation aerodrome

MAP OF RELATIVE DEFENCE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

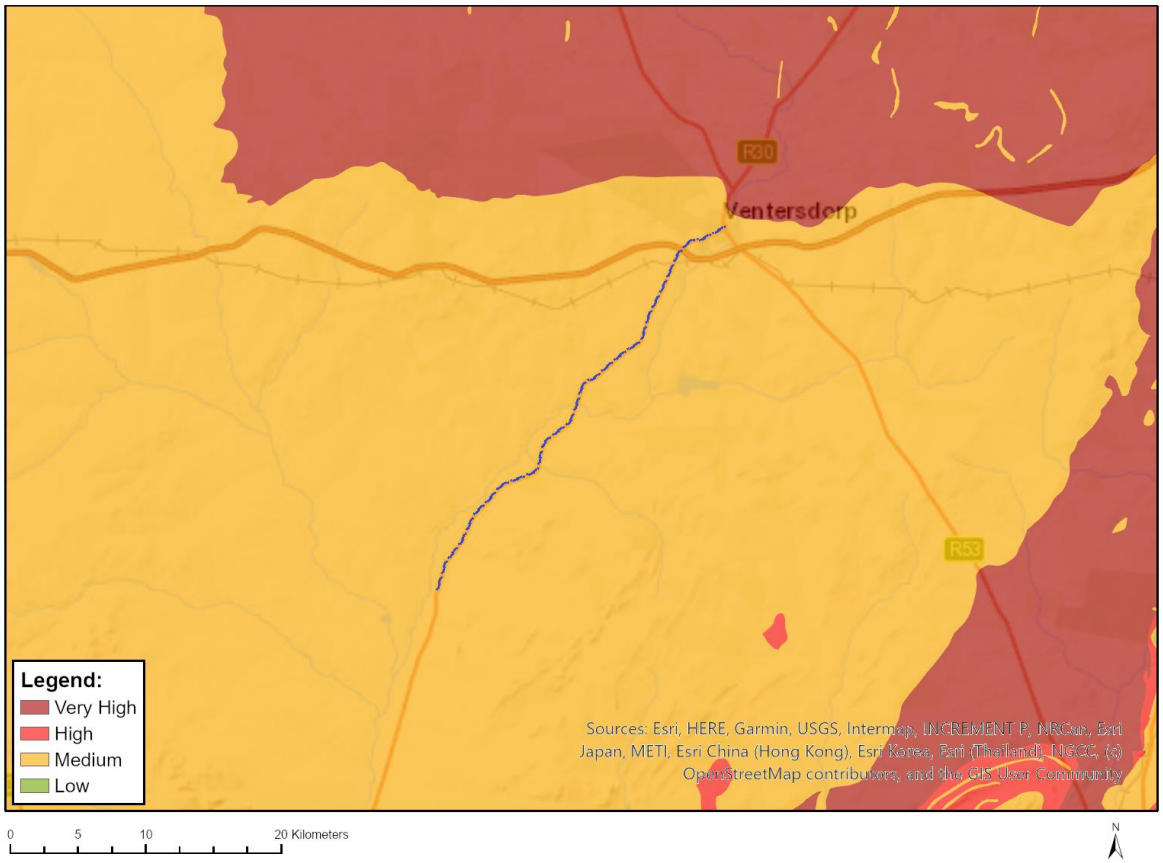
Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

OFFICIAL

Disclaimer applies

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



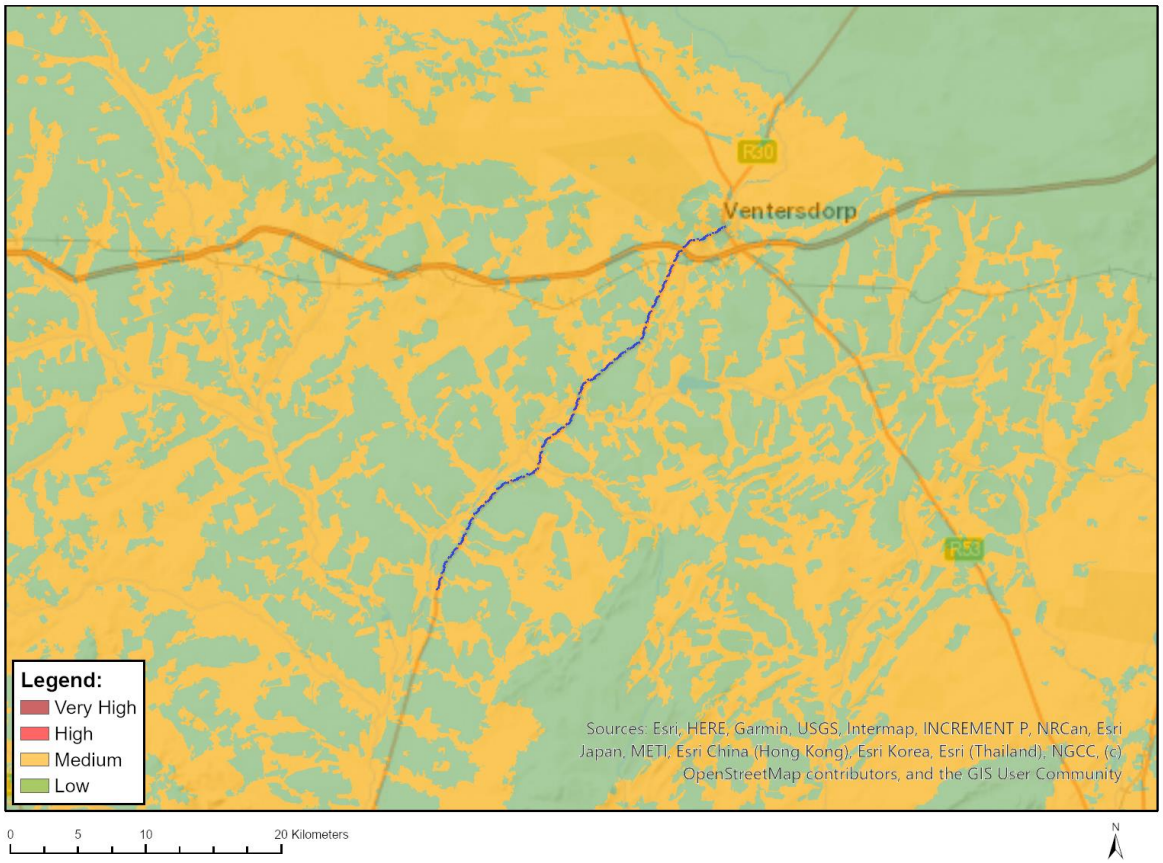
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Features with a Low paleontological sensitivity
Medium	Features with a Medium paleontological sensitivity

OFFICIAL

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

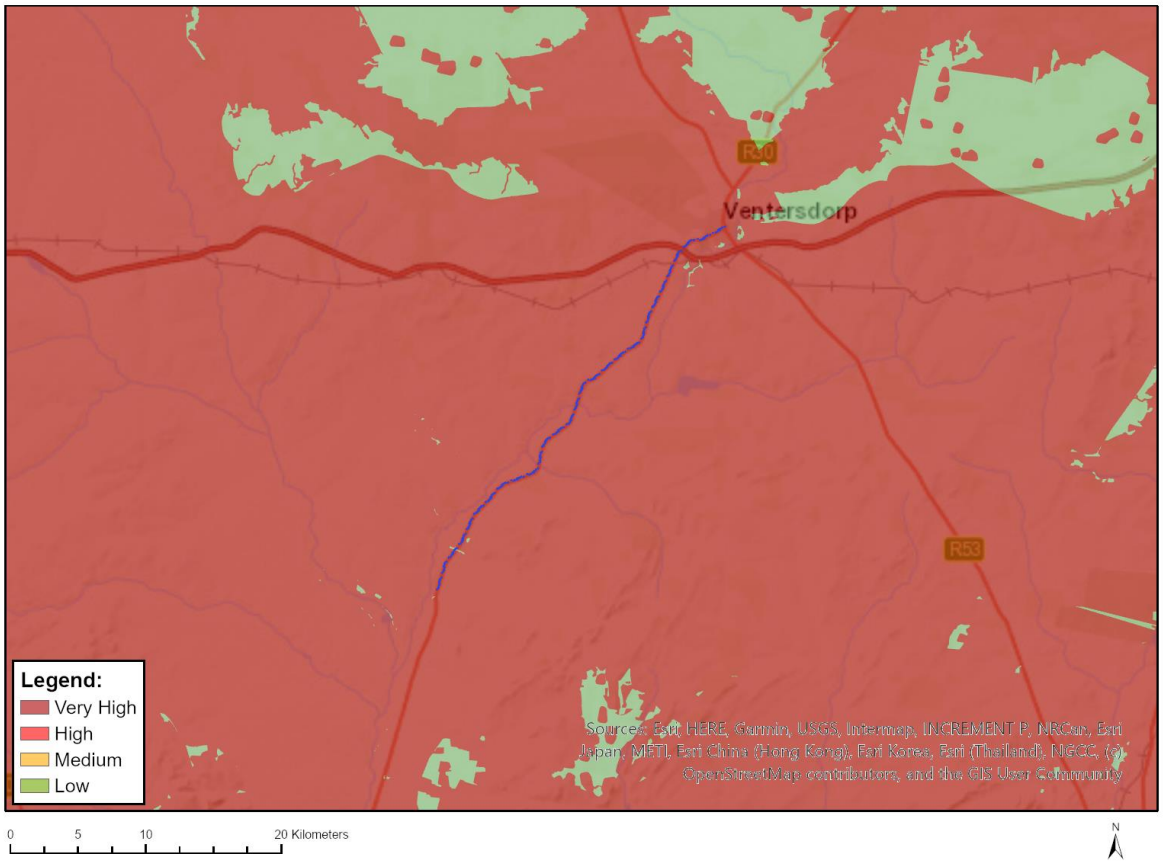
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1261

Disclaimer applies

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	Schoonspruit Nature Reserve
Very High	CBA 1
Very High	CBA 2
Very High	ESA 1
Very High	ESA 2
Very High	National Protected Area Expansion Strategy (NPAES)
Very High	EN_Vaal-Vet Sandy Grassland

Disclaimer applies

APPENDIX 5.1: TERRESTRIAL COMPLIANCE STATEMENT

TERRESTRIAL BIODIVERSITY COMPLIANCE STATEMENT:

FOR THE PROPOSED UPGRADE OF NATIONAL ROAD R30 SECTION 8 FROM KM 36.8 TO VENTERSDORP KM 68.646, IN THE MATLOSANA AND JB MARKS LOCAL MUNICIPALITIES, DR KENNETH KAUNDA DISTRICT MUNICIPALITY, NORTHWEST PROVINCE.



PRODUCED BY:

PRODUCED BY:	ENVIRONMENTAL ASSESSMENT PRACTITIONER	PRODUCED FOR:
 Physical Address: **5 13th Avenue, Fairlands, Randburg 2170** Mobile Number: **071 2082 364**Email: **info@ntumbulukoconsulting.co.za**	Earthlink Environmental Services	 South African National Roads Agency SOC Limited

July 2025

CONDITIONS RELATING TO THIS REPORT

DECLARATION OF INTEREST

Ntumbuluko Consulting Pty (Ltd) has no vested interest in the property studied nor is it affiliated with any other person/body involved with the property and/or proposed development. Ntumbuluko Consulting Pty (Ltd) is not a subsidiary, legally or financially of the proponent. The study was undertaken by Mr Tshuxekani Maluleke, he is a registered Natural Scientists with the following details:

QUALIFICATIONS

SPECIALIST	QUALIFICATION
Mr Tshuxekani Maluleke (SACNASP Reg. No. 120501)	MSc Environmental Sciences (Wits University) BSc Hons Zoology (University of Limpopo) BSc Hons Animal, Plant and Environmental Sciences (Wits University)

APPROVAL

PREPARED BY:

Mr Tshuxekani Maluleke



Wetland and Biodiversity Specialist

Msc. Environmental Sciences

SACNASP

17 July 2025

INDEMNITY

Although Ntumbuluko Consulting Pty (Ltd) exercises due care and diligence in rendering services and preparing documents, the client takes full responsibility for this report and its implementation in terms of the National Environmental Management Act of 1998, and exempt Ntumbuluko Consulting Pty (Ltd) and its associates and their sub-contractors from any legal responsibility based on the timing of the assessment, the result and the duration thereof, which has an influence on the credibility and accuracy of this report. Ntumbuluko Consulting Pty (Ltd) accepts no liability, and the client indemnifies Ntumbuluko Consulting Pty (Ltd) and its directors, managers, agents, and employees against all actions, claims, demands, losses, liabilities, costs, damages, and expenses arising from or in connection with services rendered, directly or indirectly, by Ntumbuluko Consulting Pty (Ltd) and by the use of this document.

TABLE OF CONTENTS

1 INTRODUCTION 9

2 PROJECT DESCRIPTION AND BACKGROUND 10

3 STUDY AREA 11

4 TERMS OF REFERENCE 14

4.1 SCOPE OF STUDY 14

4.1.1 Floral study: 14

4.1.2 Faunal study: 15

5 LEGAL FRAMEWORK 15

5.1 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT NO 107 OF 1998) (NEMA) AS AMENDED 15

5.2 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT (ACT NO 10 OF 2004) (NEM: BA) 16

5.3 THE NATIONAL BIODIVERSITY FRAMEWORK (2017-2022) 16

5.4 THE NORTHWEST BIODIVERSITY MANAGEMENT ACT, 2016 (ACT NO. 4 OF 2016) (NWBMA) 16

5.5 CONSERVATION OF AGRICULTURAL RESOURCES ACT (ACT NO 43 OF 1983) (CARA): 17

5.6 THE NATIONAL FOREST ACT (ACT NO 84 OF 1998) (NFA) 17

5.7 CONVENTION ON BIOLOGICAL DIVERSITY 18

5.8 CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA (CITES) 18

5.9 CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS 18

5.10 THE INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE 19

5.11 CONVENTION ON WETLANDS (POPULARLY KNOWN AS THE RAMSAR CONVENTION) 19

5.12 WORLD HERITAGE CONVENTION (WHC) 19

5.13 RAMSAR CONVENTION 19

5.14 INTERNATIONAL PLANT PROTECTION CONVENTION (IPPC) 20
6 REPORT LEGISLATIVE FRAMEWORK 21
7 SITE CHARACTERISTICS 23
7.1 GEOLOGY & SOILS 23
7.2 CLIMATE 23
7.3 VEGETATION TYPE ASSOCIATED WITH THE R30 S8 ROAD UPGRADE 23
7.3.1 VAAL-VET SANDY GRASSLAND (GH 10) 23
7.3.2 AZa 5 Highveld Alluvial Vegetation 24
7.4 Gh 10 Vaal-Vet Sandy Grassland's Conservation Status 28
7.5 2015 NORTH WEST BIODIVERSITY SECTOR PLAN 28
8 METHODOLOGY 31
8.1 DESKTOP ASSESSMENT 31
8.1.1 Ecologically Important Landscape Features 31
8.1.2 Desktop Plant Species Assessment 32
8.2 BOTANICAL ASSESSMENT 33
8.3 STUDY LIMITATIONS 33
9 HABITAT SURVEY AND SITE ECOLOGICAL IMPORTANCE 34
10 RESULTS OF THE FLORA ASSESSMENT 37
10.1 FLORA SPECIES OF SPECIAL CONCERN 40
10.1.1 Ethnobotanical plant species 43
10.2 ALIEN INVASIVE SPECIES PRESENT ON SITE 44
11 RESULTS OF THE FAUNA ASSESSMENT 45
11.1 MAMMALS 45
11.1.1 Field Investigation Findings 48
11.2 REPTILES 49
11.2.1 Field investigation findings 50
11.3 AVIFAUNA 50
11.3.1 Field investigation findings 51
11.4 INVERTEBRATES 52

11.4.1 Field investigation findings 53

12 CONCLUSION 54

13 Specialist Opinion 54

14 REFERENCES 55

LIST OF FIGURES

Figure 3-1:Locality Map (Indicated in red) 12

Figure 3-2: Landuse Map (Indicated in red) 13

Figure 7-1: climate diagram for Gh 12 Vaal-Vet Sandy Grassland 23

Figure 7-2: Vegetation Map-Road R30 Section 8 27

Figure 7-3: The R30 Section 8 in relation to the 2015 North West Biodiversity Sector Plan. 30

Figure 9-1: Biodiversity SEI delineation relevant to the R30 Road section 8. 36

Figure 10-1:Overview of the state of vegetation found along the road servitude (Representing start Middle and End of the Road). 37

Figure 10-2:Degraded grassland observed next to the road servitude. 38

Figure 10-3: Watercourse located next to the road servitude with an abundance of Phragmites 39

Figure 10-4: Eucalyptus trees observed along the road servitude. 39

Figure 10-5: Phragmites species observed along the road servitudes. 40

Figure 10-6:Eucalyptus tree observed onsite 45

Figure 11-1:Grazing Cattle observed on a property next to the road. 49

Figure 11-2: Long-crested Eagle (Lophaetus occipitalis) observed on a telephone line along the servitude. 51

Figure 11-3: Example of the Long-tailed widowbird. 52

Figure 11-4: Potamonautes species observed onsite. 53

LIST OF TABLES

Table 6-1: Terrestrial Biodiversity Compliance Statement information requirements as per the relevant protocol, including the location of the information within this report. 21

Table 7-1: Important Taxa associated with the R30 Section 8 Upgrade (Mucina and Rutherford 2006). 24

Table 9-1: Site Ecological Importance assessment summary of the habitat types delineated within the project area. 34

Table 10-1: NCNCA are known to be found in the area. 41

Table 11-1: Sensitive mammals that are likely to occur onsite 45

Table 11-2: ReptileMAP — Reptile Atlas of Africa Summary information for locus 2626DA 49

Table 11-3: Butterfly species expected to occur on site. 52

LIST OF ABBREVIATIONS

CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CBD	Convention on Biological Diversity
CR	Critically Endangered
ESA	Ecological Support Areas
EN	Endangered
GIS	Geographic Information System
IPPC	International Plant Protection Convention
IUCN	International Union for Conservation of Nature
LC	Least Concern
NEMA	National Environmental Management Act (Act 107 of 1998)
NFEPA	National Freshwater Ecosystem Priority Areas
NT	Near Threatened
PA	Protected Areas
SANBI	South African National Biodiversity Institute
SSC	Species of Special Concern
VU	Vulnerable

DEFINITIONS

Alien animal	(a) Any live vertebrate, including a bird and a reptile, but excluding a fish, belonging to a species or subspecies that is not a recognised domestic species and the natural habitat of which is not in the Republic; or (b) The egg of such vertebrate.
Biodiversity	Means the diversity of animals, plants or other organisms, including the diversity of animals, plants or other organisms found within and between— (a) Ecosystems; (b) Habitats; (c) The ecological complexes of which these systems and habitats are part; and (d) Species.
CITES	Means the Convention on International Trade in Endangered Species of Wild Fauna and Flora;

Endangered Species	Means a species is endangered when it is facing a very high risk of extinction in the wild in the near future and includes— (*a*) Any living or dead specimen of such a species; or (*b*) Any egg, skin, bone, feather, seed, flower or any other part or derivative of such a species.
Environment	Means the surroundings within which humans exist and that are made up of— (*a*) The land, water and atmosphere of the earth; (*b*) Microorganisms, plant and animal life; (*c*) Any part or combination of (*a*) and (*b*) and the interrelationships amongst and between them; and (*d*) The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing;
Indigenous plant	(*a*) Means any living or dead plant which is indigenous to the Republic, whether artificially propagated or in its wild state; and (*b*) Includes the flower, pollen, seed, cone, fruit, bulb, tuber, stem or root or any other part or derivative of such plant but does not include a plant declared a weed in terms of any legislation.
Protected area	Means— (*a*) A provincial nature reserves; (*b*) A site of ecological importance; (*c*) A protected environment; (*d*) A private nature reserves; or (*e*) A resource use area.
Protected environment	Means an area declared a Protected Environment or Private Nature Reserve in terms of section 21 (1) (*a*).

1 INTRODUCTION

Ntumbuluko Consulting (Pty) Ltd has been appointed by Earthlink Environmental Services (Pty) Ltd on behalf of the South African National Roads Agency SOC Ltd (hereafter referred to as SANRAL) to conduct a terrestrial biodiversity assessment(covering both Plant and Animal Species), and to compile a compliance statement for the proposed upgrade of the national road R30 Section 8 from Km 36.8 to Ventersdorp Km 68.646, within the Matlosana And JB Marks Local Municipalities, in the Dr Keneth Kaunda District Municipality, North West Province.

In June 2025, a comprehensive ecological assessment of the R30 Section 8 Road servitude was undertaken. This included both a desktop study and a field survey to establish the baseline ecological condition of the project area and to provide a detailed description of the receiving environment. The investigation encompassed the identification and characterization of locally relevant sensitive receptors. Furthermore, potential impacts of the proposed development on these receptors were systematically evaluated.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations, 2014 (No. 326, 7 April 2017) of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998). The approach has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 20 March 2020 as well as the Government Notice 1150 in terms of NEMA dated 30 October 2020.''Procedures for the Assessment and Minimum Criteria for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorization''. The National Web based Environmental Screening Tool has characterized the terrestrial biodiversity theme for the project area as ''Very High'' sensitivity (National Environmental Screening Tool, 2022).

The purpose of the specialist study is to provide relevant input into the overall assessment and application process. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making as to the ecological viability of the project and the impacts that its implementation may have on the natural environment.

2 PROJECT DESCRIPTION AND BACKGROUND

South African National Road Agency SOC Limited (SANRAL) proposes to upgrade Road R30 section 8, a 31.846-kilometer stretch located from (km 36.8) to Ventersdorp (km 68.646). The project starts at km 36.800, south of the Opraap road-side junction, and continues up to km 68.646 west of the 3-way stop control intersection with the R 53 to Potchefstroom. This project falls within the City Matlosana and JB Marks Local Municipalities and is situated within the Dr Kenneth Kaunda District Municipality in the North West province, with Ventersdorp the closest town. The R 30 Section 8 is a two-lane single carriageway rural road with bi-directional traffic movement and can be classified as an AASHTO Class IIIA secondary rural arterial. The road cross-section varies considerably, with gravel shoulders provided up to km 67.00. The new proposed carriageway width will be 13.4m under normal conditions and 12.4m on high fills.

The project is aimed at improving the road geometry by adding surfaced shoulders and rehabilitating the existing pavement structure to enable it to carry a 20-year design traffic load.

The major aspects of this project include the following:

- Increase of the road reserve width is anticipated,
- Improvement of the existing pavement structure,
- general widening of the existing road cross section to 3.7m lanes and 2.5m (high fill) – 3.0m(normal conditions) surfaced shoulders,
- Isolated vertical and horizontal geometric improvements,
- widening of river bridges and some major and minor culverts,
- Demolishing and construction of new river bridges
- horizontal re-alignment of the road at curves:
  - from KM 46.9 to KM 47.7
  - from KM 53.9 to KM 55
  - from KM60.2 to KM60.7
- Possible 6.5m wide temporary deviation to accommodate two-way traffic during construction.
- Possible Opening of one hard-rock quarry and re-entry into 5 potential borrow pits
- Stockpile areas and vegetation clearance outside road reserve in excess of one hectare.

- Possible utilisation of four detours/bypasses during construction, these are provincial/municipal roads, both gravel and/or surfaced. The contractor will be responsible for maintaining these roads
- Stockpile areas and vegetation clearance outside road reserve more than 1 Hectare.

3 STUDY AREA

This project is located within the jurisdiction of the City of Matlosana and JB Marks Local Municipalities, under the administration of the Dr Kenneth Kaunda District Municipality in the Northwest Province. The nearest urban center is Ventersdorp (refer to **Figure 3-1**). The site is predominantly surrounded by cultivated agricultural land (**Figure 3-2**). The GPS coordinates are listed below:

Start Point: 26°31'56.56"S; 26°38'9.19"E

End Point:26°18'54.98"S, 26°49'38.86"E

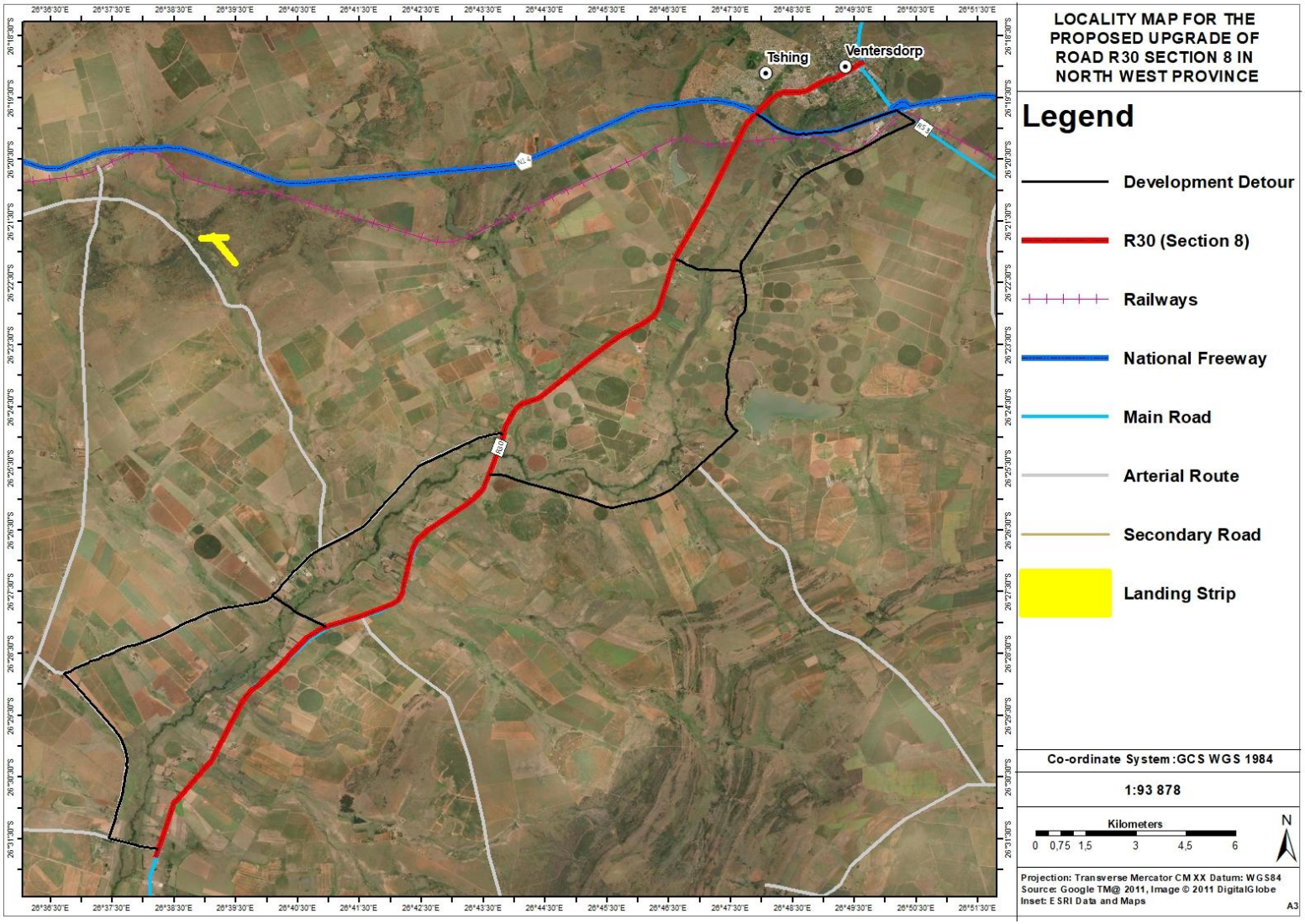


Figure 3-1:Locality Map (Indicated in red)

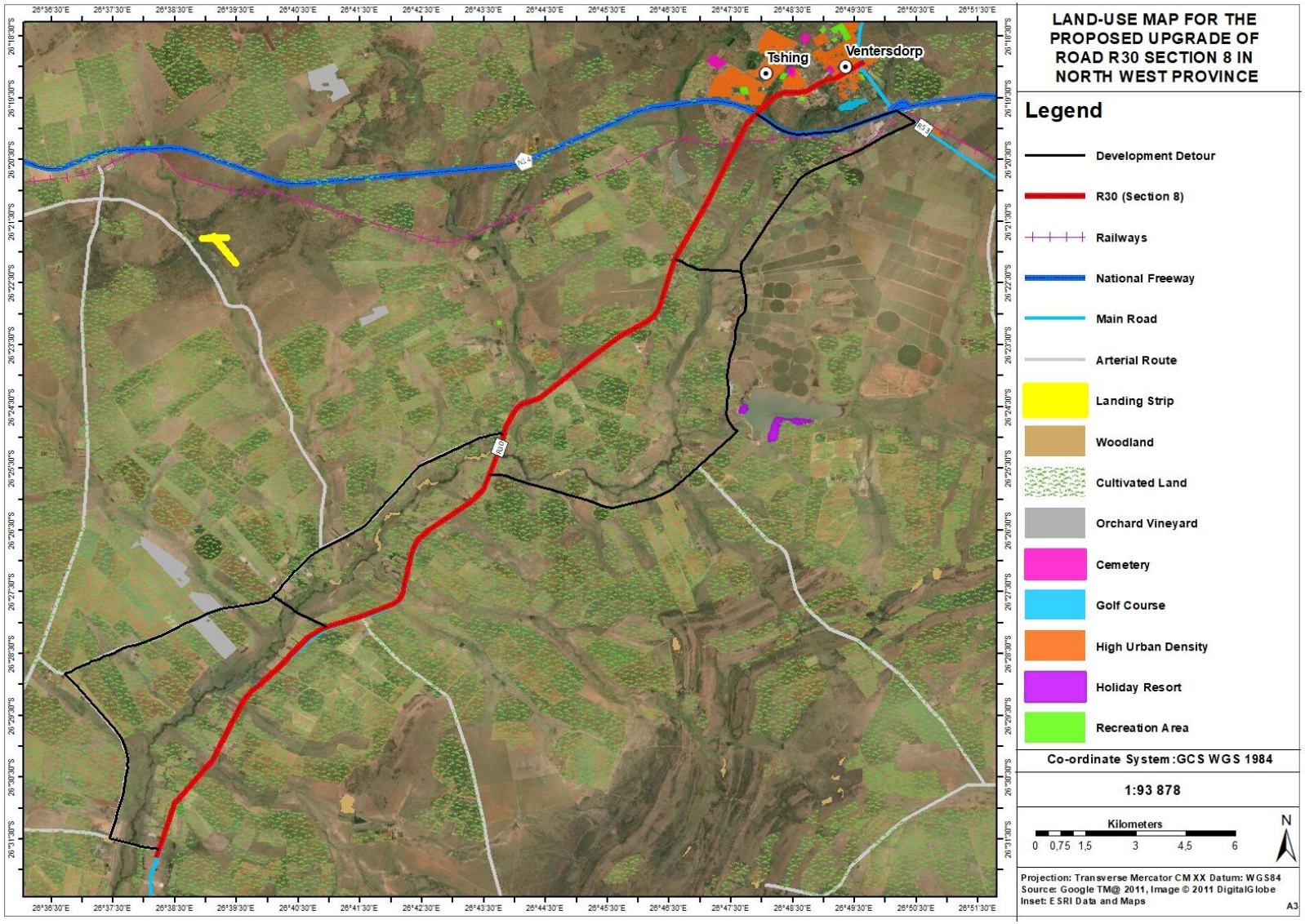


Figure 3-2: Landuse Map (Indicated in red)

4 TERMS OF REFERENCE

The principal aim of the assessment was to adequately assess the current state of the terrestrial biodiversity in order to identify any significant and/or sensitive ecological receptors that may be impacted upon by the proposed road upgrade. The following are the terms of reference are applicable to the project:

- Description of the baseline receiving environment specific to the field of expertise (including the general surrounding area as well as the site-specific environment);
- Identification and description of any sensitive receptors in terms of relevant specialist disciplines (i.e., terrestrial biodiversity) that occur in the project area, and the manner in which these sensitive receptors may be affected by the activity;
- Screening to identify any critical issues (potential fatal flaws) that may result in a rejection of the application; and
- Provide a map to identify sensitive receptors in the project area, based on available maps and database information;

4.1 SCOPE OF STUDY

4.1.1 Floral study:

- Conduct fieldwork to locate and identify the current state of vegetation on the study area, with emphasis on the footprint of the R30-S8.
- Determine the species that are present on each onsite.
- Identify sensitive vegetation types and critical biodiversity areas on each site.
- Identify Critical Biodiversity and Ecological Support Areas on each site.
- Determine whether the location of the R30-S8 is located within the distribution range of species listed as Vulnerable, Endangered or Critically Endangered and Protected.
- Provide photographic evidence of the current state of vegetation on each site (i.e. natural or transformed, disturbed etc.) identify and describe the conservation value and conservation planning that are relevant to the site.
- Determine alien species present onsite and the recommended management actions.

- Describe the potential direct, indirect and cumulative negative and positive impacts of the proposed activity on the vegetation species during construction, operation and decommissioning phases of the project.
- Identification of issues and potential direct, indirect and cumulative biodiversity impacts.
- Provide monitoring requirements, mitigation measures and recommendations.

4.1.2 Faunal study:

- Conduct fieldwork to describe and assess the current state of terrestrial fauna in the area.
- Describe the existing micro-habitats, and the species associated with those habitats.
- Provide a description of species composition and conservation status in terms of protected, endangered or vulnerable faunal species.
    - This description will include species which are likely to occur within, traverse across or forage within the proposed project area, as well as species which may not necessarily occur on site, but which are likely to be impacted upon as a result of the proposed development.

5 LEGAL FRAMEWORK

The following national and provincial legislative guidelines and requirements were followed as part of this study:

5.1 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT NO 107 OF 1998) (NEMA) AS AMENDED

This Act embraces all three (3) fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures. NEMA provides for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state; and to provide for matters connected therewith.

5.2 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT (ACT NO 10 OF 2004) (NEM: BA)

NEMBA was signed into law in mid-2004 and entered into effect on 1 September 2004. NEM: BA provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities. Certain activities, known as Restricted Activities, are regulated on listed species using permits by a special set of regulations published under the Act. Restricted activities regulated under the act are keeping, moving, having in possession, importing and exporting, and selling.

5.3 THE NATIONAL BIODIVERSITY FRAMEWORK (2017-2022)

The National Biodiversity Framework (NBF) is a requirement under Section 38 of the National Environmental Management: Biodiversity Act (Act 10 of 2004, hereafter referred to as the 'Biodiversity Act'). The NBF is a short to medium-term coordination tool that shows the alignment between the strategic objectives and outcomes identified in the National Biodiversity Strategy and Action Plan (NBSAP v.2, 2015) and other key national strategies, frameworks and systems that currently guide the work of the biodiversity sector and identifies mechanisms through which this work is coordinated. It also identifies a set of interventions or "acceleration measures" that can unlock or fast-track implementation of the NBSAP and indicates the relative roles of the many agencies involved in implementing these activities. The purpose of the NBF is not to provide a comprehensive review of all work currently being undertaken in the biodiversity sector, nor to list all of the actions required to conserve and manage South Africa's biodiversity in support of sustainable development.

5.4 THE NORTHWEST BIODIVERSITY MANAGEMENT ACT, 2016 (ACT NO. 4 OF 2016) (NWBMA).

The objective of this act is to provide for the management and conservation of the North West Province's biophysical environment and protected areas within the framework of the National Environmental Management Act, 1998 (Act No 107 of 1998); to provide for the protection of species and ecological systems that warrant provincial protection; to provide for the sustainable use of indigenous biological resources; and to provide for matters connected therewith.

As per Chapter 4 Part 1 Section 13 (2), in addition to the species contemplated in schedule 2 and 3 of this Act, the responsible Member may, by notice in the Gazette, publish a further list of:

(a) Specially protected species, includes all indigenous species of animals and plants that are potentially threatened, exploited and economically important, and those that are listed under Section 56(1) of the Biodiversity Act, as well as under the National Forests Act of 1998 (Act No 84 of 1998), and those to receive additional protection beyond that of the ordinary species in the province;

(b) ordinary species, includes all common, widely distributed, indigenous species of vertebrates of the province that are not otherwise listed in any other categories, and that are to receive nominal protection.

Restricted activities involving listed specially protected species as per section 15 include:

(1) Any person who intends to carry out a restricted activity involving a specimen of listed specially protected species must do so by means of a permit issued in terms of Chapter 8;

(2) Permits contemplated in subsection (1) may differentiate between different categories of applicants and may impose different validity periods, and

(3) No person may import, introduce into the province from another country, export or re –export from the Province to another country a specimen of any listed species in the Appendices of the CITES without a permit issued in terms of Chapter 8.

5.5 CONSERVATION OF AGRICULTURAL RESOURCES ACT (ACT NO 43 OF 1983) (CARA):

This act regulates the utilization and protection of wetlands, soil conservation and all matters relating thereto; control and prevention of veld fires, control of weeds and invader plants, the prevention of water pollution resulting from farming practices and losses in biodiversity.

5.6 THE NATIONAL FOREST ACT (ACT NO 84 OF 1998) (NFA)

The main objective of the National Forests Act, 1998 is to promote the sustainable management and development of forests and to provide protection for certain forests and

trees. This said protection is provided through the protection of all natural forests (Section 7 (1), the protection of all trees declared to be protected in terms of section 12(1) of the Act, and the regulation of certain activities in a proclaimed State forest (Section 23(1)(a) – (k)). It should be noted that there are other environmental legislation administered by other State Departments that also regulate natural resources. The Act is responsible for:

- Promotes the sustainable management and development of forests for the benefit of all;
- Creates the conditions necessary to restructure forestry in South Africa;
- Provide special measures for the protection of certain forests and protected trees;
- Promotes the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes;
- Promotes community forestry; and
- Promotes greater participation in all aspects of forestry and the forest products industry by persons disadvantaged by unfair discrimination.

5.7 CONVENTION ON BIOLOGICAL DIVERSITY

The objectives of the CBD are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from commercial and other utilization of genetic resources. The agreement covers all ecosystems, species, and genetic resources.

5.8 CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA (CITES)

The CITES aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Through its three appendices, the Convention accords varying degrees of protection to more than 30,000 plant and animal species.

5.9 CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS

The CMS, or the Bonn Convention aims to conserve terrestrial, marine and avian migratory species throughout their range. Parties to the CMS work together to conserve migratory

species and their habitats by providing strict protection for the most endangered migratory species, by concluding regional multilateral agreements for the conservation and management of specific species or categories of species, and by undertaking co-operative research and conservation activities.

5.10 THE INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

The objectives of the Treaty are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security. The Treaty covers all plant genetic resources for food and agriculture, while it's Multilateral System of Access and Benefit-sharing covers a specific list of 64 crops and forages. The Treaty also includes provisions on Farmers' Rights.

5.11 CONVENTION ON WETLANDS (POPULARLY KNOWN AS THE RAMSAR CONVENTION)

The Ramsar Convention provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The convention covers all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well-being of human communities.

5.12 WORLD HERITAGE CONVENTION (WHC)

The primary mission of the WHC is to identify and conserve the world's cultural and natural heritage, by drawing up a list of sites whose outstanding values should be preserved for all humanity and to ensure their protection through a closer co-operation among nations.

5.13 RAMSAR CONVENTION

The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Ramsar Convention is the only global environmental treaty that deals with

a particular ecosystem. The treaty was adopted in the Iranian city of Ramsar in 1971 and the Convention's member countries cover all geographic regions of the planet.

5.14 INTERNATIONAL PLANT PROTECTION CONVENTION (IPPC)

The IPPC aims to protect world plant resources, including cultivated and wild plants by preventing the introduction and spread of plant pests and promoting the appropriate measures for their control. The convention provides the mechanisms to develop the International Standards for Phytosanitary Measures (ISPMs), and to help countries to implement the ISPMs and the other obligations under the IPPC, by facilitating the national capacity development, national reporting and dispute settlement. The Secretariat of the IPPC is hosted by the Food and Agriculture Organization of the United Nations (FAO).

6 REPORT LEGISLATIVE FRAMEWORK

In line with the protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial biodiversity, as per Government Notice 320 published in terms of NEMA, dated 20 March 2020. "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Act, 1998, when applying for Environmental Authorisation"-section 3, subsection 1:

- An applicant intending to undertake an activity identified in the scope of the protocol, on a site identified on the screening tool as being of 'Very High sensitivity for terrestrial biodiversity, must submit a Terrestrial Biodiversity Specialist Assessment; however
- Where the information gathered from the site sensitivity verification differs from the designation of Very High terrestrial biodiversity sensitivity on the screening tool and it is found to be of a Low sensitivity, then a Terrestrial Biodiversity Compliance Statement must be submitted.

The information obtained from a site sensitivity verification, which involved both a desktop assessment as well as a field survey, confirmed that the site the site (R30-S8 Road servitude) is mostly of a 'Low' sensitivity. Therefore, a Terrestrial Biodiversity Compliance Statement will be completed and submitted for this project.

As per sections 2 and 3 of the protocol discussed above, a Terrestrial Biodiversity Compliance Statement must contain the information as presented in **Table 6-1** below.

Table 6-1: Terrestrial Biodiversity Compliance Statement information requirements as per the relevant protocol, including the location of the information within this report.

Information to be Included (as per GN 320, 20 March 2020)	**Report Section**
Methodology used to undertake the site assessment and survey, and prepare the compliance statement, including relevant equipment and modelling used	8
Description of the assumptions and any uncertainties or gaps in knowledge or data	8.3
A baseline profile description of biodiversity and ecosystems of the site	7 and11

Information to be Included (as per GN 320, 20 March 2020)	**Report Section**
Site sensitivity verification: Desktop Analysis using satellite imagery and available information	7.1
A statement on the duration, date and season of the site inspection	9
Site sensitivity verification: Onsite inspection, include a description of current land use and vegetation found on-site	10
Site sensitivity verification: Photographs/evidence of environmental sensitivity	10
Screening tool confirmation/dispute: The assessment must verify the "low" sensitivity of the site, in terms of plant, animal and terrestrial biodiversity themes	9
Indicate whether or not the proposed development will have any impact on the terrestrial environment, animals and/or plants	12
A signed statement of independence by the specialist	6
Specialist details, including a CV	

A signed copy of the compliance statement must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

7 SITE CHARACTERISTICS

7.1 GEOLOGY & SOILS

The area consists of aeolian and colluvial sand overlying sandstone, mudstone and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba.

7.2 CLIMATE

The study site is warm-temperate, with a summer-rainfall climate. The area has an overall Mean Annual Precipitation (MAP) of 530 mm, with high summer temperatures. The area experiences severe frost (37 days per year on average) occurs in winter. See also climate diagram below (**Figure 7-1**).

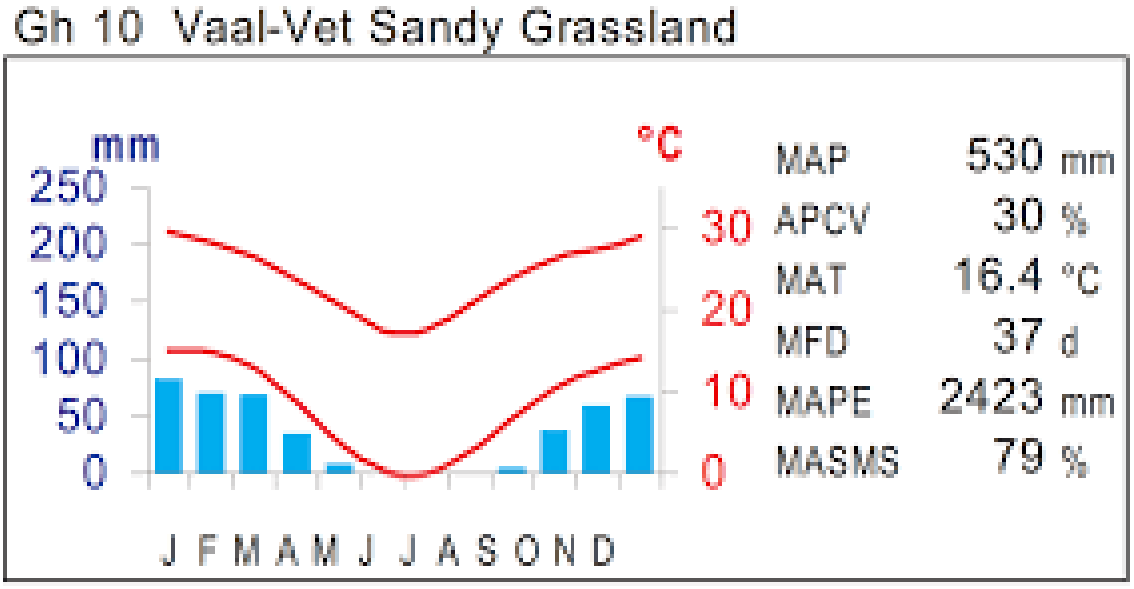


Figure 7-1: climate diagram for Gh 12 Vaal-Vet Sandy Grassland

7.3 VEGETATION TYPE ASSOCIATED WITH THE R30 S8 ROAD UPGRADE

7.3.1 VAAL-VET SANDY GRASSLAND (GH 10)

A significant portion of the road R30-S8 is located within the Vaal-Vet Sandy Grassland (Gh 10) vegetation unit (**Figure 7-2**). This vegetation unit is found in plains-dominated

landscape with some scattered, slightly irregular undulating plains and hills. The vegetation unit consist of low-tussock grasslands with an abundant karroid element. The vegetation unit is dominated by *Themeda triandra* which is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

The Vaal-Vet Sandy Grassland (Gh 10) is distributed in the North-West and Free State Provinces, South of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. This vegetation unit is found in altitudes ranging between 1 220 and 1 560 m, it is generally found in 1 260–1 360 m.

7.3.2 AZa 5 Highveld Alluvial Vegetation

A small section of the road cuts through the Highveld Alluvial Vegetation unit, this vegetation unit can be forms flat topography supporting riparian thickets mostly dominated by *Acacia karroo*, accompanied by seasonally flooded grasslands and disturbed herblands often dominated by alien plants.

This vegetation unit is distributed in the Free State, North-West, Mpumalanga and Gauteng Provinces as well as in Lesotho and Swaziland: Alluvial drainage lines and floodplains along rivers embedded within the Grassland Biome and marginal (eastern) units of the Kalahari (Savanna Biome), such as along upper Riet, Harts, upper Modder, upper Caledon, Vet, Sand, Vals, Wilge, Mooi, middle and upper Vaal Rivers etc. and their numerous tributaries. Altitude ranging from 1 000–1 500 m.

The taxa associated with the dominant vegetation units are summarized on **Table 7-1 below**.

Table 7-1: Important Taxa associated with the R30 Section 8 Upgrade (Mucina and Rutherford 2006).

PLANT FORM	SPECIES
Gh 10 Vaal-Vet Sandy Grassland	
Graminoids:	*Anthephora pubescens (d), Aristida congesta (d), Chloris virgata (d), Cymbopogon caesius (d), Cynodon dactylon (d), Digitaria argyrograpta (d), Elionurus muticus (d), Eragrostis chloromelas (d), E. lehmanniana (d), E. plana (d), E. trichophora (d), Heteropogon contortus (d), Panicum gilvum (d),*

PLANT FORM	SPECIES
	Setaria sphacelata (d), Themeda triandra (d), Tragus berteronianus (d), Brachiaria serrata, Cymbopogon pospischilii, Digitaria eriantha, Eragrostis curvula, E. obtusa, E. superba, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides.
Herbs	*Stachys spathulata (d), Barleria macrostegia, Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Geigeria aspera var. aspera, Helichrysum caespititium, Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Vernonia oligocephala.*
Geophytic Herbs	*Bulbine narcissifolia, Ledebouria marginata*
Succulent Herb	*Tripteris aghillana var. integrifolia*
Low Shrubs	*Felicia muricata (d), Pentzia globosa (d), Anthospermum rigidum subsp. pumilum, Helichrysum dregeanum, H. paronychioides, Ziziphus zeyheriana.*
AZa 5 Highveld Alluvial Vegetation	
Riparian thickets	**Small Trees:** *Acacia karroo (d), Salix mucronata subsp. mucronata (d), S. mucronata subsp. woodii (d, within subescarpment grasslands of KwaZulu-Natal), Ziziphus mucronata (d), Celtis africana, Rhus lancea.* **Tall Shrubs:** *Gymnosporia buxifolia (d), Rhus pyroides (d), Diospyros lyci¬o¬ides, Ehretia rigida, Grewia flava. Low Shrubs: Asparagus laricinus (d), A. suaveolens (d).* **Woody Climber:** *Clematis brachiata. Succulent Shrub: Lycium hirsutum (d). Graminoids: Setaria verticillata (d), Panicum maximum.* **Herb:** *Pollichia campestris.*
Reed beds Megagraminoid	*Phragmites australis (d).* **Flooded grasslands & herblands Low Shrubs:** *Gomphocarpus fruticosus (d), Felicia muricata. Succulent Shrub: Salsola rabieana. Graminoids: Agrostis lachnantha (d), Andropogon eucomus (d), Chloris virgata (d), Cynodon dactylon (d), Eragrostis plana (d), Hemarthria altissima (d), Imperata cylindrica (d), Ischaemum fasciculatum (d), Miscanthus junceus (d), Paspalum distichum (d), Andropogon appendiculatus, Brachiaria marlothii, Cyperus denudatus, C. longus, Echinochloa holubii, Eragrostis obtusa, E. porosa, Fimbristylis ferruginea, Panicum coloratum, Pycreus mundii, Sporobolus africanus, S. fimbriatus, Themeda triandra, Urochloa panicoides. Herbs: Persicaria lapathifolia (d), Alternanthera sessilis, Barleria macrostegia, Corchorus asplenifolius,*

PLANT FORM	SPECIES
	Equisetum ramosissimum, Galium capense, Hibiscus pusillus, Lobelia angolensis, Nidorella resedifolia, Persicaria amphibia, P. hystricula, Pseudognaphalium oligandrum, Pulicaria scabra, Rorippa fluviatilis var. fluviatilis, Senecio inornatus, Stachys hyssopoides, Vahlia capensis. **Geophytic Herbs:** *Crinum bulbispermum, Haplocarpha lyrata. Open water* **Aquatic Herb: Myriophyllum spicatum**.

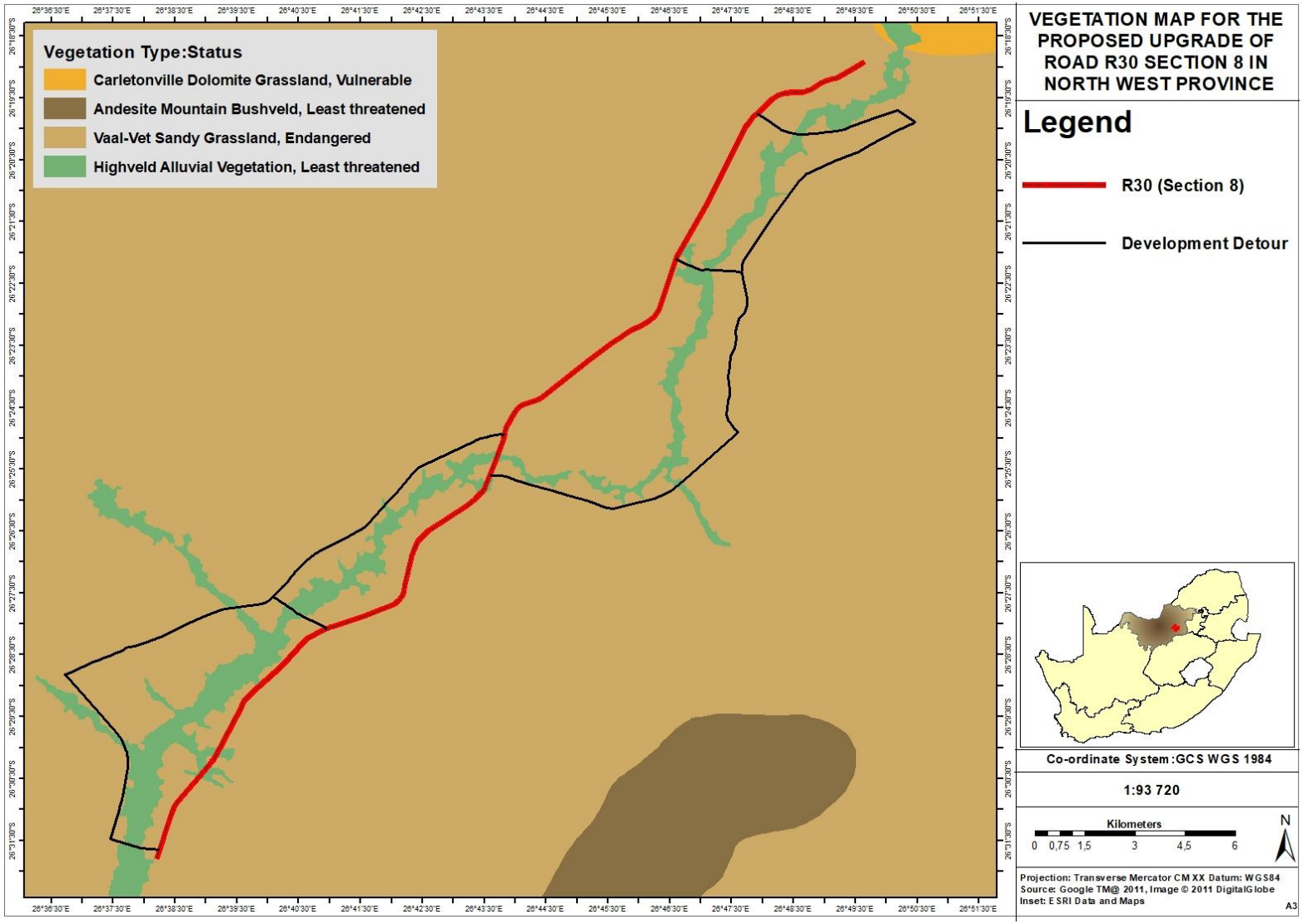


Figure 7-2: Vegetation Map-Road R30 Section 8

7.4 Gh 10 Vaal-Vet Sandy Grassland's Conservation Status

The Gh 10 Vaal-Vet Sandy Grassland is classified as **Endangered**. A conservation target of 24% has been set. Only 0.3% is statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. Erosion very low (85.3%) and low (11%).

The AZa 5 Highveld Alluvial Vegetation is classified as Least threatened. A conservation target of 31% has been set with nearly 10% statutorily conserved in the Barberspan (a Ramsar site), Bloemhof Dam, Christiana, Faan Meintjes, Sandveld, Schoonspruit, Soetdoring and Wolwespruit Nature Reserves. More than a quarter has been transformed for cultivation and by building of dams (Bloemhof, Erfenis, Krugersdrif, Mockes and Vaalharts Dams). The highveld alluvia are prone to invasion by a number of weeds, obviously encouraged by the high nutrient status of soils and ample water supply. Woody plants such as *Salix babylonica*, *Schinus molle*, *Melia azedarach*, *Celtis sinensis*, *Morus alba*, *Populus* x *canescens*, *Nicotiana glauca* and *N. longiflora* and forbs such as *Argemone ochroleuca*, *Chenopodium strictum*, *Conyza canadensis*, *Datura stramonium*, *Melilotus alba*, *Oenothera indecora*, *Paspalum dilatatum*, *P. urvillei*, *Pennisetum clandestinum*, *Tagetes minuta*, *Verbena bonariensis*, *Xanthium strumarium* agg. and *Zinnia peruviana* (see Cilliers et al. 1998, Malan et al. 2001a, b, L. Mucina, unpublished data) often dominate either the riverine thickets or grasslands or form ruderal communities in disturbed habitats. The undergrowth of the alluvial riparian thickets and the accompanying grasslands suffer from heavy overgrazing in many places.

7.5 2015 NORTH WEST BIODIVERSITY SECTOR PLAN

The Northwest Biodiversity Sector Plan identifies a network of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) in the province based on a systematic biodiversity plan. Collectively, the CBAs and ESAs cover 57% of the province. These were first identified in the Northwest Biodiversity Conservation Assessment (DACERD, 2009), and are comprehensively re-assessed and updated for this plan. The provincial Biodiversity Sector Plan is intended to be the biodiversity sector's input into government sector planning and development processes.

The aim of the Biodiversity Sector Plan is to identify the minimum area necessary to conserve and maintain biodiversity and major ecological infrastructure in the province. Where possible, it is spatially aligned with other relevant spatial plans for the province, such as the Provincial Spatial Development Framework and gazetted Environmental Management Frameworks[1].

According to the 2015 North West Biodiversity Sector Plan, the proposed Upgrade of section 8 of the road R30 are located within the following:

- Critical Biodiversity Area 1 and 2[2]
- Ecological Support Area 1[3].

Refer to Figure 7-3 below for the Sensitivity map**.**

[1] 2008 North-West Province Biodiversity Conservation Assessment
[2] Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan.
[3] Ecological Support Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services.

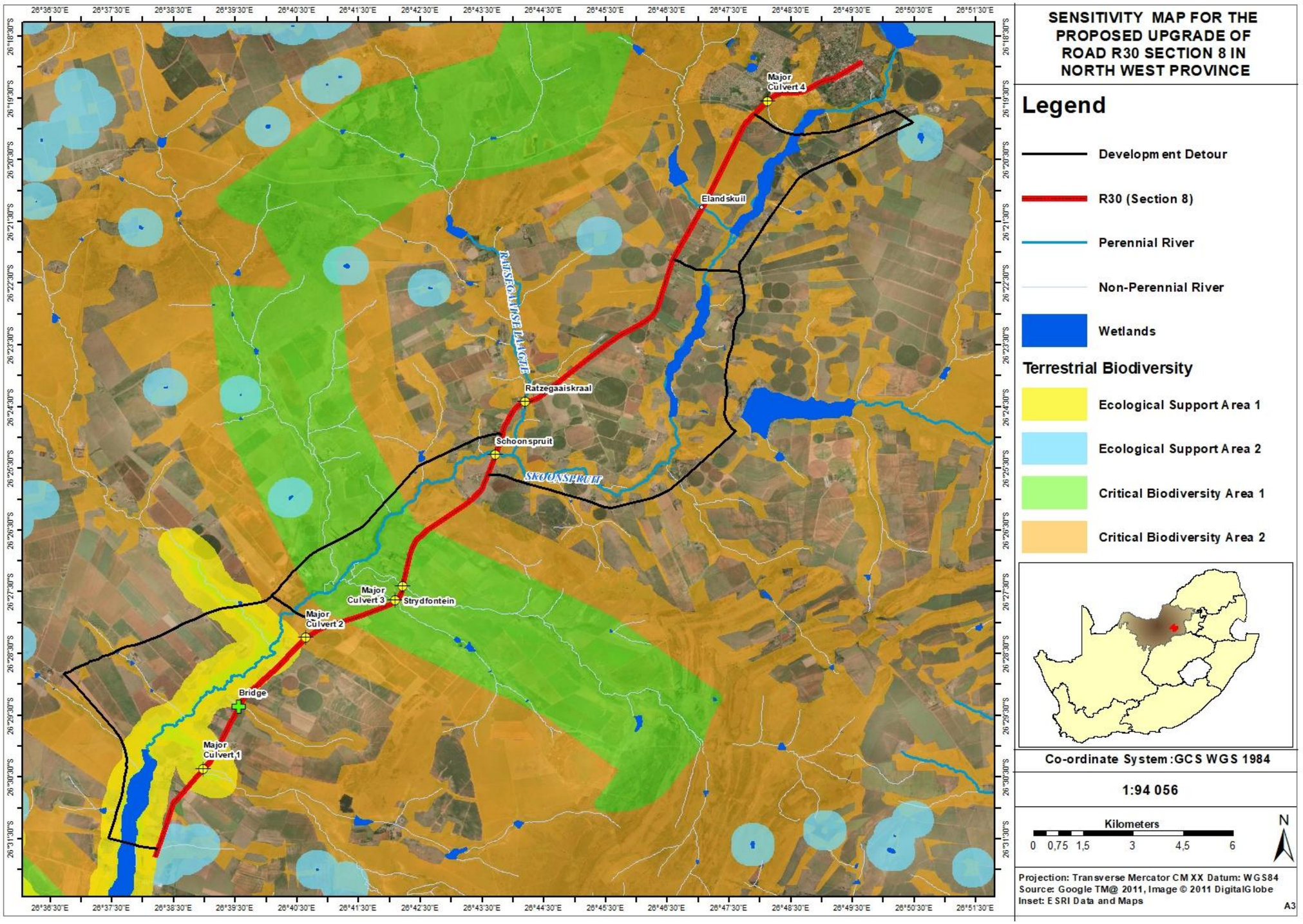


Figure 7-3: The R30 Section 8 in relation to the 2015 North West Biodiversity Sector Plan.

8 METHODOLOGY

The site inspection was done on **21 June 2025**. The site visit entailed walking and driving along the road R30-S8 servitude while investigating both fauna and flora. The aim of the fieldwork component was to scan the study site to gain insight into the current faunal and floral assemblages, to detect any special species that might be present on site.

8.1 DESKTOP ASSESSMENT

The desktop assessment was principally undertaken using a Geographic Information System (GIS) to access the latest available spatial datasets to develop digital cartographs and species lists. These datasets and their date of publishing are provided below.

The potential impacts of the proposed expansion, existing operations and the alternatives were rated using a clearly defined rating scale. The significance rating formula is as follows:

8.1.1 Ecologically Important Landscape Features

- Existing ecologically relevant data layers were incorporated into a GIS to establish how the proposed development might interact with any ecologically important entities. Emphasis was placed around the following spatial datasets:
    - Ecosystem Threat Status – indicator of an ecosystem's wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition.
    - Ecosystem Protection Level – indicator of the extent to which ecosystems are protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. Not Protected, Poorly Protected or Moderately Protected ecosystem types are collectively referred to as under-protected ecosystems.
- The Northwest Biodiversity Sector Plan (NWBSP) classified areas within the province based on their contribution to reaching the conservation targets within the province. These areas are classified as Critical Biodiversity Areas (CBAs) and

Ecological Support Areas (ESAs) to ensure sustainability in the long term. The CBAs are classified as either 'Irreplaceable' (must be conserved), or 'Important'.

- Important Bird and Biodiversity Areas (BirdLife South Africa, 2015) – Important Bird and Biodiversity Areas (IBAs) constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified through multi-stakeholder processes using globally standardised, quantitative, and scientifically agreed criteria;

8.1.2 Desktop Plant Species Assessment

The vegetation of South Africa, Lesotho, and Swaziland (Mucina & Rutherford, 2006) was used in order to identify the vegetation type that would have occurred under natural or preanthropogenically altered conditions. Furthermore, the Plants of Southern Africa (POSA) database was accessed to compile a list of expected flora species within the proposed development area and surrounding landscape. The Red List of South African Plants (Raimondo et al., 2009; SANBI, 2020) was utilized to provide the most current national conservation status of flora species.

8.1.3 Desktop Animal Species Assessment

8.1.4 Mammals

- A list of mammal species that are known to occur in the region was compiled based on the historic distribution ranges presented in Stuart and Stuart (2007); and
- These data were cross-referenced with mammal species listed for the 2430CC Quarter Degree Square (QDS) on the MammalMAP database (Fitzpatrick Institute of African Ornithology, 2024).

8.1.5 Birds

- A list of bird species that are known to occur in the region was compiled based on the historic distribution ranges presented in Stuart and Stuart (2007); and

8.1.6 Herpetofauna (Reptiles and Amphibians)

Sampling for reptiles and amphibians was based on opportunistic observations made while driving/working in the study area were recorded.

8.2 BOTANICAL ASSESSMENT

The botanical assessment encompassed an assessment of all the vegetation units and habitat types within the project area. The focus was on an ecological assessment of habitat types as well as identification of any Red Data species within the known distribution of the project area. The South African National Biodiversity Institute (SANBI) provides an electronic database system, namely the Botanical Database of Southern Africa (BODATSA), to access distribution records on southern African plants. T

8.3 STUDY LIMITATIONS

- The site inspections were over a single day, during the wet season, and thus it is possible that some of the plant species may have missed due to time and budgetary constraints.
- It is assumed that plant species flowering only during specific times of the year could be confused with a very similar species of the same genus.
- Some plant species that emerge and bloom during another time of the year or under very specific circumstances may have been missed entirely.
- Data collection in this study relied heavily on data from representative, homogenous sections of vegetation units, as well as general observations, analysis of satellite imagery from the past until the present, generic data and a desktop analysis.
- No faunal trapping was conducted as part of this study. The faunal assessment relied heavily on desktop and literature studies, supported by on-site observations.
- The specialist responsible for this study reserves the right to amend this report, recommendations and/or conclusions at any stage should any additional or otherwise significant information come to light.

9 HABITAT SURVEY AND SITE ECOLOGICAL IMPORTANCE

The main habitat types identified across the project area were initially identified and pre delineated largely based on aerial imagery from 1985. These habitat types were then refined based on the field coverage and data collected during the survey. Four habitat units are delineated for the project area: transformed, degraded grassland, secondary grassland, and wetland.

Degraded grassland habitat as well as secondary grassland habitat were identified along the project area. Both these habitats have been impacted upon by historic mismanagement and land use activities, most notably to accommodate various agricultural practises such as planted pastures, maize and grazing. The difference between the secondary grassland habitat and the disturbed thornveld is the extent of the disturbance in the degraded grassland being more severe.

The delineated habitat types have each been allocated a sensitivity category, or SEI, and this breakdown is presented in **Table 9-1** below. In order to identify and spatially present sensitive features in terms of the relevant specialist discipline, the sensitivities of each of the habitat types delineated within the project area are mapped in **Figure 9-1**.

It is important to note that this map does not replace any local, provincial, or national government legislation relating to these areas or the land use capabilities or sensitivities of these environments.

Table 9-1: Site Ecological Importance assessment summary of the habitat types delineated within the project area.

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance
Transformed	Medium	Low	Low	Low	Low
Degraded Grassland	Medium	Low	Low	Low	Low
Secondary Grassland	Medium	Low	Low	Low	Medium
Wetland	Medium	High	Medium	Medium	Medium

Consider the following guidelines when interpreting SEI in the context of any proposed development or disturbance activities:

- Very Low: Minimisation mitigation - Development activities of medium to high impact acceptable and restoration activities may not be required.
- Low: Minimisation and restoration mitigation - Development activities of medium to high impact acceptable followed by appropriate restoration activities.
- Medium: Minimisation and restoration mitigation - Development activities of medium impact acceptable followed by appropriate restoration activities.

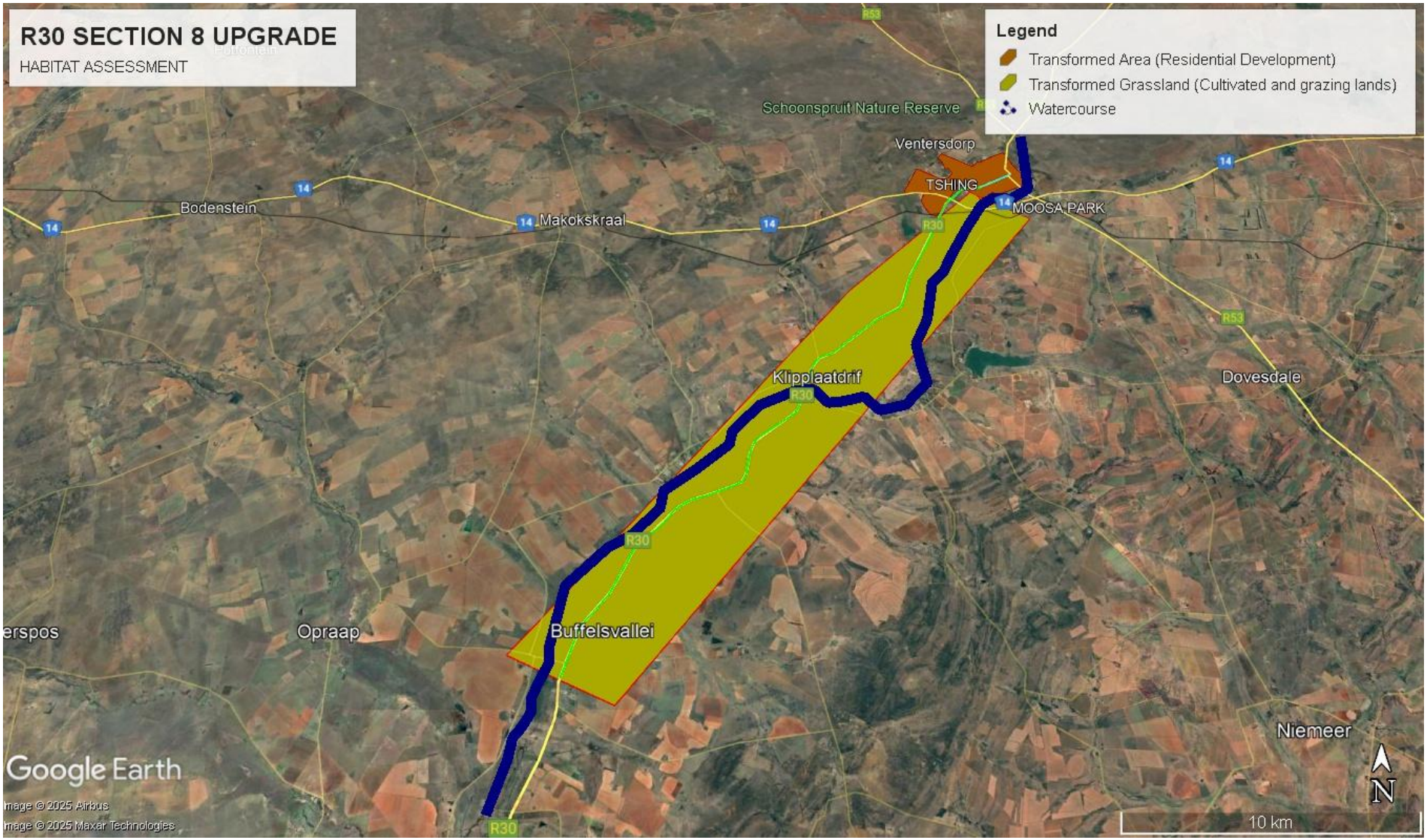


Figure 9-1: Biodiversity SEI delineation relevant to the R30 Road section 8.

10 RESULTS OF THE FLORA ASSESSMENT

The proposed upgrade of the National Road R30 Section 8 from km 36.8 to Ventersdorp km 68.646 is located on the Vaal-Vet Sandy Grassland (Gh 10) vegetation unit, which consists of low-tussock grasslands with an abundant karroid element. However, the road servitude has been transformed as part of the maintenance of the existing road. The servitude is dominated by *Themeda triandra* and *Hyparrhenia hirta* (**Figure 10-1**). In certain areas, bear patches of soil can be observed along the road servitude (**Figure 10-1**).



Figure 10-1:Overview of the state of vegetation found along the road servitude (Representing start Middle and End of the Road).

Some of the properties next to the road servitude have tree species which may include Acacia trees and *Dichrostachys cineria* (**Figure 10-2**), the other species that were observed along the road servitude are depicted on **Figure 10-3** to **Figure 10-5**.



Figure 10-2:Degraded grassland observed next to the road servitude including Acacia and *Dichrostachys cinerea* in the neighbouring properties.



Figure 10-3: Watercourses observed located next to the road servitude with an abundance of Phragmites



Figure 10-4: Eucalyptus trees observed along the road servitude.



Figure 10-5: Phragmites species observed along the road servitudes.

10.1 FLORA SPECIES OF SPECIAL CONCERN

South Africa has become the first country to fully assess the status of its entire flora (Domitilla and Raimondo, 2011). Major threats to the South African flora are identified in terms of the number of plant taxa Red-Listed as threatened with extinction as a result of threats like, habitat loss (e.g. infrastructure development, urban expansion, crop cultivation and mines), invasive alien plant infestation (e.g. outcompeting indigenous plant species), habitat degradation (e.g. overgrazing, inappropriate fire management etc.), unsustainable harvesting, demographic factors, pollution, loss of pollinators or dispersers, climate change and natural disasters (e.g. such as droughts and floods)[4]. South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the Red List of South African plants. However, due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction but may nonetheless be of high conservation importance. As a result, a SANBI uses an amended system of categories in order to highlight species that may be of low risk of extinction but are still of conservation concern (SANBI, 2015).

In the Northwest, species of conservation concern are also protected in terms of national and provincial legislation, namely:

[4] RAIMONDO, Domitilla. The Red List of South African plants: a global first. S. Afr. j. sci., Pretoria , v. 107, n. 3-4, p. 01-02, Apr. 2011 . on 17 Aug. 2021. http://dx.doi.org/10.4102/sajs.v107i3/4.653.

- The following species protected in terms of the North West Biodiversity Management Act, No.4 of 2016 are known to be found in the area (**Table 10-1**).

Table 10-1: NCNCA are known to be found in the area.

FAMILY	SPECIES	NATIONAL STATUS	HABITAT	POC
AIZOACEAE	*Delosperma leendertziae*	NT	**Range:** Magaliesberg, Roodepoort Ridge and Suikerbosrand. **Major habitats:** Gold Reef Mountain Bushveld, DwarsbergSwartruggens Mountain Bushveld, Loskop Mountain Bushveld, Andesite Mountain Bushveld, Gauteng Shale Mountain Bushveld. **Description:** Steep, south-facing slopes of quartzite in mountain grassland. **Population trend:** Decreasing	Low
APOCYNACEAE	*Stenostelma umbelluliferum*	NT	**Range:** Pretoria North and adjacent areas in North West Province. **Major habitats:** Savanna **Description:** Deep black turf in open woodland mainly in the vicinity of drainage lines. **Population trend:** Decreasing	Medium
ASPHODELACEAE	*Kniphofia typhoides*	NT	**Range:** Parys to Lydenburg to Paulpietersburg to	Low

			Newcastle. **Major habitats:** Grassland **Description:** Low lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on heavy black clay soils, tends to disappear from degraded grasslands. Population trend: Decreasing	
CRASSULACEAE	*Adromischus umbraticola*	NT	**Range:** Potchefstroom and Zeerust to Cullinan. **Major habitats:** Savanna **Description:** South-facing rock crevices on ridges, restricted to Gold Reef Mountain Bushveld in the northern parts of its range, and Andesite Mountain Bushveld in the south. **Population trend:** Decreasing	Low
FABACEAE	*Melolobium subspicatum*	VU	**Range:** Krugersdorp to Pretoria. **Major habitats:** Soweto Highveld Grassland, Egoli Granite Grassland, Carletonville Dolomite Grassland **Description:** Grassland **Population trend:** Stable	Low
ORCHIDACEAE	*Habenaria mossii*	EN	**Range:** Johannesburg, Pretoria and Krugersdorp.	Low

	Major habitats: Andesite Mountain Bushveld, Carletonville Dolomite **Grassland Description:** Open grassland on dolomite or in black, sandy soil. **Population trend:** Decreasing

EN= Endangered; EW = Extinct in the Wild; NT = Near Threatened; VU= Vulnerable; P= Protected; POC = Probability of Occurrence

During the field investigation no floral SCCs were found and the chances that the species above re-establish themselves on the site is medium to low. Should any floral SCC be encountered during any phase of the proposed development, these species should be rescued and relocated by a suitably qualified specialist and either relocated to suitable habitat within the study area outside of the development footprint, utilised within the landscaping plan of the project, or moved to registered nurseries such as the Agricultural Research Council (ARC) or the South African National Biodiversity Institute (SANBI).

10.1.1 Ethnobotanical plant species

Ethnobotany/ Ethnoecology is a branch of botany that focuses on the use of plants for medicines, cultural and recreational purposes. The overexploitation of indigenous plants for ethnobotanical purposes can be detrimental to populations of those particular plant species, and the other species that depend on its existence for their survival.

South Africa has a rich diversity of medicinal plants that not only have a global significance, but also have a cultural and historical role (van Wyk *et al.* 2009). There is a rapidly growing concern for conservation of medicinal plants that are dwindling in number due to illegal harvesting (Institute of Natural Resources 2003). This is particularly apparent in rural areas where medicinal plants are overexploited by traditional doctors.

During the site inspection, no medical plants were encountered along the road servitude.

10.2 ALIEN INVASIVE SPECIES PRESENT ON SITE

An "invasive species" is any species whose establishment and spread outside of its natural distribution range (i) threatens ecosystems, habitats or other species or has a demonstrable potential to threaten ecosystems, habitats or other species; and (ii) may result in economic or environmental harm or harm to human health. Invasive alien plant species are globally considered as one of the greatest threats to the environment, biodiversity, ecosystem integrity and the economy.

According to the Conservation of Agricultural Resources Act (No. 43 of 1983 - Regulation 15, 30 March 2001) (CARA), for agricultural land, and the National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA), for natural areas, invasive alien plant species should be controlled and eradicated with an emphasis on urgent action in biodiversity priority areas. NEMBA published a list of Alien and Invasive Species (No 599) in 2014 which regulates the management of alien and invasive plants in natural environments. The Invasive Species that were observed onsite are listed below

1. *Eucalyptus camaldulensis* (Commonly known as Gumtree)

The genus Eucalyptus, with about 800 species, belongs to the myrtle family, Myrtaceae, and is almost entirely native to Australia. The Eucalypts are best known for their commercial use as timber trees and windbreaks. They are also cultivated for ornament, shade, firewood and honey production.

Eucalyptus species are invasive and pose a threat to the natural resources of the country. Most invasion occurs along watercourses but also on forest margins, in gaps within native forest and plantations as well as into Fynbos and grassland. Eucalypts are well known for their ability to use large volumes of water and this increases with increasing availability of water such as along watercourses.



Figure 10-6:Eucalyptus tree observed onsite

11 RESULTS OF THE FAUNA ASSESSMENT

11.1 MAMMALS

According to the desktop study conducted, the species listed in **Table 11-1** were identified as being possible to occur within the study area or the immediate vicinity of the proposed construction area. It must be noted that some of these species are very sensitive to habitat and in some instances; the likeliness for them to occur is minimal. There are six (6) sensitive mammal species that have a HIGH chance of occurring in the study area.

Table 11-1: Sensitive mammals that are likely to occur onsite

#	Scientific name	Common name	Red list category
1	Macroscelidea indet.	Macroscelidea indet.	
2	Rodentia indet.	Rodentia indet.	
3	Aepyceros melampus	Impala	Least Concern
4	Alcelaphus buselaphus	Hartebeest	

5	Alcelaphus buselaphus caama	Red Hartebeest	Least Concern (2008)
6	Antidorcas marsupialis	Springbok	Least Concern (2016)
7	Connochaetes gnou	Black Wildebeest	Least Concern (2016)
8	Connochaetes taurinus	Blue Wildebeest	Least Concern (ver 3.1, 2017)
9	Connochaetes taurinus taurinus		Least Concern (2016)
10	Damaliscus pygargus phillipsi	Blesbok	Least Concern (2016)
11	Hippotragus equinus	Roan Antelope	Endangered (2016)
12	Hippotragus niger	Sable Antelope	Least Concern (ver 3.1, 2017)
13	Hippotragus niger niger		Vulnerable (2016)
14	Kobus ellipsiprymnus	Waterbuck	Least Concern (ver 3.1, 2016)
15	Oryx gazella	Gemsbok	Least Concern (2016)
16	Pelea capreolus	Vaal Rhebok	Near Threatened (2016)
17	Raphicerus campestris	Steenbok	Least Concern (2016)
18	Redunca arundinum	Southern Reedbuck	Least Concern (2016)
19	Redunca fulvorufula	Mountain Reedbuck	Least Concern
20	Sylvicapra grimmia	Bush Duiker	Least Concern (2016)
21	Taurotragus oryx	Common Eland	Least Concern (2016)
22	Tragelaphus angasii	Nyala	Least Concern (2016)
23	Tragelaphus scriptus	Bushbuck	Least Concern
24	Tragelaphus strepsiceros	Greater Kudu	Least Concern (2016)

25	Canidae indet.	Canidae indet.	
26	Canis mesomelas	Black-backed Jackal	Least Concern (2016)
27	Vulpes chama	Cape Fox	Least Concern (2016)
28	Chlorocebus pygerythrus	Vervet Monkey	Least Concern (2016)
29	Chlorocebus pygerythrus pygerythrus	Vervet Monkey (subspecies pygerythrus)	Least Concern (2008)
30	Papio ursinus	Chacma Baboon	LC (IUCN, 2016)
31	Dama dama	Fallow Deer	Introduced
32	Equus quagga	Plains Zebra	Near Threatened (IUCN, 2016)
33	Giraffa giraffa giraffa	South African Giraffe	Least Concern (2016)
34	Atilax paludinosus	Marsh Mongoose	Least Concern (2016)
35	Cynictis penicillata	Yellow Mongoose	Least Concern (2016)
36	Herpestes sanguineus	Slender Mongoose	Least Concern (2016)
37	Suricata suricatta	Meerkat	Least Concern (2016)
38	Hyaena brunnea	Brown Hyena	Near Threatened (2015)
39	Proteles cristata	Aardwolf	Least Concern (2016)
40	Hystrix africaeaustralis	Cape Porcupine	Least Concern
41	Lepus indet.	Lepus indet.	
42	Lepus capensis	Cape Hare	Least Concern
43	Lepus saxatilis	Scrub Hare	Least Concern
44	Pronolagus indet.	Pronolagus indet.	
45	Pronolagus randensis	Jameson's Red Rock Hare	Least Concern (2016)
46	Aethomys namaquensis	Namaqua Rock Mouse	Least Concern

47	Mastomys indet.	Mastomys indet.	
48	Rhabdomys pumilio	Four-striped Grass Mouse	Least Concern (2016)
49	Aonyx capensis	African Clawless Otter	Near Threatened (2016)
50	Orycteropus afer	Aardvark	Least Concern (2016)
51	Pedetes capensis	South African Spring Hare	Least Concern (2016)
52	Procavia capensis capensis	Cape Rock Hyrax	LC (IUCN 2015, global sp. level)
53	Xerus inauris	South African Ground Squirrel	Least Concern
54	Myosorex varius	Forest Shrew	Least Concern (2016)
55	Phacochoerus africanus	Common Warthog	Least Concern (2016)
56	Genetta maculata	Common Large-spotted Genet	Least Concern
57	Genetta genetta	Common Genet	Least Concern (2016)
58	Genetta tigrina	Cape Genet (Cape Large-spotted Genet)	Least Concern (2016)

11.1.1 Field Investigation Findings

None of the sensitive mammals which were expected were spotted on site except for grazing cattle (Figure 11-1).



Figure 11-1:Grazing Cattle observed on a property next to the road.

11.2 REPTILES

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Large areas surrounding the site have resulted in increased habitat modification and transformation as well as increased human presence and associated disturbances (illegal reptile collecting, indiscriminate killing of all snake species, fires) surrounding the site coupled with increased habitat destruction and disturbances on the neighbouring properties are all causal factors in the alteration and disappearance of reptile diversity in the area. A list of the reptile species that can be expected onsite is listed below.

Table 11-2: ReptileMAP — Reptile Atlas of Africa Summary information for locus 2626DA

#	Scientific name	Common name	Red list category
1	*Agama aculeata distanti*	Distant's Ground Agama	Least Concern (SARCA 2014)
2	*Agama atra*	Southern Rock Agama	Least Concern (SARCA 2014)
3	*Chamaeleo dilepis*	Common Flap-neck Chameleon	Least Concern (SARCA 2014)
4	*Crotaphopeltis hotamboeia*	Red-lipped Snake	Least Concern (SARCA 2014)

5	*Hemachatus haemachatus*	Southern Rinkhals	Least Concern (IUCN 2022)
6	*Naja nivea*	Cape Cobra	Least Concern (SARCA 2014)
7	*Lygodactylus capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)
8	*Pachydactylus capensis*	Cape Gecko	Least Concern (SARCA 2014)
9	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	Least Concern (SARCA 2014)
10	*Boaedon capensis*	Brown House Snake	Least Concern (SARCA 2014)
11	*Lamprophis aurora*	Aurora House Snake	Least Concern (SARCA 2014)
12	*Psammophylax tritaeniatus*	Striped Grass Snake	Least Concern (SARCA 2014)
13	*Pseudaspis cana*	Mole Snake	Least Concern (SARCA 2014)
14	*Pelomedusa galeata*	South African Marsh Terrapin	Least Concern (IUCN 2018)
15	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink	Least Concern (IUCN 2021)
16	*Trachylepis varia sensu lato*	Common Variable Skink Complex	Least Concern (SARCA 2014)
17	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern (SARCA 2014)
18	*Varanus albigularis albigularis*	Rock Monitor	Least Concern (SARCA 2014)
19	*Bitis arietans arietans*	Puff Adder	Least Concern (IUCN 2014)

11.2.1 Field investigation findings

None of the expected reptiles were observed on site during the site visit.

11.3 AVIFAUNA

Birds are generally regarded as good ecological indicators, because their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological conditions are directly linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land cover is directly linked to habitats within the study area. The diversity of these habitats should give rise to many different species.

According to the South African Bird Atlas Project (SABAP2), almost 399 species of birds have been identified in the Klerksdorp area; 14 of the species are classified as threatened,

while 5 species are classified as introduced. All birds that could be present within the vicinity of the study area are listed in **Appendix B**.

11.3.1 Field investigation findings

A few avifaunal species were spotted onsite during the site visit, most notably Ostriches were observed on borrow pit. R30 S8-10, which is located next to the road servitude (**Figure 11-2**). A few avifauna species were observed along the road servitudes especially near the watercourse (**Figure 11-3** to **Error! Reference source not found.**).



Figure 11-2: Long-crested Eagle (*Lophaetus occipitalis*) observed on a telephone line along the servitude.



Figure 11-3: Example of the Long-tailed widowbird.

11.4 INVERTEBRATES

Butterflies are a good indication of the habitats available in a specific region (Woodhall 2005). Although many species are eurytropes (able to use a wide range of habitats) and are widespread and common, South Africa has many stenotrope or endemic species (specific habitat requirements with populations concentrated in a small area) which may be very specialised (Woodhall 2005). Butterflies are useful indicators as they are relatively easy to locate and catch and therefore identify. A list of butterflies that are likely to be observed on the study site and the surrounding areas are summarised in **Table 11-3**.

Table 11-3: Butterfly species expected to occur on site.

Scientific Name	Common Name
Melanitis leda Helena	Evening Brown
Acraea anemosa	Broad-bordered Acraea
Acreae neobule	Wandering Acraea
Danaus chrysippus	African Monarch butterfly
Junonia hierta cebrene	Yellow Pansy butterfly
Danays chrysippus	Southern Milkweed
Charaxes jasius	Koppie Emperor
Cyclyrius pirithous	Common Blue
Hyalites esebria	Dusky Acrea butterfly

Scientific Name	Common Name
Phalantha aethiopica	Poplar Leopard
Alaena amazoula	Yellow Zulu
Catacroptera cloanthe	Pirate butterfly
Charaxes achaemenses	Bushveld Emperor
Pinacopteryx eriphia	Zebra White butterfly
Eurema brigitta	Broad-bordered yellow
Vanessa cardui	Painted Lady
Papilio demodocus	Citrus Swallowtail butterfly

11.4.1 Field investigation findings

No invertebrates were observed in the other sites. However one of the watercourses had evidence of a *Potamonautes* species commonly known as crab.



Figure 11-4: *Potamonautes* species observed onsite.

12 CONCLUSION

The majority of the project area has historically been altered to accommodate agricultural activities and, as a result, remains in a transformed state. Nevertheless, the site retains distinct habitat features, most notably wetland systems. Anticipated negative environmental impacts resulting from the proposed development include:

- The loss and fragmentation of vegetation communities;
- Impairment of safe movement corridors for faunal species; and
- The direct and indirect disturbance or loss of floral and faunal species and assemblages.

Following completion of the terrestrial biodiversity assessment, the sensitivity classification assigned by the National Environmental Screening Tool was contested. The findings indicate that, due to extensive historical disturbance along the road servitude and the absence—or extremely low likelihood—of Species of Conservation Concern (SCC), the majority of the area warrants a revised sensitivity rating of Very Low to Low.

However, one sub-area, comprising the wetland and watercourse systems, has been assigned a 'Medium' sensitivity classification. These wetlands remain in a moderately natural condition, having largely been excluded from direct historic anthropogenic disturbance. Consequently, they continue to provide viable habitat for indigenous vegetation and commonly occurring faunal species.

13 Specialist Opinion

The R30 S8 road servitude is classified as having a sensitivity rating of ‘Very Low’, is likely to face minimal further impacts from any development activities, and as such the proposed activities may proceed within these areas.

As previously noted, the development footprint falls within the 500-meter regulated buffer zone of a wetland. Consequently, all activities must adhere strictly to the guidelines outlined in the project’s wetland assessment report.

14 REFERENCES

Acocks, J.P.H. 1953. Veld types of South Africa. Mem. Bot. Surv. S. Afr. 28: 1-192.

Branch, B. 1998. Field Guide to Snakes and Other Reptiles of Southern Africa. Struik Publishers, Cape Town.

Department of environmental affairs, department of mineral resources, chamber of mines, South African mining and biodiversity forum and South African National Biodiversity Institute 2013. Mining and biodiversity guidelines: mainstream biodiversity into the mining sector. Pretoria: 100pp.

Desmet, P. G., Holness, S., Skowno, A. & Egan, V.T. (2013) Limpopo Conservation Plan v.2: Technical Report. Contract Number EDET/2216/2012. Report for Limpopo Department of Economic Development, Environment & Tourism (LEDET) by ECOSOL GIS.

Desmet, P. G., Holness, S., Skowno, A. & Egan, V.T. (2013) Limpopo Conservation Plan v.2: Technical Report. Contract Number EDET/2216/2012. Report for Limpopo Department of Economic Development, Environment & Tourism (LEDET) by ECOSOL GIS.

Du Preez V. and Carruthers L. 2009. A Complete guide to the frogs of Southern Africa.

Germihuizen, G. and Meyer, N.L. (eds) 2003. Plants of southern Africa: an annotated checklist. Strelitzia 14.

Institute of Natural Resources 2003. Indigenous medicinal plant trade: Sector analysis. Investigation report: no. 248.

LepiMAP 2014. Accessed at: http://lepimap.adu.org.za/ on 2014-09-12.

Maria Luisa Bárcenas-Argüello, Ma. del Carmen Gutiérrez- Castorena and Teresa Terrazas. 2013. The Role of Soil Properties in Plant Endemism – A Revision of Conservation Strategies. Soil trends and current trends in quality assessment.

Mpumalanga Tourism and Parks Agency and Department of Agriculture and Land Administration. 2007. Mpumalanga Biodiversity Conservation Handbook.

Mucina L. and Rutherford M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

SARCA 2014. Southern African Reptile Conservation Assessment. Accessed at: 9:05am on 2014-04-29. Accessed at: http://vmus.adu.org.za/vm_sp_list.php.

Schmidt E., Lotter M. and McCleland W. 2004. Trees and shrubs of Mpumalanga and the Kruger National Park. Jacana Publishers: 683 pp.

Van Wyk B., van Oudtshoorn B. and Gericke N. 2009. Medicinal Plants of South Africa. Briza Publications: 330 pp.

Victor J.E., Siebert S.J., van Wyk A.E.B. and Hoare D. 2005. Sekhukhuneland grasslands: a treasure house of biodiversity. www.fao.org.

APPENDIX 5.2: WETLAND DELINEATION AND IMPACT ASSESSMENT REPORT

WETLAND DELINEATION AND IMPACT ASSESSMENT REPORT OF THE FOR THE PROPOSED IMPROVEMENT OF THE NATIONAL ROAD R30 SECTION 8 FROM KM 36.8 TO VENTERSDORP KM 68.646, IN THE MATLOSANA AND JB MARKS LOCAL MUNICIPALITIES, DR KENNETH KAUNDA DISTRICT MUNICIPALITY, NORTHWEST PROVINCE.



PRODUCED BY:

PRODUCED BY:	ENVIRONMENTAL ASSESSMENT PRACTITIONER	PRODUCED FOR:
	Earthlink Environmental Services	
Physical Address: **5 13th Avenue, Fairlands, Randburg 2170** Mobile Number: **071 2082 364**Email: **info@ntumbulukoconsulting.co.za**		South African National Roads Agency SOC Limited

JULY 2025

CONDITIONS RELATING TO THIS REPORT

DECLARATION OF INTEREST

Ntumbuluko Consulting Pty (Ltd) has no vested interest in the property studied nor is it affiliated with any other person/body involved with the property and/or proposed development. Ntumbuluko Consulting Pty (Ltd) is not a subsidiary, legally or financially of the proponent. The study was undertaken by Mr Tshuxekani Maluleke, he is a registered Natural Scientists with the following details:

QUALIFICATIONS

SPECIALIST	QUALIFICATION
Mr Tshuxekani Maluleke (SACNASP Reg. No. 120501)	MSc Environmental Sciences (Wits University) BSc Hons Zoology (University of Limpopo) BSc Hons Animal, Plant and Environmental Sciences (Wits University)

APPROVAL

PREPARED BY:

Mr Tshuxekani Maluleke



Wetland and Biodiversity Specialist

Msc. Environmental Sciences

18 July 2025

INDEMNITY

Although Ntumbuluko Consulting Pty (Ltd) exercises due care and diligence in rendering services and preparing documents, the client takes full responsibility for this report and its implementation in terms of the National Environmental Management Act of 1998, and exempt Ntumbuluko Consulting Pty (Ltd) and its associates and their sub-contractors from any legal responsibility based on the timing of the assessment, the result and the duration thereof, which has an influence on the credibility and accuracy of this report. Ntumbuluko Consulting Pty (Ltd) accepts no liability, and the client indemnifies Ntumbuluko Consulting Pty (Ltd) and its directors, managers, agents, and employees against all actions, claims, demands, losses, liabilities, costs, damages, and expenses arising from or in connection with services rendered, directly or indirectly, by Ntumbuluko Consulting Pty (Ltd) and by the use of this document.

TABLE OF CONTENTS

1. INTRODUCTION 8
2. BACKGROUND 8
3. SITE LOCATION 9
4. LEGAL FRAMEWORK 12
4.1 National Environmental Management Act (Act No. 107 of 1998) 12
4.2 National Waste Act, 2008 (Act No. 59 of 2008) 12
4.3 National Water Act, 1998 (Act No. 36 of 1998) 12
4.4 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) 13
5. SCOPE OF WORK 13
5.1 Wetland Delineation and Assessment 13
6. ASSUMPTIONS AND LIMITATIONS 13
7. METHODOLOGY 14
7.1 Wetland Assessment 14
7.1.1 Desktop Assessment 14
7.1.2 Field Assessment 14
7.1.3 Wetland Functionality and Health 15
7.2 Risk Assessment to Watercourses 20
8. ENVIRONMENTAL BASELINE INFORMATION 22
8.1 GEOLOGY & SOILS 22
8.2 CLIMATE 22
8.3 VEGETATION TYPE ASSOCIATED WITH THE R30 S8 ROAD IMPROVEMENT 22
8.3.1 VAAL-VET SANDY GRASSLAND (GH 10) 22
8.3.2 AZa 5 Highveld Alluvial Vegetation 23
8.4 SURFACE HYDROLOGY 23
8.4.1 Details of the Quaternary Catchment 23
9. RESULTS 27

9.1 Wetland Delineation and Assessment 27
9.1.1 Desktop Assessment 27
9.1.2 Terrain indicator 33
9.1.3 Soil wetness and soil form indicator 33
9.1.4 Vegetation indicator 34
9.1.5 Wetland Delineation 35
9.2 Wetland Functional and Health Assessment 37
9.2.1 Wetland Ecological Importance and Sensitivity 37
9.2.2 Wetland Health and PES 38
9.2.3 Wetland ecoservices 39
9.3 Ecological Assessment 39
9.3.1 Critical Biodiversity Areas 39
9.3.2 Freshwater Aquatic Species 42
10. RISK ASSESSMENT OF DELINEATED WETLAND 42
10.1.1 Sedimentation and soil erosion 46
10.1.2 Pollution of water resources and soil 46
10.1.3 Alien Invasive Species 47
10.1.4 Mitigation 47
10.2 ASSESSMENT OF THE NO-GO ALTERNATIVE 49
10.3 MONITORING REQUIREMENTS 49
11. FINAL COMMENTS 49
12. RECOMMENDATIONS 49
13. REFERENCES 51

LIST OF FIGURES

Figure 3-1: Locality Map 10
Figure 3-2: lansduse Map. 11
Figure 7-1: Different zones of wetness found in wetlands, indicating how the soil wetness and vegetation indicators change (DWAF, 2005) 15

Figure 7-2: Diagrammatic representation of common wetland systems identified in Southern Africa (based on Kotze et al., 2008). 20
Figure 8-1: climate diagram for Gh 12 Vaal-Vet Sandy Grassland 22
Figure 8-2: Surface Water Map 25
Figure 8-3: Surface Water Map 1 26
Figure 9-1: Overview of the disturbed Vaal-Vet Sandy Grassland vegetation unit observed onsite. 29
Figure 9-2: Overview of the Highveld Alluvial Vegetation unit. 30
Figure 9-3:Map of the wetland and watercourses within 500m of the R30 Section 8. 31
Figure 9-4: Watercourse and Wetland observed within 500m of the road (A-C Represents the watercourse and D represents the wetland (Dam) 32
Figure 9-5: Slope of the R30 Section 8 National Road. 33
Figure 9-6:Soil Observed within one the watercourses. 34
Figure 9-7: Phragmite species observed onsite. 35
Figure 9-8:Wetland delineation Map 36
Figure 9-9: Eco services 39
Figure 9-10: The R30 Section 8 in relation to the2015 North West Biodiversity Sector Plan. 41
Figure 9-11:Typical Freshwater Habitat onsite. 42

LIST OF TABLES

Table 7-1: Ecosystem services provided by wetlands (Kotze et al, 2008). 17
Table 7-2: Guideline for interpreting the magnitude of impacts on wetland integrity. 18
Table 7-3: Health categories used by WET-Health for describing the integrity of wetlands. 19
Table 7-4: Significance of the Section 21 C and I ratings matrix as prescribed by the National Water Act 1998 (Act No. 36). 21
Table 9-1: EIS calculation of the wetland 37
Table 9-2:PES classes (from Kleynhans 1999) indicating the interpretation of the mean scores to rate the PES category. 38
Table 9-3: Summary of EIS onsite. 39
Table 10-1: Impact 1-Degradation and / or destruction of Freshwater habitats (Watercourses). 42
Table 10-2: Impact 2-Loss of indigenous fauna and flora diversity associated with watercourses. 44

LIST OF ABBREVIATIONS AND ACCRONYMS

BGIS: Biodiversity Geographic Information System

DEM: Digital Elevation Model

DWAF: Department of Water Affairs and Forestry

DWS: Department of Water Affairs and Sanitation

EA: Environmental Auhorisation

EIS: Ecological Importance and Sensitivity

EMPr: Environmental Management Program

GIS: Geographic Information System

HGM: Hydrogeomorphic

NFEPA: National Freshwater Priority Area

NWA: National Water Act (Act no 36 of 1998)

PES: Present Ecological Status

QDS: Quarter Degree Square

SANBI: South African National Biodiversity Institute

TWQRs: Target Water Quality Ranges

WMA: Water Management Areas

WUL: Water Use Licence

TERMS OF REFERENCE

Ntumbuluko Consulting Pty (Ltd) was requested to conduct a wetland delineation of the wetland/s present on the study sites. This report includes the delineation and provides an assessment on the ecological state of these areas.

1. INTRODUCTION

Ntumbuluko Consulting (Pty) Ltd has been appointed by Earthlink Environmental Services (Pty) Ltd on behalf of The South African National Roads Agency SOC Ltd or SANRAL to conduct a wetland delineation and impact assessment of the proposed improvement of the national road R30 Section 8 from Km 36.8 to Ventersdorp Km 68.646, within the Matlosana And JB Marks Local Municipalities, in the Dr Keneth Kaunda District Municipality, North West Province..

The investigation has been undertaken to form part of the Environmental Impact assessment (EIA), and associated management plan (EMP). This report presents the findings of the wetland assessment and delineation of which the fieldwork was conducted on the **21 June 2025**

2. BACKGROUND

South African National Road Agency SOC Limited (SANRAL) proposes to improve the National R30 Road Section 8, a 31.846-kilometer stretch located from (km 36.8) to Ventersdorp (km 68.646). The project starts at km 36.800, south of the Opraap road-side junction, and continues up to km 68.646 west of the 3-way stop control intersection with the R 53 to Potchefstroom. This project falls within the City Matlosana and JB Marks Local Municipalities and is situated within the Dr Kenneth Kaunda District Municipality in the Northwest province, with Ventersdorp the closest town. The R 30 Section 8 is a two-lane single carriageway rural road with bi-directional traffic movement and can be classified as an AASHTO Class IIIA secondary rural arterial. The road cross-section varies considerably, with gravel shoulders provided up to km 67.00. The new proposed carriageway width will be 13.4m under normal conditions and 12.4m on high fills.

The project is aimed at improving the road geometry by adding surfaced shoulders and rehabilitating the existing pavement structure to enable it to carry a 20-year design traffic load.

The major aspects of this project include the following:

- Increase of the road reserve width is anticipated,
- Improvement of the existing pavement structure,
- general widening of the existing road cross section to 3.7m lanes and 2.5m (high fill) – 3.0m(normal conditions) surfaced shoulders,
- Isolated vertical and horizontal geometric improvements,
- widening of river bridges and some major and minor culverts,

- Demolishing and construction of new river bridges
- horizontal re-alignment of the road at curves:
  - from KM 46.9 to KM 47.7
  - from KM 53.9 to KM 55
  - from KM60.2 to KM60.7
- Possible 6.5m wide temporary deviation to accommodate two-way traffic during construction.
- Possible Opening of one hard-rock quarry and re-entry into 5 potential borrow pits
- Stockpile areas and vegetation clearance outside road reserve in excess of one hectare.
- Possible utilisation of four detours/bypasses during construction, these are provincial/municipal roads, both gravel and/or surfaced. The contractor will be responsible for maintaining these roads
- Stockpile areas and vegetation clearance outside road reserve more than 1 Hectare.

3. SITE LOCATION

This project is located within the jurisdiction of the City of Matlosana and JB Marks Local Municipalities, under the administration of the Dr Kenneth Kaunda District Municipality in the North West Province. The nearest urban center is Ventersdorp (refer to **Figure 6-1**). The site is predominantly surrounded by cultivated agricultural land (**Figure 6-2**). The GPS coordinates are listed below:

Start Point: 26°31'56.56"S; 26°38'9.19"E

End Point:26°18'54.98"S, 26°49'38.86"E

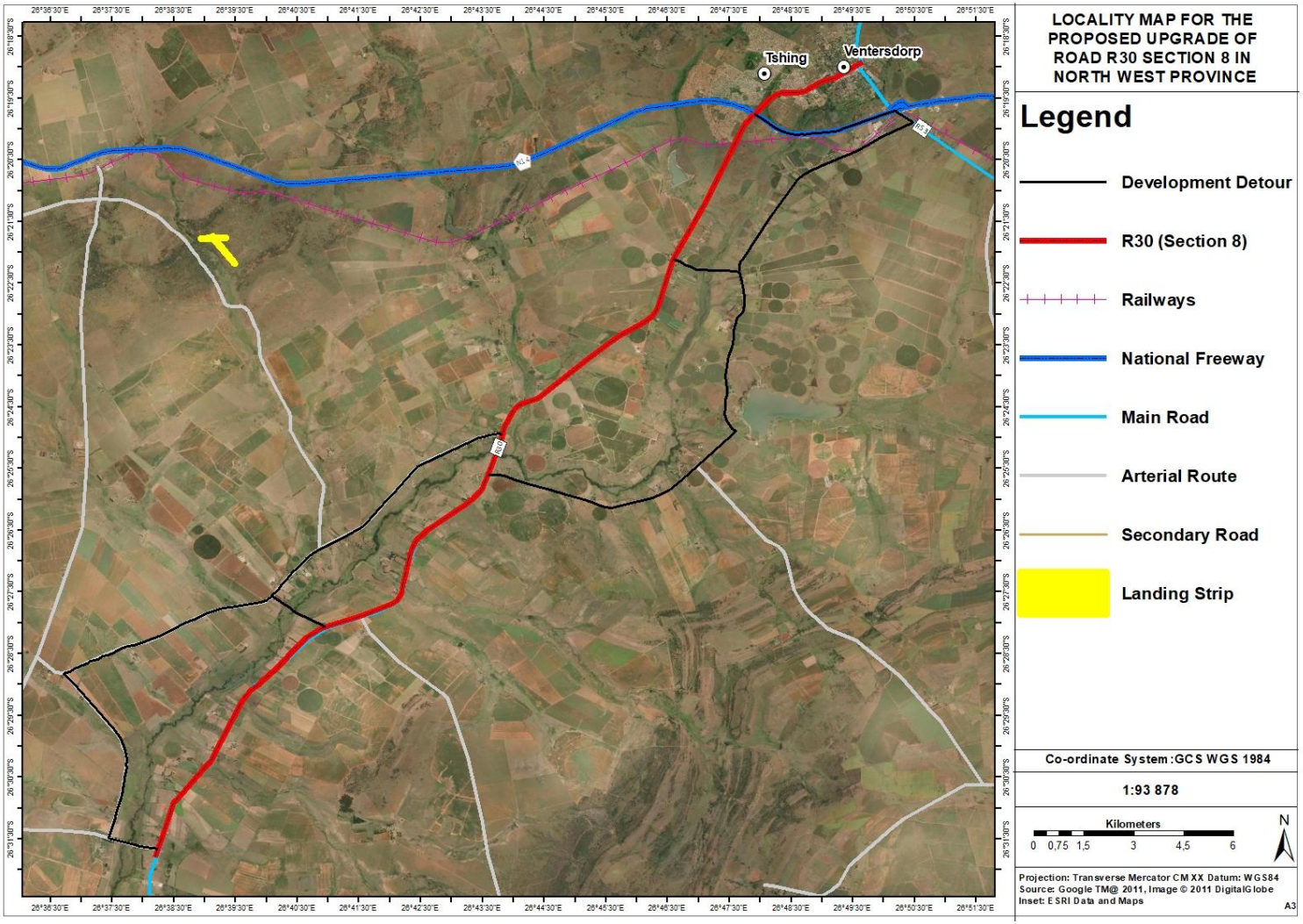


Figure 3-1: Locality Map

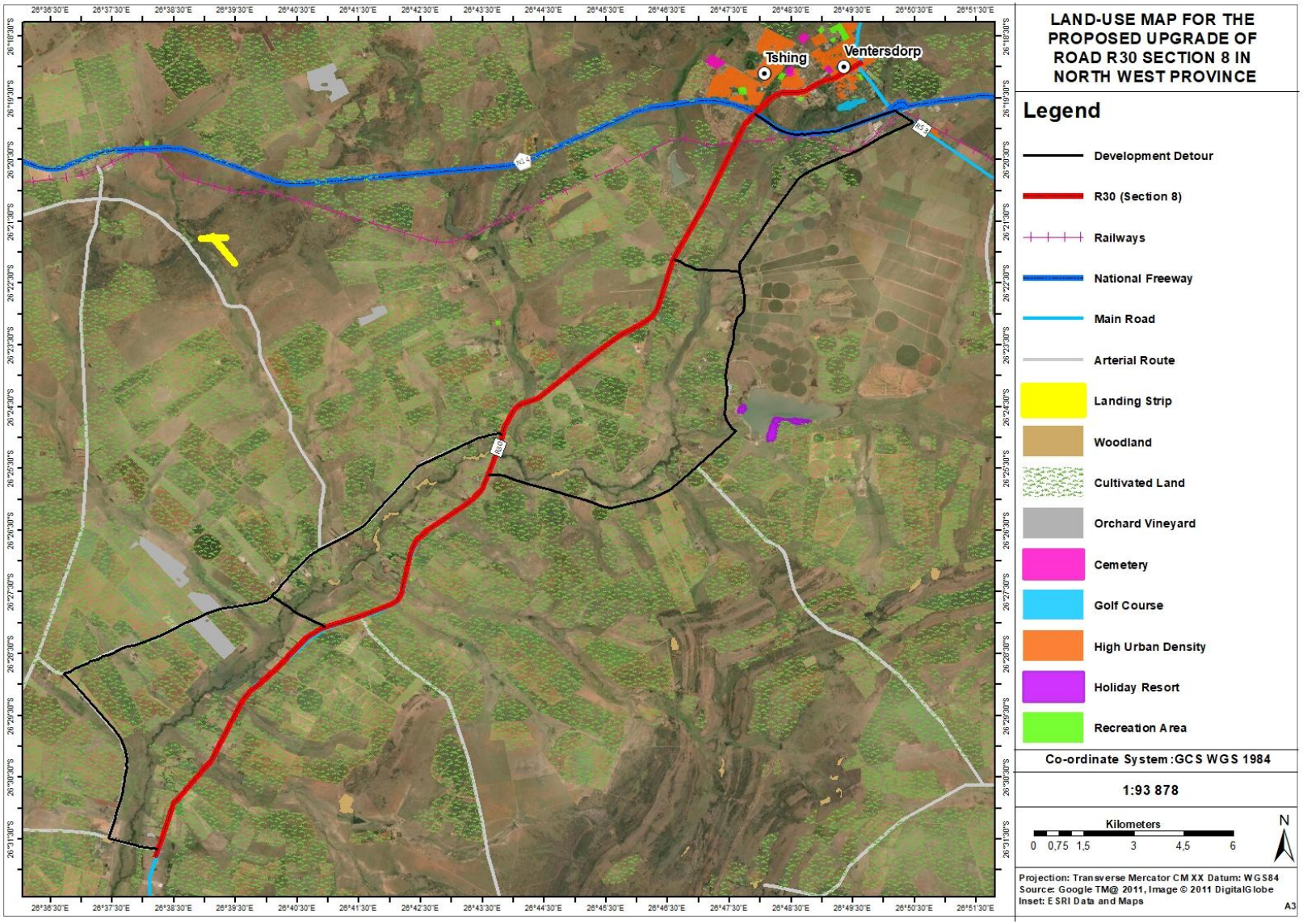


Figure 3-2: lansduse Map.

4. LEGAL FRAMEWORK

4.1 National Environmental Management Act (Act No. 107 of 1998)

The EIA Regulations, promulgated under NEMA, focus primarily on creating a framework for co-operative environmental governance. NEMA provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by State Departments and to provide for matters connected therewith.

4.2 National Waste Act, 2008 (Act No. 59 of 2008)

The NEMWA aims at promoting sustainable waste management practices through the implementation of "Integrated Waste Management Planning", where "Integrated Waste Management Planning is viewed as a holistic approach of managing waste, aimed at optimising waste management practises to ensure that the implementation thereof yields practical solutions that are environmentally, economically and socially sustainable and acceptable to the public and all relevant spheres of government".

4.3 National Water Act, 1998 (Act No. 36 of 1998)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) aims to provide management of the national water resources to achieve sustainable use of water for the benefit of all water users. This requires that the quality of water resources is protected as well as integrated management of water resources with the delegation of powers to institutions at the regional or catchment level. The purpose of the Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in responsible ways. Of specific importance to this application is Section 19 of the NWA, which states that an owner of land, a person in control of land or a person who occupies or uses the land which thereby causes, has caused or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring and must therefore comply with any prescribed waste standard or management practices.

Regulations GN 704 dated June 1999 under the NWA, 1998 (Act 36 of 1998) stipulates that no development activities may take place within the 1:100 year floodline of a watercourse, or within 100 m of the watercourse, whichever is the furthest.

Regulations GN 509 dated August 2016 under the Section 21 c and i water uses of the NWA, 1998 (Act No 36 of 1998) stipulates the:

"Extent of a watercourse" as:

(a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam.

"Regulated area of a watercourse" for section 21(c) or (i) of the Act water uses in terms of this Notice means:

(a) The outer edge of the 1 in 100-year flood line and /or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

(b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or

(c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

4.4 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)

The purpose of the Biodiversity Act is to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA and the protection of species and ecosystems that warrant national protection. As part of its implementation strategy, the National Spatial Biodiversity Assessment was developed.

5. SCOPE OF WORK

5.1 Wetland Delineation and Assessment

The scope of work entailed the following:

- Field visit to delineate the outer boundary of wetland/riparian habitats within a 500 m buffer from the existing R30 Section 8 site according to the methods contained in the manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005);
- Assess and describe the health of any wetland units identified, through evaluation of indicators based on geomorphology, hydrology and vegetation as per the WET-Health methods;
- Assess and describe the Ecological Services, Importance and Sensitivity (EIS) of any wetlands identified on site;
- Identify potential negative impacts on the wetland(s) from the National R30 Road Section 8 and assess the significance of these impacts;
- Provide recommended mitigation measures for the identified impacts in order to avert or lower the significance of the negative impacts.

6. ASSUMPTIONS AND LIMITATIONS

- In order to obtain a comprehensive understanding of the dynamics of the wetland habitats of the study area, surveys should ideally have been replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible and this survey was conducted in one season during a once-off site visit.

- Data collection in this study relied heavily on data from representative, homogenous wetland sections, as well as general observations, analysis of satellite imagery from the past until the present, generic data and a desktop analysis.
- No formal water quality or aquatic faunal assessments (e.g., SASS 5) were conducted as part of this study. All comments on these subjects were made from estimations of the current, visible situation in the field.
- The specialist responsible for this study reserves the right to amend this report, recommendations and/or conclusions at any stage should any additional or otherwise significant information come to light.

7. METHODOLOGY

7.1 Wetland Assessment

For the purpose of this assessment, wetlands are considered as those ecosystems defined by the National Water Act No. 36 of 1998 as:

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

7.1.1 Desktop Assessment

Examination of the National Freshwater Ecosystem Priority Areas (NFEPA)'s databases were undertaken for the project. The NFEPA project aims to produce maps which provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or FEPAs. FEPAs are determined through a process of systematic biodiversity planning and involved collaboration of over 100 freshwater researchers and practitioners. They are identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (MacFarlane et al., 2009).

The assessment of the study site involved the investigation of aerial photography, GIS databases including the NFEPA and South African National Wetland maps as well as literature reviews of the study site in order to determine the likelihood of wetland areas within this site.

7.1.2 Field Assessment

The wetland delineation was conducted as per the procedures described in 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas – Edition 1' (Department of Water Affairs, 2005) (**Figure 7-1**). This document requires the delineator to give consideration to four indicators in order to find the outer edge of the wetland zone:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation. Signs of wetness are characterised by a variety of aspects. These include marked variations in the colours of various soil components, known as mottling; a gleyed soil matrix or the presence of Mn/Fe concretions. It should be noted that the presence of signs of wetness within a soil profile is sufficient to classify an area as a wetland area despite the lack of other indicators.

In assessing whether an area is a wetland, the boundary of a wetland or a non- wetland area should be considered to be the point where the above indicators are no longer present. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland, to delineate the boundary of that wetland and to assess its level of functionality and health.

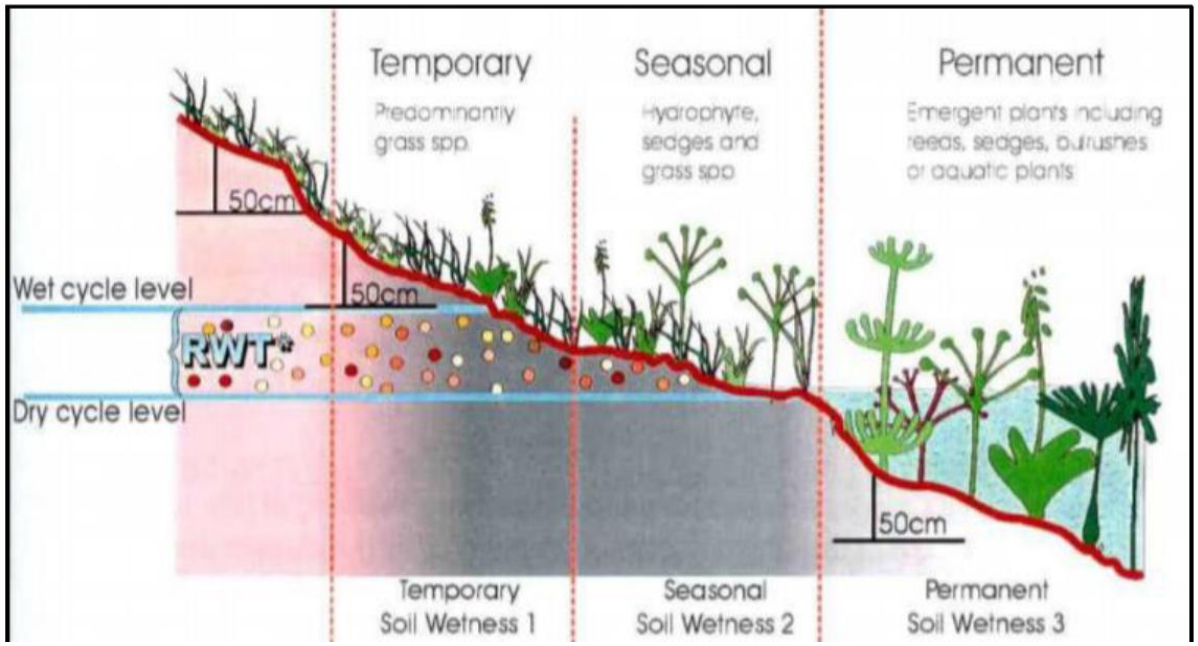


Figure 7-1: Different zones of wetness found in wetlands, indicating how the soil wetness and vegetation indicators change (DWAF, 2005).

7.1.3 Wetland Functionality and Health

Wetlands within the study area serve to improve habitat within and potentially downstream of the study area through the provision of various ecosystem services. Many of these functional benefits contribute

directly or indirectly to increased biodiversity within the transformed study area as well as downstream of the study area through provision and maintenance of appropriate habitat and associated ecological processes (**Table 7-1**).

Table 7-1: Ecosystem services provided by wetlands (Kotze et al, 2008).

Ecosystem services supplied by wetlands	Indirect benefits	Regulating and supporting benefits	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream.
			Streamflow regulation		Sustaining streamflow during low flow periods.
			Water quality enhanced benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters.
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters.
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters.
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
			Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter.
	Biodiversity Maintenance				Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity of the surrounding area.
	Direct benefits	Provisioning benefits	Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agriculture or other purposes.
			Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
			Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods.
		Cultural benefits	Cultural heritage		Places of special cultural significance in the wetland, e.g., for baptisms or harvesting of culturally significant plants.
			Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife.
	Education and research				Sites of value in the wetland for education or research.

An indication of the functions and ecosystem services provided by wetlands can be assessed through the WET- Ecoservices manual (Kotze et al., 2008) and are based on a number of characteristics that are relevant to the particular benefit provided by the wetland. A Level 2 WET-Ecoservices assessment was undertaken for the wetlands occurring on site. A Level 2 assessment is the highest form of WET-Ecoservices assessment that can be undertaken and involves an on-site and desktop assessment.

Each wetland's ability to contribute to ecosystem services within the study area is further dependant on the particular wetland's Present Ecological State (PES) in relation to a benchmark or reference condition. A Level 2 Wetland Health assessment was conducted on the wetlands delineated as per the procedures described in 'Wet- Health: A technique for rapidly assessing wetland health' (MacFarlane et al., 2009). This document assesses the health status of a wetland through evaluation of three main factors –

Hydrology: defined as the distribution and movement of water through a wetland and its soils.

Geomorphology: defined as the distribution and retention patterns of sediment within the wetland.

Vegetation: defined as the vegetation structural and compositional state.

The WET-Health tool evaluates the extent to which anthropogenic changes have impacted upon wetland functioning or condition through assessment of the above-mentioned three factors. Scores range from 0 indicating no impact to a maximum of 10 which would imply that impacts had completely destroyed the functioning of a particular component of the wetland. Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions (**Table *7-2***).

Table 7-2: Guideline for interpreting the magnitude of impacts on wetland integrity.

IMPACT CATEGORY	DESCRIPTION	RANGE
None	No discernible modification or the modification is such that it has no impact on wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on wetland integrity is clearly identifiable, but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a clearly adverse effect on this component of habitat integrity. Well in excess of 50% of the wetland integrity has been lost.	6 – 7.9
Critical	The modification is present in such a way that the ecosystem processes of this component of wetland health are totally / almost totally destroyed.	8– 10

The tool evaluates the health of the wetland and is determined by a score known as the Present Ecological Score. The health assessments for the hydrology, geomorphology and vegetation components were then represented by the Present Ecological State (PES) categories. The PES categories are divided into six units (A-F) based on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in **Table *7-3***.

Table 7-3: Health categories used by WET-Health for describing the integrity of wetlands.

DESCRIPTION	IMPACT SCORE	HEALTH CATEGORY
Unmodified, natural.	0 – 1.0	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.1 - 2.0	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2.1 - 4.0	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4.1 - 6.0	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6.1 - 8.0	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.1 - 10.0	F

Since hydrology, geomorphology and vegetation are interlinked their scores have been aggregated to obtain an overall PES health score using the following formula (MacFarlane et al., 2009):

Health = ((Hydrology score) x3 + (Geomorphology score) x2 + (Vegetation score) x2)) ÷ 7

This gives a score ranging from 0 (pristine) to 10 (critically impacted in all respects). Hydrology is weighted by a factor of 3 since it is considered to have the greatest contribution to wetland health. Due to differences in the pattern of water flow through various hydro-geomorphic (HGM) types (**Figure *7-2***), the tool requires that the wetland is divided into distinct HGM units at the outset. Ecosystem services for each HGM unit are then assessed separately.

Each HGM unit is discussed on the following pages in more detail in terms of the functional integrity, Present Ecological Score and the impacts which affect these.

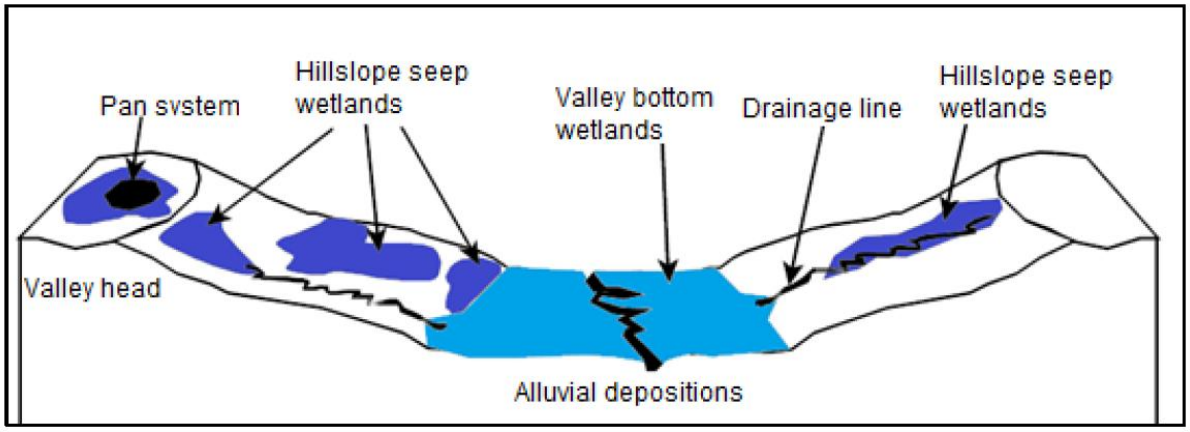


Figure 7-2: Diagrammatic representation of common wetland systems identified in Southern Africa (based on Kotze et al., 2008).

7.2 Risk Assessment to Watercourses

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines.

The matrix assesses impacts in terms of consequence and likelihood. Consequence is calculated based on the following formula:

Consequence = Severity + Spatial Scale + Duration

Whereas likelihood is calculated as:

Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection.

Significance is calculated as:

Significance \Risk= Consequence x Likelihood.

Each metric of the severity (flow regime, water quality, geomorphology, biota and habitat) and spatial scale, duration, frequency of the activity, frequency of the incident/impact and detection are rated to a 1 to 5 scale (GNR 509, of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as Defined in Section 21(C) or Section 21(I), 2016). The score is then placed into one of the three classes, with low risks to the watercourse will qualify for a General Authorisation (GA). Medium and high-risk activities will require a Section 21(C) and (I) water use licence as per the National Water Act of 1998 (**Table *7-4***).

Table 7-4: Significance of the Section 21 C and I ratings matrix as prescribed by the National Water Act 1998 (Act No. 36).

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

8. ENVIRONMENTAL BASELINE INFORMATION

8.1 GEOLOGY & SOILS

The area consists of aeolian and colluvial sand overlying sandstone, mudstone and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba.

8.2 CLIMATE

The study site is warm-temperate, with a summer-rainfall climate. The area has an overall Mean Annual Precipitation (MAP) of 530 mm, with high summer temperatures. The area experiences severe frost (37 days per year on average) occurs in winter. See also climate diagram below (**Figure 8-1**).

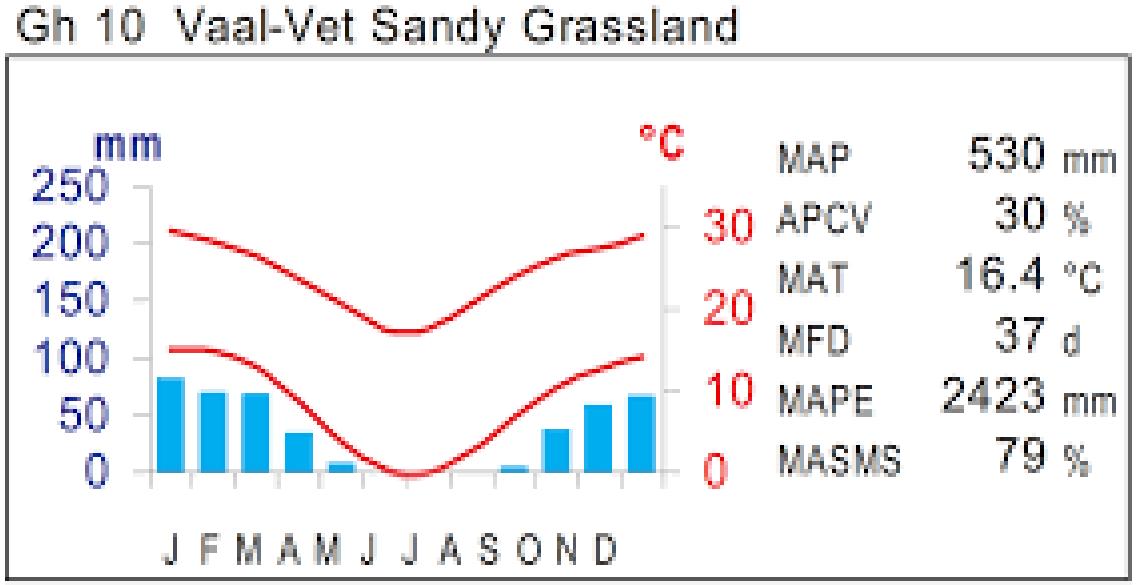


Figure 8-1: climate diagram for Gh 12 Vaal-Vet Sandy Grassland

8.3 VEGETATION TYPE ASSOCIATED WITH THE R30 S8 ROAD IMPROVEMENT

8.3.1 VAAL-VET SANDY GRASSLAND (GH 10)

A significant portion of the road R30-S8 is located within the Vaal-Vet Sandy Grassland (Gh 10) vegetation unit (Error! Reference source not found.). This vegetation unit is found in plains-dominated landscape with s ome scattered, slightly irregular undulating plains and hills. The vegetation unit consist of low-tussock grasslands with an abundant karroid element. The vegetation unit is dominated by *Themeda triandra* which is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase

in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

The Vaal-Vet Sandy Grassland (Gh 10) is distributed in the North-West and Free State Provinces, South of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein. This vegetation unit is found in altitudes ranging between 1 220 and 1 560 m, it is generally found in 1 260–1 360 m.

8.3.2 AZa 5 Highveld Alluvial Vegetation

A small section of the road cuts through the Highveld Alluvial Vegetation unit, this vegetation unit can be forms flat topography supporting riparian thickets mostly dominated by *Acacia karroo*, accompanied by seasonally flooded grasslands and disturbed herblands often dominated by alien plants.

This vegetation unit is distributed in the Free State, North-West, Mpumalanga and Gauteng Provinces as well as in Lesotho and Swaziland: Alluvial drainage lines and floodplains along rivers embedded within the Grassland Biome and marginal (eastern) units of the Kalahari (Savanna Biome), such as along upper Riet, Harts, upper Modder, upper Caledon, Vet, Sand, Vals, Wilge, Mooi, middle and upper Vaal Rivers etc. and their numerous tributaries. Altitude ranging from 1 000–1 500 m.

8.4 SURFACE HYDROLOGY

The aquatic sensitivity of the proposed site is classified as **VERY HIGH** in the Screening Report, which was confirmed to be "High" due to the watercourses within 500m of the road improvement. The National Freshwater Ecosystems Priority Areas (NFEPA) identifies important wetlands in South Africa (**Figure 7**). The National Freshwater Ecosystems Priority Areas (NFEPA) identifies important wetlands in South Africa. The study site falls under the Middle Vaal Water Management Area (WMA). The road is located on quaternary catchment C24E **Figure 7 and 8** is a specific representation of the watercourses/wetlands that are found along section 8 of the road R30.

8.4.1 Details of the Quaternary Catchment

As indicated above the road is locate on quaternary catchment C24E, Quaternary catchment C24E is a hydrological unit within South Africa's national water resource classification system, situated in the Vaal Water Management Area and encompassing part of the Schoonspruit River system. As one of the 1,946 quaternary catchments demarcated for water resource planning and management, C24E serves as a foundational unit for assessing ecological integrity, water availability, and land-use impacts. According to the Department of Water and Sanitation's ecological reserve determination, C24E has a **Present Ecological State (PES)** of Category C, indicating a moderately modified condition, and a **Target Ecological Category (TEC)** also set at Category C, reflecting a goal to maintain its current ecological functionality. The catchment exhibits **low ecological importance and sensitivity (EIS)**, yet it supports

key aquatic ecosystems, particularly along the Schoonspruit River reach designated as EWR S1. Hydrologically, C24E contributes a **Mean Annual Runoff (MAR)** of approximately 59.38 million cubic meters, with an ecological reserve requirement of **35.8% of MAR**, underscoring its role in sustaining aquatic biodiversity and basic human needs. The catchment's landscape is shaped by agricultural activities, which influence runoff patterns and ecological pressures, making it a focal point for integrated water resource management and conservation planning.

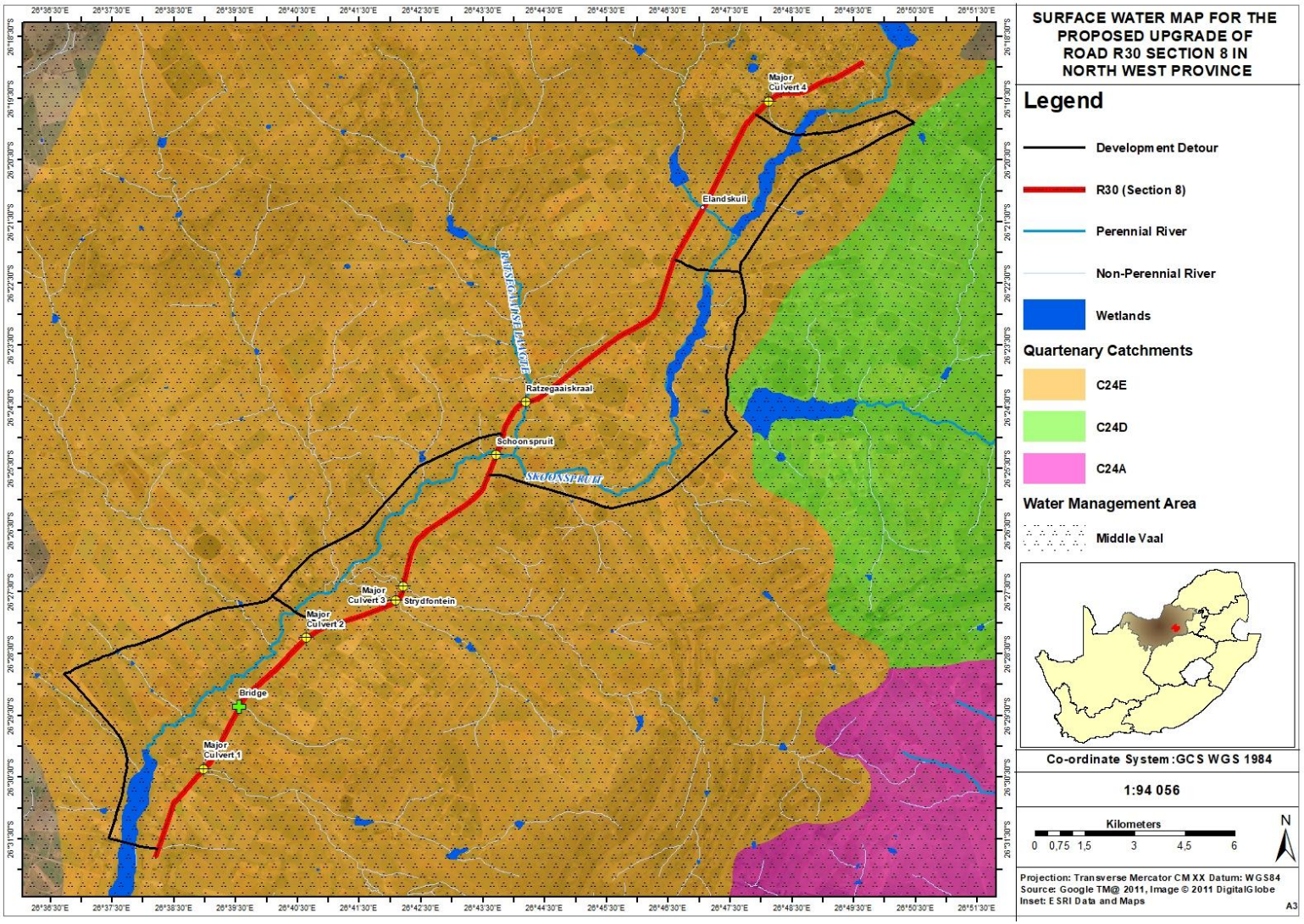


Figure 8-2: Surface Water Map

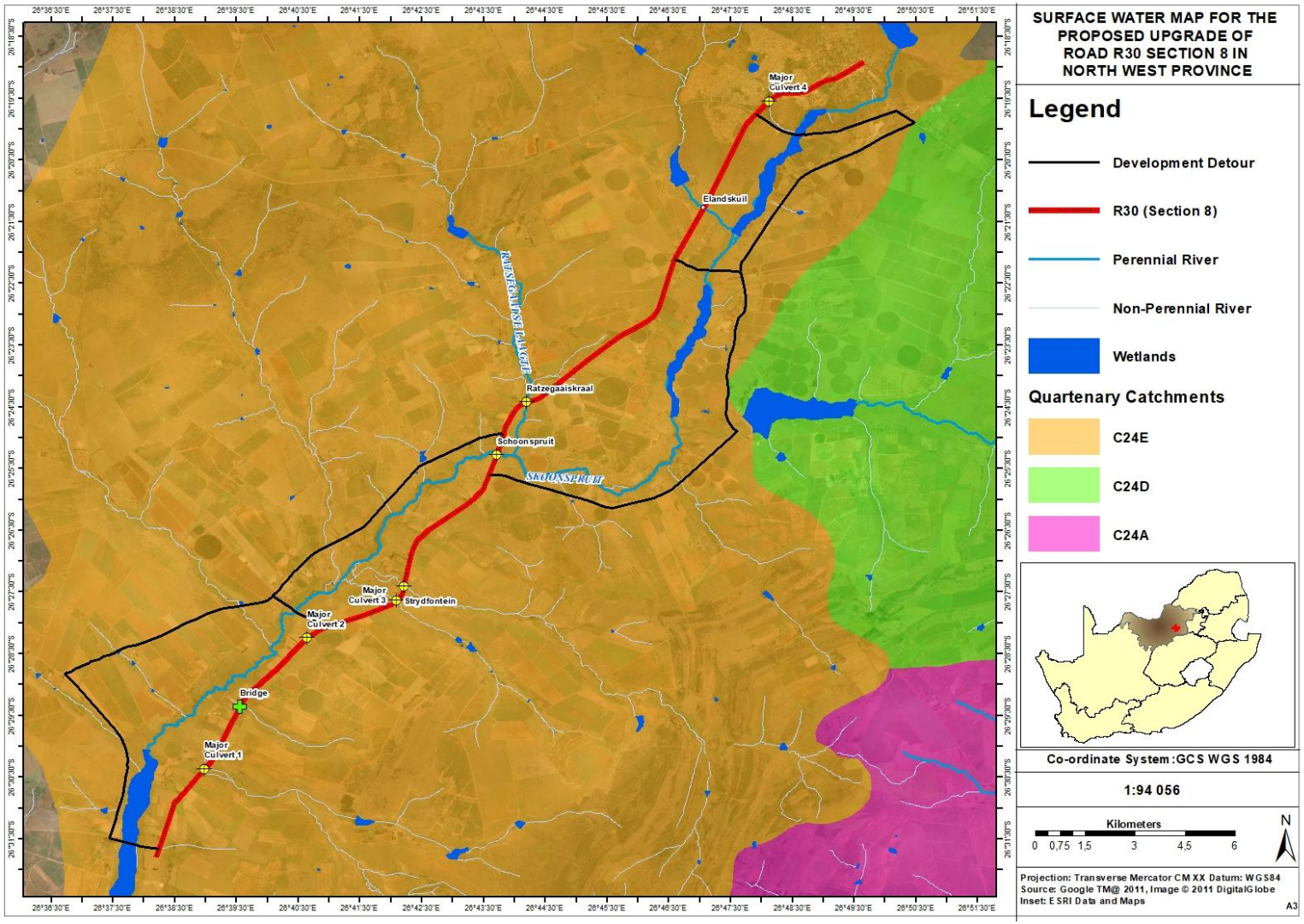


Figure 8-3: Surface Water Map 1.

9. RESULTS

9.1 Wetland Delineation and Assessment

This section provides the findings of the various methodologies utilised during the wetland assessment.

9.1.1 Desktop Assessment

Examination of the National Freshwater Ecosystem Priority Areas (NFEPA) database were undertaken for the study site. The NFEPA project aims to produce maps which provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. They were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (MacFarlane et al., 2009). Identification of FEPA Wetlands are based on a combination of special features and modelled wetland conditions that include expert knowledge on features of conservation importance as well as available spatial data on the occurrence of threatened frogs and wetland-dependent birds.

9.1.1.1 FIELD SURVEY

The road servitude has suffered various degrees of disturbance as a result of the existing road and associated infrastructure, and the surrounding anthropogenic activities onsite such as farming. The disturbance has taken place over time. The proposed improvement of National Road R30 Section 8 from km 36.8 to Ventersdorp km 68.646 is located on the Vaal-Vet Sandy Grassland (Gh 10), which consists of low-tussock grasslands with an abundant karroid element. While the main watercourse consists of the the Highveld Alluvial Vegetation unit, this vegetation unit can be forms flat topography supporting riparian thickets mostly dominated by *Acacia karroo*, accompanied by seasonally flooded grasslands and disturbed herblands often dominated by alien plants.

The proposed improvement of National Road R30 Section 8, extending from kilometre marker 36.8 to 68.646 near Ventersdorp, traverses the **Vaal-Vet Sandy Grassland (Gh10)** vegetation unit. This unit is characterised by low-tussock grasslands and includes a prominent karroid component, indicative of its semi-arid ecological nature.

However, the existing road servitude has undergone substantial transformation due to previous maintenance activities, resulting in a modified vegetation structure. The dominant species within the servitude area are **Themeda triandra** (Red Grass) and **Hyparrhenia hirta** (Common Thatching Grass), as shown in **Figure 9-1**. These species reflect a degree of ecological resilience but also signal anthropogenic influence and habitat disturbance along the road corridor.

9.1.1.2 WETLAND FEATURES

R30 Road Section 8 traverses a regulated area encompassing multiple watercourses, each falling within the 500-meter buffer zone stipulated by the National Water Act (Act No. 36 of 1998) for aquatic ecosystem

protection. These features are illustrated in **Figures 9-1 through 9-4**. The most significant watercourse was identified along the northern segment of the alignment during the site inspection (refer to **Figure 9-4**).

Hydrological observations indicate the presence of seasonal and possibly perennial wetland features exhibiting saturated soils and standing water indicative of palustrine systems. Vegetation within these systems includes dominant hydrophytic species such as Phragmites australis (common reed), confirmed in Figure 9.4. This species plays a critical role in stabilizing wetland margins, enhancing water quality through sediment filtration, and providing nesting and roosting habitat for a range of avifaunal species, including wetland-dependent birds.

The ecological function of these riparian habitats must be carefully considered in route planning and environmental compliance, particularly in relation to Section 21(c) and (i) water use authorizations. Mitigation measures, including buffer demarcation, erosion control, and avoidance of construction within critical ecological zones, are recommended to preserve the integrity of the aquatic ecosystem.



Figure 9-1: Overview of the disturbed Vaal-Vet Sandy Grassland vegetation unit observed onsite.



Figure 9-2: Overview of the Highveld Alluvial Vegetation unit.

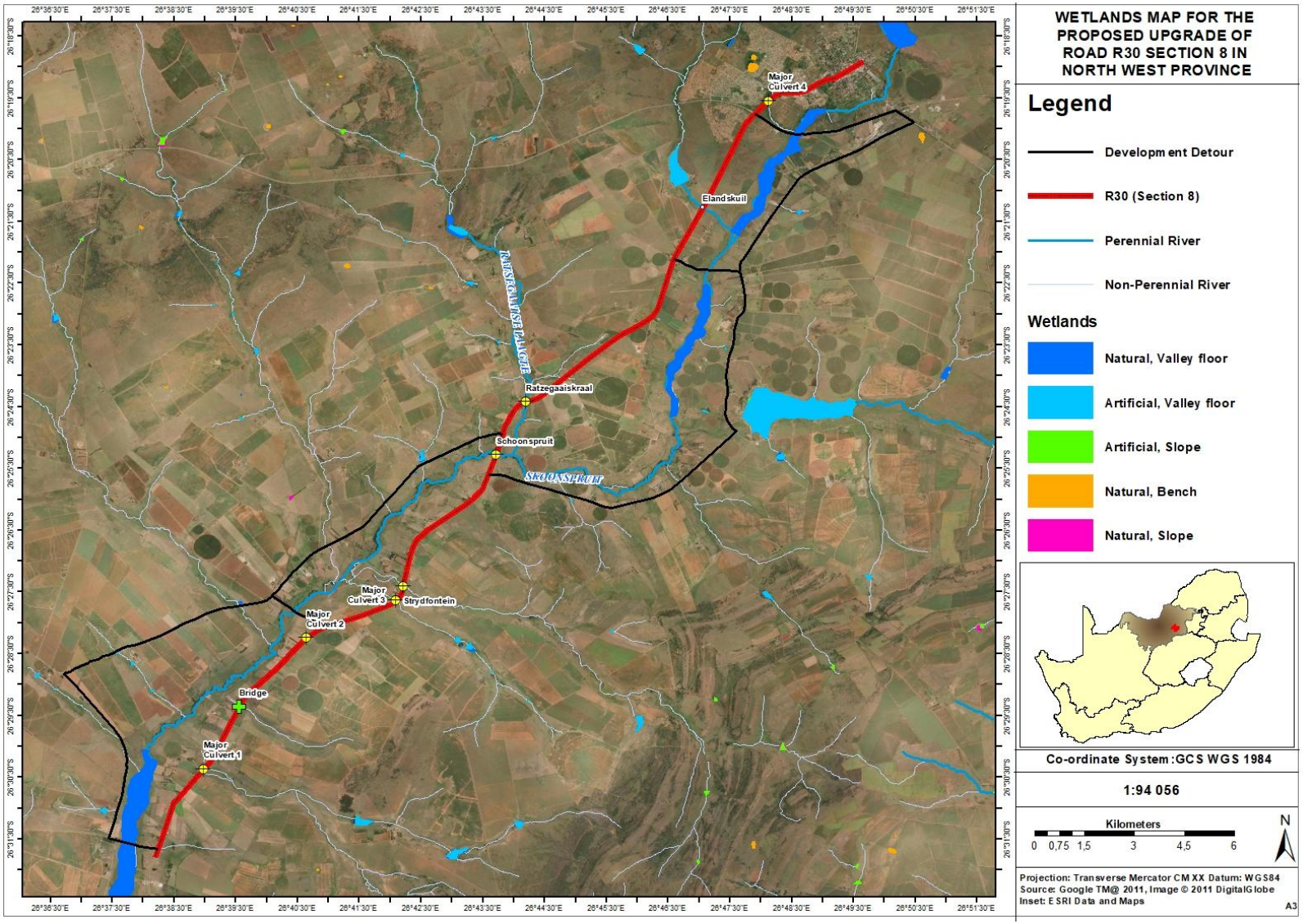


Figure 9-3:Map of the wetland and watercourses within 500m of the R30 Section 8.



Figure 9-4: Watercourse and Wetland observed within 500m of the road (A-C Represents the watercourse and D represents the wetland (Dam)

9.1.2 Terrain indicator

The topography of an area is generally a good practical indicator for identifying those parts in the landscape where wetlands are likely to occur. Generally, wetlands occur as a valley bottom unit however wetlands can also occur on steep to mid slopes where groundwater discharge is taking place through seeps (DWAF, 2005). In order to classify a wetland system, the localised landscape setting must be taken into consideration through ground-truthing of the study site after initial desktop investigations (Ollis et al., 2014).

The study site can be characterized as Gently to moderately sloping upper pediment slopes (**Figure 9-5**).



Figure 9-5: Slope of the R30 Section 8 National Road.

9.1.3 Soil wetness and soil form indicator

The watercourses onsite have water and support a host of hydrophytes and terestrial plant species. Wetland areas were identified and mainly delineated according to the presence of hydric (wetland) soil types. Hydric soils are defined as those which show characteristics (redoximorphic features). The watercourses consist mainly of clay soils (**Figure 9-6**).



Figure 9-6:Soil Observed within one the watercourses.

9.1.4 Vegetation indicator

According to DWAF (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act, Act 36 of 1998. However, using vegetation as a primary wetland indicator requires an undisturbed condition (DWAF, 2005). Major disturbances were however noted in the wetland systems making it difficult to rely solely on vegetation as a wetland indicator. Disturbances included the presence of agricultural activities, servitude of the road and powerlines along the R30 National Road. There was evidence of hydrophytes as reeds(*Phragmites australis*) (**Figure 9-7**),



Figure 9-7: Phragmite species observed onsite.

Refer to Figure 9-1 for the conditions of the vegetation observed along the road.

9.1.5 Wetland Delineation

Any wetlands identified on the site were categorised according to the National Wetland Classification System for South Africa (Ollis et al., 2013). The wetland area was classified as a hydrogeomorphic (HGM) unit. An HGM unit is a recognisable physiographic wetland-unit based on the geomorphic setting, water source of the wetland and the water flow patterns (MacFarlane et al., 2009). The proposed project is located within 500m of the Strydfonetin, Schoon and Ratzegaai streams (**Figure 9-8**).

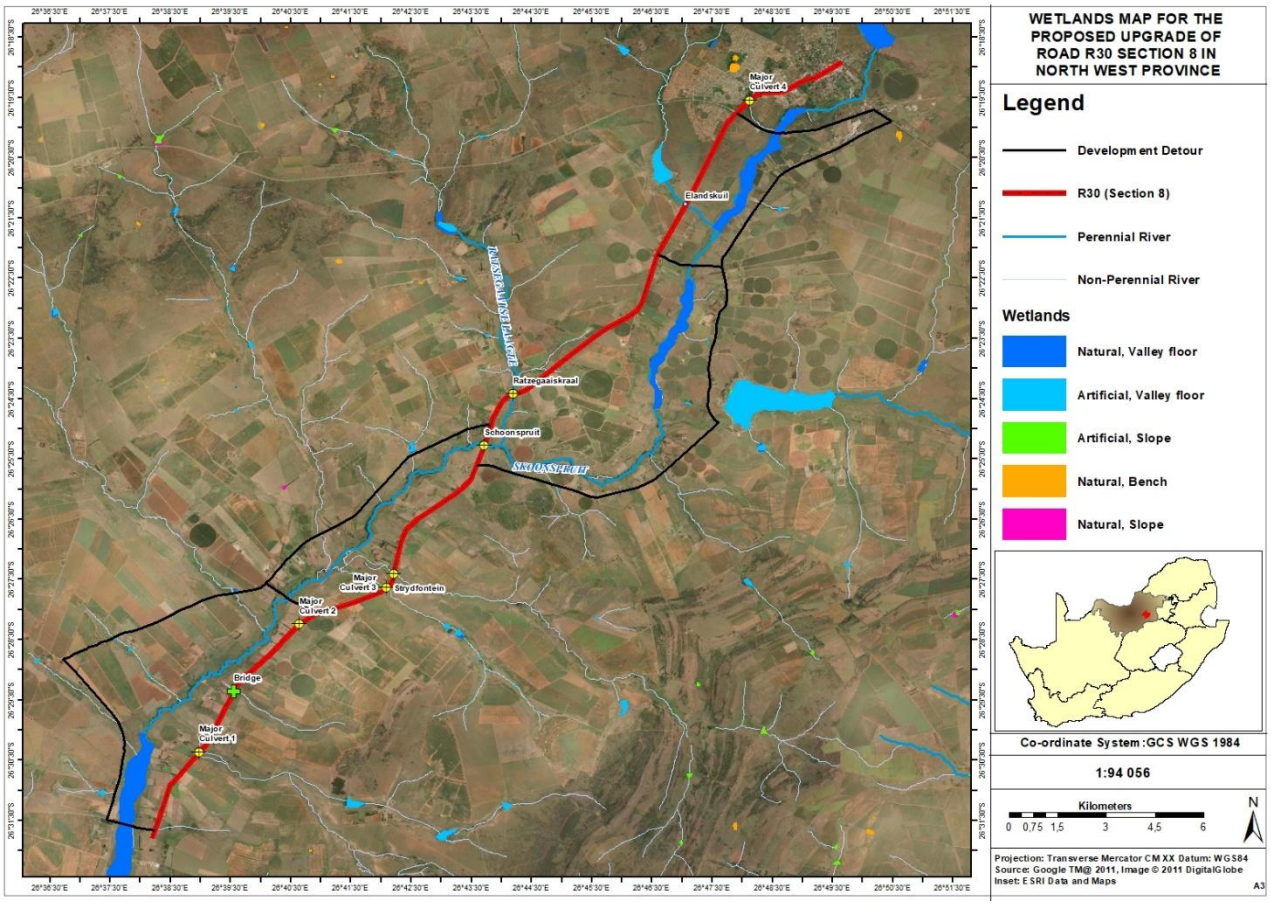


Figure 9-8:Wetland delineation Map

9.2 Wetland Functional and Health Assessment

9.2.1 Wetland Ecological Importance and Sensitivity

The EIS and functions were calculated using the new draft DWA guidelines and model, as developed by M. Rountree, but not yet published. Information used form the SIBIS and VEGMAP products. A mean score between 0 and 4 is obtained, with 0 as the lowest and 4 as the highest score. No classification of the scores is given.

The watercourses onsite have an Ecological Importance and Sensitivity (EIS) score of 1 (**Table 7**). This is a value between 0 and 4, with 0 being very low and 4 very high. The rivers, therefore, have a Medium EIS score. It is regarded as being modified.

Table 9-1: EIS calculation of the wetland

ECOLOGICAL IMPORTANCE AND SENSITIVITY	SCORE (0-4)	*CONFIDENCE (1-5)*	MOTIVATION
Biodiversity support	**3.00**	*4*	
Presence of Red Data species	**4.00**	*4.00*	No known red data or protected species observed on site.
Populations of unique species	**0.00**	*4.00*	No unique plant or animal populations were observed.
Migration/ breeding/ feeding sites	**2.00**	*4.00*	Though a few bird species were observed, few nests were present.
Landscape scale	**1.00**	*4.80*	
Protection status of the wetland	**4.00**	*5.00*	The wetland and surrounding area have been exposed to various industrial and housing developments surrounding the area.
Protection status of the vegetation type	**4.00**	*5.00*	The wetland is located in an Endangered and Vulnerable vegetation types. Although dominated by *Phragmites* it is very homogeneous .
Regional context of the ecological integrity	**2.50**	*5.00*	The wetland is in PES class D due to the large scale degradation of the surrounding areas as well as the wetland area itself.
Size and rarity of the wetland type/ s present	**4.00**	*4.00*	The wetland is not particularly rare and has no vulnerable ecosystem present.

ECOLOGICAL IMPORTANCE AND SENSITIVITY	SCORE (0-4)	*CONFIDENCE (1-5)*	MOTIVATION
Diversity of habitat types	**1.00**	*5.00*	The wetland has a low species diversity as well as habitat diversity. The wetland is dominated by a homogeneous stand of *Phragmites australis*.

9.2.2 Wetland Health and PES

It should be noted in **Table 8** by Kleynhans (1999) that if a score of less than 2 is attributed to any impact, the lowest rating, rather than the mean, is used to attribute PES class.

Table 9-2:PES classes (from Kleynhans 1999) indicating the interpretation of the mean scores to rate the PES category.

WITHIN GENERALLY ACCEPTABLE RANGE		
Category	**Score**	**Description**
A	>4	Unmodified, or approximates natural condition and/or represents a natural condition due to successful rehabilitation process/program(s) which has occurred and/or are in the process of occurring.
B	>3 and 4	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged Moderately modified.
C	>2 and 3	Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D	2	Largely modified. A large loss of natural habitats and basic Ecosystem functions has occurred.
OUTSIDE GENERAL ACCEPTABLE RANGE		
E	>0 and 2	Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive Critically modified.
F	0	Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat

The wetland perennial rivers in the study area have EIS categories and EMC values as indicated in **Table 9**.

Table 9-3: Summary of EIS onsite.

Wetland	EIS category	EMC
Strydfontein River	C	C
Schoon River	C	C
Ratzegaai River	C	C
Unnamed Tributaries	C	C

9.2.3 Wetland ecoservices

WET-EcoServices (Kotze et al. 2004) is a tool for evaluating the services provided by the watercourses (Rivers, allowing for more informed planning and decision-making. In general, the riverine wetland provides low-moderate ecosystem services (spider diagram right). Because of the destruction of natural vegetation and the resulting loss of habitat for insects and amphibians, it has a low species richness and biodiversity. (See **Figure 9-9**).

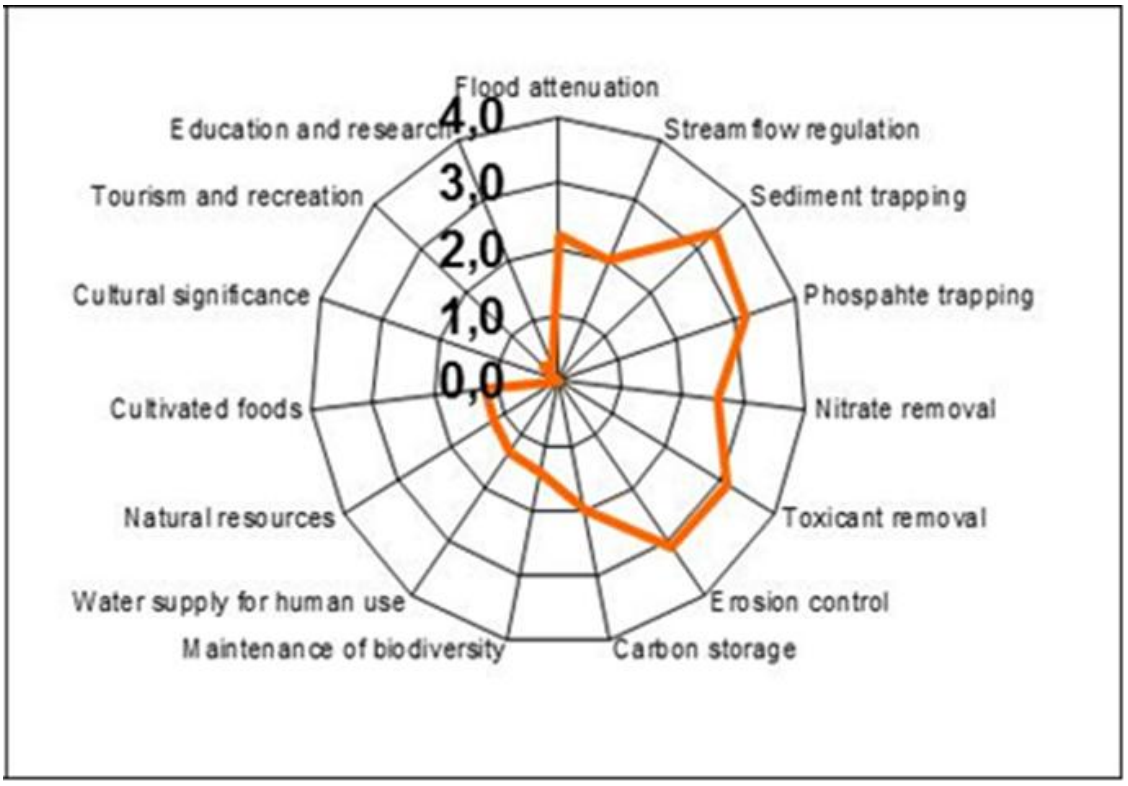


Figure 9-9: Eco services

9.3 Ecological Assessment

9.3.1 Critical Biodiversity Areas

The Northwest Biodiversity Sector Plan identifies a network of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) in the province based on a systematic biodiversity plan. Collectively, the

CBAs and ESAs cover 57% of the province. These were first identified in the Northwest Biodiversity Conservation Assessment (DACERD, 2009), and are comprehensively re-assessed and updated for this plan. This Biodiversity Sector Plan therefore represents the most current information available on biodiversity in the province and is an update of the data given in the NW Environment Outlook Report (2013) and other assessments that precede it, such as the National Biodiversity Assessment (2011), the National Freshwater Ecosystem Priority Assessment (2011).

The provincial Biodiversity Sector Plan is intended to be the biodiversity sector's input into government sector planning and development processes. The aim of the Biodiversity Sector Plan is to identify the minimum area necessary to conserve and maintain biodiversity and major ecological infrastructure in the province. Where possible, it is spatially aligned with other relevant spatial plans for the province, such as the Provincial Spatial Development Framework and gazetted Environmental Management Frameworks[1].

According to the 2015 North West Biodiversity Sector Plan, the proposed Improvement of section 8 of the road R30 are located within the following:

- Critical Biodiversity Area 2[2]
- Ecological Support Area 1[3].

Refer to **Figure 9-10** below for the Sensitivity map.

[1] 2008 North-West Province Biodiversity Conservation Assessment
[2] Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan.
[3] Ecological Support Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services.

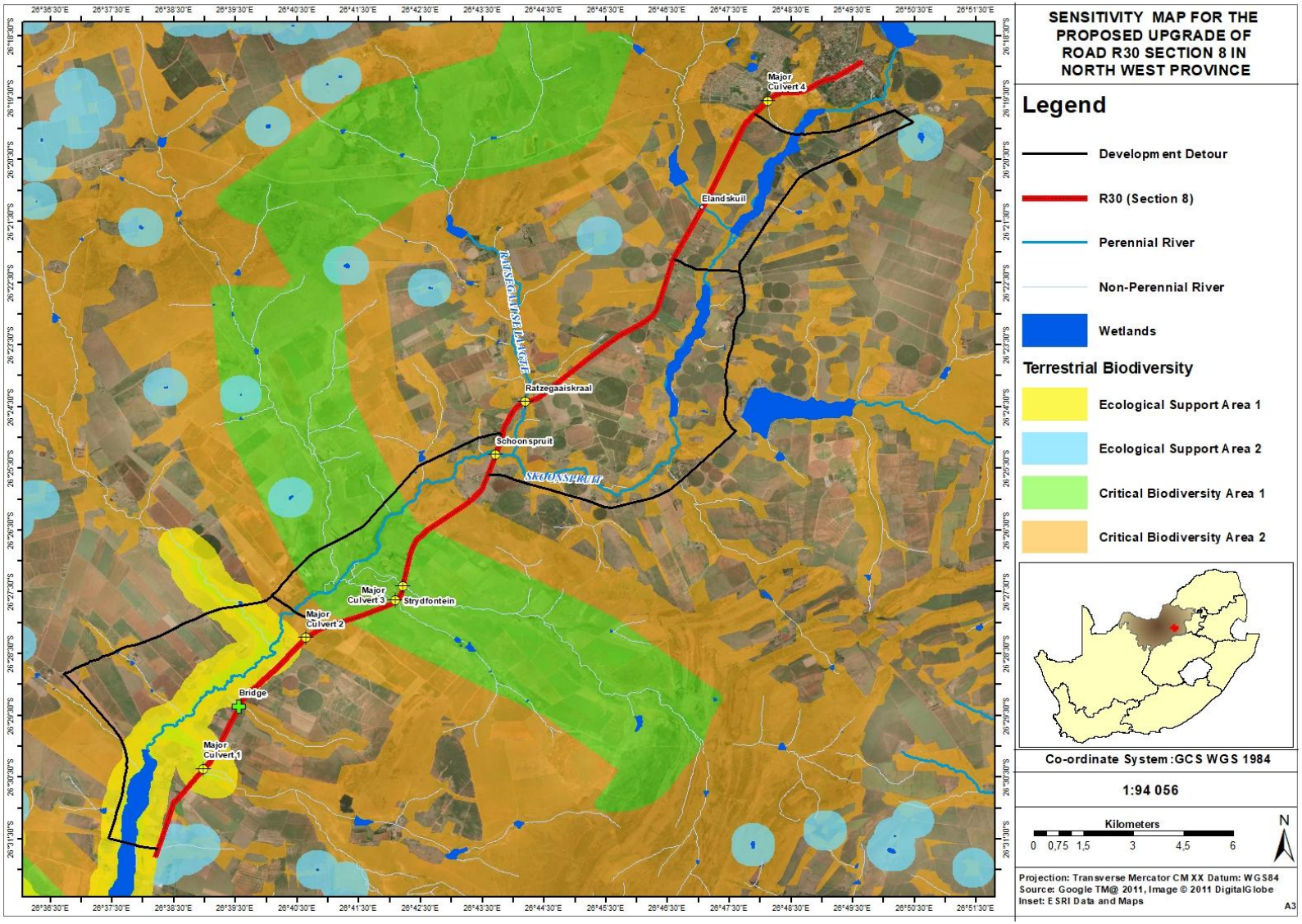


Figure 9-10: The R30 Section 8 in relation to the2015 North West Biodiversity Sector Plan.

9.3.2 Freshwater Aquatic Species

The freshwater habitats onsite, as illustrated in **Figure 9-11**, predominantly consist of aquatic plant species such as algae, water lilies (*Nymphaea spp.*), and green algae. These taxa play an essential ecological role by enhancing water quality—utilizing their root systems to filter out pollutants and excess nutrients, thereby supporting nutrient cycling and maintaining aquatic ecosystem health.

During the site inspection, several unnamed tributary watercourses were found to be dry, indicating a **seasonal or ephemeral hydrological regime**, which limits their capacity to support ichthyofaunal (fish) populations. In contrast, major rivers exhibited signs of aquatic fauna presence, with one instance involving a deceased fish observed within the channel (**Figure 9-11**), suggesting intermittent aquatic activity.

Additionally, these freshwater habitats provide suitable ecological conditions for avifaunal species, serving as functional nesting, roosting, and foraging grounds for birds adapted to riparian and wetland environments. Their presence also contributes to supporting onsite agricultural activities, likely through water retention, soil moisture regulation, and habitat diversification—further underscoring the ongoing ecological value of these habitats despite variable water availability.



Figure 9-11:Typical Freshwater Habitat onsite.

10. RISK ASSESSMENT OF DELINEATED WETLAND

The following impact assessment is supplied, the assessment was conducted only for existing degradation of the study site by the existing R30 National Road section 8 site with the focus on wetland habitats. From the assessments it is clear that impacts can be expected from the proposed activities (**Table 10-1**).

Table 10-1: Impact 1-Degradation and / or destruction of Freshwater habitats (Watercourses).

Impact Name	**1. Degradation and/or destruction of wetland habitats.**				
Alternative	**Proposal**				
Phase	**All phases**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	1	1
Extent of Impact	1	1	Reversibility of Impact	2	1
Duration of Impact	2	1	Probability	3	2
Environmental Risk (Pre-mitigation)					-4.50

Mitigation Measures

In terms of section 19 of the NWA (1998), owners / managers / people occupying land on which any activity orprocess undertaken which causes or is likely to cause pollution or degradation of a water resource must take all reasonable measures to prevent any such disturbance from occurring, continuing or recurring. These measures may include measures to (inter alia):

- Cease, modify, or control any act or process causing the pollution/degradation.
- Comply with any prescribed waste standard or management practice.
- Contain or prevent the movement of pollutants or the source of degradation.
- Remedy the effects of the pollution/degradation.
- Remedy the effects of any disturbance to the bed and banks of a watercourse/wetland.

According to the NWA (1998) part of the definition of pollution of water resources states that any physical alterations to a water resource, for example the excavation of a wetland / stream or changes to the morphology of such a water resource may be considered to be pollution. Activities which cause an alteration to the biological properties of a wetland i.e. the fauna and flora contained within and supported by that water resource are therefore also considered to be a form of pollution.

Any construction activities in or within a delineated buffer zone of a water resource may only take place afterthe necessary water use license has been obtained.

Where wetlands may be encroached upon by proposed activities, the edge of the wetland must be clearly demarcated in the field with pegs or poles that will last for the duration of the construction phase, color-codedas follows:

• RED – Indicating the edge of the wetland (Note: This includes the permanent, seasonal and temporal zonesof wetlands, or parts thereof; and no vehicles or building materials are allowed in this zone). These should beput along the entire length of the site.

• ORANGE – Indicating the edge of the buffer zone

Construction machinery and associated vehicles may not be allowed to enter wetlands. Strictly no re-fueling ofvehicles or machinery should be allowed to take place in any area close to a wetland.

During and after construction areas of exposed soil can easily erode and subsequently end up in the wetlands. A well-designed storm water system must be put in place to avoid erosion into wetlands. Naturalrunoff from the natural terrestrial habitat surrounding the wetlands should however not be restricted unnecessarily.

The use of potential pollutants (paint, chemicals, etc.) during construction and operational phases must bestrictly controlled and a high quality of management and supervision concerning such materials must be enforced, especially close to wetland buffer zone areas. Sanitary facilities must be made available to construction workers to prevent urine and human waste enteringthe wetlands. If at any point construction activities encroach on wetlands, it is strongly advised that a wetland/aquaticspecialist is appointed during all phases to monitor impacts and related mitigation measures regardingwetland habitats.	
Environmental Risk (Post-mitigation)	-2.00
Degree of confidence in impact prediction:	High
Impact Prioritisation	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it isprobable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	1
The impact is unlikely to result in irreplaceable loss of resources.	
Prioritisation Factor	1.17
Final Significance	-2.33

Table 10-2: Impact 2-Loss of indigenous fauna and flora diversity associated with watercourses.

Impact Name	**2. Loss of indigenous fauna and flora diversity associated with wetlands.**				
Alternative	**Proposal**				
Phase	**All phases**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	1	Reversibility of Impact	4	2
Duration of Impact	2	2	Probability	2	1
Environmental Risk (Pre-mitigation)					-5.00
Mitigation Measures					
Destruction of natural wetland vegetation must be avoided at all costs. Special attention should be paid to alien and invasive control within the whole study area. Alien and invasivevegetation control should take place throughout all development phases to prevent loss of habitat of indigenous fauna and flora.					

Movement of vehicles and construction workers in wetlands and buffer zones should be strictly prohibited. No harvesting of plants or animals should be allowed. Any specimens of protected plant species known to occur in the wetlands and the delineated buffer zone and may potentially be impacted by the construction activities, are to be fenced off for the duration of the activity. Conservation of these specie and their natural habitat must be a high priority. If at any point construction activities encroach on wetlands, it is strongly advised that a wetland/aquatic specialist is appointed during all phases to monitor impacts and related mitigation measures regarding wetland habitats. Red Data listed and protected species as well as sensitive habitats related to wetlands should be strictly monitored. Any conservation recommendations and measures that aim to mitigate the impacts of this development must also be monitored by such a specialist during the construction, operational and decommissioning phases.

Environmental Risk (Post-mitigation)	-1.50
Degree of confidence in impact prediction:	High
Impact Prioritisation	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value(services and/ or functions) of these resources is limited.	
Prioritisation Factor	1.33
Final Significance	-2.00

Vegetation clearing has occurred and resulted increased turbidity and sedimentation in the watercourse as well as altered flow patterns. The machinery used has a risk of hydrocarbon spills into the watercourse. There are impacts on the flow patterns to the watercourse.

This report highlights the findings for a one site survey, limiting the confidence for the risk assessment in the **Tables above**.

Operational Phase

Increased sedimentation may occur as a result from the runoff from the road improvement. This has the potential to change habitat structure within the receiving environment and this will in turn result in changes in ecosystem function. Changes in habitat structure due to sedimentation would result in changes in the species composition.

Water quality impairment has the potential to change ecosystem function, change community structure as species sensitive to water quality impairment are eliminated and tolerant species increase in number, this results in a loss of biodiversity of sensitive species.

Invasive alien plants have far-reaching detrimental effects on native biota and has been widely accepted as being a leading cause of biodiversity loss. They typically have rapid reproductive turnover and are able to outcompete native species for environmental resources, alter soil stability, and promote erosion, change litter accumulation and soil properties. In addition, certain alien plants exacerbate soil erosion whilst others contribute to a reduction in stream flow thereby potentially increasing sediment inputs and altering natural hydrology of receiving watercourses. These impacts negatively affect areas that are largely natural (with low existing weed levels) greater than for areas already characterised by dense infestations of alien plants with low indigenous plant diversity (Macfarlane *et al.*, 2014).

10.1.1 Sedimentation and soil erosion

Soil erosion will result in the deposition of sediment into the freshwater system; posing a risk to the downstream catchment geomorphological/functional integrity. Subsequent impacts that are likely to result are:

- sedimentation of the watercourse that will be destructive to many faunal species affecting their habitat; breeding and feeding cycles.

Local site factors such as soil erodibility, vegetation cover, gradient of local slopes and regional rainfall/runoff intensity will affect the probability and intensity of erosion impacts (Macfarlane *et al.*, 2014). Typical results of erosion & sedimentation on water resources may include:

- Localised scouring at stormwater discharge points into watercourses
- Deposition of large masses of sediment downstream causing localised channel braiding, instability of the riverbanks and alterations in water distribution.

10.1.2 Pollution of water resources and soil

Changes to the water quality will result in changes to the ecosystem structure and function as well as a potential loss of biodiversity. Water quality pollution leads to modification of the species composition where sensitive species are lost and organisms tolerant to environmental changes dominate the community structure. Any substances entering and polluting watercourses will directly impact downstream ecology through surface runoff during rainfall events, or subsurface water movement, particularly during the wetter summer months.

Contaminants such as hydrocarbons, solids, pathogens and hazardous materials may enter watercourses (examples include petrol/diesel, oil/grease, paint, cement/concrete and other hazardous substances). These contaminants negatively affect aquatic ecosystems including sensitive or intolerant species of flora and

fauna. Where significant changes in water quality occur, this will ultimately result in a shift in aquatic species composition, favouring more tolerant species, and potentially resulting in the localised exclusion of sensitive species. Water quality monitoring must be implemented to ensure sustainable management of water sources within that area. Sudden drastic changes in water quality can also have chronic effects on aquatic biota leading to localised extinctions. Deterioration in water quality will also affect its suitability for human domestic/agricultural use and have far reaching impacts for local communities who may rely on rivers as water supply (Macfarlane et al., 2014).

10.1.3 Alien Invasive Species

There are alien invasive plant species currently present along the Road. Any ground disturbance provides an opportunity for alien invasive plant species to spread and for new species to establish themselves in the areas. Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs (Zedler & Kercher, 2004). Such changes on the ecology of the riparian habitat have/will have a detrimental impact on its ability to maintain both floral and faunal biodiversity. Invasive alien plant species, particularly woody species, have much increased water usage compared with indigenous vegetation. Many alien invasive plant species are particularly found in riparian ecosystems and their invasion results in the destruction of indigenous species; increased inflammable biomass (high fire intensity); erosion; clogging of waterways such as small streams and drainage channels causing decreased river flows and incision of riverbeds and banks. This results in an overall impact on the hydrological functioning of the system.

10.1.4 Mitigation

The proposed upgrading of the road will have negative effects on the environment. The following mitigation measures may reduce the severity of impacts:

- Rehabilitation of the disturbed areas;
- Minimising pollutants entering the watercourse;
- Implement a programme for the clearing/eradication of alien species including long term control of such species;
- Wetland monitoring and biomonitoring must take place bi-annually.

Sedimentation and soil erosion

Mitigation options

- Do not allow surface water or stormwater to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place.
- Exposed soils must be rehabilitated as soon as practically possible to limit the risk of erosion. Erosion control measures must be employed where required.

- Riparian vegetation bordering on drainage lines, wetlands and rivers will be considered environmentally sensitive and impacts on these habitats should be avoided.
- If erosion has taken place, rehabilitation will commence as soon as possible.

Pollution of water resources and soil

Mitigation options

- Demarcate wetland areas to avoid unauthorised access.
- No washing of any equipment in close proximity to a watercourse is permitted.
- No releases of any substances that could be toxic to fauna or faunal habitats within the channels or any watercourses is permitted.
- Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil must be removed, and the affected area rehabilitated immediately.
- Education of workers is key to establishing good pollution prevention practices. Training programs must provide information on material handling and spill prevention and response, to better prepare employees in case of an emergency.
- Signs should also be placed at appropriate locations to remind workers of good housekeeping practices including litter and pollution control.
- The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be ensured. All employees handling fuels and other hazardous materials are to be properly trained. Storage containers must be regularly inspected so as to prevent leaks.
- All contractors and employees should undergo induction which is to include a component of environmental awareness.

Alien Invasive Species

Mitigation Options

- Ongoing alien plant control must be undertaken, particularly in the disturbed areas as these areas will quickly be colonised by invasive alien species, especially in the riparian zone, which is particularly sensitive to AIP infestation.
- Herbicides must be carefully applied, in order to prevent any chemicals from entering the river. Spraying of herbicides within or near to the wetland areas is strictly forbidden.
- Re-instate indigenous vegetation (grasses and indigenous trees) in disturbed areas.
- After rehabilitation, re-vegetate any exposed surfaces and mulch re-vegetated areas.
- Select appropriate species for wetland and terrestrial areas and ensure species diversity is enhanced, with species commonly found in the natural wetland area.

10.2 ASSESSMENT OF THE NO-GO ALTERNATIVE

Currently there is no proposal from a wetland point of view of a no-go alternative, Since the road is already in existence.

10.3 MONITORING REQUIREMENTS

In the event that the proposed road improvement activities will encroach on the watercourses, the following is strongly advised from a wetland point of view:

- It is strongly advised that a wetland/aquatic specialist is appointed during the construction, operational and decommissioning phases to monitor impacts and related mitigation measures regarding wetlands and the faunal and floral assemblages occurring in this habitat.

11. FINAL COMMENTS

The R30 Road improvement intersects sensitive freshwater ecosystems within the Middle Vaal Water Management Area, including seasonal and perennial watercourses with ecologically significant aquatic vegetation. While construction-related activities pose risks to these habitats, such impacts can be mitigated. Given the existing alignment of the road, a no-go alternative is not feasible from a wetland perspective. Therefore, continuous involvement of a wetland or aquatic specialist across all project phases is critical to ensure ecological integrity and compliance with environmental safeguards.

12. RECOMMENDATIONS

- Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats.
- Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
- No stockpiling of material may take place within the wetland/watercourse areas and temporary construction camps and infrastructure should also be located outside the wetland footprint.
- Regular cleaning up of the wetland areas should be undertaken to remove litter.
- Design and implement a construction stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site.
- Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to August) to limit erosion due to rainfall runoff.
- Store and handle potentially polluting substances and waste in designated, bunded facilities.
- Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities.
- Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.

- Keep sufficient quantities of spill clean-up materials on site.

13. REFERENCES

ACOCKS, J.P.H. 1988. Third Edition. Veld Types of South Africa. Memoirs of the Botanical Survey of South Africa No. 57, Botanical Research Institute, RSA

BREEN, C.M. (ED.). 1997. How Wet is a Wetland? – An Introduction to Understanding Wetland Hydrology, Soils and Landforms, Wetland-Use Booklet 2, Share-Net, Wildlife Society of South Africa

BROMILOW, C. 2001. Problem plants of South Africa. Briza Publications, Pretoria.

COLLINS, N.B. 2005. Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.

(DWAF) DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 2003. A Practical field procedure for identification and delineation of wetlands and riparian areas, Final Draft.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY (2003). National Water resource Strategy (Final Draft). DWAF. Pretoria. South Africa.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY (1998). National Water Act; Act No.36 of 1998. South Africa.

ENVIROGUARD ECOLOGICAL SERVICES. 2010. Wetland delineation for remaining extent of Portion 7 of the Farm Mooifontein 141 IR Gauteng Province. Unpublished report.

(DWAF) DEPARTMENT OF WATER AFFAIRS AND FORESTRY. (2005). A practical field procedure for the identification and delineation of wetlands and riparian areas. DWAF, Pretoria, South Africa.

HENDERSON, L. (2001). Alien weeds and invasive plants – A complete guide to declared weeds and invaders in South Africa. Plant Protection Research Institute, Agricultural Research Council Handbook No 12. Pretoria.

LOW, A. B. AND REBELO, A. G. (EDS) (1998). Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria.

KOTZE, D.C., KLUG, J.R., HUGHES, J.C. AND BREEN, C.M., 1996. Improved criteria for classifying hydromorphic soils in South Africa. S.Afr. J. Plant and Soil, 13(3)

KOTZE, D.C., MARNEWECK, G.C. Draft document 1999: Guidelines for delineating the wetland boundary and zones within a wetland under the South African Water Act.

KOTZE, D.C., MARNEWECK, G.C., BATCHELOR, A.L., LINDLEY, D.S., AND COLLINS, N.B., 2005. WET-EcoServices - A technique for rapidly assessing ecosystem services supplied by wetlands, Draft unpublished report.

MUCINA, L AND RUTHERFORD, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. SANBI, Pretoria.

SOIL CLASSIFICATION WORKING GROUP. 1991. Soil Classification: a taxonomic system for South Africa. Memoirs of the Agricultural Natural Resources of South Africa, No 15,

VAN OUDTSHOORN, F. (1999). Guide to grasses of southern Africa. Briza Publications, Pretoria.

APPENDIX 5.3: HERITAGE IMPACT ASSESSMENT

Shasa Heritage Consultants

HERITAGE SCOPING REPORT FOR THE IMPROVEMENT OF NATIONAL ROAD R30 SECTION 8 FROM KM 36.800 TO VENTERSDORP KM 68.646 WITHIN DR KENNETH KAUNDA DISTRICT MUNICIPALITY IN THE NORTH WEST PROVINCE.

FIELDWORK: F ROODT

REPORT COMPILED BY: FE ROODT

PRINCIPAL INVESTIGATOR: F ROODT

DATE: 17 July 2025

Heritage consultant
54 Wildebeestfontein smallholdings
Polokwane
Limpopo
0700

Phone: 078 618 6204 (Frans)
Email:
shasaheritageconsultants@gmail.com

Contents

Pg	Section		Section Heading
2	**1**		**Introduction and terms of reference**
3	**2**		**Method**
		2.1	Sources of information and methodology
		2.2	Limitations
		2.3	Categories of significance
		2.4	Terminology
6	**3**		**Description of the proposed development and terrain**
7	**4**		**Results of the scoping survey and discussion**
		4.1.	Intangible Heritage and Social consultation
		4.2.	Recent Historical Period and Built Environment
		4.3.	Graves
		4.4.	Iron Age/ Early Farming remains
		4.5.	Stone Age remains
		4.6.	Palaeontological sensitivity
21	**5**		**Background information**
22	**6**		**Statement and evaluation of significance**
26	**7**		**Recommendations**
26	**8**		**Bibliography**

List of figures

Pg	Figure	Description
6	1	View of area
6	2	View of area
7	3	View of area
7	4	View of area
7	5	View of area
7	6	View of area
7	7	View of area
7	8	View of area

Pg	Map No	Description
10	9	View of historical building
12	10	View of canal
14	11	View of graveyard 1
16	12	View of graveyard 2
18	13	View of marker
8	1	Historical map
28	2	View- Google Earth map 1
28	3	View- Google Earth map 2
29	4	View- Google Earth map 3
29	5	View- Google Earth map 4
30	6	View- Google Earth map 5
30	7	View- Google Earth map 6
31	8	View- Google Earth map 7
31	9	View- Google Earth whole route
32	10	View- Google Earth finds map

EXECUTIVE SUMMARY

Earthlink Environmental Services contracted the author to survey the proposed area for the improvement and development and produce a scoping report for a Phase 1 heritage study to advise on potential impacts and mitigation measures. South African National Road Agency SOC Limited (SANRAL) proposes to improve Road R30 section 8, a 31.846-kilometer stretch located from (km 36.8) to Ventersdorp (km 68.646). The project starts at km 36.800, south of the Opraap road-side junction, and continues up to km 68.646 west of the 3-way stop control intersection with the R 53 to Potchefstroom. This project falls within the City Matlosana and JB Marks Local Municipalities and is situated within the Dr Kenneth Kaunda District Municipality in the North West province, with Ventersdorp the closest town.

Project description and parameters:

- Increase of the road reserve width is anticipated
- Improvement of the existing pavement structure
- general widening of the existing road cross section to 3.7m lanes and 2.5m (high fill) – 3.0m (normal conditions) surfaced shoulders,
- Isolated vertical and horizontal geometric improvements,
- widening of river bridges and some major and minor culverts,
- Demolishing and construction of new river bridges
- horizontal re-alignment of the road at curves:
  - from KM 46.9 to KM 47.7
  - from KM 53.9 to KM 55
  - from KM 60.2 to KM60.7
- Possible 6.5m wide temporary deviation to accommodate two-way traffic during construction.

Environmental consultant:

Earthlink Environmental Services

Kgakile Mapoulo

572
24th Road
Withok Estates
Brakpan
1541

Cell: 0718788295

Email: kgakile@earthlinkenvironmental.co.za

© COPYRIGHT
Shasa Heritage Consultants retains the copyright holder of this document. This document and its findings and/or images are protected under the copyright laws of South Africa. Any unauthorised use or reproduction of this work is strictly prohibited. You may not copy, distribute, display, or perform this work without the permission of the owner. Should any part or the whole be used it should be appropriately referenced.

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT
The findings, outcomes, interpretations, recommendations and mitigation measures provided in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on field survey and observations which are limited by the level of required reporting, access and cost and/or time related limitations. The author reserves the right to amend aspects of the report including the recommendations if and when new information becomes available.

Although Shasa Heritage Consultants endeavours to provide diligent and accurate reporting, Shasa Heritage Consultants accepts no liability, and the client, by receiving this document, indemnifies Shasa Heritage Consultants against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered.

DECLARATION OF INDEPENDENCE

This report has been compiled by Mr FE Roodt and Ms L Stegmann, sub-contracted by Earthlink Environmental Services, South Africa. The views expressed in this report are entirely those of the author/s and no other interest was displayed during the decision-making process for this Project.

Specialist: Mr FE Roodt

Signature: 

EXPERTISE OF SPECIALIST

The Heritage Consultant: Mr FE Roodt
Qualifications: BA Hon Archaeology
Experience: >20 years' heritage studies and over 400 projects completed

1. INTRODUCTION AND TERMS OF REFERENCE

Application purpose: Proposed R30 (Section 8 Opraap to Ventersdorp) improvement and associated infrastructure (intersections)

Area: R30 North West Province

Size: ±32 km

GPS:
Start: S 26° 31' 56.56"; E 26° 38' 09.19"
End: *S 26° 18' 54.98", E 26° 49' 38.86"*

Map reference number: 2626 DA and 2626 BD

This report will enable the Applicant to take pro-active measures to limit the adverse effects that the development could have on heritage resources.

In terms of the National Heritage Resources Act (1999) the following is of relevance:

Historical remains

Section 34(1) No person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.

Archaeological remains

Section 35(4) No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface, or otherwise disturb any archaeological or palaeontological site or any meteorite

Burial grounds and graves

Section 36 (3)(a) No person may, without a permit issued by SAHRA or a provincial heritage resources authority-

(c) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(b) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in detection or recovery of metals.

Culture resource management

Section **38(1)** Subject to the provisions of subsection (7), (8) and (9), any person who intends to undertake a development* …

must at the very earliest stages of initiating such development notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed development.

***'development'** means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place, or influence its stability and future well-being, including-

(a) construction, alteration, demolition, removal or change of use of a place or a structure at a place;
(b) carry out any works on or over or under a place*;
(e) any change to the natural or existing condition or topography of land, and
(f) any removal or destruction of trees, or removal of vegetation or topsoil;

***" place** means a site, area or region, a building or other structure* ..."

***" structure** means any building, works, device or other facility made by people and which is fixed to the ground, …"

2. METHOD

2.1 Sources of information and methodology

The source of information was primarily the field reconnaissance and referenced literary sources.

A pedestrian and vehicular survey of the area was undertaken, during which standard methods of observation were applied. The area was surveyed on 22 June 2025 during the early morning to late afternoon and was thoroughly traversed. Mr FE Roodt conducted fieldwork. Both sides of the road were surveyed and drainage lines were surveyed for possible stone age materials.

Special attention was given to any areas displaying soil and or vegetative changes. As most archaeological material occurs in single or multiple stratified layers beneath the soil surface, special attention was given to disturbances, both man-made such as roads and clearings, as well as those made by natural agents such as burrowing animals and erosion. Locations of heritage remains were recorded by means of a Google map pins correct to 1m and images captured with an S9 cellular phone.

The area was surveyed on both sides of the road. Where bridges were noted, embankments were searched. Private property was not entered and not surveyed. Maps included at the end of this document.

2.2 Limitations

The scoping survey was thorough, but limitations were experienced due to the fact that archaeological sites are subterranean and only visible when disturbed. Vegetation was sparse and dense in patches. Private property was not entered. Visibility was fair. Due to the road existing, verges and sides have caused impact to the area during original construction. The road is originally over 100 years old.

2.3 Categories of significance

The significance of heritage resources is ranked into the following categories.

Significance rating	Action required
Not protected	1a. No action required
Low	2a. Recording and documentation (Phase 1) of site adequate; no further action required 2b. Controlled sampling (shovel test pits, auger sampling), mapping and documentation (Phase 2 investigation); permit required for sampling and destruction
Medium	3. Excavation of representative sample, 14C dating, mapping and documentation (Phase 2 investigation); permit required for sampling and destruction [including 2a & 2b]
High	4a. Nomination for listing on Heritage Register (National, Provincial or Local) (Phase 2 & 3 investigation); site management plan; permit required if utilised for education or tourism 4b. Graves: Locate demonstrable descendants through social consulting; obtain permits from applicable legislation, ordinances and regional by-laws; exhumation and reinternment [including 2a, 2b & 3]

Nomination and protection levels of significance:

Level	Details	Action
National (Grade 1)	Site is considered to be of National Significance	Nominated to be declared by SAHRA
Provincial (Grade 2)	Site is considered to be of Provincial Significance	Nominated to be declared by Provincial Heritage Authority
Local Grade 3A	Site is considered to be of HIGH significance locally	Site should be retained as a heritage site
Local Grade 3B	Site is considered to be of HIGH significance locally	The site should be mitigated and part retained as a heritage

		site
Generally Protected A	High to Medium significance	Mitigation necessary before destruction
Generally Protected B	Medium significance	Site needs to be recorded before destruction
Generally Protected C	Low significance	No further recording before destruction

The significance of heritage resources is based on the amount of deposit, the integrity of the context, the kind of deposit and the potential to help answer present research questions. Historical structures are defined by Section 34 of the National Heritage Resources Act, 1999, while other historical and cultural significant sites, places and features, are generally determined by community preferences.

A crucial aspect in determining the significance and protection status of a heritage resource is often whether or not the sustainable social and economic benefits of a proposed development outweigh the conservation issues at stake. Many aspects must be taken into consideration when determining significance, such as rarity, national significance, scientific importance, cultural and religious significance, and not least, community preferences. When, for whatever reason the protection of a heritage site is not deemed necessary or practical, its research potential must be assessed and mitigated in order to gain data / information which would otherwise be lost. Such sites must be adequately recorded and sampled before being destroyed. These are generally sites graded as of low or medium significance.

2.4 Terminology

Early Stone Age: Predominantly the Acheulean hand axe industry complex dating to + 1Myr yrs – 250 000 yrs. before present.

Middle Stone Age: Various lithic industries in SA dating from ± 250 000 yr. - 30 000 yrs. before present.

Late Stone Age: The period from ± 30 000-yr. to contact period with either Iron Age farmers or European colonists.

Early Iron Age: Most of the first millennium AD

Middle Iron Age: 10th to 13th centuries AD

Late Iron Age: 14th century to colonial period. *The entire Iron Age represents the spread of Bantu speaking peoples.*

Historical: Mainly cultural remains of western influence and settlement from AD1652 onwards – mostly structures older than 60 years in terms of Section 34 of the NHRA, though more recent remains can be termed historically

significant should the remains hold social significance for the local community.

Phase 1 assessment: Scoping surveys to establish the presence of and to evaluate heritage resources in a given area

Phase 2 assessments: In depth culture resources management studies which could include major archaeological excavations, detailed site surveys and mapping / plans of sites, including historical / architectural structures and features. Alternatively, the sampling of sites by collecting material, small test pit excavations or auger sampling is required.

Sensitive: Often refers to graves and burial sites although not necessarily a heritage place, as well as ideologically significant sites such as ritual / religious places. *Sensitive* may also refer to an entire landscape / area known for its significant heritage remains.

3. DESCRIPTION OF THE PROPOSED DEVELOPMENT AND TERRAIN

Vegetation: Vaal-Vet Sandy Grassland GH 10

Geology: The entire study area is deeply underlain by Precambrian rocks of the Pretoria and Chuniespoort groups of the Transvaal Supergroup, as well as igneous diabase of the Bushveld Igneous Complex. These rocks are in turn, in isolated places, overlain by Quaternary alluvial deposits. (extracted from the PIA)

Terrain: The terrain is **severely impacted** by the existing road and subsequent degradation of the road.

Proposed development: To improve section (8) of the R30

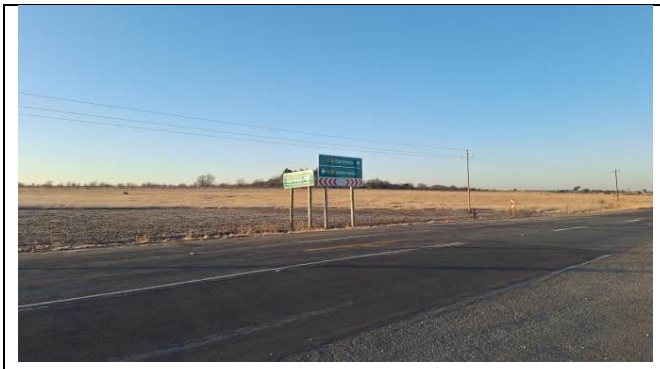


Fig 1. View of area



Fig 2. View of area



Fig 3. View of area



Fig 4. View of area



Fig 5. View of area



Fig 6. View of area



Fig 7. View of area road side

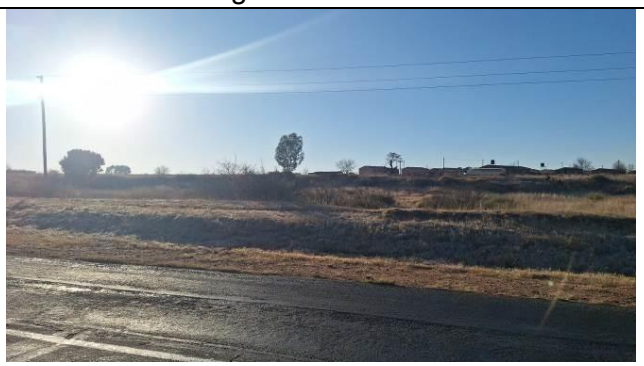


Fig 8. View of area

4. RESULTS OF THE SCOPING SURVEY AND DISCUSSION

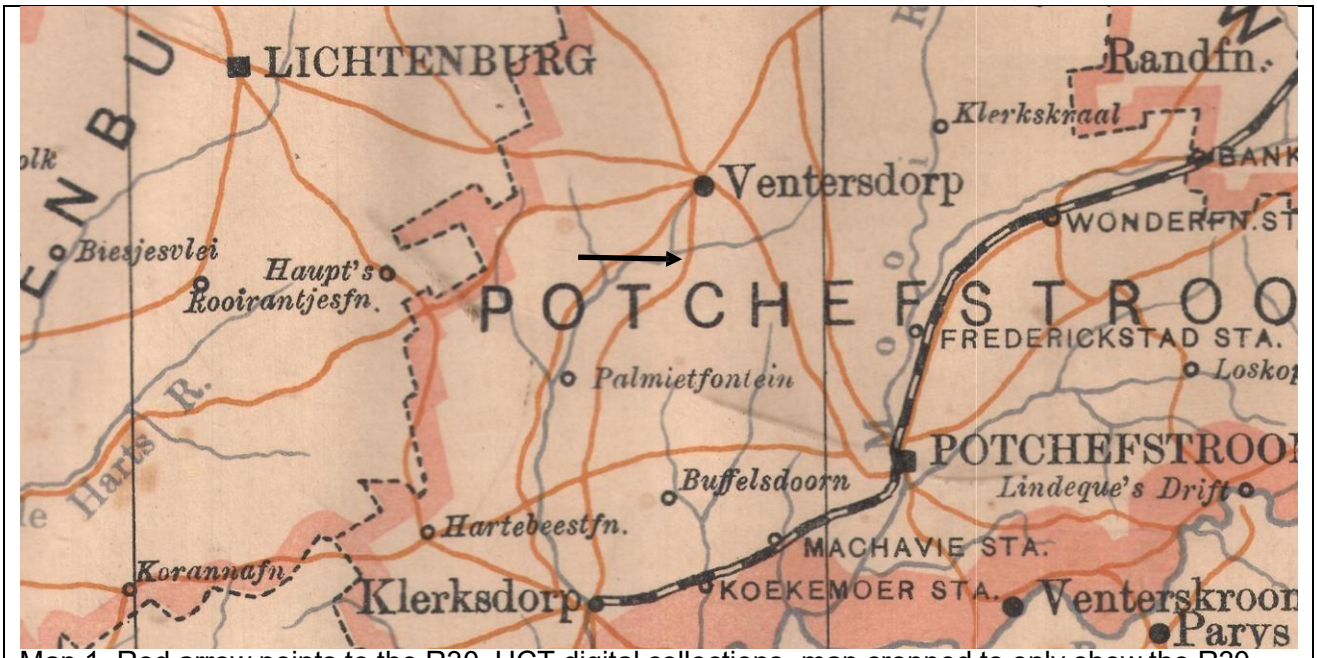
4.1 SOCIAL and/or RELIGIOUS INTANGIBLE HERITAGE

The section of the R30 traverses predominately active farmlands before entering the town of Ventersdorp. No active social or religious areas were recorded along the route.

Significance: None- no further action required

4.2 HISTORICAL PERIOD AND BUILT ENVIRONMENT

Historical maps from UCT digital collections were perused for information pertaining to the R30. A map from 1900, clearly shows that what is now the R30 existed at that time. Cognisance should be taken of this fact, as the road in various forms has connected Klerksdorp and Rustenburg for well over a century. However, as population increase occurred the road would have undergone many improvements over more than 120 years.



Map 1. Red arrow points to the R30. UCT digital collections- map cropped to only show the R30

General site description: BE R39_9_03
GPS: *S26º 30' 01.00" E26º 39' 12.0"*
Potential historical building, possibly dating to the early to mid-1900's. The building should not be impacted by the widening if the road. The house is well set back, but the building should be noted to avoid impact by trucks possibly working carelessly in the area.

A. Site evaluation		
1. Heritage value	**Yes**	**No**
Historic value		
It has importance to the community or pattern of South Africa's history or precolonial history.	X	
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		X
It has significance relating to the history of slavery in South Africa.		X
Aesthetic value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		X
Scientific value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		X
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		X
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.		X
Social value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	X	
Tourism value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		X
Rarity value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		X
Representative value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		X
2. Regional context		
Other similar sites in the regional landscape.	Possibly	
3. Condition of site		
Integrity of deposits/structures.	Poor	

B. Sphere of significance	**High**	**Medium**	**Low**
International			X
Provincial			X
Local		X	
Specific community		X	

C. Field Register rating	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	
Generally protected B [Medium significance, to be recorded]	X
Generally Protected C [Low significance, no further action]	

D. General statement of site significance	
Low	
Medium	X
High	

E. Rating of potential impact of development	
None	
Peripheral	X
Destruction	
Uncertain	

F. Recommended mitigation

The building should not be impacted through widening of the road; care should also be taken when working around in the immediate area

G. Applicable legislation and legal requirements

NHRA act 25 of 1999.

H. Images



Fig 9. View of building

A. General site description: Canal (R30_01) **GPS:** S26º 22' 41.3" E26º 46' 23.4" A canal was evident on 2010 1:50 000 topocadastral maps. The canal is not evident on the 50k topocadastral map published in 1979. The end of the canal is however only 10m from the road and should be avoided during the construction phase. Primarily mentioned for noting.		
B. Site evaluation		
B1. Heritage value	**Yes**	**No**
Historic value		
It has importance to the community or pattern of South Africa's history or precolonial history.		X
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		X
It has significance relating to the history of slavery in South Africa.		X
Aesthetic value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		X
Scientific value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		X
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		X
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.		X
Social value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).		X
Tourism value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		X
Rarity value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		X
Representative value		
It is important in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		X
B2. Regional context		
Other similar sites in the regional landscape.		X
B3. Condition of site		
Integrity of deposits/structures.	Fair	

C. Sphere of significance	**High**	**Medium**	**Low**
International			X
Provincial			X
Local			X
Specific community			X

D. Field Register rating	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	
Generally protected B [Medium significance, to be recorded]	
Generally Protected C [Low significance, no further action]	X

E. General statement of site significance	
Low	X
Medium	
High	

F. Rating of potential impact of development	
None	X
Peripheral	
Destruction	

Uncertain	
G. Recommended mitigation – Unknown age, but appears to be younger than 46 years, due to not having been captured on 1979 topocadastral map. Avoid during construction, if possible, to negate a possible oversight during redrawing the individual 1913 topological maps into a combined country wide map	
H. Applicable legislation and legal requirements- National Heritage Resources Act (Act No. 25 of 1999)	
I. Images	



Fig 10. View of canal

4.3 GRAVES

Significance: High- buffer zones of 5 to 15m where practicable, see each individual grave below

General site description: GR01_R30_25
GPS: *S26º 29' 14.1" E26º 39' 35.1"*
Graves on Private property, off to side of road. The graves are still visited as grave goods were recorded at graves.

A. Site evaluation		
1. Heritage value	**Yes**	**No**
Historic value		
It has importance to the community or pattern of South Africa's history or precolonial history.		X
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		X
It has significance relating to the history of slavery in South Africa.		X
Aesthetic value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		X
Scientific value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		X
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		X
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	X	
Social value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	X	
Tourism value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		X
Rarity value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		X
Representative value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		X
2. Regional context		
Other similar sites in the regional landscape.	Possibly	
3. Condition of site		
Integrity of deposits/structures.	Fair	

B. Sphere of significance	**High**	**Medium**	**Low**
International			X
Provincial			X
Local			X
Specific community	X		

C. Field Register rating	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	X
Generally protected B [Medium significance, to be recorded]	
Generally Protected C [Low significance, no further action]	

D. General statement of site significance	
Low	
Medium	X
High	

E. Rating of potential impact of development

None	
Peripheral	X
Destruction	
Uncertain	

F. Recommended mitigation

The graves are situated 24m from the road. The graves post-date the road (1997 and 2000) and as such the road cannot be moved. It is recommended that the graveyard be properly fenced with a gate for family access, with a 5m buffer around the graves. Although a 30-50m buffer is preferred for graves, this is not practicable in this case. Should this not be feasible, 2 alternatives remain-

1- Reduce the width of the northbound verge to provide a small 5-10m buffer or;
2- Relocate all graves to a formal graveyard of the families choosing.

G. Applicable legislation and legal requirements

NHRA act 25 of 1999.

H. Images



Fig 11. View of graveyard

General site description: GR02_R30_25
GPS: *S26º 31' 02.7" E26º 38' 26.6"*
Graves on Private property, off to side of road

A. Site evaluation		
1. Heritage value	**Yes**	**No**
Historic value		
It has importance to the community or pattern of South Africa's history or precolonial history.		X
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		X
It has significance relating to the history of slavery in South Africa.		X
Aesthetic value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		X
Scientific value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		X
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		X
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	X	
Social value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	X	
Tourism value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		X
Rarity value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		X
Representative value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		X
2. Regional context		
Other similar sites in the regional landscape.	Possibly	
3. Condition of site		
Integrity of deposits/structures.	Fair	

B. Sphere of significance	**High**	**Medium**	**Low**
International			X
Provincial			X
Local			X
Specific community	X		

C. Field Register rating	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	X
Generally protected B [Medium significance, to be recorded]	
Generally Protected C [Low significance, no further action]	

D. General statement of site significance	
Low	
Medium	X
High	

E. Rating of potential impact of development	
None	
Peripheral	X
Destruction	
Uncertain	

F. Recommended mitigation
The graveyard is situated 9m from the road verge. The graves post-date the road and as such the road cannot be

moved. It is recommended that the graveyard be properly fenced with a gate for family access, with a 5m buffer around the graves. Although a 30-50m buffer is preferred for graves, this is not practicable in this case. Should this not be feasible, 2 alternatives remain-

3- Reduce the width of the verge to provide a small 5-10m buffer or;
4- Relocate all graves to a formal graveyard of the families choosing.

G. Applicable legislation and legal requirements

NHRA act 25 of 1999.

H. Images



Fig 12. View of graveyard

General site description: Mem_R30_1
GPS: *S26º 22' 18.4" E26º 46' 31.6"*
A marker left on roadside, usually indicating the passing of a loved one due to a motor vehicle accident. Within the road reserve.

I. Site evaluation		
1. Heritage value	**Yes**	**No**
Historic value		
It has importance to the community or pattern of South Africa's history or precolonial history.		X
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		X
It has significance relating to the history of slavery in South Africa.		X
Aesthetic value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		X
Scientific value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		X
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		X
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.		X
Social value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).		X
Tourism value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		X
Rarity value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		X
Representative value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		X
2. Regional context		
Other similar sites in the regional landscape.	Possibly	
3. Condition of site		
Integrity of deposits/structures.	Good	

J. Sphere of significance	**High**	**Medium**	**Low**
International			X
Provincial			X
Local			X
Specific community			X only family

K. Field Register rating	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	
Generally protected B [Medium significance, to be recorded]	X
Generally Protected C [Low significance, no further action]	

L. General statement of site significance	
Low	
Medium	
High	X

M. Rating of potential impact of development	
None	
Peripheral	X
Destruction	
Uncertain	

N. Recommended mitigation

	This is an informal memorial to mark where a family member passed usually due to a road accident. It would have meant only to the family but cannot be considered in terms a grave. It is recommended that a local newspaper advert be placed to check how the family would like to handle it, perhaps the marker could be moved to the side of the rehabilitated road, but roughly in the same position, just a few meters to the left. As there is no pertinent legislation governing this, a sensitive approach is recommended.
O.	**Applicable legislation and legal requirements** NHRA act 25 of 1999.
P.	**Images**



Fig 13. View of marker

4.4 IRON AGE/ EARLY FARMING REMAINS

According to the most recent archaeological cultural distribution sequences by Huffman (2007), this area falls within the distribution area of various cultural groupings originating out of the Urewe Tradition. The facies that may be present are:

Urewe Tradition: Blackburn branch- Ntsuanatsatsi facies AD 1450 - 1650
Uitkomst facies AD 1650- 1820
Olifantspoort facies AD 1500- 1700
Buispoort facies AD 1700- 1840

No remains from the Iron Age were recorded.

Primarily, the Iron age in the North West and Gauteng is characterized by Late Iron Age, Stone walled sites. A large proportion of Late Iron Age sites are derived from occupation of Fokeng settlements who spread north across the Vaal river and settled in the Suikerbosrand (Heidelberg area) and Klipriviersberg areas (Huffman 2007). Most known Tswana archaeological sites are

known from north of Rustenburg, and in the Koster and Groot Marico area, spreading into the Waterberg (Bergh 1999). Sites are also known and have been researched in the Pilanesberg Mountains, north west of the R30.

Walling primarily consists of circular patterned stone walls often displaying scallop patterns. Enclosed within these walls are the main occupation areas of the settlement, consisting of huts with clay walls and floors and cooking areas as well as small stock enclosures.

Significance: None- no recorded artefacts or features

4.5 STONE AGE REMAINS

No Stone Age remains were recorded.

The below mentioned is generic background to the area adapted from Deacon and Deacon: 1999:

The Stone Age covers most of southern Africa and the earliest consist of the Oldowan and Acheful artefacts assemblages. Oldowan tools are regularly referred to as “choppers”. Oldowan artefacts are associated with Homo *habilis*, the first true humans. In South Africa definite occurrences have been found at the sites of Sterkfontein and Swartkrans, located East of the study area. They are dated to between 1.7 and 2 million years old. This was followed by the Acheulian technology from about 1.4 million years ago which introduced a new level of complexity. The large tools that dominate the Acheulian artefact assemblages range in length from 100 to 200 mm or more. Collectively they are called bifaces because they are normally shaped by flaking on both faces. In plain view they tend to be pear-shape and are broad relative to their thickness. Most bifaces are pointed and are classified as handaxes, but others have a wide cutting end and are termed cleavers. The Acheulian design persisted for more than a million years and only disappeared about 250 000 years ago.

The change from Acheulian with their characteristic bifaces, handaxes and cleavers to Middle Stone Age (MSA), which are characterized by flake industries, occurred about 250 000 years ago and ended about 30 000 – 22 000 years ago. For the most part the MSA is associated with modern humans; Homo sapiens. MSA remains are found in open spaces where they are regularly exposed by erosion as well as in caves. Characteristics of the MSA are flake blanks in the 40 – 100 mm size range struck from prepared cores, the striking platforms of the flakes reveal one or more facets, indicating the preparation of the platform before flake removal (the prepared core

technique), flakes show dorsal preparation – one or more ridges or arise down the length of the flake – as a result of previous removals from the core, flakes with convergent sides (laterals) and a pointed shape, and flakes with parallel laterals and a rectangular or quadrilateral shape: these can be termed pointed and flake blades respectively. Other flakes in MSA assemblages are irregular in form.

The change from Middle Stone Age to Later Stone Age (LSA) took place in most parts of southern Africa little more than about 20 000 years ago. It is marked by a series of technological innovations or new tools that, initially at least, were used to do much the same jobs as had been done before, but in a different way. Their introduction was associated with changes in the nature of hunter-gatherer material culture. LSA sites are known from the Magaliesberg mountains The innovations associated with the Later Stone Age "package" of tools include rock art – both paintings and engravings (engravings such as these mentioned are known in the Magaliesberg Mountain area North West of the R30, smaller stone tools, so small that the formal tools less that 25mm long are called microliths (sometimes found in the final MSA) and Bows and arrows.

Significance: None- no further action required.

4.6 PALAEONOTOLOGICAL SENSITIVITY

Extract below is taken from the PIA compiled by Prof. M. Bamford (2025 PIA):

Based on the walkdown and observations, as well as experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying soils of the Quaternary. There is a very small chance that trace fossils may occur in the dolomites or quartzites of the Malmani Subgroup so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for the road or quarrying for material have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, as far as the palaeontology is concerned, so the project should be authorised.

Significance: Low- Chance Finds Protocol

5. BACKGROUND ON THE AREA

Generic background on Klerksdorp is provided below.

1837	12 Voortrekker families settled on the banks of the Skoonspruit
1865	The first shop in Klerksdorp was opened by James A. Taylor
1888	Klerksdorp was declared as a town as of 12 September 1888.
1899-1902	The Klerksdorp commando who under the leadership of Gen. Piet Cronje took part of the Siege of Mafeking/Mafikeng During the Anglo-Boer War, Ellaton became an African concentration camp- where many later settled and became known as Makweteng
1939	African people still living in Hartbeesfontein were forcibly removed to go and live on land later known as Tigane.

Generic background on Ventersdorp is provided below

1866	Town grew around the establishment of a Dutch Reformed Church, officially proclaimed in 1867
1991	9 August 1991- Battle of Ventersdorp- incident between AWB and SAPS. The incident occurred due to opposition by the ABW IRO President FW De Klerk recognising the African National Congress and releasing Nelson Mandela.

Early farmers/Iron Age

The general Highveld area- of which the study forms part has been settled for roughly the past 500 years. Iron Age people started to settle in southern Africa around Broederstroom around 500 AD. These groups are considered to belong to the period known as the Early Iron Age and their agricultural cultivation practices were centred around sorghum and millet. This limited their geographical distribution to specific rainfall areas. Early Iron Age (EIA) people did not move outside this rainfall zone, and neither did they occupy the central interior Highveld area. Because of their specific technology
and economy, Iron Age people preferred to settle on the alluvial soils near rivers, where fertility, water, firewood and hunting were plentiful.

By the 1500's, the climate became warmer and wetter, and they could start to move into previously uninhabitable areas, and Now termed Late Iron Age groups began to occupy the central Highveld interior, of which the study area forms part.

This period came to a dramatic end between 1800 and 1820 heralding a major drought causing tension between groups, which would later be known as the Mfecane. Marauding groups form KwaZulu-Natal interrupted life on the Highveld, often displacing Sotho- Tswana groups, who were also fighting amongst each other.
As a result of this troubled period, Sotho-Tswana people concentrated into large towns for defensive

purposes. Due to the lack of trees on the grasslands of the Highveld, they built their settlements in stone. These stone-walled villages were almost always located near cultivatable soil and a source of water.

6. EVALUATION AND STATEMENT OF SIGNIFICANCE

6.1	Significance	Rating
1	The importance of the cultural heritage in the community or pattern of South Africa's history (Historic and political significance)	Graves- yes
2	Possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage (Scientific significance).	None
3	Potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage (Research/scientific significance	None
4	Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects (Scientific significance)	None
5	Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group (Aesthetic significance)	None
6	Importance in demonstrating a high degree of creative or technical achievement at a particular period (Scientific significance)	None
7	Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (Social significance)	Graves- yes
8	Strong or special association with the life and work of a person, group or organization of importance in the history of South Africa (Historic significance)	None
9	The significance of the site relating to the history of slavery in South Africa.	None

6.2 Section 38(3) (c) An assessment of the impact of the development on such heritage resources.

The development should have no impact on any heritage resources the graveyards are peripheral, and care should take to avoid any damage when working in the vicinity of graves.

6.3 ***Section 38(3) (d) An evaluation of the impact of the development on heritage resources relative to the sustainable economic benefits to be derived from the development***.

Roads are essentially the backbone of commerce and no heritage resources besides the graveyards, which are known and currently in use were recorded. The development should technically have no impact on these.

The Memorial markers are another situation all together. Technically, they are not provided for under graves, as they are not graves, yet they hold memory for the people who placed them. As the road will surely go through it, the impact would be high- see recommendations

6.4 ***Section 38(3) (e) The results of consultation with the communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources***.

Social consultative process is ongoing as part of EIA.

6.5 Section 38(3)(f) If heritage resources will be adversely affected by the proposed development the consideration of alternatives.

The road is an improvement. However, the improvement is unlikely to impact any resources, site foremen should be made aware of the graveyards and work with care in these areas.

6.6 Section 38(3)(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

Activity	Potential Impact	Significance without mitigation	Mitigation Measures	Significance with mitigation	Monitoring
Proposed road improvement	Surface and ground disturbance will destroy potential heritage and environmental resources	Low	• Identify heritage resources prior to development- • Exclude areas from development to reduce impact on known heritage resources	Low	Monitoring

Nature
R30 improvement

Topographical Extent		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	Impact limited to site
2	Local/District	Impact limited to district
3	Province/Region	Impact will affect region
4	International/National	Impact is on a national or international scale

Probability		
The probability of the impact occurring		
2	Unlikely	The chance of the impact occurring is extremely low (Less than 25% chance of occurrence).
4	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
6	Probable	The impact will likely occur (Between 50% to 75% chance of occurrence).

8	Definite	Impact will certainly occur (Greater than 75% chance of occurrence).
Reversibility		
The degree to which the impact on heritage resources can be reversed after the activity has been completed		
1	Completely reversible	The impact is reversible with minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures will be required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible regardless of mitigation measures.
Permanent loss of heritage resources		
The degree to which heritage resources will be lost as a result of proposed activity. This applies to destruction of the context of the resource, as excavation could preserve objects but not context.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of any resources.
3	Severe loss of resource	The impact will result insignificant loss of resources.
4	Complete loss of resource	The impact results in a complete loss of all resources.
Duration		
The duration of the impact on the heritage parameter. Duration indicates the lifetime of a result of the proposed activity.		
1	Short	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in span shorter than the construction phase (0-1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0-2 years).
2	Medium	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2-10 years).
3	Long	The impact and its effects will continue or last for entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10-50 years).
4	Permanent	The only class of the impact that will non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

Cumulative effect		
The cumulative effect of the impacts on the heritage resource. A cumulative effect/impact is an effect, which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects.
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative Impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects.
Magnitude		
The severity of the impact- it must be considered that once a heritage resource is removed from its original context much of its significance is lost.		
1	Low	Impact affects the quality, use and integrity of the Heritage resource in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the heritage resource but heritage resource still continues and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the heritage resource and the quality, use, integrity and context of heritage resource is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very High	Impact affects the continued viability of the heritage resource and the quality, use, integrity and context of the heritage resource permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible, rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation. This would involve a destruction permit or reconstruction- essentially losing the essence of what made the resource significant in the first place.
Significance		
It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. (S) is formulated by adding the sum of numbers assigned to Topographical effect (E), Duration (D), and Magnitude (M) and multiplying the sum by the Probability. S= (E+D+M) P		
<30	Low	Mitigation of impacts is easily achieved where this impact would not have a direct influence on the decision to develop in the area.
30-60	Medium	Mitigation of impact is both feasible and fairly easy. The impact could influence the decision

		to develop in the area unless it is effectively mitigated.
>60	High	Significant impacts where there is difficult. The impact must have an influence on the decision process to develop in the area.

Impact and rating

Impact	Rating
Nature	Road improvement - R30 S8
Topographical effect	1- limited to site
Reversibility	2
Permanent loss of heritage resources	1
Cumulative effect	1
Duration	3
Magnitude	1
Probability	2
Significance S= (E+D+M) P	1+3+1 x2 =10 The area is considered of low significance
Mitigation	Monitoring on site

7. RECOMMENDATIONS

1. We do not have an objection to the development going ahead. Monitoring is recommended.
2. The contractor should be apprised of the procedures to follow should any heritage materials be unearthed during construction
3. Contractors to be apprised of working with care near the grave/yards
4. Contractor should be apprised of the protocol to follow for paleontological chance finds.
5. The markers should be locally advertised to establish the family wishes regarding memorial markers, either moved the side of the road, once reestablished or moved to a local cemetery

The discovery of previously undetected subterranean heritage remains on the terrain must be reported to the Heritage Authority or the heritage practitioner and may require further mitigation measures.

8. BIBLIOGRAPHY

Bamford, M. 2024. Palaeontological Impact Assessment for the proposed improvement of the R30 from Ventersdorp to Buffelsvallei, Section 8, North West Province

Bergh, J.S. (ed.). 1999. *Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies*. Pretoria: J.L. van Schaik.

Deacon, HJ and Deacon, J. 1999. *Human Beginnings in South Africa. Uncovering the Secrets of the Stone Age.* David Philip Publishers. Cape Town & Johannesburg.

Huffman, T.N. 2007. *Handbook to the Iron Age. The Archaeology of Pre-colonial Farming Societies in Southern Africa.* University of KwaZulu-Natal Press.

Mucina, L and Rutherford, M.C. 2006. *The Vegetation of South Africa, Lesotho and Swaziland.* South African National Biodiversity Institute, Pretoria.

UCT Digital collections https://exhibits.stanford.edu/maps-of-africa/catalog/bf050my3437 Map of the Transvaal Colony

SAHRIA website for reports in immediate area
https://www.matlosana.gov.za/

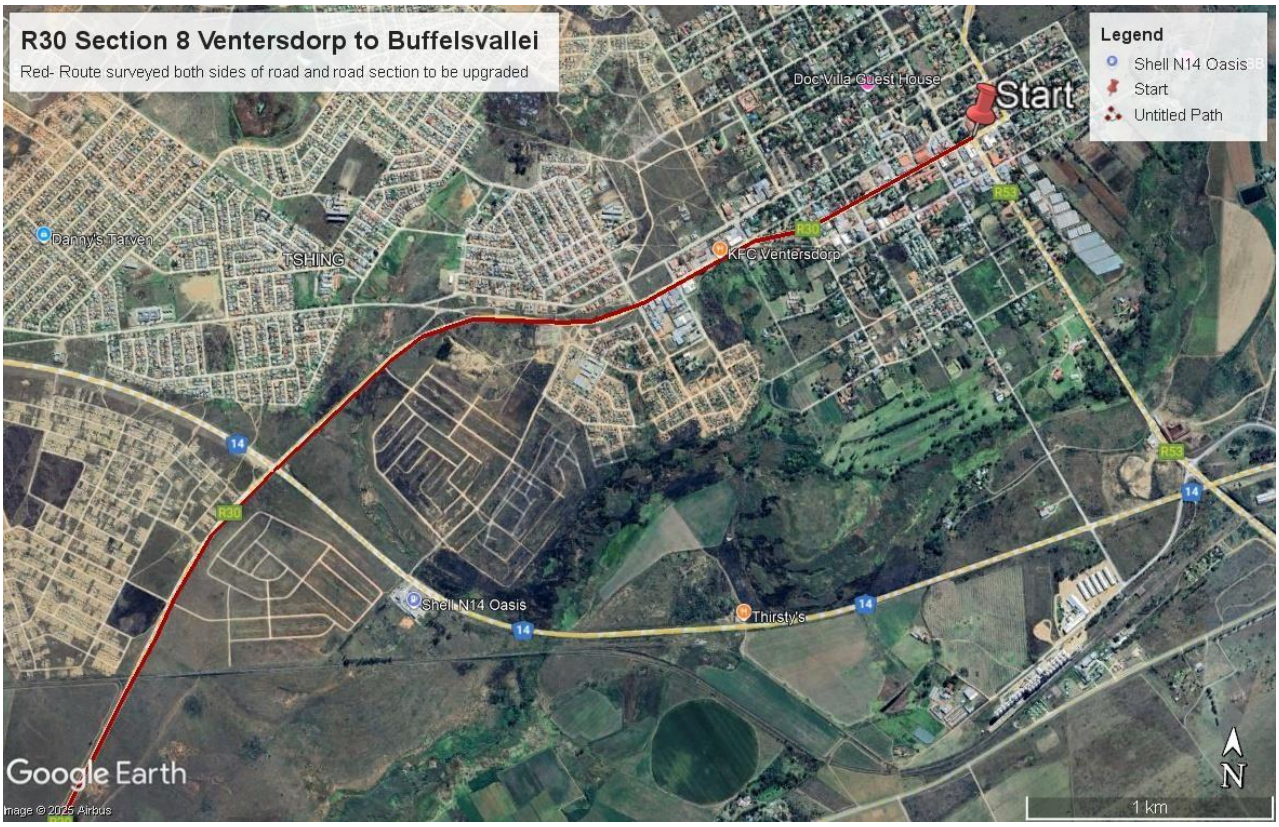


Frans E Roodt
BA Hons Archaeology Unisa,

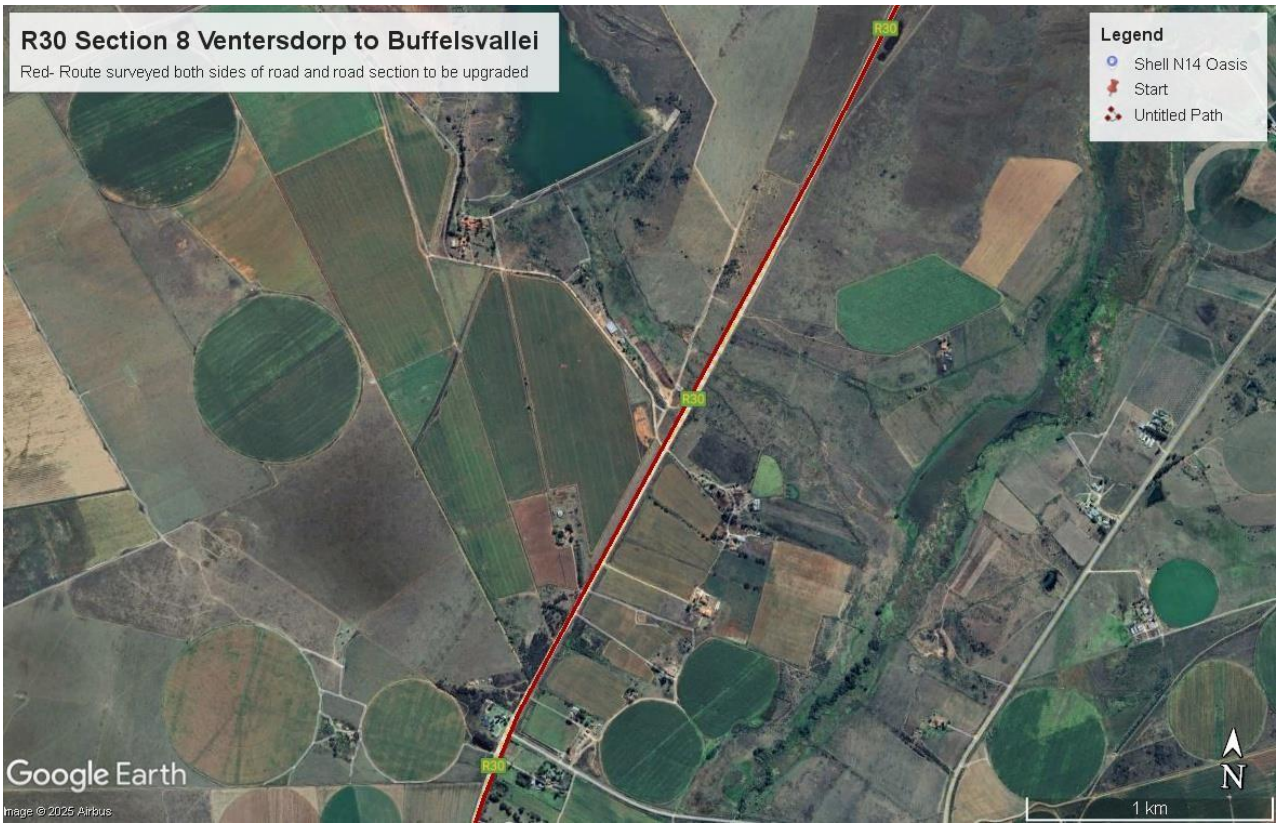


FRANS ROODT (*BA Hons, MA Archaeology, Post Grad. Dip. Museology; UP*)
Principal Investigator for SHASA Heritage Consultants

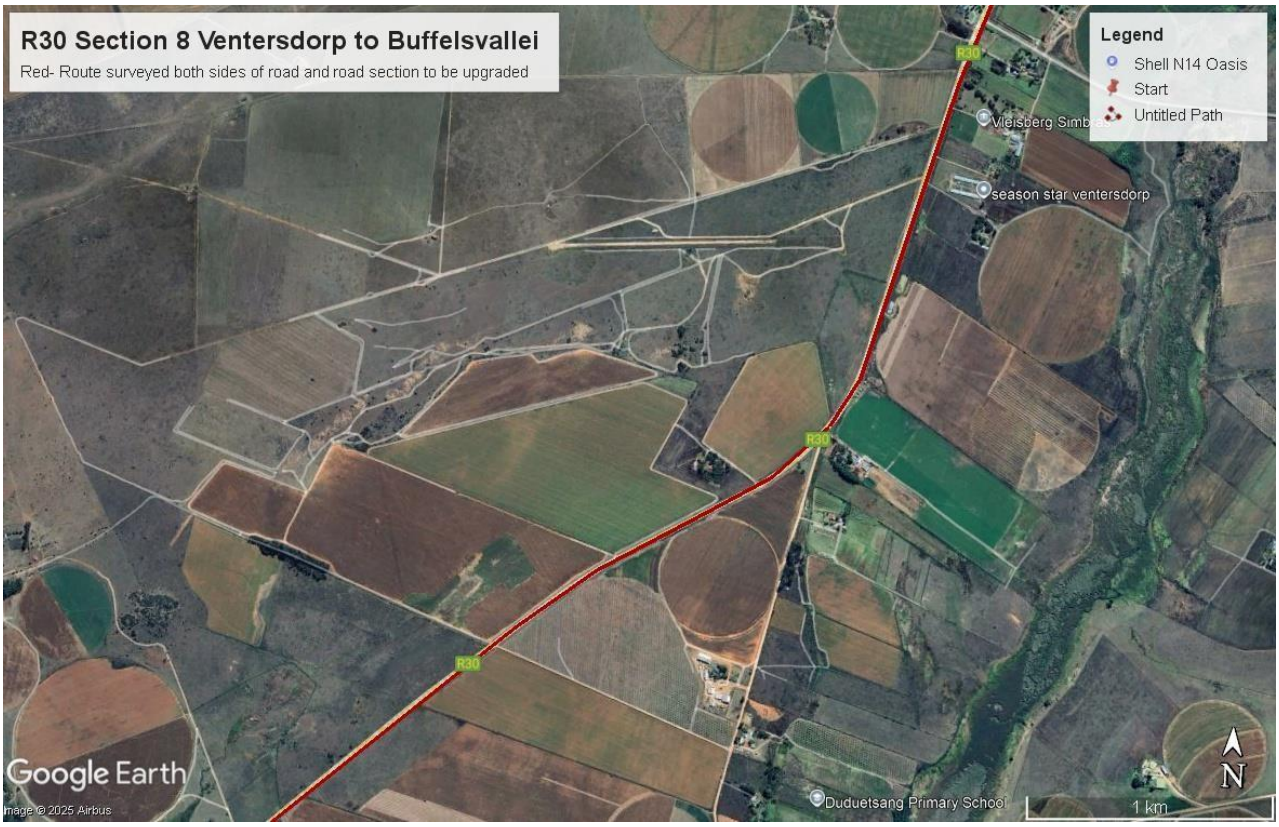
Maps below are close up views of adjoining sections of the R30. These also serve as survey maps as each side was surveyed



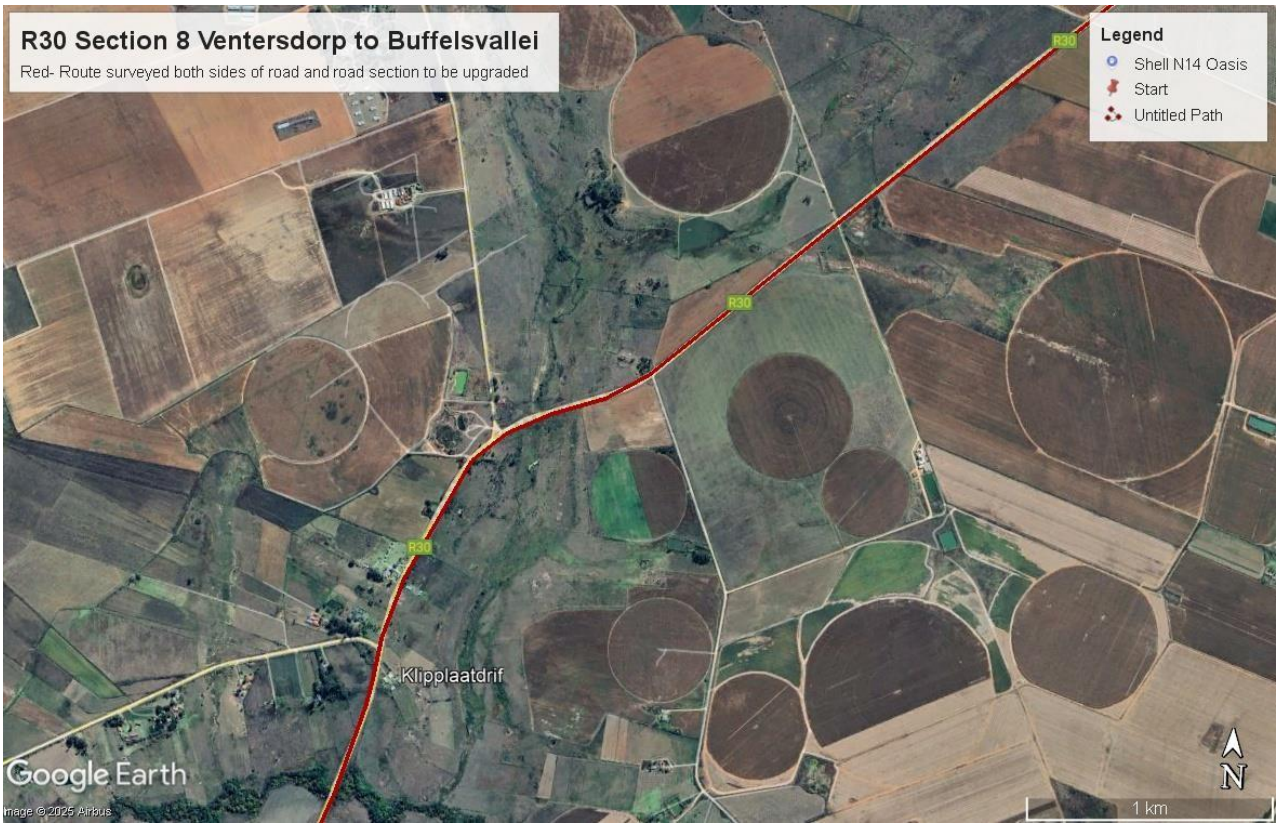
Map 2. Google map 1



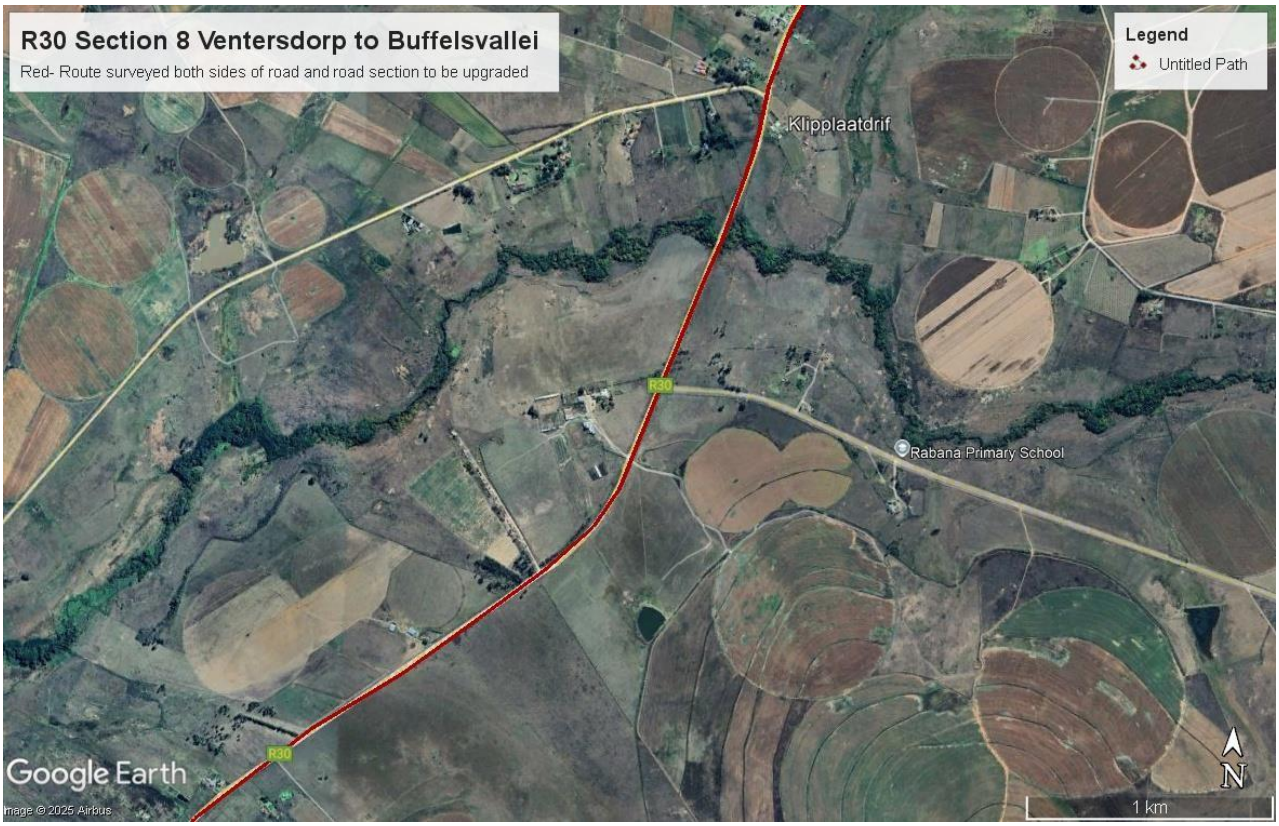
Map 3. Map 2



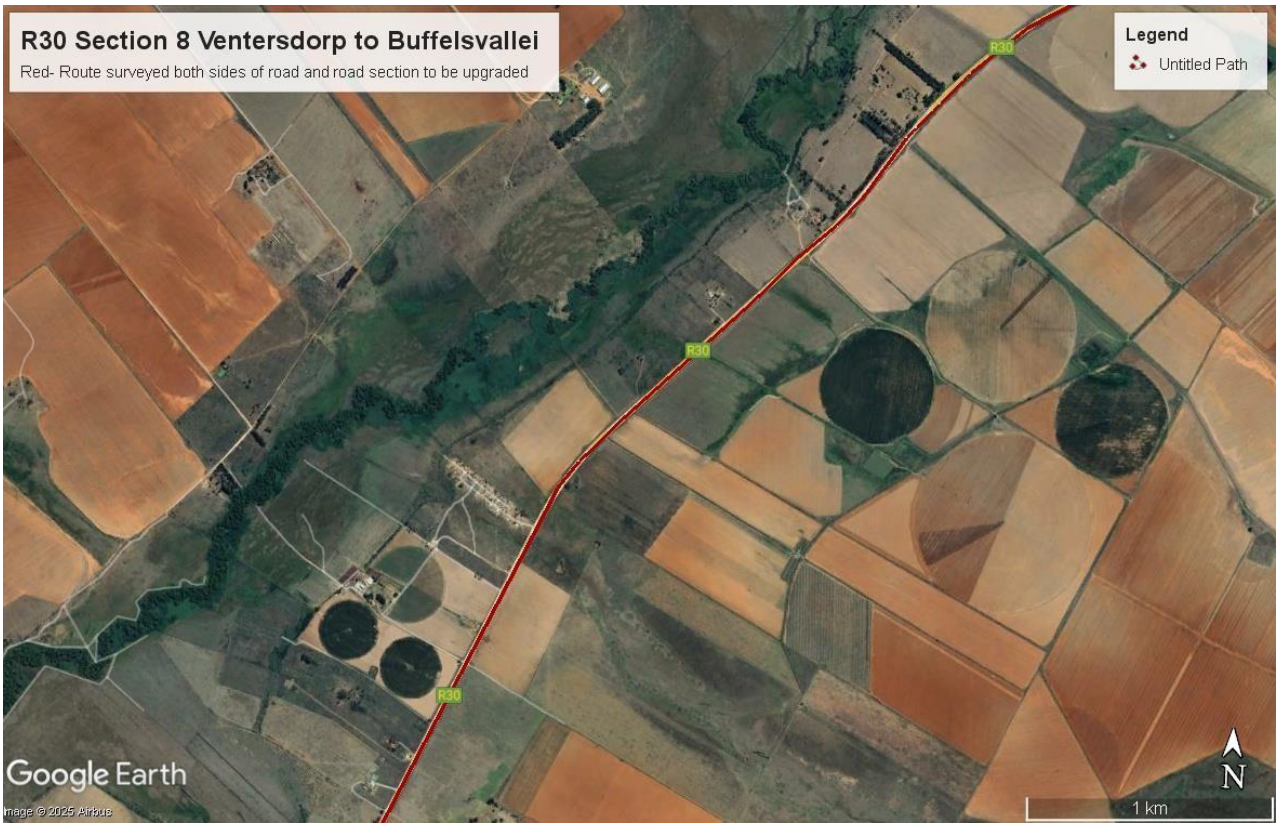
Map 4. Map 3



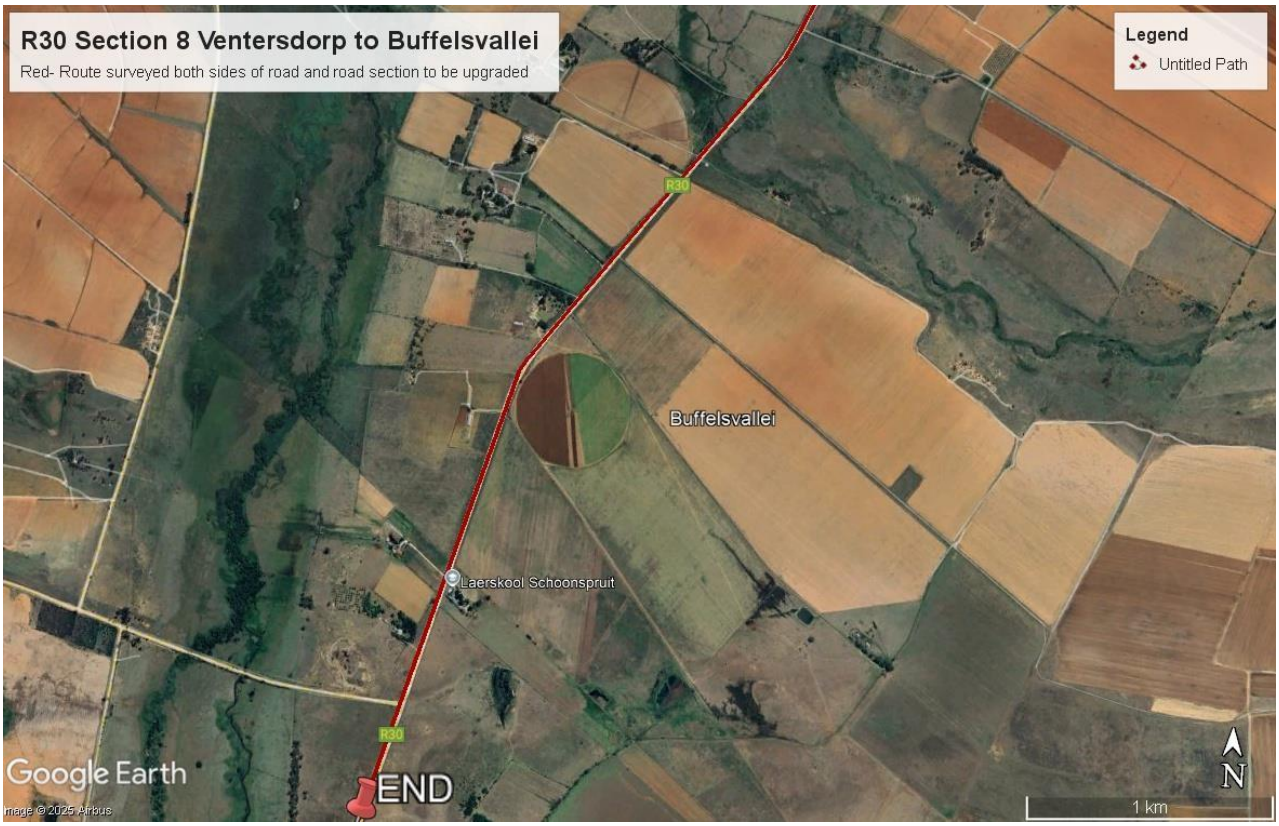
Map 5. Map 4



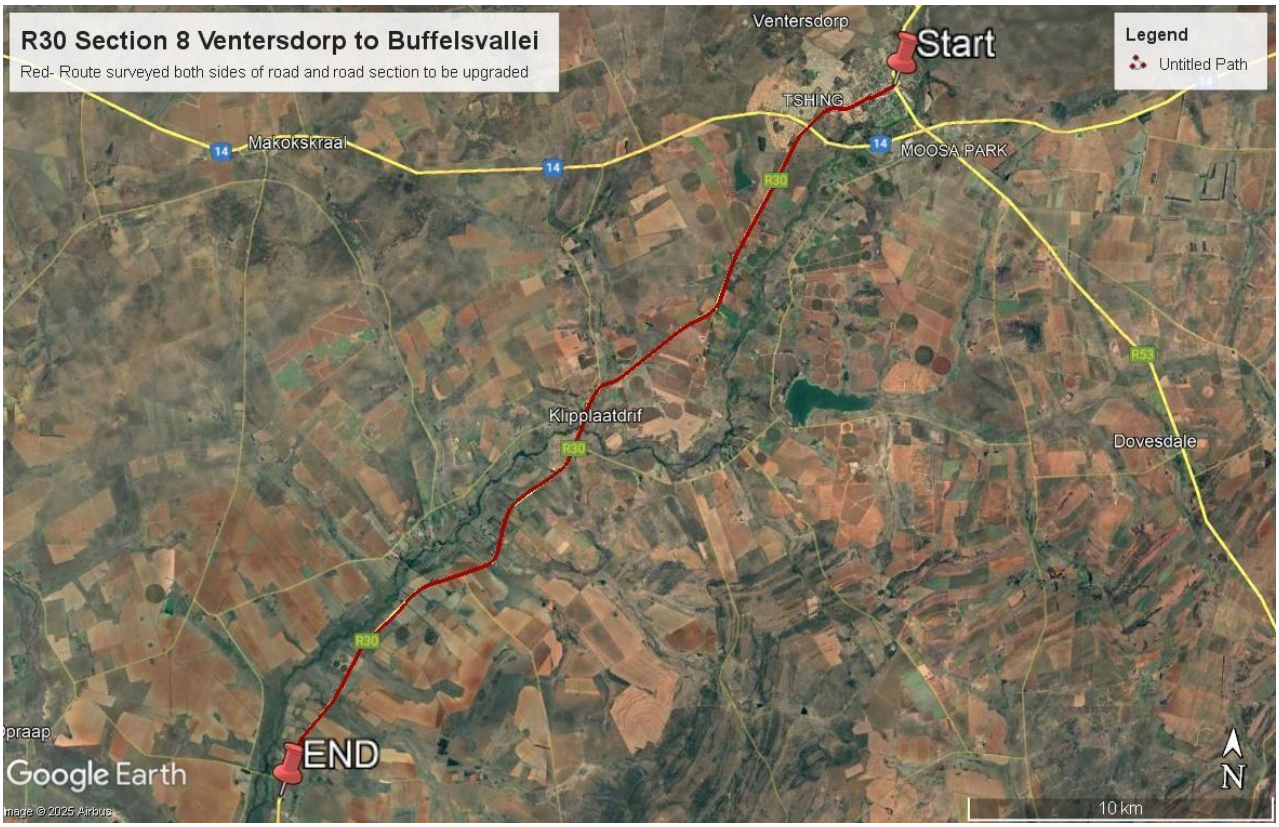
Map 6. Map 5



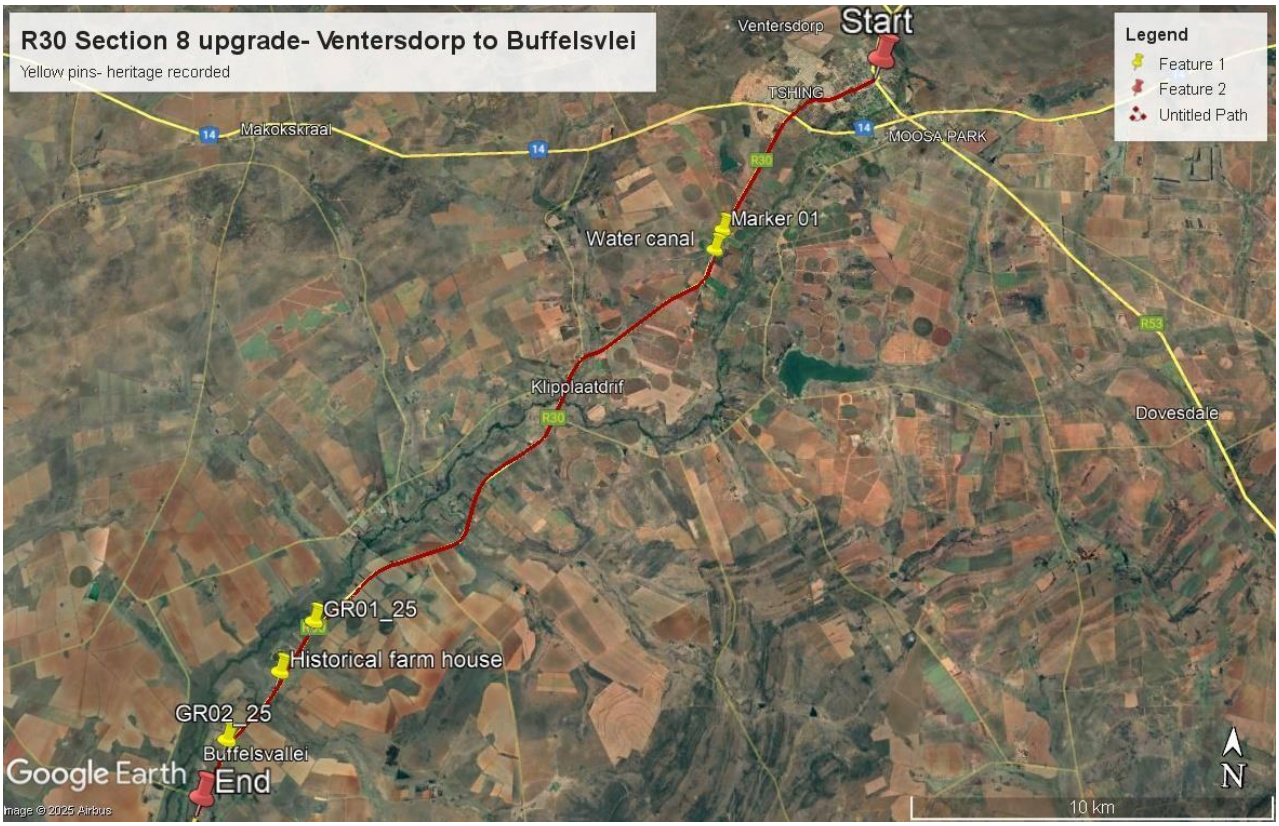
Map 7. Map 6



Map 8. Map 7



Map 9. Whole route



Map 10. Finds map

APPENDIX 5.4: PALEONTOLOGICAL REPORT

Palaeontological Impact Assessment For The Improvement Of National Road R30 Section 8 From Km 36.800 To Ventersdorp Km 68.646 Within Dr Kenneth Kaunda District Municipality In The North West Province.

Desktop Study (Phase 1)

Subcontracted by

Shasa Heritage Consultants

16 July 2025

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

1. Executive Summary

A Palaeontological Impact Assessment was requested for the proposed improvement by (SANRAL) of Road R30 section 8, a 31.846-kilometer stretch located from (km 36.8) to Ventersdorp (km 68.646), Nort West Province. The southern section is on potentially very highly sensitive rocks of the Malmani Subgroup while the northern section is on highly sensitive rocks of the lower Pretoria Group, all members of the Transvaal Supergroup.

To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The site visit and walkdown in June 2025 along the existing road route and the borrow pits confirmed that they **do not have any fossils present on the surface**. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer, or other designated responsible person once excavations or drilling activities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Very High to High	Low	Palaeontological Impact Assessment	Section 7.2. SAHRA Requirements

2. **Declaration of independence and summary of expertise**.

a. Declaration

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Shasa Heritage Consultants, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision-making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

b. Expertise

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf, PSSA
Experience: 36 years research and lecturing in Palaeontology; over 28 years PIA studies and over 450 projects completed.

c. Specialist declaration of independence and statement of objectivity for the assessment.

Declaration of Independence

I, Marion Bamford, declare that –

General declaration:

- I act as the independent palaeontology practitioner in this application,
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant,
- I declare that there are no circumstances that may compromise my objectivity in performing such work,
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations, and all other applicable legislation,
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application,
- I have no, and will not engage in, conflicting interests in the undertaking of the activity,
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority,
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties

and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application,
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct,
- I will perform all other obligations as expected from a heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

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

d. **Summary of the specialist's expertise**

I, Marion Bamford, am a professional Palaeontologist with a PhD in Palaeontology (Wits University, 1990). I have more than 35 years of experience in palaeontological research and have published over 190 papers in peer-reviewed journals and published more than 14 scholarly book chapters. I review manuscripts for international and local journals and also review funding proposals for international funding bodies. Currently I am the Director of the Evolutionary Studies Institute, the only palaeontological institute in Southern Africa.

I have completed more than 450 palaeontological impact assessments (desktop and site visit studies) in the last 28 years for a variety of projects (solar energy projects, wind energy projects, powerlines, roads, infrastructure, housing, and retail projects and from all over South Africa. I have been subcontracted by over 30 different companies. From my own projects and training provided by me and other staff in the ESI for Palaeontological Impact Assessments, I am familiar with the legislation.

Table of Contents

1. Executive Summary i
2. Declaration of independence and summary of expertise 1
3. Project Background 4
4. Methods and Terms of Reference 6
5. Geology and Palaeontology 7

i. Project location and geological context 7
ii. Palaeontological context 11
iii. Site visit Observations 14

6. Impact assessment 15
7. Assumptions and uncertainties 18
8. Recommendation 18
9. References 19
10. Chance Find Protocol 20
11. Appendix A – Examples of fossils from the 21

Figure 1: Google Earth map of the general area to show the relative land marks 6
Figure 2: Geological map of the area around the project site 7
Figure 3: SAHRIS palaeosensitivity map for the site 12
Figures 4-5: Site visit photographs 14-15

Table 1: NEMA and EIA Regulations 4
Table 2: List of abbreviations for geology map 7
Table 3: Summary of palaeosensitivities 12
Table 4: Impact Assessment criteria 16

3. Project Background

South African National Road Agency SOC Limited (SANRAL) proposes to improve Road R30 section 8, a 31.846-kilometer stretch located from (km 36.8) to Ventersdorp (km 68.646). The project starts at km 36.800, south of the Opraap road-side junction, and continues up to km 68.646 west of the 3-way stop control intersection with the R 53 to Potchefstroom. This project falls within the City Matlosana and JB Marks Local Municipalities and is situated within the Dr Kenneth Kaunda District Municipality in the North West province, with Ventersdorp the closest town. The R 30 Section 8 is a two-lane single carriageway rural road with bi-directional traffic movement and can be classified as an AASHTO Class IIIA secondary rural arterial. The road cross-section varies considerably, with gravel shoulders provided up to km 67.00. The new proposed carriageway width will be 13.4m under normal conditions and 12.4m on high fills.

The project is aimed at improving the road geometry by adding surfaced shoulders and rehabilitating the existing pavement structure to enable it to carry a 20-year design traffic load.
The major aspects of this project include the following:

- Increase of the road reserve width is anticipated,
- Improvement of the existing pavement structure,
- general widening of the existing road cross section to 3.7m lanes and 2.5m (high fill) – 3.0m(normal conditions) surfaced shoulders,
- Isolated vertical and horizontal geometric improvements,
- widening of river bridges and some major and minor culverts,
- Demolishing and construction of new river bridges
- horizontal re-alignment of the road at curves:
    - from KM 46.9 to KM 47.7
    - from KM 53.9 to KM 55
    - from KM60.2 to KM60.7
- Possible 6.5m wide temporary deviation to accommodate two-way traffic during construction.
- Opening of 4 borrow pits

A Palaeontological Impact Assessment was requested for the road improvement project and associated Borrow Pits project. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6). Includes the requirements from GNR Appendix 6 of GN 326 EIA Regulation 2017.

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report,	Section 2
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Section 2
b	A declaration that the person is independent in a form as may be specified by the competent authority	Section 2
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 3
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 6
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 4
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 6
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 8
k	Any mitigation measures for inclusion in the EMPr	Section 10, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 10, Appendix A
n (i)	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 8
n (ii)	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Sections 8, 10
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
p	A summary and copies of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

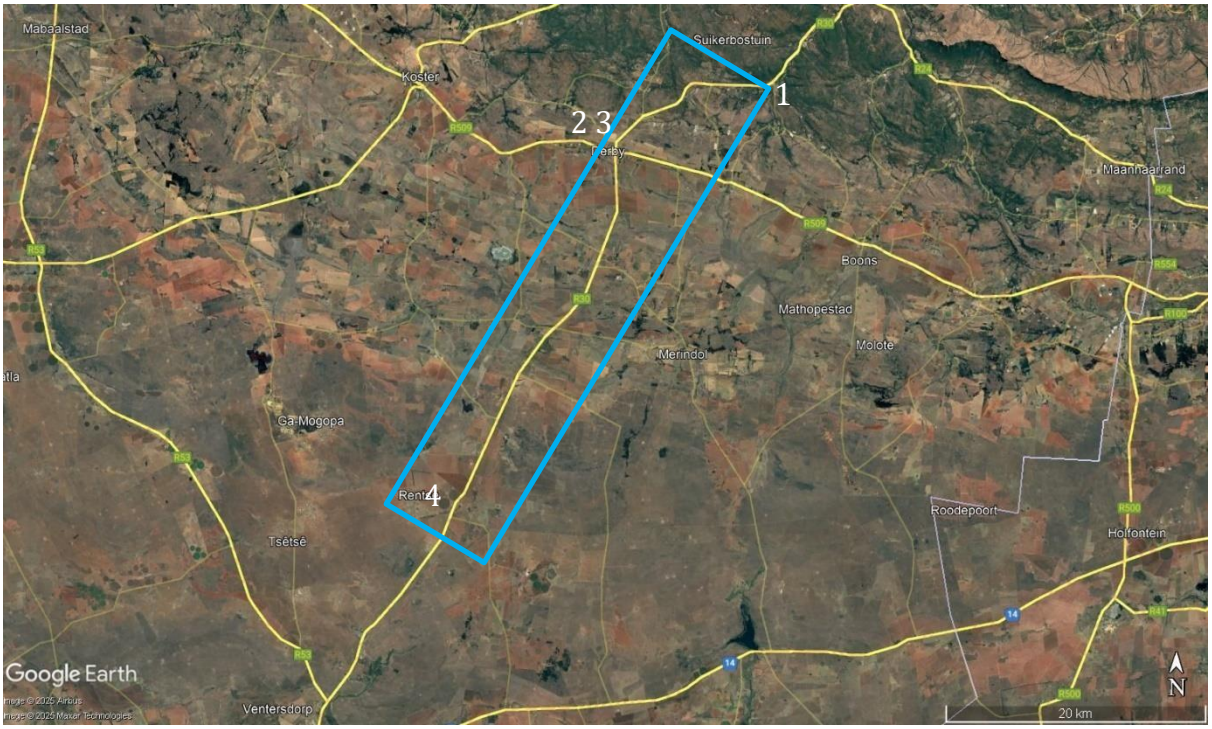


Figure 1: Google Earth map of the general area to show the relative land marks. Section 8 of the R30 is shown within the blue outline. The borrow pit locations are shown by the numbers.

4. Methods and Terms of Reference

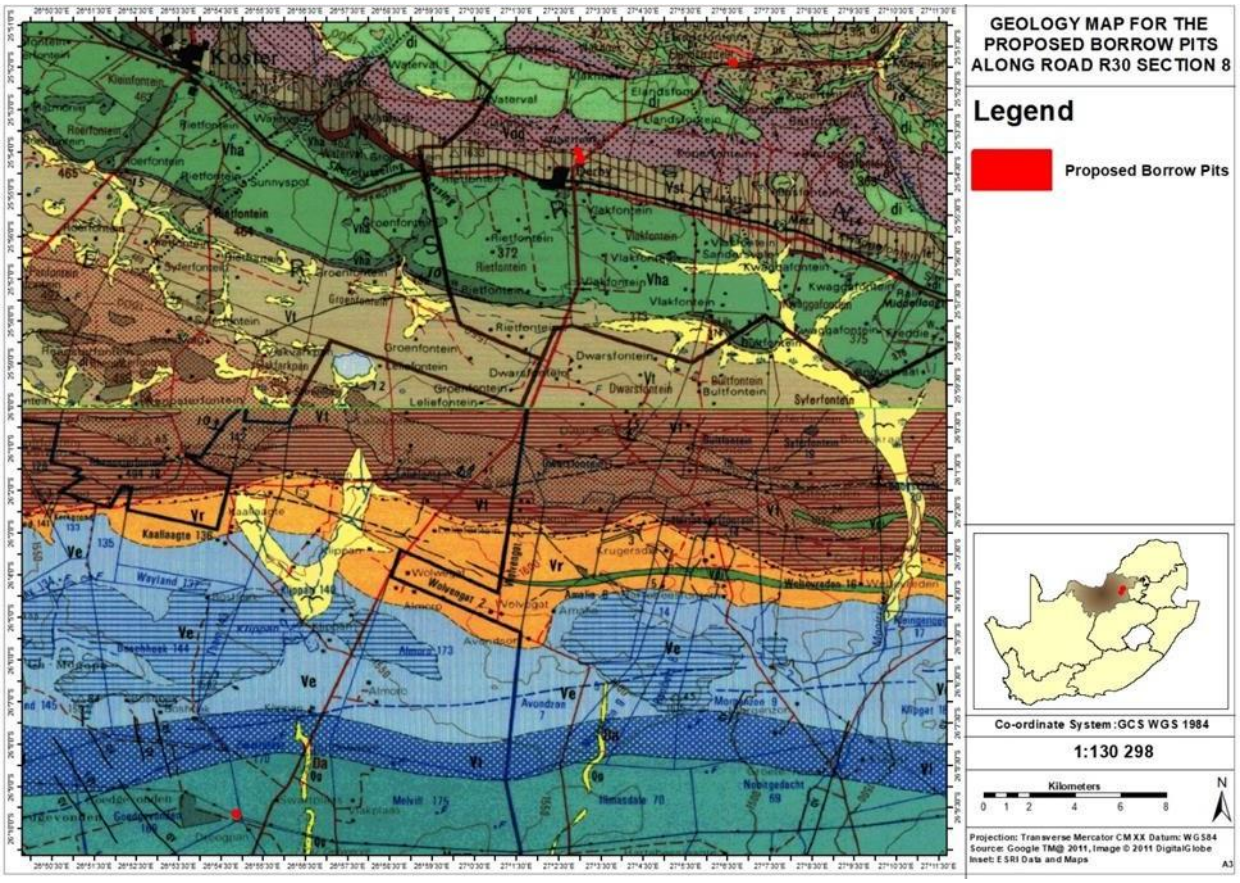
The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources include records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases; e.g. https://sahris.sahra.org.za/map/palaeo

2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representativity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

5. Geology and Palaeontology

i. Project location and geological context



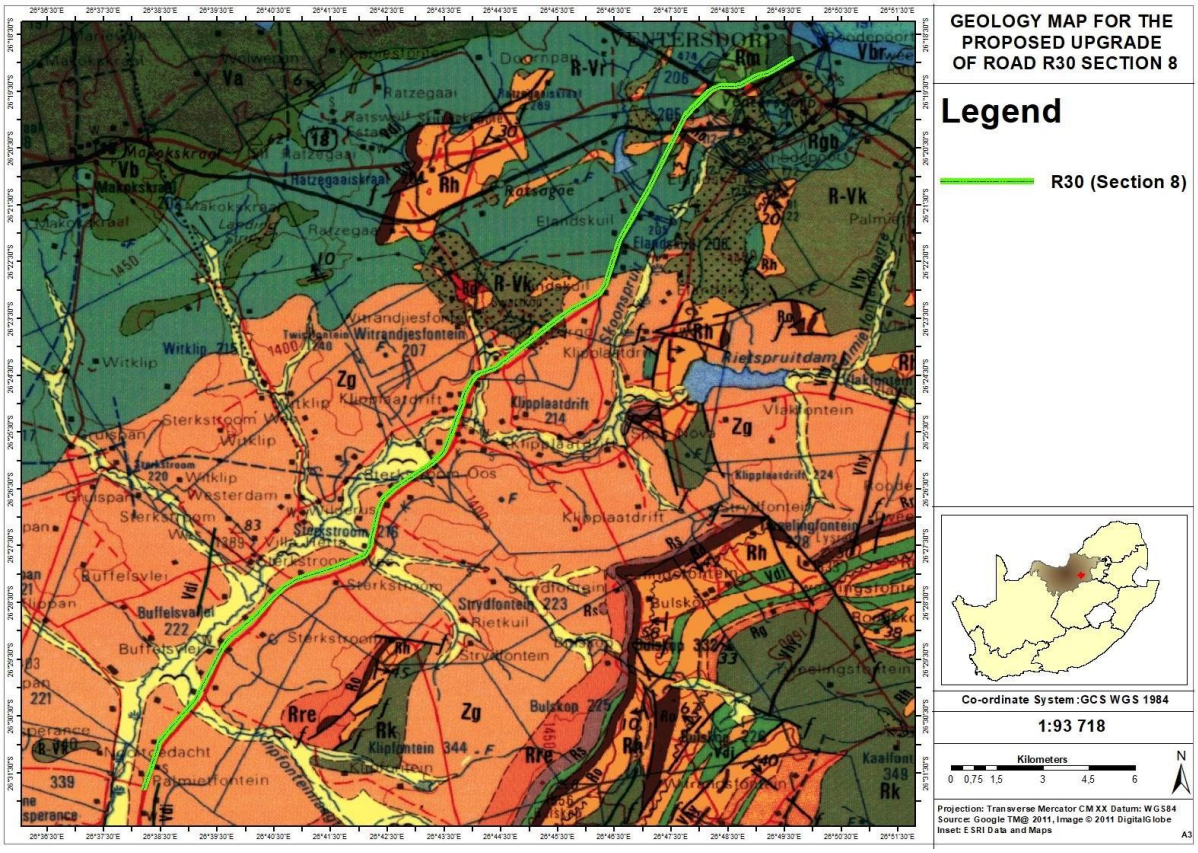


Figure 2 and 3: Geological map of the area around Section 8 of the R30 road for improvement. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2526 Rustenburg (north) and 2626 West Rand (south).

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006; Zeh et al., 2020). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Quaternary ca 1.0 Ma to Present
Vdi	Diabase	Intrusive volcanic dykes and sills	Post Transvaal SG
Vdq	Daspoort Fm, Pretoria Group, Transvaal SG	Quartzite	<2240 Ma
Vha	Hekpoort Fm, Pretoria Group, Transvaal SG	Volcanic rocks	Ca 2224 Ma
Vb	Boshoek Fm, Pretoria Group, Transvaal SG	Quartzite	Ca 2266 Ma
Vt	Timeball Hill Fm, Pretoria Group, Transvaal SG	Shale, siltstone, conglomerate in places; dotted = Quartzite	Ca 2316 – 2266 Ma
Vr	Rooihoogte Fm, Pretoria Group, Transvaal SG	Conglomerate	<2343 Ma

Symbol	Group/Formation	Lithology	Approximate Age
Vme	Eccles Fm, Malmani Subgroup, Chuniespoort Group, Transvaal SG	Light banded dolomite and chert	Ca 2585 – 2480 Ma
Vml	Littleton Fm, Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dark chert-poor dolomite	Ca 2585 – 2480 Ma
Vmm	Monte Christo Fm, Malmani Subgroup, Chuniespoort Group, Transvaal SG	Chert-rich dolomite; circles = oolitic	Ca 2585 – 2480 Ma
Vmo	Oaktree Fm, Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dark chert-free dolomite	Ca 2585 – 2480 Ma

The project lies in the Transvaal Basin where the rocks of the Palaeoproterozoic Transvaal Supergroup are exposed (Figure 2).

TRANSVAAL SUPERGROUP

The Late Archaean to early Proterozoic Transvaal Supergroup is preserved in three structural basins on the Kaapvaal Craton (Eriksson et al., 2006). In South Africa are the Transvaal and Griqualand West Basins, and the Kanye Basin is in southern Botswana. The Griqualand West Basin is divided into the Ghaap Plateau sub-basin and the Prieska sub-basin. Sediments in the lower parts of the basins are very similar but they differ somewhat higher up the sequences. Several tectonic events have greatly deformed the south western portion of the Griqualand West Basin between the two sub-basins

The Transvaal Supergroup comprises one of world's earliest carbonate platform successions (Beukes, 1987; Eriksson et al., 2006; Zeh et al., 2020). In some areas there are well preserved stromatolites that are evidence of the photosynthetic activity of blue green bacteria and green algae. These microbes formed colonies in warm, shallow seas.

In the Transvaal Basin, the Transvaal Supergroup is divided into two Groups, the lower Chuniespoort Group, and the upper Pretoria Group (with ten formations; Eriksson et al., 2006). The Chuniespoort Group is divided into the basal Malmani Subgroup that comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales, and erosion surfaces. The top of the Chuniespoort Group has the Penge Formation and the Duitschland Formation.

Making up the lower Pretoria Group are the **Rooihoogte and Timeball Hill Formations** and the Boshoek Formation. The Hekpoort, Dwaalheuwel, Strubenkop and **Daspoort Formations** form a sequence as the middle part of the Pretoria Group, Transvaal Supergroup, and represent rocks that are over 2060 million years old. The Hekpoort Formation is a massive lava deposit and is overlain by the Dwaalheuwel conglomerates, siltstone, and sandstone (not present here). A hiatus separates the Strubenkop Formation slates and shales from the overlying quartzites of the Daspoort Formation. Upper Pretoria Group formations are the Silverton, Magaliesberg, Vermont, Lakenvalei, Nederhorst, Steenkampsberg and Houtenbek Formations

The Transvaal sequence has been interpreted as three major cycles of basin infill and tectonic activity with the first deep basin sediments forming the Chuniespoort Group, the second cycle deposited the lower Pretoria Group, and the sediments in this area are from the interim low stand that preceded the third cycle. These sediments were deposited in shallow lacustrine, alluvial fan and braided stream environments (Eriksson et al., 2012).

Chuniespoort Group in the Transvaal Basin comprises the Malmani Subgroup at the base, followed by the Penge Formation and Duitschland Formation (Eriksson et al., 2006). According to Zeh et al., (2020) the Chuniespoort Group includes the Black Reef Fm, Malmani Subgroup, and the Penge Fm.

The **Malmani Subgroup** is up to 2000m thick and has been divided into five formations based on the composition of cherts, stromatolites, limestones, and shales. At the base, overlying the Black Reef Formation, is the base is the **Oaktree Formation** that represents a transition from siliciclastic sedimentation to platform carbonates (Eriksson et al., 2006). It is composed of carbonaceous shales, stromatolitic dolomites and locally developed quartzites. Next is the **Monte Christo Formation** that has an erosive breccia base and continues with stromatolitic and oolitic platformal dolomites. Above that is the **Lyttleton Formation** that is composed of shales, quartzites and stromatolitic dolomites. The overlying **Eccles Formation** includes a series of erosion breccias that locally contain gold deposits. This mineralisation has been attributed to hydrothermal remobilisation of fluids by the Bushveld complex (Eriksson et al., 2006). The topmost formation is the **Frisco Formation** that is composed mainly of stromatolitic dolomites but these become more shale rich towards the top of the sequence because of the deepening depositional environment.

Pretoria Group

The Pretoria Group is approximately 6-7km thick and is composed mostly of mud rocks alternating with quartzitic sandstones, significant interbedded basaltic-andesitic lavas, and subordinate conglomerates, diamictites and carbonate rocks. These have been subjected to low grade metamorphism (Eriksson et al., 2006). The Bushveld Complex intrusion has affected the layering of the formations.

The model of Eriksson et al., 2006, 2012 and collaborators shows the Transvaal Basin to have experienced three major tectonically controlled transgressive-regressive sequences. The first shallow seaway with a carbonate and a BIF platform is represented by the Chuniespoort Group followed by an 80 Ma gap. The second shallow embayment with clastic sediments is represented by the Rooihoogte and Timeball Hill Formations, and the third shallow embayment is represented by the Daspoort, Silverton and Magaliesberg Formations.

The basal **Rooihoogte Formation** overlies a deeply weathered paleontography that developed on the carbonates of the Chuniespoort Group. Composition of the rocks of this formation vary locally but generally comprise chert conglomerate, chert-rich sandstones, mud rocks, and sandstones. An alluvial fan and fluvial braid-plain depositional setting has

been interpreted from the conglomerates and sandstones, and a shallow lacustrine basin has been interpreted for the mud rocks and dolomites (Eriksson et al., 2006).

Overlying the Rooihoogte Formation is the **Timeball Hill Formation** which is composed of thick shales and subordinate sandstones that were deposited in a fluvio-deltaic basin-filling sequence (Eriksson et al., 2006). A number of facies are included in this formation. At the base is black shale facies associated with subsurface lavas and pyroclastic rocks of the Bushy Bend Lava Member. Above these are rhythmically interbedded mudstones/siltstones and fine-grained sandstones that have been interpreted as turbidite deposits (Eriksson et al., 2006). These fine-grained sediments grade up into the medial Klapperkop Quartzite Member that has been interpreted as fluvio-deltaic sandstones which fed the more distal turbidites (ibid). Above this is an upper shale member and rhythmite facies. In the east of the Transvaal Basin the Upper Timeball Hill shales have undergone extensive soft-sediment deformation caused by the onset of tectonic instability that led to the eventual fan deposits of the Boshoek Formation and the flood basalts of the Hekpoort Formation (ibid).

There is an unconformity between the Strubenkop shales and the overlying **Daspoort Formation**. In the east of the Transvaal Basin the latter is composed of mature quartz arenites and subordinate mud rocks and ironstones, but in the west of the basin it is mostly made up of immature sandstones, pebbly arenites, conglomerates, and mud rocks (Eriksson et al., 2006). This formation probably represents a fluvial setting succeeded by a shallow marine setting that was the precursor to a major transgression that formed the succeeding Silverton Formation (Erikson et al., 2006). At the top of the Daspoort Formation are localised occurrences of stromatolitic carbonates and cherts (ibid).

Within the **Silverton Formation** are the lower Boven Shale Member, Macha Dorp Volcanic Member, and upper Lydenburg Shale Member. The lower shales are alumina-rich and best represented in the eastern part of the Transvaal Basin. Shallow subaqueous eruptive formed the tholiitic basalts and then the tuffaceous shales that are high in CaO- MnO-MgO formed the Lydenburg Member (Eriksson et al., 2006). The Silverton Formation has been interpreted as a high-stand facies tract that reflected the advance of an epeiric sea onto the Kaapvaal Craton from the east, so the Daspoort Formation would represent a low stand facies tract or a transgressive systems tract (ibid).

QUATERNARY

There were two large basins dominating southern Africa during the Cenozoic, with the Kalahari Basin to the west and the Bushveld basin to the east. Both basins are bounded along their southern extent by the more or less west-east trending Griqualand-Transvaal Axis (Partridge et al., 2006). These sediments are not easy to date but recent attempts are gradually filling in the history of the sands, sand dunes, and inter-dunes (Botha, 2021).

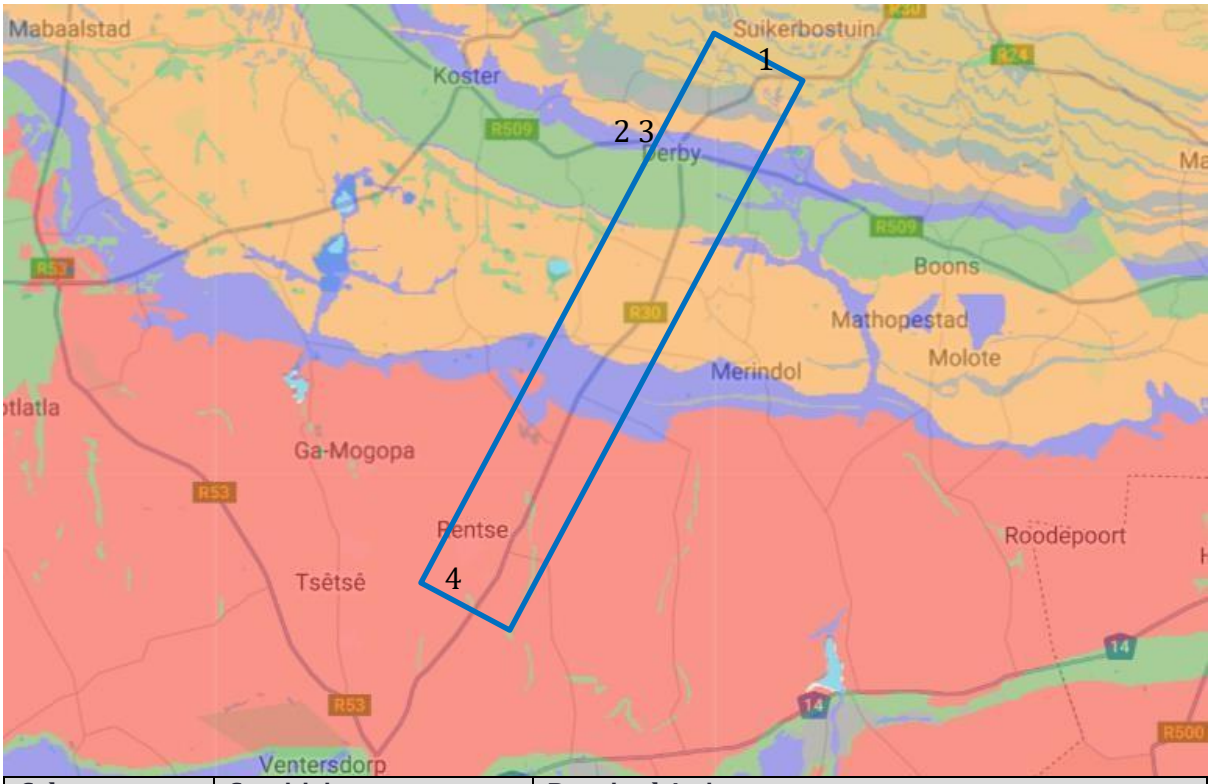
Quaternary Kalahari sands cover large parts of the rocks in this region, especially to the west. This is the largest and most extensive paleo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree, and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common. Most geological maps indicate these sands simply descriptively

(aeolian sand, gravelly sand, calcrete) or they are lumped together as the Gordonia Formation because

the detailed regional lithostratigraphic work has not been done, Nonetheless, these sands have eroded from the interior and have been transported by wind or water to fill the basin. Reworking of the sands or stabilisation by vegetation has occurred. Probable ages of dune formation are around 100 kya (thousand years), 60 kya, 27-23 kya and 17-10 kya (in Botha, 2021).

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The route and the borrow pits are on rocks of various sensitivities.



Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/ YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 3: SAHRIS palaeosensitivity map for the site for the proposed improvement of section 8 shown within the blue rectangle. Borrow pit sites are shown by the numbers.

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The palaeosensitivity of the route and sites for development are summarised in Table 3 below.

Table 3: Summary of palaeosensitivities, formations and potential fossils.

Formation	Palaeosensitivity	Fossils
Daspoort	High	Stromatolites
Strubenkop	Low	
Hekpoort	Moderate	No fossils; volcanics. caves
Timeball Hill	High	Stromatolites
Rooihoogte	Low	
Malmani Subgroup	Very High	Stromatolites

The Transvaal Supergroup sequence of sedimentary and volcanic rocks has been interpreted as having undergone three cycles of tectonically controlled basin subsidence and infilling with clastic deposits from the west and northwest. The first cycle (Chuniespoort Group) was a shallow seaway in a marine environment where the carbonate platform (**Malmani Subgroup**) was deposited and has a variety of limestones and dolomite (Erikson et al., 2012). The different lithofacies represent different depths of formation of carbonates, for example, intertidal zone, high energy zone, and shallow subtidal deposits are limestone and dolomite, with flat domes and columnar stromatolites being formed in the intertidal zone. In the high energy zone oolites, oncolites and ripples were formed, while in the deep tidal zone elongated stromatolitic mounds were formed (Truswell and Eriksson, 1973; Eriksson and Altermann, 1998).

After a hiatus of about 80 Myr, the second cycle (Duitschland, Rooihoogte and Timeball Hill Formations) occurred under glacial influence. The stromatolites in the Timeball Hill Formation are questionable but they are present in the Duitschland Formation (Schröder et al., 2016).

The age of the lower **Timeball Hill Formation** is constrained at 2322–2316 Ma by Re–Os pyrite geochronology from black shales at its base (Figure 2; Bekker et al., 2004; Hannah et al., 2004). Tuff beds in the upper Timeball Hill Formation gave U–Pb ages of 2256 ± 6 to 2266 ± 4 Ma (Fig. 2; Rasmussen et al., 2013). The Timeball Hill Formation represents deltaic deposition in an intracratonic basin, with clastics sourced from the east to northeast (Coetzee et al., 2006). There are no records of fossils in the Timeball Hill Formation (Eriksson et al., 2006, 2012). The age of the sediments precedes the evolution of body fossils (Plumstead, 1969; Benton, 2005) so only micro-organisms would have evolved. Deepwater, turbidite and tuff beds are not settings that are conducive to the preservation of fossils, particularly small and fragile fossils. The SAHRIS interpretation, based on the Palaeotechnical report of North West Province (Groenewald et al., 2014), is likely to be incorrect.

The third cycle after a brief hiatus, represented by the rest of the Pretoria Group, was deposited in a shallow embayment. Carbonates (not necessarily stromatolites) are reported from the upper Silverton Formation, the Houtenbeck and Vermont Formations.

From the Magaliesberg Formation there have been several reports of microbial features. No fossils are recorded from the Rayton Formation, and the upper Pretoria Group rocks are not listed in the Palaeotechnical report for North West (Groenewald et al., 2014), however the rocks are quartzites and shales like the underlying members of the Pretoria Group. Since Parizot et al., (2005) first recorded microbial mat features from the Magaliesberg Formation north of Pretoria, a number of other occurrences have been reported in this formation (Bosch and Eriksson, 2008; Eriksson et al., 2012).

Bosch and Eriksson (2008) described crack-like features, vermiform structures and circular imprints resembling concretions or, possibly oncolites, that occur on sand sheet surfaces within the uppermost beds of the **Magaliesberg Formation**. They indicated two localities, one north of Pretoria, on the farm Baviaanspoort 330 JR and the other on the farm Rietvlei 518 JR, east of Pretoria. Leeuwpoort is northeast of Pretoria. The presence of such microbial mat-like features are found in epeiric marine tidally dominated coastline. The rhythmic alternation of water levels inherent in such settings can explain desiccation of microbial mats growing on the sandy substrates formed within the palaeoenvironment. In addition, the shifting loci of deposition were probably also related to braided fluvial inputs, through the medium of braid deltas (Bosch and Eriksson, 2008).

Stromatolites are the trace fossils that were formed by colonies of green algae and blue-green algae (Cyanobacteria) that grew in warm, shallow marine settings. These algae were responsible for releasing oxygen via the photosynthetic process where atmospheric carbon dioxide and water, using energy from the sun, are converted into carbon chains and compounds that are the building blocks of all living organisms. The released carbon dioxide initially was taken up by the abundant reducing minerals to form oxides, e.g. iron oxide. Eventually free oxygen was released into the atmosphere and some was converted into ozone by the bombardment of cosmic rays. The ozone is critical for the filtering out of harmful ultraviolet rays.

Microbialites (sensu Burne and Moore, 1987) are organo-sedimentary deposits formed from interaction between benthic microbial communities (BMCs) and detrital or chemical sediments. In addition, Microbialites contrast with other biological sediments in that they are generally not composed of skeletal remains. Archean carbonates mostly consist of stromatolites. These platforms could have been the site of early O2 production on our planet. Stromatolites are the laminated, organo-sedimentary, non-skeletal products of microbial communities, which may have included cyanobacteria, the first photosynthetic organisms to produce oxygen. Another type of trace fossil has been termed Microbially-induced sedimentary structures (MISS sensu Noffke et al., 2001) or simply 'fossil mats' (sensu Tice et al., 2011). These include swirls, rip-ups, crinkled surfaces and wrinkles that were formed by the mucus extruded by littoral algae or microbes and bound together sand particles. Davies et al. (2016) caution against the assumption that all such structures are microbially induced unless there is additional evidence for microbes in the palaeoenvironment.

Nonetheless, stromatolites and Microbialites are accepted as trace fossils of algal colonies. MISS could be microbially or abiotically formed. The oldest stromatolites have been recorded from the Barberton Supergroup that was deposited between 3.55 to ca. 3.20 Ga, and stromatolites still form today in warm, shallow seas (Homan, 2019).

From the SAHRIS map above the southern area is indicated as very highly sensitive (red) so this section was walked down. All the borrow pit sites were also visited and photographs are provided in Figure 4.

iii. Site visit observations

The road was walked down but it already has wide verges that have been mown and no rocks remain. No rocky outcrops and no fossils were seen. The four borrow pits are on farmland and no fossils were seen. Only borrow pit 4 is on the potentially highly sensitive Malmani Subgroup dolomites.



Figure 4: Photograph of the sections of road in the southern section on the Malmani subgroup. No rocky outcrops present. (All photographs courtesy of L. Stegmann).



Figure 5: Site visit photographs. A-B – more views of the existing road route in the southern section. No fossils. C - Borrow Pit 1: S 25°51'52.83"; E 27° 6'37.23" (4.89 ha). D - Borrow Pit 2: S 25°54'9.26"; E 27° 3'0.63" (4.90 ha). E - Borrow Pit 3: S25°53'57.26"; E 27° 2'57.27" (4.93 ha). F - Borrow Pit 4: S 26°9'38.65"; E 26°54'51.55" (4.86 ha). No rocky outcrops and no fossils seen.

6. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table :

Table 4a: Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness, or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 4b: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	-
	L	Soils do not preserve fossils; so far there are no records from the Malmani Subgroup of trace fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.

PART B: Assessment		
SPATIAL SCALE	L	Since the only possible fossils within the area would be trace fossils in the dolomites, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the loose soils and sands that cover the area or in the diabase that will be quarried. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are either the wrong kind or are much too old to contain body fossils but the dolomites might have trace fossils. Furthermore, the material to be quarried is diabase and this does not preserve fossils. Since there is a small chance that trace fossils from the Malmani Subgroup Formation may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is low.

7. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales, and sands are typical for the country and only some might contain trace fossils such as stromatolites or Microbialites. The sands of the Quaternary period would not preserve fossils. The site visit and walkdown confirmed that there were no fossils present on the land surface.

8. Recommendation

Based on the walkdown and observations, as well as experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying soils of the Quaternary. There is a very small chance that trace fossils may occur in the dolomites or quartzites of the Malmani Subgroup so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for the road or quarrying for material have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, as far as the palaeontology is concerned, so the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Very High and High	Low	Palaeontological Impact Assessment	Section 7.2. SAHRA Requirements

9. References

Benton, M.J. 2005. Vertebrate Palaeontology. Oxford: Blackwell Science, 2005. 3rd edn.

Beukes, N.J., 1987. Facies relations, depositional environments, and diagenesis in a major early Proterozoic stromatolitic carbonate platform to basial sequence, Campbellrand Subgroup, Transvaal Supergroup, southern Africa. Sedimentary Geology 54, 1-46.

Beukes, N.J., 1980. Stratigrafie en lithofacies van die Campbellrand-Subgroep van die Proterofitiese Ghaap-Groep, Noordkaapland. Transactions of the Geological Society of South Africa 83, 141-170.

Bosch, P., Eriksson, P., 2008. A note on two occurrences of inferred microbial mat features preserved in the c. 2.1 Ga Magaliesberg Formation (Pretoria Group, Transvaal Supergroup) sandstones, near Pretoria, South Africa. South African Journal of Geology 111, 251-262.

Burne, R.V., Moore, L.S., 1987. Microbialites; organ sedimentary deposits of benthic microbial communities. Palaios 2(3), 241-254.

Coetzee, L.L., Beukes, N.J., Gutzmer, J., Kakegawa, T., 2006. Links of organic carbon cycling and burial to depositional depth gradients and establishment of a snowball Earth at 2.3 Ga. Evidence from the Timeball Hill Formation, Transvaal Supergroup, South Africa. S. Afr. J. Geol. 109, 109–122.

Cowan, R., 1995. History of Life. 2nd Edition. Blackwell Scientific Publications, Boston. 462pp.

Davies, N.S., Liu, A.G., Gibling, M.R., Miller, R.F., 2016. Resolving MISS conceptions and misconceptions: A geological approach to sedimentary surface textures generated by microbial and abiotic processes Earth-Science Reviews 154, 210–246.

Eriksson, P.G., Altermann, W., 1998. Eriksson, An overview of the geology of the Transvaal Supergroup dolomites (South Africa). Environmental Geology 36, 178-188.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South

Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 237-260.

Eriksson, P.G., Bartman, R., Catuneanu, O., Mazumder, R., Lenhardt, N., 2012. A case study of microbial mats-related features in coastal epeiric sandstones from the Palaeoproterozoic Pretoria Group, Transvaal Supergroup, Kaapvaal craton, South Africa; the effect of preservation (reflecting sequence stratigraphic models) on the relationship between mat features and inferred palaeoenvironment. Sedimentary Geology 263, 67-75.

Frauenstein, F., Veizer, J., Beukes, N., Van Niekerk, H.S., Coetzee, L.L., 2009. Transvaal Supergroup carbonates: Implications for Paleoproterozoic $\delta^{18}O$ and $\delta^{13}C$ records. Precambrian Research 175, 149–160.

Groenewald, G., Groenewald, D., Groenewald, S., 2014. SAHRA Palaeotechnical Report. Palaeontological Heritage of North West. 23 pages.

Homann. M., 2019. Earliest life on Earth: Evidence from the Barberton Greenstone Belt, South Africa. Earth Science Reviews 196, 102888.

Noffke, N., Gerdes, G., Klenke, T. and Krumbein, W.E. (2001). Microbially induced sedimentary structures – a new category within the classification of primary sedimentary structures. Journal of Sedimentary Research, A71, 649-656.

Lenhardt, N., Eriksson, P.G., Catuneanu, O., Bumby, A.J., 2012. Nature of and controls on volcanism in the ca. 2.32–2.06 Ga Pretoria Group, Transvaal Supergroup, Kaapvaal Craton, South Africa. Precambrian Research 214– 215, 06– 123.

Lenhardt, N., Bleeker, W., Ngwa, C.N., Aucamp, T., 2020. Shallow marine basaltic volcanism of the Machadodorp Member (Silverton Formation, Pretoria Group), Transvaal Basin, South Africa — An example of Paleoproterozoic explosive intraplate volcanic activity in an epeiric embayment. Precambrian Research 338, 105580. https://doi.org/10.1016/j.precamres.2019.105580

Parizot, M., Eriksson, P.G., Aifa, T., Sarkar, S., Banerjee, S., Catuneanu, O., Altermann, W., Bumby, A.J., Bordy, E.M., Rooy, J.L. and Boshoff, A.J. (2005). Suspected microbial mat-related crack-like sedimentary structures in the Palaeoproterozoic Magaliesberg Formation sandstones, South Africa. Precambrian Research, 138, 274-296.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Rasmussen, B., Fletcher, I.R., Muhling, J.R., 2013. Dating deposition and low-grade metamorphism by in situ U\Pb geochronology of titanite in the Paleoproterozoic Timeball Hill Formation, southern Africa. Chemical Geology 351, 29–39.

Schröder, S., Beukes, N.J., Armstrong, R.A., 2016. Detrital zircon constraints on the tectonostratigraphy of the Paleoproterozoic Pretoria Group, South Africa. Precambrian Research 278, 362 – 393.

Sumner, D.Y., Beukes, N.J., 2006. Sequence stratigraphic development of the Neoarchean Transvaal carbonate platform, Kaapvaal Craton, South Africa. South African Journal of Geology 109, 11–22.

Tice, M.M., Thornton, D.C.O., Pope, M.C., Olszewski, T.D., Gong, J., 2011. Archean microbial mat communities. Annual Review of Earth and Planetary Sciences 39, 297–319.

Truswell, J.F., Eriksson, K.A., 1973. Stromatolitic associations and their palaeo-environmental significance: a reappraisal of a lower Proterozoic locality from the northern Cape Province, South Africa. Sedimentary Geology 10, 1–23.

Zeh, A., Wilson, A.H., Gerdes, A., 2020. Zircon U-Pb-Hf isotope systematics of Transvaal Supergroup – Constraints for the geodynamic evolution of the Kaapvaal Craton and its hinterland between 2.65 and 2.06 Ga. Precambrian Research 345, 105760. https://doi.org/10.1016/j.precamres.2020.105760

10. Fossil Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks and discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (stromatolites, Microbialites, plants, insects, bone, or coal) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the trace fossils (stromatolites, rip-ups, curls, microbial mats) fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figure 6). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued, and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.

7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

11. **Appendix A** – Examples of fossils from the Malmani Subgroup



Figure 6: Photographs of different types of stromatolites in the field, to assist the on-site responsible person.

APPENDIX 5.5: AGRICULTURAL COMPLIANCE STATEMENT

AGRICULTURAL COMPLIANCE STATEMENT

For the Upgrade of National Road R30 Section 8 from Km 36.8 to Ventersdorp Km 68.646, In the Province of North West and the District Municipalities of City Matlosana and Jb Marks

Prepared by the Protocol for Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Agricultural Resources (GN R320 of 20 March 2020)

Prepared by: EnterpreBiz (Pty) Ltd

Agricultural Specialist: Mrs. Mahlatse Phala

On Behalf of: Earthlink Environmental Services

Date: June 2025

EnterpreBiz	Earthlink Environmental Services In rhythm with nature

Table of Contents

1. Introduction 1
2. Terms of reference and scope of work 1
3. Applicable environmental legislation and soil management guidelines 2
4. Purpose and objectives 2
5. Methodology of the study 3
   5.1. Desktop Study 3
   5.2. Site Inspection 3
   5.3. Sensitivity Confirmation 3
6. Limitations 4
7. Potential Impact 4
8. Agricultural and Environmental Site Assessment 5
   8.1. Identified Soil Characteristics 5
   8.2. Site Conditions and Vegetation 6
   8.3. Infrastructure and Agricultural Activities 6
9. Recommendation and Mitigation Measures 8
10. Conclusion 9
11. References 9

1. INTRODUCTION

Road R30 Section 8 is a significant infrastructure project that intersects various agricultural regions, making it essential to carefully assess its impact on farming operations and ensure adherence to applicable agricultural standards and regulations. The project extends along the R30 national road, specifically from kilometre 36.8 to Ventersdorp at kilometre 68.646, within the North West province and the district municipalities of City Matlosana and JB Marks.

In addressing the unique context of the R30 Section 8 project, particular attention has been paid to the interplay between infrastructure development and the preservation of productive farmland, recognising the intrinsic value of these landscapes for both current agricultural output and future sustainability. Comprehensive evaluation of the land's physical characteristics, such as soil fertility, drainage, and topographical suitability, underpins this approach, enabling informed recommendations that not only protect prime agricultural resources but also align with statutory frameworks and regional development plans. This integrated perspective ensures that road construction proceeds in synergy with long-term agricultural viability, setting a foundation for responsible decision-making and ongoing stewardship of the region's natural assets.



Figure 1: Road R30 Section 8 proposed for upgrade

2. TERMS OF REFERENCE AND SCOPE OF WORK

This study fulfils the requirements of the "Protocol for the specialist assessment and minimum report content requirements of environmental impacts on agricultural resources" gazetted on 20 March 2020 in GN 320 [Sections 24(5)(A) and (H) and 44 of NEMA, 1998].

- Conduct a thorough assessment, including desktop reviews and on-site verification of agricultural potential.
- Assess spatial distribution of soil types within the study area.
- Identify restrictive soil properties affecting land capability.
- Compile maps depicting on-site conditions, soil forms, and land capability using existing data.
- Classify dominant soil forms according to South African standards.
- Survey and classify existing soil types using soilexplore.net.
- Create maps showing soil forms, land use, and land capability based on field findings.
- Present a report with desktop study results and field assessment findings.
- Provide recommended mitigation measures and management practices in compliance with legislation.

3. APPLICABLE ENVIRONMENTAL LEGISLATION AND SOIL MANAGEMENT GUIDELINES

The environmental regulations pertaining to soil and agricultural resources in South Africa encompass various legislative measures, including but not limited to:

- the Sub-division of Agricultural Land Act (Act 70 of 1970)
- the North West Spatial Planning And Land Use Management Bill, 2015
- the Conservation of Agricultural Resources Act (Act 43 of 1983)
- Environment Conservation Act (Act 73 of 1989)
- National Environmental Management Act (Act 107 of 1998)

4. PURPOSE AND OBJECTIVES

The primary objective of this report is to:

- Identify the potential impacts of the road project on agricultural activities.
- Outline strategies to mitigate adverse effects while preserving agricultural integrity.
- Provide recommendations for project approval.

In pursuit of these goals, the assessment applies a multidisciplinary methodology that integrates both scientific analysis and practical consultation with local stakeholders, thereby fostering a nuanced understanding of the agricultural landscape and its sensitivities to infrastructural change. By prioritizing transparent data collection, open engagement with affected communities, and rigorous interpretation of site-specific variables, the study aims to

provide actionable guidance that upholds the integrity of agricultural systems throughout the planning and implementation phases of the R30 Section 8 project.

5. METHODOLOGY OF THE STUDY

The report follows the guidelines outlined in Government Notice 320 of 2020 (GN320), which delineates the procedures and minimum standards for agricultural assessments. These measures are used to gather the necessary data for compiling the report. The methodology presented here is in full compliance with GN320 requirements and is detailed below.

5.1. Desktop Study

A desktop study, including a literature review, was conducted to assess the land and soil capacity of the study area. Various data sources provided information on geology, topography, terrain, soil formation, land capability, and soil classification.

Data layers evaluated for potential road upgrade impacts included:

- Aerial imagery (Google EarthTM)
- Agricultural Geo-Referenced Information System (AGIS)
- Land Type Data (1972-2006)
- National land capability evaluation raster data (2017)
- Quantum GIS and Topographical data

5.2. Site Inspection

The site was traversed on foot by the agricultural specialist in June 2025 during a winter season to:

- Visually assess the condition of the land
- Identify the presence or absence of cultivation or agricultural infrastructure
- Observe soil characteristics at the surface level
- Document current land use, vegetation cover, and neighbouring activities
- Capture photographic evidence of the landscape

5.3. Sensitivity Confirmation

Information collected during the site visit was used to verify and refine the results obtained from the DFFE Screening Tool, focusing on confirming the agricultural potential and current usage of the land.

Further analysis of the land's characteristics, including its soil structure and environmental context, provided an essential foundation for classifying its agricultural capabilities. These

assessments aimed to not only validate the physical observations from the site inspection but also integrate them with climatic and topographical data, ensuring a comprehensive understanding of the land's suitability for cultivation and grazing.

6. LIMITATIONS

This assessment has the following limitations:

- Laboratory-based soil testing was not conducted; instead, soil characteristics were determined through visual analysis and secondary data. This means that the detailed chemical and physical properties of the soil have not been precisely measured, which may affect the accuracy of soil suitability assessments for specific crops or land uses.
- The site visit was limited to surface-level investigation, with no subsurface assessments undertaken. Therefore, important information regarding soil profiles, groundwater levels, and potential contaminants below the surface has not been gathered, possibly overlooking critical factors that could affect agricultural productivity or environmental compliance.
- Seasonal variations were not captured, as the site visit represents a single point in time. Consequently, changes in weather patterns, water availability, and crop growth conditions throughout different seasons are not reflected in this assessment, potentially limiting its applicability to other periods of the year.
- No yield potential modelling was conducted. Due to this, predictions regarding the expected agricultural output under various scenarios have not been made, which limits the ability to forecast long-term productivity and inform planning decisions.

Despite these limitations, the findings are considered accurate for determining the agricultural sensitivity of the site under NEMA regulations.

7. POTENTIAL IMPACT

It is anticipated that the exact placement and layout of project infrastructure will remain unchanged, staying within the designated assessment area. Additionally, it is assumed that the nature of the infrastructure will be consistent with current plans, and that all activities required for establishing and operating the project will be typical for developments of this type.

Some of the activities which are likely to affect the soil and the land capability of the area are:

- Erosion of the fertile topsoil due to clearing of vegetation
- Loss of potential agricultural soils

- Soil compaction due to increased movement of construction machinery and vehicles
- Accumulation of construction debris and waste, which may contaminate soils and hinder plant growth
- Introduction of invasive plant species through movement of equipment and materials, impacting farm area and soil fertility
- Changes in soil pH or nutrient balance due to accidental chemical spills or improper disposal of construction materials.

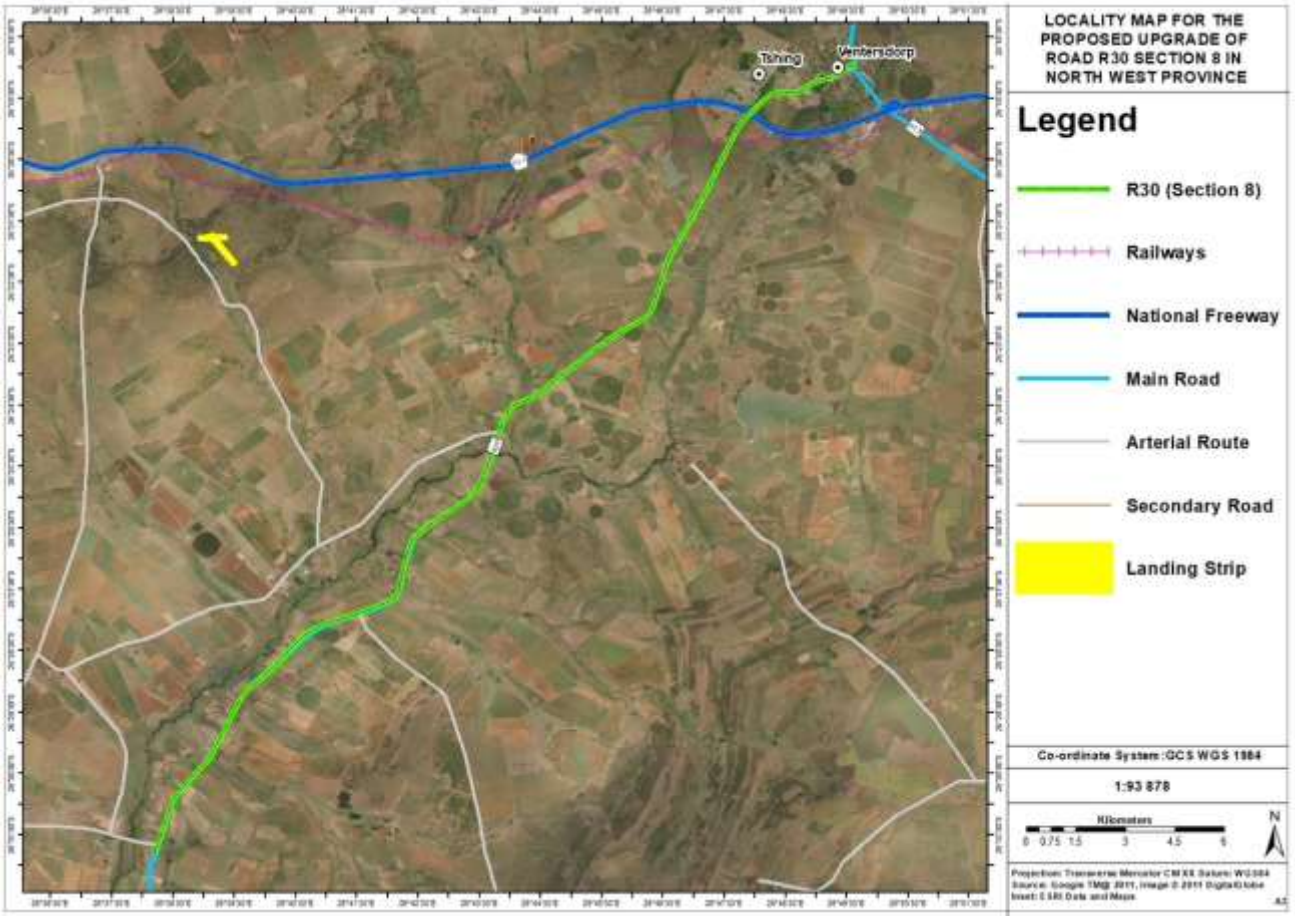


Figure 2: Locality Map for the proposed upgrade of road R30 Section 8 in the North West Province

8. AGRICULTURAL AND ENVIRONMENTAL SITE ASSESSMENT

8.1. Identified soil characteristics

National soil data from SANBI and ISRIC indicate that the main soil type at this location is classified as Alfisols. These soils are usually red, well-drained, fertile, and have a high base status. The area demonstrates a notable potential for both arable and pastoral agriculture. These findings are reinforced by the region's climatic suitability and the presence of established agricultural enterprises in adjacent lands, indicating that the integration of infrastructural developments must carefully balance the preservation of productive capacities with the demands of progress.

8.2. Site conditions and vegetation

The site was visited during the winter season, revealing patchy vegetation dominated by hardy grasses and small shrubs. These conditions suggest episodic disturbance and ongoing grazing pressure within the area. Observations included areas where the vegetation cover was notably sparse, indicating both the resilience of the soil to support regrowth and the impact of regular livestock movement.

In addition, the presence of animal tracks and compacted soil patches further corroborated the influence of grazing activity. The winter dormancy of certain native plant species was also evident, with many perennials maintaining only their basal growth or entering a period of reduced metabolic activity. Despite these seasonal limitations, some opportunistic annuals and introduced species were observed colonizing open patches, contributing to the mosaic of plant life.

The overall vegetative structure, therefore, reflects a dynamic equilibrium between natural recovery processes and human or animal-induced pressures. This complexity underscores the importance of assessing not just the current vegetation, but also the potential for ecological restoration or further degradation, depending on future land management decisions. Continued monitoring through different seasons would provide a more complete understanding of the site's capacity for both agriculture and conservation.



Figure 3: Vegetation during the visit

8.3. Infrastructure and Agricultural Activities

Road R30 Section 8, where the road upgrade is proposed, is a key infrastructure project intersecting several agricultural zones. The area is characterised by:

- Crop farming, including maize, wheat, and other cereals.
- Livestock grazing areas supporting cattle, sheep, and goats.
- Small-scale organic farming and horticulture.

This corridor passes through a patchwork of working farmlands, where a diversity of agricultural activities is evident.

Crop cultivation forms a backbone of the local economy, with expansive fields dedicated to staple grains such as maize, sorghum and sunflowers. These crops are integral not only to food security in the region but also serve as important cash crops, linking local producers to broader provincial and national markets.

Livestock farming complements crop production, with grazing pastures supporting herds of cattle. The presence of mixed farming systems reflects a strategy of resilience, allowing farmers to adapt to climatic variability and market fluctuations. Grazing lands are often interspersed with natural veld, which provides seasonal forage and helps sustain livestock during periods of lower crop productivity.

A notable feature along Section 8 is the presence of Pannar Seeds, a prominent seed supplier renowned across Africa for its research and innovation in crop genetics. Their operations not only boost local agricultural output but also provide employment opportunities and technical support to surrounding farmers, fostering a spirit of collaboration and agricultural advancement. Below are the pictures depicting the agricultural activities along the road.



Figure 4: Animal Farm along the road.



Figure 5: Sunflower Farm along the road.



Figure 6: Small crops irrigated using sprinkler irrigation system.

9. RECOMMENDATION AND MITIGATION MEASURES

Below are the recommendations and mitigating measures that should be taken to limit the effects of the road construction:

- Implement erosion control measures such as silt fences, berms, and stabilisation of disturbed soils.
- Demarcate construction boundaries to prevent encroachment onto surrounding areas.
- Control dust using water spraying, windbreaks, and covering of soil stockpiles to limit dust spread to nearby crops.

- Prevent Chemical Spill by implementing strict protocols for handling fuels, lubricants, and chemicals, and establishing response plans in case of spills.
- Use proper waste disposal methods to ensure construction waste is properly collected, recycled, or disposed of away from agricultural fields.
- Construct temporary roads or driveways to allow machinery and vehicles to reach fields during construction.
- Design permanent, safe access points for farmers to enter and exit roadways post-construction, accommodating large vehicles and equipment.
- Mark detours using signage, changes in access, and safety zones; keep farmers informed of any updates or modifications.

10. CONCLUSION

Given the presence of active farmlands and an existing roadway, the management of road construction must be carefully planned to support ongoing agricultural operations. Thoughtful coordination is necessary to ensure uninterrupted access to fields and pastures, protect valuable soils, and address any indirect effects from increased traffic or land disturbance. By implementing these recommended mitigation measures, we can uphold agricultural productivity, strengthen rural communities, and create a harmonious balance between infrastructure development and farming. This strategy not only contributes to food security and economic prosperity but also helps preserve the land's long-term health for future generations. From the specialist point of view, road construction can proceed without compromising agricultural interests.

11. REFERENCES

Centre for Environmental Management, University of the Free State. (2017). South African Land Capability Map (Raster Dataset).

Department of Forestry, Fisheries and the Environment. (2020). Protocol for the Specialist Assessment and Minimum Report Content Requirements of Environmental Impacts on Agricultural Resources (GN 320), 20 March 2020.

Department of Forestry, Fisheries and the Environment (DFFE). (n.d.). Environmental Impact Assessment Guidelines.

Department of Agriculture, Forestry and Fisheries. (n.d.). Agricultural Geo-Referenced Information System (AGIS).

Food and Agriculture Organization of the United Nations (FAO). (2015). Soil Management Guidelines.

Google Earth Pro, Satellite imagery.

Land Type Survey Staff. (1972–2006). Land Type Data. ARC-Institute for Soil, Climate and Water, Pretoria.

North West Provincial Government. (2015). Spatial Planning and Land Use Management Bill.

Pannar Seeds. (n.d.). About Us. [Company information]

South African Government. (1970). Subdivision of Agricultural Land Act, Act 70 of 1970.

South African Government. (1983). Conservation of Agricultural Resources Act, Act 43 of 1983.

South African Government. (1989). Environment Conservation Act, Act 73 of 1989.

South African Government. (1998). National Environmental Management Act, Act 107 of 1998.

South African National Biodiversity Institute (SANBI). (n.d.). Soil Data Portal.

SoilGrids (ISRIC – World Soil Information). (n.d.). Global Gridded Soil Information.

South African Weather Service. (2025). Climate Data for North West Province.

South African Institute for Agricultural Engineers. (n.d.). Best Practices for Infrastructure and Agricultural Coexistence.

World Bank Group. (2017). Environmental and Social Framework.

APPENDIX 5.6: Geotechnical Report signed

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED

PROJECT NRA R.030-080-2016/1

FOR THE IMPROVEMENT OF NATIONAL ROAD R30 SECTION 8 FROM KM 36.8 TO VENTERSDORP (KM 68.646)

GEOTECHNICAL INVESTIGATION REPORT

FEBRUARY 2023 – Ver. 00

Prepared for:
The South African National
Roads Agency SOC Ltd
NORTHERN REGION
38 Ida Street
Menlo Park
Pretoria
0081

Prepared by:
Ndodana Consulting Engineers (Pty) Ltd
River Falls Office Park
262 Rose Avenue, Tamboti Building
Doringkloof, 0157

PROJECT CONTACT DETAILS

SERVICE PROVIDER'S PERSONNEL

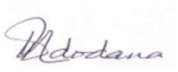
POSITION	NAME	FIRM	DIRECT EMAIL	CELL NUMBER
Project Leader	Webster Ndodana PrEng 950176	Ndodana Consulting Engineers (Pty) Ltd	main@ndodana.co.za	011 789 6984
Pavement Specialist	Arno Hefer PrEng 20020007	Ndodana Consulting Engineers (Pty) Ltd	arnoh@icon.co.za	082 958 9508
Geometric Specialist	Heiner Muller PrEng 20190655	Ndodana Consulting Engineers (Pty) Ltd	heiner@ndodana.co.za	079 504 8074
Structures Specialist	Evan Arendse PrEng 20120155	C2C Consulting Engineers cc	evana@bepsa.co.za	082 320 8111
Drainage Specialist	Marco van Dijk PrEng 20160807	Green Hippo	mvd@greenhippo.co.za	083 394 8627
Geotechnical Specialist	Pieter Oosthuizen PrEng 970670	Southern Geotechnical Engineering cc	pieter@sgeng.co.za	082 823 7794
Works Contract Engineer	Emile Horak PrEng 830357	Ndodana Consulting Engineers (Pty) Ltd	emileh@ndodana.co.za	083 228 1694

SANRAL PERSONNEL

POSITION	NAME	DIRECT EMAIL	CELL NUMBER
Project Manager	Naailah Mia	mian@nra.co.za	062 292 0965
Regional Specialist	Nontobeko Mathenjwa	MathenjwaN@nra.co.za	081 013 2545
Design and Construction Manager	Tsakane Mathebula	mathebulat@nra.co.za	071 609 5603
Bridge Network Manager	Vacant		

QUALITY VERIFICATION SHEET

CLIENT:	SANRAL SOC Limited Northern Region
CONSULTANT:	Ndodana Consulting Engineers (Pty) Ltd
PROJECT DESCRIPTION:	Improvement of National Road R30 Section 8 from Km 36.8 to Ventersdorp (Km 68.646)
CONTRACT NUMBER:	NRA R.030-080-2016/1
DOCUMENT TITLE:	Geotechnical Investigation Report.

VER. No.	DATE	ISSUED TO	PREPARED BY:		SIGNATURE
00	22 February 2023	Regional Design and Construction Manager	Structures	*Evan Arendse PrEng*	
			Geotechnical	*Pieter Oosthuizen PrEng*	
			Drainage	*Marco van Dijk PrEng*	
			CHECKED BY:		**SIGNATURE**
			Geotechnical Specialist	*Pieter Oosthuizen PrEng*	
			APPROVED BY:		**SIGNATURE**
			Project Leader	*Webster Ndodana PrEng*	

DOCUMENT CONTROL

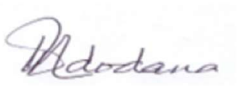
VERSION CONTROL TABLE

VER. No.	DATE	DESCRIPTION	COMMENTS
00	22 February 2023	First submission of final report including laboratory test results.	

The consultant's signature below confirms that all comments given by SANRAL have been addressed in the subsequent versions of this report and the final design.

ISSUED BY: Project Leader:

Name: Webster Ndodana



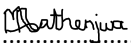
22 February 2023

....

SIGNATURE DATE

APPROVED BY: SANRAL Regional Specialist

Name: Nontobeko Mathenjwa



2023/05/08

....

SIGNATURE DATE

ACCEPTED BY: SANRAL Project Manager:

Name: Naailah Mia



8 May 2023

....

SIGNATURE DATE

Table of Contents

1. Introduction **1**
   1.1. Terms of reference and description of project 1
   1.2. Description of the stage and purpose of investigation 1
2. Description of the sites **1**
   2.1. Location of sites 1
   2.2. Accessibility of the sites 3
   2.3. Trafficability for construction equipment 3
   2.4. List of sources from which data was obtained. 4
   2.5. Regional geology 5
   2.6. Climate 7
      2.6.1. Temperature 7
      2.6.2. Rainfall 8
   2.7. Vegetation 9
   2.8. Surface water and drainage 10
   2.9. Weinert Moisture Index 10
3. Geotechnical fieldwork **10**
   3.1. Description of types of field work and equipment used. 11
      3.1.1. Rotary core borehole drilling 11
      3.1.2. Dynamic Probe Super Heavy (DPSH) testing 12
      3.1.3. Test pitting with TLB 12
   3.2. Laboratory testing program on soil/rock 13
      3.2.1. Test pits 13
      3.2.2. Core boreholes 14
4. Site specific geology and typical soil and rock profiles **15**
   4.1. Strydfontein River Bridge B1018 (see Boreholes 1 and 17) 15
      4.1.1. Investigation Method 15
      4.1.2. Site specific soil profile 16
   4.2. Schoonspruit River Bridge B1845 (see Boreholes 2, 3, 4, 5, 6 and 7) 17
      4.2.1. Investigation Method 17
      4.2.2. Site specific soil profile 18
   4.3. Ratzegaai River Bridge B4039 (see Boreholes 8, 9, 10, 11 and 12) 19
      4.3.1. Investigation Method 19

4.3.2. Site specific soil profile 20
4.4. Elandskuil River Bridge (see Boreholes 13, 14, 15 and 16) 21
4.4.1. Investigation Method 21
4.4.2. Site specific soil profile 22
4.5. Culvert at km. 39.654: (See Test pits 1 and 2 and DPSH 1 to 4) 22
4.5.1. Investigation Method 22
4.5.2. Site specific soil profile 23
4.6. Culvert at km. 41.824: (See Test pits 3 and 4 and DPSH 5 to 9) 24
4.6.1. Investigation Method 24
4.6.2. Site-Specific Soil Profile 25
4.7. Culvert at km. 44.577: (See Test pits 5, 6 and 7 and DPSH 10 to 17) 25
4.7.1. Investigation Method 25
4.7.2. Site-Specific Soil Profile 26
4.8. Culvert at km. 47.257: (See Test pits 8 and 9 and DPSH 18 to 21) 27
4.8.1. Investigation Method 27
4.8.2. Site-Specific Soil Profile 28
4.9. Culvert at km. 65.971: (See Test pits 10 and 11 and DPSH 22 to 25) 28
4.9.1. Investigation Method 28
4.9.2. Site-Specific Soil Profile 29
5. Geotechnical evaluation **30**
5.1. Seismicity 30
5.2. Discussion on soil and rock materials 30
5.2.1. Group 1 – Imported Fill Material 31
5.2.2. Group 2 – Topsoil 31
5.2.3. Group 3 – Colluvium and/or Alluvium 31
5.2.4. Group 4 – Residuum 32
5.2.5. Group 5 – Granite Rock 32
5.2.6. Group 6 – Diabase Intrusion 33
5.2.7. Group 7 – Amygdaloidal Lava Rock 33
5.3. Seepage and groundwater 33
5.4. Excavatibility and stability of excavations 35
5.4.1. Culvert structures 36
5.4.2. Bridge structures 36
5.5. Potentially expansive soils 36

5.6. Swell pressure of soils 38
5.7. Potentially compressible soils 38
5.8. Potentially collapsible soils 39
5.9. Rock hardness 39
5.10. SPT test results 40
5.11. DPSH test results 41
5.11.1. Culvert 39.654 41
5.11.2. Culvert 41.824 42
5.11.3. Culvert 44.577 42
5.11.4. Culvert 47.257 43
5.11.5. Culvert 65.971 43
5.12. Problems encountered during investigation and foreseen during construction. 44
5.12.1. Possible flooding and accessibility problems 44
5.12.2. Deeply fractured and discontinuous granite rock profile 44
5.13. Evaluation of alternative foundation systems 45
5.13.1. Relative movements between existing and new foundations 45
5.13.2. Restricted foundation excavations and stability of excavations 46
5.14. Preferred foundation systems 46
5.15. Foundation design parameters 47
5.15.1. Spread footing foundations founded within alluvium soils 47
5.15.2. Piled foundations with rock sockets 47
6. Recommendations **48**
6.1. Recommended foundation systems. 48
6.1.1. Piled foundations (bridge structures). 48
6.1.2. Spread footing foundations (culverts). 49
6.2. Recommended supplementary geotechnical investigations during construction phase 50
7. Concluding remarks 50
8. References 50

List of Appendices

Appendix A: ..... Soil Profiles
Appendix B: ..... Soil Profile Photographs
Appendix C: ..... Detailed Borehole Profile Logs
Appendix D: ..... Rotary Core Borehole Photographs
Appendix E:1 ..... DPSH Test results
Appendix E:2 ..... DPSH Test positions
Appendix F: ..... Laboratory test results :Soil
Appendix G: ..... Laboratory test results : Rock

List of Figures

Figure 1: Regional Locality map. 2
Figure 2: Local locality map. 2
Figure 3: Potential problems with accessibility at some of the bridge and culvert sites due to steep slopes and dense vegetation. 3
Figure 4: Regional geology along the length of the route after 1:250 000 scale geological map 2626 West Rand. 5
Figure 5: Average Temperature Statistics at Ventersdorp Weather Station (2000 – 2020). 8
Figure 6: Historic rainfall data for Ventersdorp. 9
Figure 7: Core drilling underway with a YWE D45 drill rig and logging by engineering geologist. 12
Figure 8: Excavation of test pit using a Cat 422E TLB type excavator. 13
Figure 9: Rotary Core Borehole Positions (Strydfontein Bridge – B1018) 16
Figure 10: Rotary Core Borehole Positions (Schoonspruit Bridge – B1845) 17
Figure 11: Rotary Core Borehole Positions (Ratsegaai Bridge – B4039). 19
Figure 12: Rotary Core Borehole Positions (Elandskuil Bridge – B1167) 21
Figure 13: Test Pit Positions Culvert (Chainage 39.654 km) 23
Figure 14: Test Pit Positions Culvert (Chainage 41.824 km) 24
Figure 15: Test Pit Positions Culvert (Chainage 44.577 km) 26
Figure 16: Test Pit Positions Culvert (Chainage 47.257 km) 27
Figure 17:Test Pit Positions Culvert (Chainage 65.971 km) 29
Figure 18: Seismic hazard map of South Africa showing peak ground acceleration with a probability of exceedance of 10% in 50 years. 30
Figure 19: Summary of DPSH test results at Culvert 39.654 41
Figure 20: Summary of DPSH test results at Culvert 41.824 42
Figure 21: Summary of DPSH test results at Culvert 44.577 42
Figure 22: Summary of DPSH test results at Culvert 47.257 43
Figure 23: Summary of DPSH test results at Culvert 65.971 43
Figure 24: Flooding of Borehole 17 position (Strydfontein River bridge) on 17 November 2023. 45

List of Tables

Table 1: Regional geology along the length of the route. 6
Table 2: Average Temperature Statistics for Ventersdorp (2000 – 2020). 7
Table 3: Average Rainfall Statistics for Ventersdorp (2000 – 2020). 9
Table 4: Summary of laboratory testing on samples extracted during the profiling of test pits. 13
Table 5: Summary of laboratory testing on samples extracted from core boreholes 14
Table 6: Summary of boreholes profiles encountered at the Strydfontein River bridge. 16
Table 7: Summary of boreholes profiles encountered at the Schoonspruit River bridge. 18
Table 8: Summary of boreholes profiles encountered at the Ratzegaai River bridge. 20
Table 9: Summary of boreholes profiles encountered at the Elandskuil River bridge. 21
Table 10: Summary of test pit profiles encountered at the culvert at km 39.654. 23
Table 11: Summary of test pit profiles encountered at the culvert at km 41.824. 25
Table 12: Summary of test pit profiles encountered at the culvert at km 44.577. 26
Table 13: Summary of test pit profiles encountered at the culvert at km 47.257. 28
Table 14: Summary of test pit profiles encountered at the culvert at km 65.971. 29
Table 15: Summary of seepage encountered and expected groundwater conditions at test pit and borehole positions. 34
Table 16: Summary of excavation conditions encountered and perceived excavation classes at all test pit and borehole positions. 35
Table 17: Summary of foundation indicator results. 37
Table 18: Summary of swell pressure values. 38
Table 19: Summary of consolidation test results 39
Table 20: Summary of UCS test results on rock core samples 39
Table 21: Summary of SPT test results 40
Table 22: Preferred foundation systems for widening of bridge structures. 46
Table 23: Preferred foundation systems for widening of culvert structures including wing walls. 47
Table 24: Recommended ultimate unit friction capacity in rock sockets for piled foundations. 48

EXECUTIVE SUMMARY

- *This report details the methodology and findings of a geotechnical investigation that was undertaken for the planned widening of existing bridge and culvert structures along National Road R30, Section 8 from km 36.8 to Ventersdorp (km 68.646). The report was compiled as part of the detailed design stage.*
- *The geotechnical investigation covered the planned widening of the following bridge and culvert structures:*
  - *Strydfontein River bridge (km 41.721),*
  - *Schoonspruit River bridge (km 52.604),*
  - *Ratzegaai River bridge (km 54.443),*
  - *Elandskuil River bridge (km 62.265).*
  - *Major culvert (km 39.654),*
  - *Major culvert (km 41.824),*
  - *Major culvert (km 44.577),*
  - *Major culvert (km 47.257),*
  - *Major culvert (km 65.971).*
- *The south-western approximate 2/3 of the route length is underlain by igneous granite and gneiss formations. The north-eastern one third of the route length is mostly underlain by sedimentary and volcanic lava, agglomerate and tuff formations. Alluvium deposits are mostly encountered at stream and wetland crossings.*
- *Surface drainage is generally expected to be poor, partly due to the flat terrain and surface layers of fine grained alluvium soils. The southern approximately one half of the route is mostly situated on granite formations and is very flat with hardly any gradient. The northern approximately one half of the route is mostly situated on lava formations and is slightly more steeply graded but still only at about a gradient of 1(v):130(h).*
- *The site has a Weinert Moisture Index between 2 and 5 and is thus considered a 'Moderate' region where both chemical and physical weathering processes prevail.*
- *Geotechnical fieldwork comprised the following:*

  <u>At bridge structures:</u>
  - *Rotary core borehole drilling,*
  - *Logging and photographing of the core,*
  - *Suitable laboratory testing.*

  <u>At major culvert structures:</u>
  - *Dynamic Probe Super Heavy (DPSH) testing,*
  - *Test pitting and profiling of test pits,*
  - *Suitable laboratory testing.*
- *Laboratory testing on soil samples comprised Foundation Indicator, Consolidation and Swell Pressure. Laboratory testing on rock core samples comprised Uniaxial Compressive Strength (UCS) tests.*
- *The following site-specific geology was encountered at the areas covered by the investigation (From top to bottom with average depth to base of layer in brackets):*
  - *Strydfontein river bridge: Alluvium (2.1 m), Residuum (3.6 m), Weathered granite (20.1 m),*
  - *Schoonspruit river bridge: Alluvium (1.6 m), Residuum (3.7 m), Weathered granite (7.5 m), Slightly weathered granite (13.5 m), Diabase intrustion (10.0).*
  - *Ratzegaai river bridge: Fill (0.6 m), Topsoil (0.6 m), Alluvium (4.5 m), Residual granite (4.6 m), Weathered granite (5.5 m), Slightly weathered granite 8.7 m).*

- *Elandskuil river bridge: Fill (0.9 m), Alluvium (1.8 m), Residual lava (2.5 m), Weathered lava (3.6 m), Slightly weathered lava (8.8 m).*
- *Culvert 39.654: Fill (0.15 m), Alluvium (3.0 m +).*
- *Culvert 41.824: Fill (0.1 m), Alluvium (2.3 m +).*
- *Culvert 44.577: Fill (0.4 m), Alluvium (0.7 m), Pebble marker (0.7 m), Residual granite (3.0 m)*
- *Culvert 47.257: Fill (0.45 m), Alluvium (3.1 m +).*
- *Culvert 65.971: Topsoil (0.4 m), Alluvium (2.4 m), Residual granite (3.0 m +).*

- *The site area is situated within a relatively high seismic hazard area with a nominal peak ground acceleration of 0.2 g (g is defined as earth gravity acceleration equal to 9.81 m/s^2).*
- *Seven primary groups of geo-materials were encountered during the investigation. Typical material parameters and layer thicknesses are discussed in the report.*
  - *Imported fill material,*
  - *Topsoil,*
  - *Transported soils (colluvium and alluvium),*
  - *Residuum (granite and lava),*
  - *Granite rock,*
  - *Diabase intrusions,*
  - *Amygdaloidal lava rock.*
- *Ground water seepage was encountered within most of the test pit excavations (since all test pits were excavated near existing water courses). Piezometers installed in four of the boreholes all recorded shallow standing ground water levels. Generally, shallow ground water conditions must be expected in all areas where bridges and culverts will be widened.*
- *Generally, 'soft' excavation conditions will be encountered to at least 3.0 m deep (from current ground levels), in all areas where existing culverts will require widening. Most of these excavations will be in transported alluvium soils.*
- *Auger excavations for piled foundations at the widening of the existing bridge structures will probably be potentially unstable and hence temporary cased Auger and/or Continuous Flight Auger (CFA) piles are recommended.*
- *Generally, near surface soils (transported and residual) are cohesive, fine-grained, clayey with at least a low/medium to medium potential expansiveness. Deeper residual soils are mostly low/medium to medium in potential expansiveness (residual granite), and medium to high in potential expansiveness (residual lava).*
- *Surface layers of alluvium soils generally recorded low swell pressure values which can be ascribed to the fact that these samples were tested at very high degrees of saturation.*
- *Based on consolidation tests, alluvium soils are rated as at least Highly compressible. Residual granite soils are similarly rated as Medium to Highly compressible. Culverts founded within these highly compressible surface soils will most likely experience excessive total (and hence differential) movements. Remedial foundation preparation works are given in the Recommendations section of the report.*
- *Standard Penetration Testing (SPT) testing was not particularly effective in quantifying in-situ soil consistencies since relatively hard (weathered rock) formations were encountered at relatively shallow depths which mostly resulted in premature refusal of the SPT test.*
- *Dynamic Probe Super Heavy (DPSH) testing at the culvert positions on average indicated 'Very soft' to 'soft' soils to about 1.0m deep, underlain by 'firm' soils to about 2.0 m deep, which is in turn underlain by 'stiff' to 'very stiff' soils for depths exceeding about 2.0 m deep.*

- *Problems encountered during the geotechnical investigation which may also possibly be encountered during the construction stage include:*
  - *Possible flooding of works within and near water courses,*
  - *Deeply fractured and discontinuous granite rock profile.*
- *The following aspects were considered in the evaluation of alternative foundation systems:*
  - *Relative movements between existing and new foundations,*
  - *Restricted foundation excavations and stability of excavations.*
- *The following conceptual foundation systems are recommended for the planned widenings:*
  - *River bridges: Temporary cased auger piles and/or Continuous Flight Auger (CFA) piles,*
  - *Culverts: Conventional spread footings with some remedial foundation works.*
- *Typical foundation design parameters are given in the report for both piled and conventional spread footing foundations. It is recommended that foundations be designed considering a Limit State Design methodology (after the applicable SANS codes which are based on the Eurocode 7 specification). Suggested factor of safety values are given for the design of both types of foundations should an Allowable Stress Design (ASD) methodology be considered for use.*
- *The following guidelines are given for the initial design and sizing of a piled foundation system:*
  - *As far as possible, piles must be augered to refusal within a medium hard rock with a modern piling rig capable of a minimum torque of 125 kNm (such as Casagrande B125),*
  - *Assuming this is achievable, piles can provisionally be designed to a maximum shaft stress (of pile cross sectional area), of around 4.5 MPa in lava rock and 5.0 MPa in granite rock. Under these loads and founding conditions, settlements at the pile head are expected to be less than about 7.5 mm.*
  - *Longitudinal steel reinforcement must typically be at least 0.8% of pile cross sectional area which will allow for an 'eccentricity' moment generated by a vertical load no more than 75 mm out of position (for piles less than 450mm diameter), and D/6 for piles with a diameter exceeding 450mm (D = pile diameter). Structural moments and shear forces working in on the piles may result in higher percentages long steel.*
  - *Minimum concrete cover to steel must be 50 mm complying with 'severe' exposure conditions using 25 MPa concrete.*
  - *Piles must be designed to SANS 1200-F : Piling (1983), SANS 10160-5:2010 and SANS 10160-1 Auger excavations must be inspected by the geotechnical design engineer at the onset of works to confirm design assumptions.*
- *The following guidelines are given for the initial design and sizing of spread footing type foundations (to culverts):*
  - *Over-excavate foundation excavations to 1.0 m deeper than the underside of foundation,*
  - *Cover the base of the excavation with a geo-composite (geogrid and geotextile),*
  - *Backfill the lower portion of the over-excavation with 2 x 350 mm thick layers of hard, unweathered rockfill obtained from an igneous rock source. Material and construction specifications are given in the text portion of the report,*
  - *Backfill remainder with 2 x 150 mm thick layers of G5 material. Material and construction specifications are given in the text portion of the report,*
  - *The spread footing foundations / culvert floor slab can be founded directly on top of the compacted stratum at an allowable bearing capacity not exceeding 150 kPa.*
- *No additional geotechnical investigations during the construction phase are anticipated for the areas covered by this investigation. The successful piling contractor may opt to drill further exploratory auger holes at the onset of the construction phase.*

1. Introduction

1.1. Terms of reference and description of project

Ndodana Consulting Engineers (Pty) Ltd (NCE) were appointed by The South African National Roads Agency SOC Ltd (SANRAL), for the Consulting Engineering Services for the Assessment, Detailed Design, Contract Documentation, and Monitoring of the Partial Reconstruction of National Road R30 Section 8 from km 36.8 to Ventersdorp (km 68.646) with a total length of 31.846 km. SANRAL approved the reclassification of the project to an *Improvement* Scope in 2020. C2C Consulting Engineers cc (C2C) were selected as the New Entrant (Targeted Enterprise) for this project. C2C will be responsible for the design of the bridges and major culverts related works under the Improvement scope. NCE contracted Southern Geotechnical Engineering (SGE) to oversee the geotechnical investigation, log boreholes, profile test pits, and compiled the geotechnical investigation report.

The geotechnical investigation covered the planned widening of the following bridge structures:

- Strydfontein River bridge (km 41.721),
- Schoonspruit River bridge (km 52.604),
- Ratzegaai River bridge (km 54.443),
- Elandskuil River bridge (km 62.265).

In addition, the planned widening of the following major culvert structures was also investigated:

- Major culvert (km 39.654),
- Major culvert (km 41.824),
- Major culvert (km 44.577),
- Major culvert (km 47.257),
- Major culvert (km 65.971).

1.2. Description of the stage and purpose of investigation

This report was compiled as part of the **preliminary design stage**. The purpose of the investigation and report is to define the founding conditions and recommend the most appropriate foundation systems for the proposed widening of the bridge structures and major culverts along the length of route as described above.

2. Description of the sites

2.1. Location of sites

The project is located on National Road R 30 Section 8 between km 36.800 and km 68.646. This project falls within the City of Matlosana and JB Marks Local Municipalities and is situated within the Dr Kenneth Kaunda District Municipality in the North-West province, with Ventersdorp the closest town. The project starts at km 36.800, south of the Opraap road-side junction, and continues up to km 68.646 west of the 3-way stop control intersection with the R 53 to Potchefstroom. The road enters the Ventersdorp town area from approximately km 64.411 and continues up to km 68.646. There are several small cross-roads along the route providing access to the local farming community as well as street crossings in Ventersdorp town. The regional and local locality maps are given in **Figures 1 and 2** below respectively.

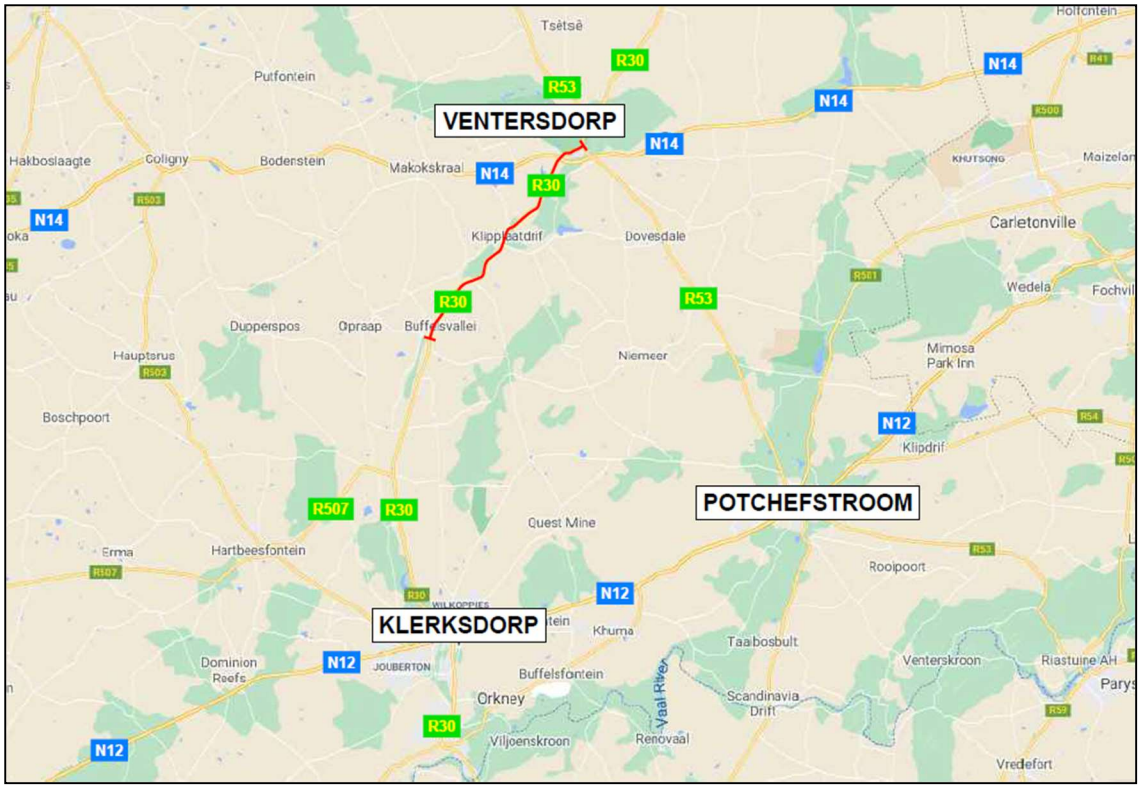


Figure 1: Regional Locality map.

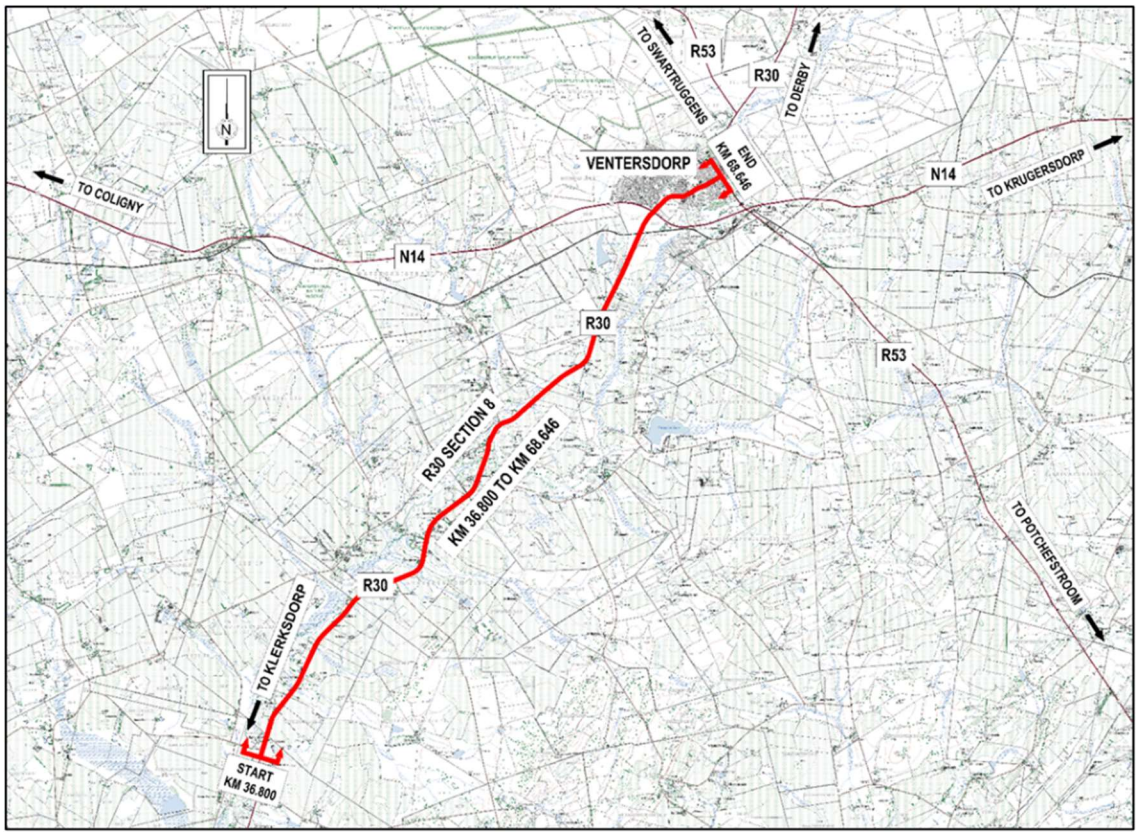


Figure 2: Local locality map

2.2. Accessibility of the sites

The general area of all four bridge sites as well as all five culvert sites are mostly easily accessible from surfaced Road R30. Localised challenges with accessibility may be due to somewhat steep slopes from top of embankments or into cuttings, water-logged areas, and thick vegetation (see Photograph below).



Figure 3: Potential problems with accessibility at some of the bridge and culvert sites due to steep slopes and dense vegetation.

A more detailed list of the potential accessibility problems at the various sites are given below:

- Culvert 39.654: Reasonably flat area, sparsely vegetated, potentially waterlogged,
- Culvert 41.824: Reasonably flat area, sparsely vegetated, potentially waterlogged,
- Culvert 44.577: Flat area, sparsely vegetated, potentially waterlogged,
- Culvert 47.257: Flat area, sparsely vegetated, potentially waterlogged,
- Culvert 65.971: Steepish slopes due to fill embankment; potentially waterlogged, sewer pollution in the general area (strong smell of sewer in general area),
- Strydfontein: Reasonably flat area, sparsely vegetated, possible flooding,
- Schoonspruit: Steep slopes, dense vegetation, probable flooding,
- Ratzegaai: Reasonably flat area, sparsely vegetated, possibly waterlogged and flooding,
- Elandskuil: Reasonably flat area, sparsely vegetated, possibly waterlogged and flooding.

2.3. Trafficability for construction equipment

The following remedial steps or a combination thereof may be required to ensure access to all required areas for construction vehicles and other equipment:

- Culvert 39.654: Geosynthetics, dump rock, cutting drainage channels, sumps, pumping,
- Culvert 41.824: Geosynthetics, dump rock, cutting drainage channels, sumps, pumping,
- Culvert 44.577: Geosynthetics, dump rock, cutting drainage channels, sumps, pumping,
- Culvert 47.257: Geosynthetics, dump rock, cutting drainage channels, sumps, pumping,
- Culvert 65.971: Access ramps, geotextiles, dump rock, cutting drainage channels, sumps, pumping.
- Strydfontein: Geosynthetics, dump rock, cutting drainage channels, sumps, pumping,
- Schoonspruit: Access ramps, geotextiles, dump rock, cutting drainage channels, sumps, pumping, even diversion of river / coffer dams,
- Ratzegaai: Geosynthetics, dump rock, drainage channels, sumps, pumping,
- Elandskuil: Geosynthetics, dump rock, drainage channels, sumps, pumping.

See the discussion about possible flooding of areas within or near watercourse in Section 5.9 below. The use of geosynthetics in the section above will probably entail using geogrid as basal reinforcement and geotextiles as separation layers and in drainage applications.

2.4. List of sources from which data was obtained.

The following sources were consulted in the preparation of this report:

- Google Earth satellite and Streetview imagery,
- 1:250 000 scale geological map 2626 West Rand,
- 1:50 000 scale topographical map 2626BD Ventersdorp,
- 1:50 000 scale topographical map 2626BC Makokskraal.
- 1:50 000 scale topographical map 2626DA Rykaartspos.

2.5. Regional geology

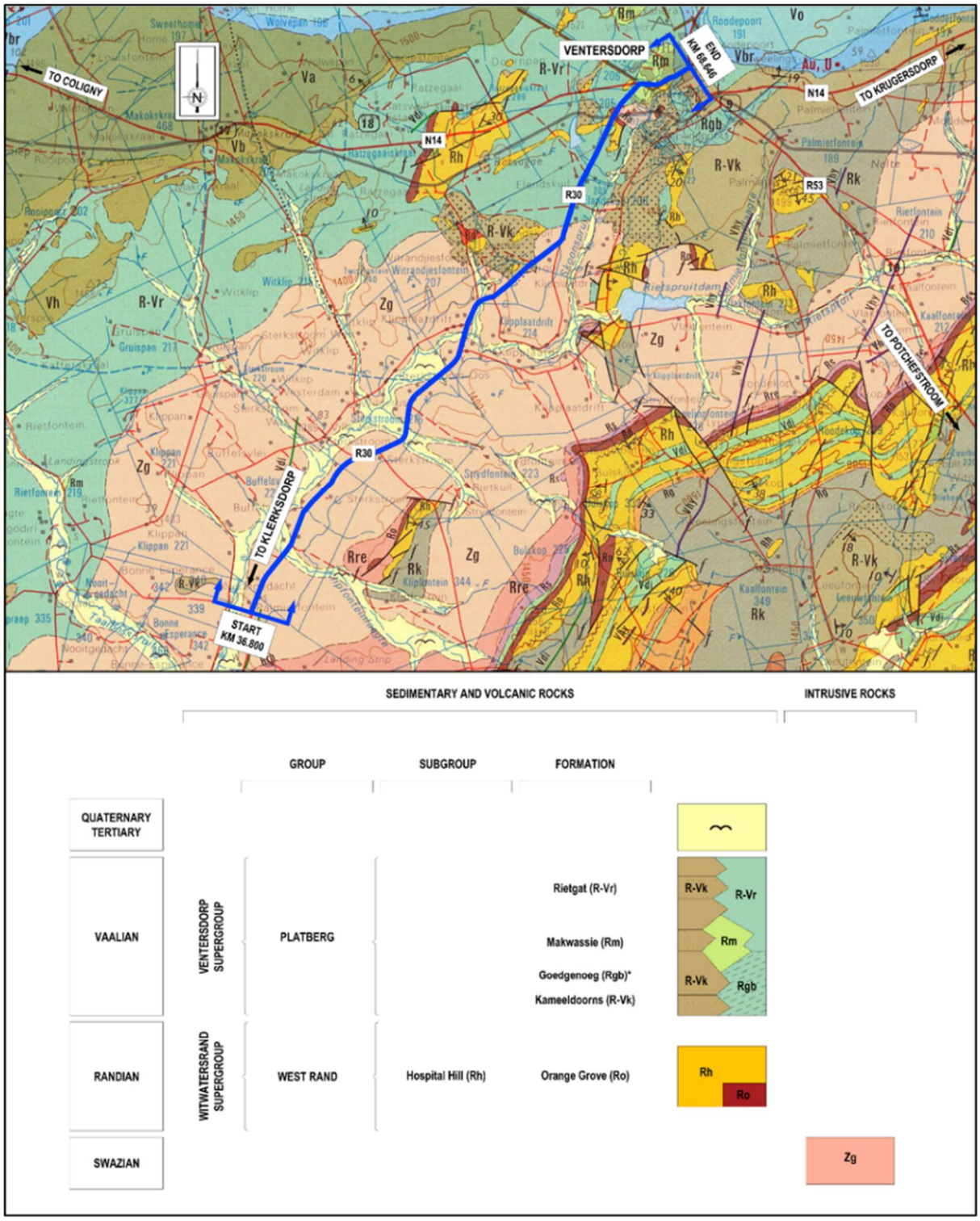


Figure 4: Regional geology along the length of the route after 1:250 000 scale geological map 2626 West Rand.

Table 1: Regional geology along the length of the route.

Chainage start	Chainage end	Geological zone
km 36.800	km 39.750	Undifferentiated granite and gneiss (Zg – Light Pink)
km 39.750	km 40.600	Alluvium (Light Yellow)
km 40.600	km 47.300	Undifferentiated granite and gneiss (Zg – Light Pink)
km 47.300	km 48.100	Alluvium (Light Yellow)
km 48.100	km 50.400	Undifferentiated granite and gneiss (Zg – Light Pink)
km 50.400	km 51.100	Alluvium (Light Yellow)
km 51.100	km 52.650	Undifferentiated granite and gneiss (Zg – Light Pink)
km 52.650	km 53.030	Alluvium (Light Yellow)
km 53.030	km 54.430	Undifferentiated granite and gneiss (Zg – Light Pink)
km 54.430	km 54.800	Alluvium (Light Yellow)
km 54.800	km 56.320	Undifferentiated granite and gneiss (Zg – Light Pink)
km 56.320	km 57.780	Breccia, conglomerate, greywacke, shale, limestone, tuff (R_Vk – Brown)
km 57.780	km 59.720	Undifferentiated granite and gneiss (Zg – Light Pink)
km 59.720	km 64.180	Amygdaloidal lava, agglomerate, tuff (R_Vr – Blue)
km 64.180	km 64.580	Vaalian, Ventersdorp Supergroup, Platberg, Makwassie (Rm)
km 64.580	km 65.120	Ferruginous shale, quartzite, bonded ironstone, (Contorted bed), hornfels (Rh – Dark Yellow)
km 65.120	km 65.370	Ferruginous shale, quartzite, bonded ironstone, (Contorted bed), hornfels (Rh – Dark Yellow) & Quartzite, shale (Maroon – Ro)
km 65.370	km 65.560	Undifferentiated granite and gneiss (Zg – Light Pink)
km 65.560	km 66.400	Amygdaloidal lava, agglomerate, tuff (R_Vr – Blue)
km 66.400	km 67.580	Quartz-feldspar porphyry (Rm – Light Green)
km 67.580	km 68.070	Ferruginous shale, quartzite, bonded ironstone, (Contorted bed), hornfels (Rh – Dark Yellow)
km 68.070	km 68.480	Quartz-feldspar porphyry (Rm – Light Green)
km 68.480	km 68.646	Basaltic amygdaloidal lava (Rgb – Blue)

The south-western approximate 2/3 of the route length (58.3%), is underlain by igneous granite and gneiss formations. The north-eastern one third of the route length (17.2%), is mostly underlain by sedimentary and volcanic lava, agglomerate and tuff formations. Alluvium deposits are mostly encountered at stream and wetland crossings and comprises in total about 9.6% of the total route length. Combined, these three geological units comprise about 85% of the total route length. Surficial geology indicated at the various bridge and culvert structures are as follows:

- Culvert 39.654: Granite formations near border of alluvium,
- Culvert 41.824: Granite formations,
- Culvert 44.577: Granite formations,
- Culvert 47.257: Alluvium near border of granite,
- Culvert 65.971: Border between Amygdaloidal lava, agglomerate, tuff and Quartz-feldspar porphyry.
- Strydfontein: Alluvium,
- Schoonspruit: Alluvium near border of granite,
- Ratzegaai: Alluvium near border of granite,
- Elandskuil: Amygdaloidal lava, agglomerate, tuff.

2.6. Climate

The project is in the North-West Province. The area can be classified as Dry Sub-Humid Highveld Grassland with a moderate climate. The region is characterised by moderate winter temperatures and warm to hot temperatures in the summer. The climate of this region is renowned for its hot but pleasant summers and mild, sunny winters. Summer temperatures are from August to March with temperatures ranging between 20°C and 30°C. Most of the annual rainfall occurs in the period October to April and reaches a maximum during December and January.

The Thornthwaite Moisture Index for this area ranges between -20 to 0, classifying the region as Dry Sub-Humid. The project location falls on the western side within the Dry Sub-Humid (Moderate) region towards the Semi-Arid (Dry) region. The Weinert N-value for this area, as specified by the Natural Road Construction Materials of South Africa by H.H Weinert, is estimated to be between 2 and 5, confirming a moderate climatic region. This indicator suggests that the dominant mode of weathering of materials will be decomposition which may result in the formation of secondary clay minerals.

Historic climatic statistical data was sourced from the South African Weather Service (SAWS) for weather station number 0473559A3 in Ventersdorp, which covers a period of 20 years from 2000 to 2020.

2.6.1. Temperature

Average maximum, minimum, highest and lowest monthly temperature statistics obtained from the SAWS are summarized in the table below. The statistical data embodies information collected between the year 2000 and 2020 (20 years).

Table 2: Average Temperature Statistics for Ventersdorp (2000 – 2020).

Month	Average Max (°C)	Average Min (°C)	Highest Recorded (°C)	Lowest Recorded (°C)
January	28.1	16.3	33.9	14.0
February	27.9	15.4	31.2	14.6
March	26.8	13.7	28.7	11.9
April	24.2	10.2	34.7	4.1
May	22.1	5.9	27.5	2.8
June	18.9	2.5	21.3	-1.2
July	19.9	2.4	27.1	0.1
August	22.7	5.5	28.5	3.0
September	25.7	9.0	29.6	4.9
October	27.9	12.5	30.6	11.0
November	27.9	13.9	31.2	11.1
December	28.0	15.0	32.7	6.7
Average	**25.0**	**10.2**	**29.8**	**6.9**

The highest, average maximum temperature, during the summer months is 28.1°C and is experienced in January and the average minimum temperature for the same month is 16.3°C. The lowest, average maximum temperature, during the winter months is 18.9°C experienced during the month of June and the minimum average temperature for the same month is 2.5°C. The average temperature statistics is graphically summarised in the figure below.

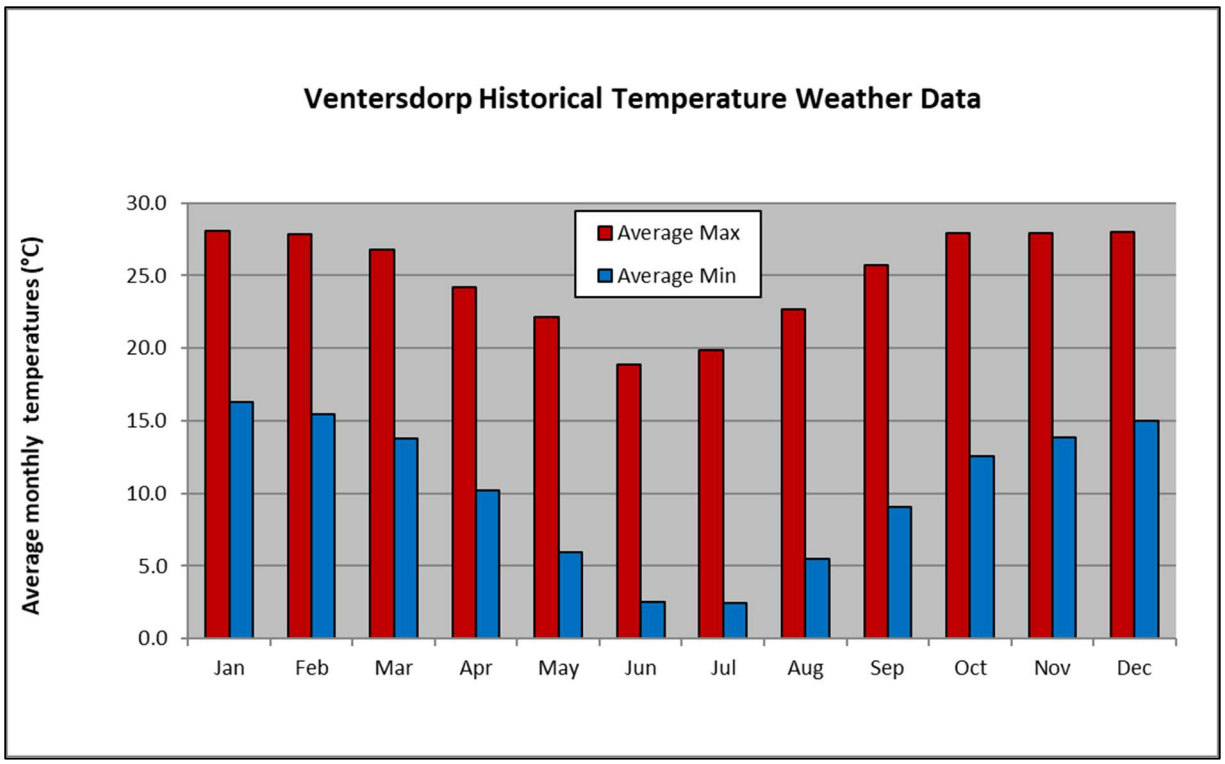


Figure 5: Average Temperature Statistics at Ventersdorp Weather Station (2000 – 2020).

2.6.2. Rainfall

The project area falls within a summer rainfall region of North-West Province, with the rainy season lasting from October to April. Rainfall along the route is highly seasonal with 85% of the yearly rainfall occurring during the summer period. The average monthly rainfall is between 0.2 mm to 92.3 mm with the highest measurements occurring in December and January. Thunderstorms are recorded often. Hail and fog are infrequent.

The average monthly and highest 24-hour rainfall statistics for Ventersdorp are summarised in the table below. The statistical data embodies information collected between the year 2000 and 2020. The average expected rain days where rainfall is ≤ 5 mm, between 5 mm & 10 mm and ≥ 10 mm are also shown in the table.

The table below shows that the highest average rainfall occurs from October to April. The average annual rainfall for 12 months in Ventersdorp is approximately 437 mm and the average expected number of rain days (more than 10 mm) are 11 days per year. Based on this historic data, it is evident that rainfall should not affect the construction program adversely. The maximum rainfall recorded over a 24-hour period was 88.4 mm which occurred on 1 December 2016. The average rainfall statistics are graphically summarised in the figures below.

Table 3: Average Rainfall Statistics for Ventersdorp (2000 – 2020).

Month	Average Monthly (mm)	Average number of days with ≤ 5 mm	Average number of days between 5 mm and 10 mm	Average number of days with ≥ 10 mm	Highest 24-hour rainfall (mm)
January	92.3	3.2	1.9	2.2	88.4
February	45.4	3.1	0.8	0.5	48.2
March	52.0	2.6	0.6	0.9	59.4
April	40.6	2.8	0.6	1.0	39.0
May	15.0	0.7	0.5	0.3	69.4
June	7.9	0.7	0.1	0.1	36.4
July	0.2	0.1	0.0	0.0	9.4
August	3.2	0.6	0.0	0.1	16.2
September	11.8	0.6	0.2	0.2	58.2
October	39.5	3.3	1.1	0.8	49.8
November	53.6	3.7	1.1	2.1	31.8
December	75.5	3.6	2.0	2.0	66.6
Total	437.0	25.0	8.9	10.2	572.8

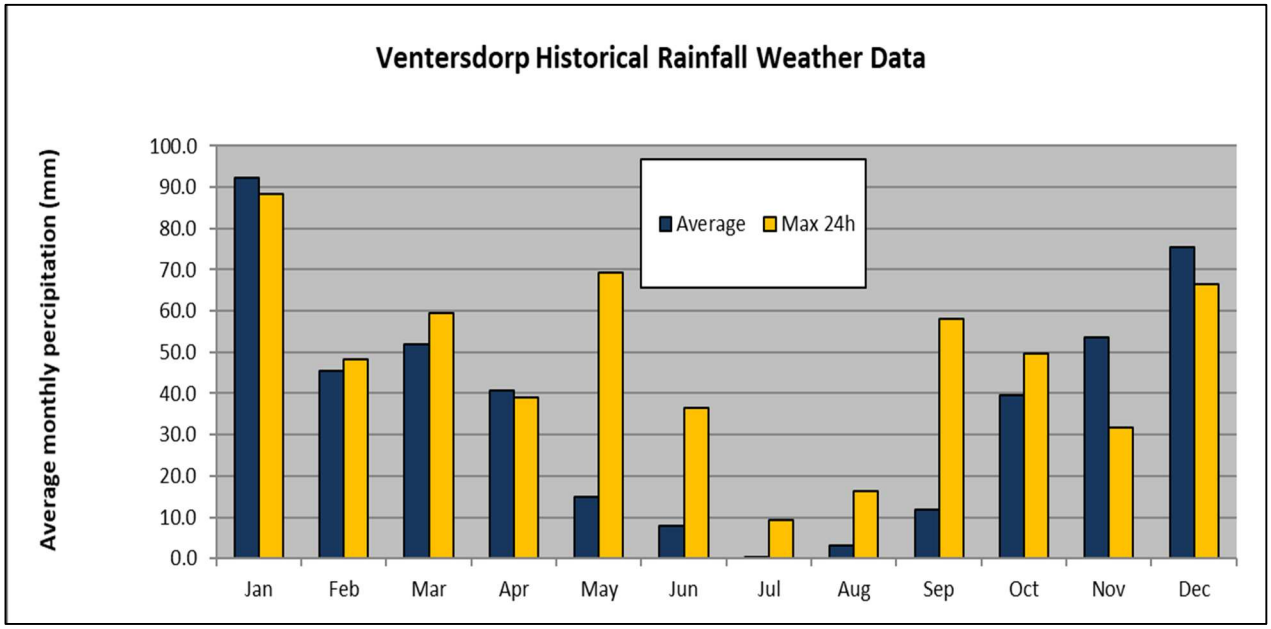


Figure 6: Historic rainfall data for Ventersdorp.

2.7. Vegetation

The project length falls within the Grassland Biome of South Africa and within the Rocky Highveld Grassland and Dry Sandy Highveld Grassland. Species within grasslands are non-grassy herbs (forbs), most of which are perennial plants with large underground storage structures. Frost, fire and grazing maintain the herbaceous grass and forb layer, and ultimately prevent the establishment of tall woody plants. There are nine vegetation types surrounding the JB Marks Local Municipality covering over 370,000 ha. The vegetation types are as follows:

- Andesite Mountain Bushveld
- Carletonville Dolomite Grassland
- Eastern Temperate Freshwater Wetlands

- Gauteng Shale Mountain Bushveld
- Highveld Alluvial Vegetation
- Highveld salt Pans
- Klerksdorp Thornveld
- Rand Highveld Grassland
- Vaal-Vet Sandy Grassland

The surrounding ecosystem is classified as a threatened system. It is mainly low-tussock grasslands with an abundant karroid element. Dominance of Themeda triandra is an important feature of this vegetation ecosystem. Locally low cover of Themeda triandra and the associated increase in Elionurus muticus, Cymbopogon pospischilii and Aristida congesta is attributed to heavy grazing and/or erratic rainfall. At least one endemic plant species occurs in the ecosystem.

2.8. Surface water and drainage

The project area falls within the Vaal River Valley. This is a fertile, agricultural region with plenty of tourist attractions. Streams and rivers in the area are of a permanent nature and is seen as extremely ecologically sensitive, specifically the Molopo and Ventersdorp Eyes. The rivers that fall within the JB Marks Local Municipality are:

- Kromdraaispruit,
- Mooi river,
- Mooirivierloop,
- Rietspruit,
- Schoonspruit,
- Taaibosspruit.

There are approximately 40 major wetland areas in the North-West Province. They comprise riverine wetlands, dolomitic eyes, palustrine wetlands and endorheic wetlands or pans. These wetlands are usually not permanent, like those fed by dolomite springs. The wetlands, or eyes, in the immediate Ventersdorp region, are permanent wetlands, fed by dolomite springs.

As a result of the mining and agricultural activities, the risk for erosion occurrence is steadily increasing, specifically in the general region and flow path of the rivers along the route. Non-erosive forms of soil erosion are all important in this area. Soil degradation resulting from soil pollution, in the magisterial district of Dr Kenneth Kaunda is cause for great concern.

Surface drainage is generally expected to be poor as was noted after rainfall events with standing water everywhere. This is partly due to the flat terrain. The southern approximately one half of the route predominantly situated on granite formations is very flat with hardly any gradient. The northern approximately one half of the route predominantly situated on lava formations is slightly more steeply graded but still only at about 1(v):130(h). (These observations are based on Google Earth imagery and profile elevations generated with the software).

2.9. Weinert Moisture Index

The site has a Weinert Moisture Index between 2 and 5 and is thus considered a ‘Moderate’ region where both chemical and physical weathering processes prevail.

3. Geotechnical fieldwork

Geotechnical fieldwork comprised the following:

At bridge structures:

- Rotary core borehole drilling by Terra Monitoring during the period 25 October 2022 to 24 November 2022.
- Site supervision during core drilling was undertake by RockSoil Consult (Chris Homan, junior engineering geologist).
- The logging and photographing of the core were also undertaken by RockSoil Consult (Kobus Roux, senior engineering geologist).

At major culvert structures:

- Dynamic Probe Super Heavy (DPSH) testing by Terra Monitoring during the period 25 October 2022 to 29 October 2022.
- Test pitting using a TLB provided by Big 5 Plant Hire and profiling by RockSoil Consult (Kobus Roux, senior engineering geologist) during the period 10 November 2022.

The laboratory testing program was compiled by Southern Geotechnical Engineering (Pieter Oosthuizen, Geotechnical Engineer), in collaboration with RockSoil Consult (Kobus Roux).
The initial and final geotechnical investigation reports were compiled by a geotechnical engineer (Pieter Oosthuizen Pr. Eng of Southern Geotechnical Engineering).

3.1. Description of types of field work and equipment used.

3.1.1. Rotary core borehole drilling

A total of 17 boreholes were drilled using either a YWE D90R or YWE D45 drill rig provided by Terra Monitoring. A total drill length of 196.96m was achieved (average drill length per borehole of approximately 11.6m). Core drilling was undertaken using a combination of NXC (softer material), and NWD4 (harder material) core bits, in conjunction with wash boring techniques (wash boring were undertaken only where necessary). Standard Penetration tests were conducted where possible (due to the hardness of the in-situ materials, at maximum depth intervals of 1.5m). Due to the general hardness of the materials drilled into, very few SPT tests were conducted (a total of 36). A total of 4 standpipe piezeometers were installed with a total installation length of 48.91m. No Shelby tube samples were extracted.



Figure 7: Core drilling underway with a YWE D45 drill rig and logging by engineering geologist.

3.1.2. Dynamic Probe Super Heavy (DPSH) testing

DPSH testing was undertaken using a 60-degree disposable cone (50mm in diameter), driven into the ground by a 63.5 kg hammer falling through 762 mm (using an automatic trip hammer). The number of blows required to drive the cone through a successive 300 mm of penetration was continuously recorded. Refusal was defined as 100 or more blows required for 300 mm penetration.

3.1.3. Test pitting with TLB

Test pitting was undertaken with a hired Cat 422E (4x2), Tractor Loader Backhoe (TLB) type excavator. Test pits were excavated to refusal or maximum depth reach at around 3.0 m deep. The excavation was entered, profiled and sampled by the engineering geologist following the ***MCCSSO*** system as advocated by Jennings, Brink and Williams (1973) where ***M*** – Moisture, ***C*** – Colour, ***C*** -Consistency, ***S*** - Structure, ***S*** – Soil type, ***O*** – Origin).



Figure 8: Excavation of test pit using a Cat 422E TLB type excavator.

3.2. Laboratory testing program on soil/rock

3.2.1. Test pits

The following table summarises the laboratory testing performed on samples extracted during the profiling of the test pits. The details of the tests are as follow:

- Foundation Indicator test: Sieve and hydrometer analyses plus Atterberg limits,
- Consolidation test: Standard consolidation test after BS 1377 Part 5.
- Swell pressure test: after BS 1377 Part 5.

Table 4: Summary of laboratory testing on samples extracted during the profiling of test pits.

Test Pit number	Sample Depth (mbcgl)	Chainage	Foundation Indicator	Standard Consolidation	Swell pressure
Disturbed samples					
1	0.5 – 1.5	39.654	√		
2	1.5 – 2.5	39.654	√		
3	0.2- 0.5	41.824			
3	1.6 – 2.6	41.824			
4	0.8 – 1.5	41.824			
5	1.0 – 2.0	44.577			
6	0.7 – 1.1	44.577	√		
7	1.0 – 2.5	44.577			
8	1.0 – 1.5	47.257			
8	2.0 – 3.0	47.257			
9	1.8 – 2.8	47.257			
10	0.5 - 1.5	65.971			
10	2.5 – 2.8	65.971			

Test Pit number	Sample Depth (mbcgl)	Chainage	Foundation Indicator	Standard Consolidation	Swell pressure
11	1.5 – 2.2	65.971	**√**		
Undisturbed samples					
3	2.0	41.824	**√**	**√**	**√**
3	1.0	41.824			
4	1.5	41.824	**√**	**√**	**√**
5	2.0	44.577	**√**	**√**	**√**
7	1.5	44.577	**√**	**√**	**√**
8	1.2	47.257			
8	1.9	47.257	**√**	**√**	**√**
9	2.0	47.257	**√**	**√**	**√**
10	1.6	65.971	**√**	**√**	**√**
Bulk samples					
7	1.0 – 2.5	44.577	**√**		
TOTALS			**12**	**7**	**7**

3.2.2. Core boreholes

The following table summarises the laboratory testing performed on both soil and rock samples extracted from the core boxes. The details of the tests are as follow:

- Foundation Indicator test: Sieve and hydrometer analyses plus Atterberg limits,
- Uniaxial Compressive Strength (UCS) tests on rock core samples.

Table 5: Summary of laboratory testing on samples extracted from core boreholes

Borehole number	Sample Depth (mbcgl)	Position	Foundation Indicator (soils) Disturbed samples	Uniaxial Compressive Strength (rock) Rock core samples
1	2.5 – 3.0	Strydfontein	**√**	
2	1.2 – 1.5	Schoonspruit	**√**	
2	5.8 -6.0	Schoonspruit	**√**	
2	9.42	Schoonspruit		**√**
2	11.7	Schoonspruit		**√**
3	4.0 – 4.5	Schoonspruit	**√**	
3	13.9	Schoonspruit		**√**
4	1.0 – 1.5	Schoonspruit	**√**	
4	5.75	Schoonspruit		**√**
5	0.3- 0.6	Schoonspruit	**√**	
5	1.3 – 1.5	Schoonspruit	**√**	
5	5.5	Schoonspruit		**√**
5	9.55	Schoonspruit		**√**
6	0.75 – 1.25	Schoonspruit	**√**	
6	4.45	Schoonspruit		**√**
7	0.6 – 0.9	Schoonspruit	**√**	
7	7.62	Schoonspruit		**√**
7	11.5	Schoonspruit		**√**
8	2.7 – 2.95	Ratsegaai	**√**	
8	6.45	Ratsegaai		**√**
9	6.55	Ratsegaai		**√**

Borehole number	Sample Depth (mbcgl)	Position	Foundation Indicator (soils) Disturbed samples	Uniaxial Compressive Strength (rock) Rock core samples
10	1.2 – 1.5	Ratsegaai	**√**	
10	7.4	Ratsegaai		**√**
11	3.5 – 4.0	Ratsegaai	**√**	
11	4.4	Ratsegaai		**√**
12	2.0 – 2.6	Ratsegaai	**√**	
12	6.3	Ratsegaai		**√**
13	2.1 – 2.6	Elandskuil	**√**	
13	6.75	Elandskuil		**√**
14	2.0 – 2.3	Elandskuil	**√**	
14	8.8	Elandskuil		**√**
15	0.5 – 0.9	Elandskuil	**√**	
15	7.25	Elandskuil		**√**
16	0.7 – 1.4	Elandskuil	**√**	
16	2.45	Elandskuil		**√**
17	1.0 – 1.5	Strydfontein	**√**	
17	19.0	Strydfontein		**√**
TOTALS			**18**	**19**

4. Site specific geology and typical soil and rock profiles

4.1. Strydfontein River Bridge B1018 (see Boreholes 1 and 17)

4.1.1. Investigation Method

Two rotary core boreholes BH01 and BH17 were drilled in this focus area. The positions of the two boreholes are depicted in the figure below. Boreholes BH01 and BH17 were drilled from surface down to 20.32 and 20.0 mbgl, respectively. The boreholes were drilled into completely to highly and occasionally moderately to slightly weathered granite rock. The retrieved core was logged by a registered engineering geologist. A perforated piezometer was installed in borehole BH01. Selected soil and rock samples were retrieved and submitted to commercial soil/rock testing laboratories.



Figure 9: Rotary Core Borehole Positions (Strydfontein Bridge – B1018)

Table 6: Summary of boreholes profiles encountered at the Strydfontein River bridge.

Borehole number	Depth to base of layer (mbgl)				
	Transported Alluvium	Granite residuum	Completely to highly weathered granite	Moderately weathered granite	Slightly to unweathered granite
1	2.4	3.0	20.3	-	-
17	1.8	4.1	20.0	-	-
Min	***1.8***	***3.0***	***20.0***	**-**	**-**
Average	***2.1***	***3.6***	***20.1***	**-**	**-**
Max	***2.4***	***4.1***	***20.3***	**-**	**-**

4.1.2. Site specific soil profile

Simplified profile encountered in this focus area:

- Alluvium was encountered in boreholes BH01 and BH17 down to 2.40 and 1.80 mbgl, respectively.
- The transported material is underlain by reworked residual granite (silty sandy clay) transgressing into residual granite (clayey silty sand) down to between 3.03 and 4.15 mbgl, as encountered in BH01 and BH17, respectively.
- The residuum was generally described as soft to firm becoming firm to stiff at depth in BH17 (refer to the SPT values for consistency confirmation). The soil structure is slightly open to slightly shattered.
- The residuum generally transgresses from grey to khaki brown speckled to mottled white, pink and black.

- The residuum is underlain by a highly undulating completely to highly weathered and occasional moderately to slightly weathered, very soft to soft and occasionally medium hard rock granite down to termination depths.
- Prominent core/material losses were encountered in both boreholes.
- Prominent shearing and abundant fractures are present throughout the weathered granite rock.
- No corestones encountered, however cannot be out ruled. The intrusive geological setting is however well known for its spheroidal weathering resulting in small to large sized corestones.
- The standing water level, as measured on 2022-11-22, was at 0.03 mbgl in borehole BH01.

4.2. Schoonspruit River Bridge B1845 (see Boreholes 2, 3, 4, 5, 6 and 7)

4.2.1. Investigation Method

Six rotary core boreholes BH02 to BH07 were drilled in this focus area. The positions of the 6 boreholes are depicted in the figure below. The boreholes were drilled from surface down to between 10.71 and 16.10 mbgl. The boreholes were drilled into competent slightly to unweathered granite or diabase rock. The retrieved core was logged by a registered engineering geologist. A perforated piezometer was installed in borehole BH05. Selected soil and rock samples were retrieved and submitted to commercial soil/rock testing laboratories.



Figure 10: Rotary Core Borehole Positions (Schoonspruit Bridge – B1845)

Table 7: Summary of boreholes profiles encountered at the Schoonspruit River bridge.

Borehole number	Depth to base of layer (mbgl)					
	Transported Alluvium	Granite residuum	Completely to highly weathered granite	Moderately weathered granite	Slightly to unweathered granite	Diabase intrusion (Depth from – to)
2	3.0	8.3	-	9.0	12.3	-
3	1.9	-	9.0	9.5	16.10	9.5 – 14.5
4	0.9	2.5	5.2	-	-	5.2 – 10.7
5	0.9	1.8	-	-	15.0	1.8 – 4.8
6	1.8	-	-	5.6	12.1	5.6 – 7.9
7	0.9	2.0	4.5	6.0	12.0	11.0 – 11.8
Min	***0.85***	***1.8***	***4.5***	***5.6***	***12.0***	***4.8***
Average	***1.6***	***3.7***	***6.2***	***7.5***	***13.5***	***10.0***
Max	***3.0***	***8.3***	***9.0***	***9.5***	***16.1***	***14.5***

4.2.2. Site specific soil profile

Simplified profile encountered in this focus area:

- Alluvium was encountered from surface down to between 0.85 and 3.00 mbgl.
- Concrete was encountered in boreholes BH02 (2.81 to 3.00 mbgl) and BH03 (0.90 to 1.50 mbgl). The concrete seemingly forms part of the bridge structure.
- The transported material, as encountered in boreholes BH02, BH04, BH05 and BH07, is underlain by grey to brown reworked residual granite (silty clayey SAND to clayey gravelly silty sand) down to between 1.80 and 8.30 mbgl. The consistency of the reworked residual norite clay is generally described as soft to firm or loose to medium dense. The soil structure is generally slightly open with relict jointing.
- The alluvial horizon at borehole BH03 is underlain by completely weathered granite down to 5.82 mbgl, transgressing into highly weathered granite.
- The alluvial horizon at borehole BH05 is underlain by a sharp transition to completely to highly weathered diabase at 1.80 mbgl.
- The alluvial horizon at borehole BH06 is underlain by a sharp transition to highly to slightly weathered granite at 1.82 mbgl.
- Completely to moderately weathered granite was encountered below the residuum in boreholes BH02, BH03, BH04, BH06 and BH07. The completely to moderately weathered rock was encountered from between 4.50 and 9.50 mbgl.
- Completely to unweathered diabase intrusions were encountered in boreholes BH03, BH04, BH05, BH06 and BH07. The thickness of the intrusions varies.
- Khaki brown to greenish grey, completely to unweathered, fine grained diabase intruded into the granite host rock with thickness of between 0.60 and 5.51 m across all the boreholes except BH02.
- Borehole BH04 was terminated in unweathered hard competent diabase rock at 10.71 mbgl.

- Competent slightly to unweathered hard to very hard rock granite was encountered in boreholes BH02, BH03, BH05, BH06 and BH07. The slightly to unweathered rock was encountered from between 6.00 and 14.53 mbgl down to termination depths of between 12.00 and 16.10 mbgl.
- The depth to medium hard and hard rock granite or diabase is highly variable.
- No corestones were encountered/identified. The presence of corestones can however not be out ruled, as typically encountered in this geomorphological setting.
- The standing water level, as measured on 2022-11-04, was at 0.71 mbgl in borehole BH05.

4.3. Ratzegaai River Bridge B4039 (see Boreholes 8, 9, 10, 11 and 12)

4.3.1. Investigation Method

Five rotary core boreholes BH08 to BH12 were drilled in this focus area. The positions of the 5 boreholes are depicted in the figure below. The boreholes were drilled from surface down to 7.87 and 9.07 mbgl. The boreholes were drilled into competent slightly to unweathered granite rock. The retrieved core was logged by a registered engineering geologist. A perforated piezometer was installed in borehole BH10. Selected soil and rock samples were retrieved and submitted to commercial soil/rock testing laboratories.

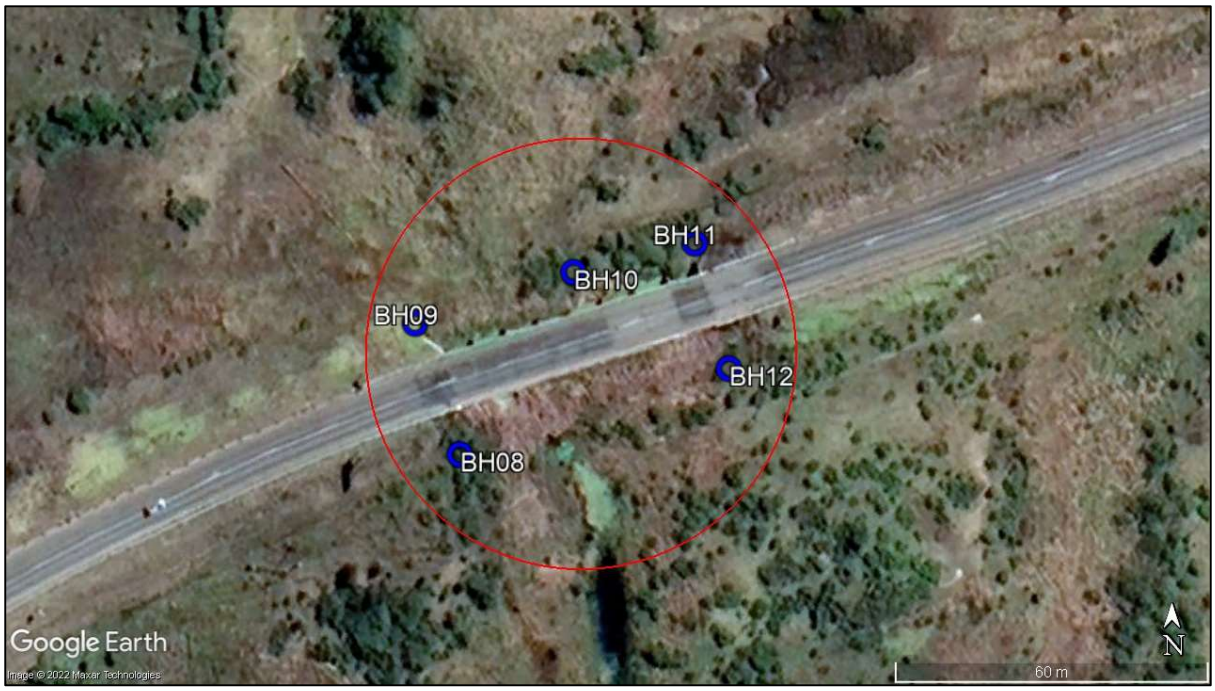


Figure 11: Rotary Core Borehole Positions (Ratsegaai Bridge – B4039).

Table 8: Summary of boreholes profiles encountered at the Ratzegaai River bridge.

Borehole number	Depth to base of layer (mbgl)						
	Imported fill	Topsoil	Transported Alluvium	Residual granite	Completely to highly weathered granite	Moderately weathered granite	Slightly to unweathered granite
8	-	0.3	4.5	5.6	-	-	8.9
9	0.4	0.85	2.5	4.3	5.6	-	9.1
10	0.8	1.0	1.5	4.5	5.8	-	9.1
11	-	-	2.5	4.0	-	-	7.9
12	-	0.2	0.9	4.5	5.1	-	8.6
Min	***0.4***	***0.2***	***0.9***	***4.0***	***5.1***	***-***	***7.9***
Average	***0.6***	***0.6***	***2.4***	***4.6***	***5.5***	***-***	***8.7***
Max	***0.8***	***1.0***	***4.5***	***5.6***	***5.8***	***-***	***9.1***

4.3.2. Site specific soil profile

Simplified profile encountered in this focus area:

- Engineered fill was encountered from surface down to 0.40 and 0.80 mbgl in boreholes BH09 and BH10, respectively.
- Brown to dark brown topsoil (clayey gravelly silty SAND to sandy clayey SILT) was encountered in boreholes BH08 to BH10 and in BH12 down to between 0.20 and 1.00 mbgl.
- The engineered fill and topsoil material were underlain by alluvial material (silty sandy clay to gravelly silty clayey SAND) down to between 0.90 and 4.50 mbgl. The alluvial horizon has soft to firm and loose to medium dense soil consistency. The material has a slightly open to slightly shattered soil structure. The alluvium varied from black to grey and brown speckled to mottled white, orange and black.
- The alluvium is underlain by grey to brown residual granite (gravelly silty clayey SAND to sandy silty clay) down to between 4.00 and 5.58 mbgl. The residual granite has a very soft to firm soil consistency. The residual granite soil structure is generally slightly open to slightly shattered.
- The residuum at boreholes BH08 and BH11 is underlain by a sharp transition into competent slightly to unweathered, medium hard to hard rock granite at 5.58 and 4.00 mbgl, down to termination depths of 8.86 and 7.87 mbgl, respectively.
- The residuum at boreholes BH09, BH10 and BH12 is underlain by a thin 0.65 to 1.35m completely weathered, very soft rock granite which transgress sharply into competent slightly to unweathered, medium hard to hard rock granite.
- Depth to medium hard and very hard rock granite across the focus area is fairly uniform, however, deeper weathering zones can be expected.
- No corestones were encountered/identified. The presence of corestones can however not be out ruled, as typically encountered in this geomorphological setting.
- The standing water level, as measured on 2022-11-22, was at 0.53 mbgl in borehole BH10.

4.4. Elandskuil River Bridge (see Boreholes 13, 14, 15 and 16)

4.4.1. Investigation Method

Four rotary core boreholes BH13 to BH16 were drilled in this focus area. The positions of the 4 boreholes are depicted in the figure below. The boreholes were drilled from surface down to 5.20 and 10.50 mbgl. The boreholes were drilled into competent slightly to unweathered amygdaloidal rock. The retrieved core was logged by a registered engineering geologist. A perforated piezometer was installed in borehole BH13. Selected soil and rock samples were retrieved and submitted to commercial soil/rock testing laboratories.



Figure 12: Rotary Core Borehole Positions (Elandskuil Bridge – B1167)

Table 9: Summary of boreholes profiles encountered at the Elandskuil River bridge.

Borehole number	Depth to base of layer (mbgl)					
	Imported fill	Topsoil	Transported Alluvium	Lava Residuum	Completely to highly weathered lava	Moderately to unweathered lava
13	0.9	-	2.1	2.9	4.5	10.5
14	-	-	1.8	2.7	4.3	9.5
15	-	-	1.7	2.0	3.5	9.8
16	-	-	1.7	-	2.2	5.2
Min	***0.9***	***-***	***1.7***	***2.0***	***2.2***	***5.2***
Average	***0.9***	***-***	***1.8***	***2.5***	***3.6***	***8.8***
Max	***0.9***	***-***	***2.1***	***2.9***	***4.5***	***10.5***

4.4.2. Site specific soil profile

Simplified profile encountered in this focus area:

- The focus area is generally covered with alluvial material (gravelly silty sandy CLAY). The alluvial material was encountered down to between 1.70 and 2.05 mbgl. The alluvium was typically dark brown to black speckled to mottled red to grey and orange with a very soft to firm consistency and slightly open to shattered soil structure.
- Engineered fill was encountered locally at borehole BH13, from surface down to 0.90 mbgl which is underlain by alluvium down to 2.05 mbgl.
- The transported material in boreholes BH13, BH14 and BH15 is underlain by a grey to khaki brown reworked residual amygdaloidal lava (sandy silty CLAY) transgressing into residual amygdaloidal lava (silty clayey fine sand) down to between 2.00 and 2.90 mbgl. The reworked residual is generally described as soft to firm and occasionally stiff.
- The alluvium at borehole BH16 has a sharp transition into competent slightly to unweathered, medium hard to very hard rock lava from 2.15 mbgl, down to termination depths of 5.20 mbgl.
- The residuum, as encountered in boreholes BH13, BH14 and BH15, is underlain by highly to occasional moderately weathered, very soft to occasionally medium hard rock lava between 2.00 and 2.90 mbgl. The highly to occasional moderately weathered lava transgress into competent slightly to unweathered, medium hard to very hard rock, down to termination depths of between 9.50 and 10.50mbgl.
- Depth to medium hard and very hard rock granite across the focus area is fairly undulating.
- No corestones were encountered/identified. The presence of corestones can however not be out ruled, as typically encountered in this geomorphological setting.
- The standing water level, as measured on 2022-11-24, was at 0.09 mbgl in borehole BH13.

4.5. Culvert at km. 39.654: (See Test pits 1 and 2 and DPSH 1 to 4)

4.5.1. Investigation Method

Two test pits TP01 and TP02 were excavated in this focus area. The positions of the two test pits are depicted in the figure below. The test pits were excavated from surface down to 3.20 mbgl. The soil profile was logged by a registered engineering geologist. Selected soil samples were retrieved and submitted to commercial soil testing laboratory.



Figure 13: Test Pit Positions Culvert (Chainage 39.654 km)

Table 10: Summary of test pit profiles encountered at the culvert at km 39.654.

Test pit number	Depth to base of layer (mbgl)	
	Imported fill	Alluvium
1	0.2	3.0 +
2	0.1	3.0 +
Min	***0.1***	***3.0***
Average	***0.15***	***3.0***
Max	***0.2***	***3.0***

4.5.2. Site specific soil profile

The detailed soil profile logs and profile photographs are attached in Appendices A and B, respectively. A basic summary of the simplified profile horizons and conditions encountered are provided in the table above.

Simplified profile encountered in this focus area:

- Engineered fill was encountered in test pits TP01 and TP02 down to 0.20 and 0.10 mbgl, respectively.
- The engineered fill material was underlain by a thick alluvial horizon down to termination depths of 3.00 mbgl. The upper alluvial horizon was encountered in test pit TP01 and TP02 down to 1.60 and 1.30 mbgl. The upper alluvium was black to dark grey speckled brown to red, silty sandy CLAY with a firm to soft in-situ soil consistency with depth. The upper alluvium has a slickensided and shattered soil structure.

- The lower alluvial horizon was described as greyish brown mottled black to orange, sandy silty CLAY to silty sandy CLAY with a soft in-situ soil consistency and a slickensided to shattered soil structure.
- Prominent desiccation cracks were observed in the upper alluvium, indicative of volume changes due to shrink-swell movement.
- Soft excavation conditions were encountered at termination depth.
- No seepage water was encountered in test pits, however expected, as indicated by the presence of pedogenic formation (mottling appearance).

4.6. Culvert at km. 41.824: (See Test pits 3 and 4 and DPSH 5 to 9)

4.6.1. Investigation Method

Two test pits TP03 and TP04 were excavated in this focus area. The positions of the 2 test pits are depicted in the figure below. The test pits TP03 and TP04 were excavated from surface down to 3.00 and 1.60 mbgl, respectively. Test pit TP03 was terminated at 3.00 mbgl (near maximum reach of the TLB) and test pit TP04 was terminated at 1.60 mbgl due to a fibre optic cable. The soil profile was logged by a registered engineering geologist. Selected soil samples were retrieved and submitted to commercial soil testing laboratory.



Figure 14: Test Pit Positions Culvert (Chainage 41.824 km)

Table 11: Summary of test pit profiles encountered at the culvert at km 41.824.

Test pit number	Depth to base of layer (mbgl)	
	Imported fill	Alluvium
3	-	3.0 +
4	0.1	1.6 +
Min	***0.1***	***1.6 +***
Average	***0.1***	***2.3 +***
Max	***0.1***	***3.0 +***

4.6.2. Site-Specific Soil Profile

The detailed soil profile logs and profile photographs are attached in Appendix A and B, respectively. A basic summary of the simplified profile horizons and conditions encountered are provided in the table above.

Simplified profile encountered in this focus area:

- Engineered fill was encountered in test pit TP04 down to 0.10 mbgl.
- A thick alluvial horizon down to 3.00 mbgl was encountered in test pit TP03. Interlayered silty sand and sandy clay were encountered from surface down to 0.50 mbgl. The upper alluvial horizon was underlain by a dark grey speckled orange to red, silty clayey sand down to 1.40 mbgl. The horizon has a soft to firm in-situ soil consistency and a slightly open to shattered soil structure.
- The engineered fill material in test pit TP04 was underlain by a grey to dark grey mottled black to white, silty sandy clay to silty clayey sand. The alluvium has a firm to soft with depth in-situ soil consistency and a slightly open and shattered soil structure.
- Soft excavation conditions were encountered at termination depth.
- Seepage water was encountered in test pits TP03 and TP04 from 1.90 and 1.20 mbgl, respectively.

4.7. Culvert at km. 44.577: (See Test pits 5, 6 and 7 and DPSH 10 to 17)

4.7.1. Investigation Method

Three test pits TP05, TP06 and TP07 were excavated in this focus area. The positions of the 3 test pits are depicted in the figure below. The test pits were excavated from surface down to termination depths of between 2.90 and 3.00 mbgl. The soil profile was logged by a registered engineering geologist. Selected soil samples were retrieved and submitted to commercial soil testing laboratory.



Figure 15: Test Pit Positions Culvert (Chainage 44.577 km)

Table 12: Summary of test pit profiles encountered at the culvert at km 44.577.

Test pit number	Depth to base of layer (mbgl)			
	Imported fill	Alluvium or colluvium	Pebble marker	Reworked residual granite
5	0.2	0.5	0.7	3.0 +
6	0.7	1.2	1.4	2.9 +
7	0.3	0.5	0.7	3.0 +
Min	***0.2***	***0.5***	***0.7***	***3.0***
Average	***0.4***	***0.7***	***0.7***	***3.0***
Max	***0.7***	***1.2***	***0.7***	***3.0***

4.7.2. Site-Specific Soil Profile

The detailed soil profile logs and profile photographs are attached in Appendix A and B, respectively. A basic summary of the simplified profile horizons and conditions encountered are depicted in the table above.

Simplified profile encountered in this focus area:

- Engineered fill was encountered in test pits TP05, TP06 and TP07 down to 0.20, 0.70 and 0.30 mbgl, respectively.
- The engineered fill material was underlain by silty sandy transported material down to 0.50, 1.15 and 0.50 mbgl at test pits TP05, TP06 and TP07, respectively. The upper sandy transported material has a loose to medium dense in-situ soil consistency.

- The upper transported material was underlain by a clayey gravelly sand pebble marker zone indicating the boundary between the upper transported material and the lower residual soils. The pebble marker zone is generally slightly ferruginised and approximately 0.20 m thick.
- The pebble marker zone was underlain by slightly ferruginised residual granite down to termination depths.
- The residual granite was described as grey mottled black to orange, silty clayey sand with a soft to firm to occasionally stiff with depth in-situ soil consistency. The horizon typically has a slightly open to fissured soil structure. Weakly to strongly cemented ferricrete concretions are also present.
- Soft excavation conditions were encountered at termination depth.
- Seepage water was encountered in test pits TP05, TP06 and TP07 from 1.20, 2.20 and 1.00 mbgl, respectively.

4.8. Culvert at km. 47.257: (See Test pits 8 and 9 and DPSH 18 to 21)

4.8.1. Investigation Method

Two test pits TP08 and TP09 were excavated in this focus area. The positions of the 2 test pits are depicted in the figure below. Test pits TP08 and TP09 were excavated from surface down to termination depths of 3.05 and 3.20 mbgl, respectively. The soil profile was logged by a registered engineering geologist. Selected soil samples were retrieved and submitted to commercial soil testing laboratory.



Figure 16: Test Pit Positions Culvert (Chainage 47.257 km)

Table 13: Summary of test pit profiles encountered at the culvert at km 47.257.

Test pit number	Depth to base of layer (mbgl)	
	Imported fill	Alluvium or colluvium
8	0.5	3.2 +
9	0.4	3.0 +
Min	***0.4***	***3.0 +***
Average	***0.45***	***3.1 +***
Max	***0.5***	***3.2 +***

4.8.2. Site-Specific Soil Profile

The detailed soil profile logs and profile photographs are attached in Appendix A and B, respectively. A basic summary of the simplified profile horizons and conditions encountered are provided in the table above.

Simplified profile encountered in this focus area:

- Engineered fill was encountered in test pits TP08 and TP09 down to 0.50 and 0.40 mbgl.
- The engineered fill material was underlain by a thick alluvial horizon encountered in test pits TP08 and TP09 down to 1.70 and 3.20 mbgl. The upper alluvium was described as dark grey mottled white, silty sandy clay with a stiff to soft in-situ soil consistency with depth. The upper alluvium has a slightly open to slickensided and shattered soil structure.
- The lower alluvial horizon in test pit TP08 was described as light brown mottled white to blue grey, gravelly silty clayey sand with a firm in-situ soil consistency and a slightly open to shattered soil structure.
- Soft excavation conditions were encountered at termination depth.
- Seepage water was encountered in test pits TP08 and TP09 from 2.10 and 2.30 mbgl, respectively.

4.9. Culvert at km. 65.971: (See Test pits 10 and 11 and DPSH 22 to 25)

4.9.1. Investigation Method

Two test pits TP10 and TP11 were excavated in this focus area. The positions of the 2 test pits are depicted in the figure below. The northern portion of the major culvert was not accessible for the TLB, and two test pits were excavated on the southern portion in accessible areas. The test pits (TP10 and TP11) were excavated from surface down to termination depths of 2.90 and 3.10 mbgl, respectively. The soil profile was logged by a registered engineering geologist. Selected soil samples were retrieved and submitted to commercial soil testing laboratory.



Figure 17: Test Pit Positions Culvert (Chainage 65.971 km)

Table 14: Summary of test pit profiles encountered at the culvert at km 65.971.

Test pit number	Depth to base of layer (mbgl)		
	Topsoil	Alluvium	Residual granite
10	0.4	2.4	2.9 +
11	0.4	2.4	3.1 +
Min	***0.4***	***2.4***	***2.9 +***
Average	***0.4***	***2.4***	***3.0 +***
Max	***0.4***	***2.4***	***3.1 +***

4.9.2. Site-Specific Soil Profile

The detailed soil profile logs and profile photographs are attached in Appendix A and B, respectively. A basic summary of the simplified profile horizons and conditions encountered are provided in the table above.

Simplified profile encountered in this focus area:

- Topsoil was encountered in the test pits down to 0.40 mbgl.
- The topsoil was underlain by a thick slightly ferruginised alluvial horizon down to 2.40 mbgl. The alluvium was described as light brown mottled white, black and orange, silty sandy CLAY with a firm in-situ soil consistency and a fissured to shattered soil structure.
- Ferricrete and calcrete concretions are present in the alluvial horizon.
- The alluvial horizon was underlain by reworked residual to residual granite (quart-feldspar porphyry) in test pits TP10 and TP11 down to termination depths of 2.90 and 3.10 mbgl, respectively.

- The residual granite was described as greyish white mottled pink to orange, clayey silt sand with a firm to medium dense in-situ soil consistency. The upper reworked horizon typically has a slightly open to shattered soil structure transgressing to a relict structure with depth.
- Soft excavation conditions were encountered at termination depth.
- Seepage water was encountered in test pits TP10 to TP11 from 2.30 and 1.80 mbgl, respectively.

5. Geotechnical evaluation

5.1. Seismicity

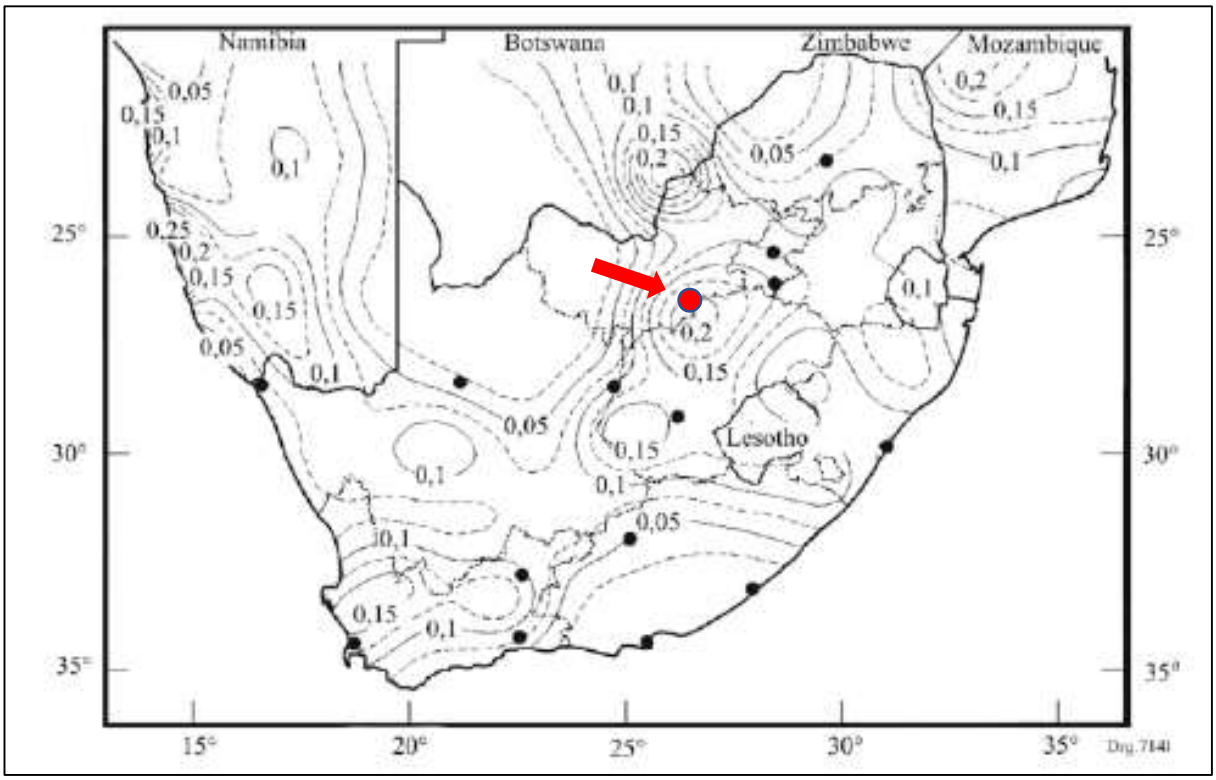


Figure 18: Seismic hazard map of South Africa showing peak ground acceleration with a probability of exceedance of 10% in 50 years.

The figure above is taken from SANS10160-4. (2017). *Basis of structural design and actions for buildings and industrial structures. Part 4: Seismic actions and general requirements for buildings.* South African National Standard. It illustrates a seismic hazard map of South Africa showing peak ground acceleration with a probability of exceedance of 10% in 50 years. It includes both natural and mining induced seismicity. According to this map, the site area is situated within a high seismic hazard area with a nominal peak ground acceleration of 0.2 *g* (*g* is defined as earth gravity acceleration equal to 9.81 m/s^2).

5.2. Discussion on soil and rock materials

For the purposes of this study, the materials and formations encountered regionally and site-specifically are grouped into 7 main groups with sub-groups.

- **Group 1** – **Engineered fill material.**
- **Group 2** – **Topsoil.**
- **Group 3** – **Colluvium and/or Alluvial material.**
- **Group 4** – **Residuum (Reworked residuum and residual material).**
- **Group 5** – **Granite rock.**
    - Group 5a – Completely to highly weathered granite rock.
    - Group 5b – Moderately weathered granite rock.
    - Group 5c – Slightly to unweathered granite rock.
- **Group 6** – **Diabase intrusion.**
- **Group 7** – **Amygdaloidal lava rock.**
    - Group 7a – Completely to highly weathered lava rock.
    - Group 7b – Moderately to unweathered lava rock.

The material groups are discussed in the following sections. The detailed material descriptions are provided as detailed soil profiles and core logs within the various attachments to this report.

5.2.1. Group 1 – Imported Fill Material

Engineered fill was encountered in all test pits, except in TP03, TP10 and TP11. The engineered fill was encountered locally in boreholes BH09, BH10 and BH13. The engineered fill was encountered down to between 0.10 and 0.90 mbgl. The horizon is generally described as a gravelly clayey silty SAND to locally gravelly silty sandy CLAY material with angular gravel of mixed origin and aggregate/asphalt fragments. The material seemingly forms part of the road shoulder and varies in composition. The consistency was generally described as loose to medium dense, at the prevailing moisture content at the time of inspection.

5.2.2. Group 2 – Topsoil

The topsoil was only encountered at test pits TP10 and TP11 and boreholes BH08 to BH10 and BH12. The horizon is generally encountered at surface. The topsoil is generally absent possibly due to historic workings and erosion. This horizon is generally described as brown to dark brown clayey silty SAND to sandy clayey SILT. The in-situ consistency was generally described as loose to medium dense or firm, at the prevailing moisture content at the time of inspection. This horizon is generally pinholed to intact with scattered roots. The thickness of this horizon varies between 0.20 and 0.45 m.

5.2.3. Group 3 – Colluvium and/or Alluvium

Transported colluvium and/or alluvial material was encountered in all test pits and boreholes due to the nature of the depositional environment and positions of test pits and boreholes within or next to the drainage features. The horizon is generally encountered from surface or underlies the localised thin fill and/or topsoil material. The transported colluvium and/or alluvial horizon was encountered down to between 0.70 and 4.50 mbgl (average of 2.03 mbgl with a standard deviation of 0.92 m). Due to the nature of the depositional environment the horizon varies in composition. The material generally consists of black to light grey silty sandy CLAY to gravelly silty clayey SAND with traces of

sub-angular to rounded gravel to localised cobbles of mixed origin. The in-situ consistency was generally recorded as soft to firm, at the prevailing moisture content at the time of inspection. This horizon is generally slightly open structured to slickensided and fissured. The slickensided and fissured structure is indicative of shrink/swell movement due to moisture fluctuations.

Thin pebble marker horizons were encountered locally. The pebble marker horizon indicates the boundary between the upper transported material and the lower residuum.

Concrete was encountered in boreholes BH02 (from 2.81 to 3.00 mbgl) and BH03 (0.90 to 1.50 mbgl).

5.2.4. Group 4 – Residuum

Residuum was encountered in test pits TP05 to TP07 (from between 0.70 and 1.35 mbgl) and in test pits TP10 and TP11 (from 2.40 mbgl). The reworked residuum or residuum was encountered in all boreholes except BH03, BH06 and BH16. The residuum generally underlies the transported material down to between 1.80 (BH05) and 8.30 mbgl (BH02).
The residuum is predominantly of granitic origin. Residuum originating from lava was encountered at Elandskuil bridge. Residuum originating from quartz-feldspar porphyry (coarse to very coarse grain granite) was encountered at the northern culvert chainage 65.971 km.
The granitic residuum generally consists of a grey to light brown speckled to mottled orange, black and pink/red, gravelly silty clayey SAND to locally silty sandy clay with trace to minor amounts of quartz and plagioclase gravel. The in-situ consistency (as encountered in the test pits) was generally recorded as very soft to firm, at the prevailing moisture content at the time of inspection. Stiff and loose to dense consistencies were recorded occasionally. This horizon is generally slightly open structured to shattered or fissured. The shattered/fissured structure is indicative of shrink/swell movement due to moisture fluctuations.
The reworked residual to residual amygdaloidal lava is generally grey to khaki brown speckled to mottled orange, black and blotched blue-green, (gravelly) sandy silty CLAY with trace amounts of quartz and amygdaloidal lava fragments.
Pedogenic nodules and concretions (calcrete and ferricrete nodules) were recorded in the residuum.

5.2.5. Group 5 – Granite Rock

5.2.5.1. Group 5a – Completely to Highly Weathered Granite Rock

The residual soils generally transgress into a brown to grey speckled to mottled green, white, red and black, completely to highly weathered, coarse grained, very highly to highly fractured, very soft to soft rock granite at boreholes BH01, BH03, BH04, BH07, BH09, BH10, BH12 and BH17. Prominent core/material loss were encountered in all the boreholes especially boreholes BH01 and BH17. This is potentially due to very highly fractured or sheared nature of the rock at boreholes BH01 and BH17 or the transition between completely to highly weathered rock where wash boring can occur.

It is expected that completely weathered rock is present in boreholes BH03, BH04, BH07, BH09, BH10 and BH12 at the prominent core/material loss zones.

5.2.5.2. Group 5b – Moderately Weathered Granite Rock

Grey to pinkish white speckled to mottled green, black and red, moderately weathered, coarse grained, very highly to moderately fractured, soft to medium to hard rock granite were encountered in boreholes BH02, BH03, BH06 and BH07 at the Schoonspruit bridge. The boreholes transgress into slightly to unweathered granite down to termination depths.

5.2.5.3. Group 5c – Slightly to Unweathered Granite Rock

Grey speckled to mottled white, pink and green, slightly to unweathered, coarse grained and massive, very highly to slightly fractured, medium to very hard rock granite was encountered in boreholes BH02, BH03 and BH05 to BH12. The boreholes were terminated in unweathered hard to very hard rock (competent rock) granite.

Shallower more uniform slightly to unweathered granite rock was encountered at Ratsegaai bridge in boreholes BH08 (5.58 mbgl), BH09 (5.62 mbgl), BH10 (5.80 mbgl), BH11 (4.00 mbgl) and BH12 (5.10 mbgl). The boreholes were terminated in unweathered, hard to very hard rock at BH08 (8.86 mbgl), BH09 (9.07 mbgl), BH10 (9.05 mbgl), BH11 (7.87 mbgl) and BH12 (8.55 mbgl).

5.2.6. Group 6 – Diabase Intrusion

Diabase intrusions were encountered in boreholes BH03 to BH07 at the Schoonspruit bridge. Khaki brown to greenish grey, completely to unweathered, fine grained diabase, intruded the granite host rock. The thickness of the diabase varied between 0.60 to 5.51 m (as encountered in 5 boreholes). The depth from where these diabase intrusions were encountered varies significantly. Prominent alterations to the host rock are evident (discoloration) above and below the diabase intrusions.

Borehole BH04 was terminated in unweathered hard rock diabase, at 10.71 mbgl.

5.2.7. Group 7 – Amygdaloidal Lava Rock

5.2.7.1. Group 7a – Completely to Highly Weathered Lava Rock

The alluvium and residual soils at the Elandskuil bridge generally transgress into a khaki brown to blueish grey, completely and/or highly weathered, fine grained, very highly to highly fractured, very soft to soft rock lava, at boreholes BH13, BH14, BH15 and BH16. Prominent flow bands are present. Limited core/material loss were generally encountered at boreholes BH13, BH14 and BH15 in the very highly to highly fractured rock (potential fracture or shear zones). Occasional residual to completely weathered zones were also recorded in between the intact blocks.

5.2.7.2. Group 7b – Moderately to Unweathered Lava Rock

Blueish grey to greenish grey, moderately to slightly weathered, fine grained to flow banded, very highly to moderately fractured, medium to hard rock lava were encountered in boreholes BH13 (4.50 mbgl), BH14 (4.30 mbgl), BH15 (3.53 mbgl) and BH16 (5.20 mbgl). The boreholes were terminated in unweathered hard to very hard rock lava (competent rock) at BH13 (10.50 mbgl), BH14 (9.50 mbgl), BH15 (9.78 mbgl) and BH16 (5.20 mbgl).

5.3. Seepage and groundwater

Piezometers were installed in 4 of the 17 boreholes drilled at boreholes BH01, BH05, BH10 and BH13. The standing water levels were measured 2 to 14 days after drilling (5 to 25 November 2022), which falls in the beginning of the wet season for this region. The results are summarized in the table below. Standing water levels were measured between 0.03 and 0.71 mbgl. A rise in water level can be expected during and towards the end of the wet season. The available piezometers can be monitored to establish seasonal variation in the standing water levels.

Test pitting was conducted on 10 November 2022, which walls towards the beginning of the wet season. Seepage water was encountered in test pits TP03 to TP11, between 1.00 and >2.30 mbgl.

Refer to individual soil profile log descriptions attached in Appendix A. A summary of the depths is presented in the table below.
Pedogenic formation was generally encountered from 0.10 down to >3.20 mbgl (see table below). The pedogenic formation is an indication of expected water level depths and seasonal fluctuations. Seepage water is expected to be mainly in, but not limited to the transported, residual materials and within the weathered granite, lava and quartz-feldspar porphyry horizons.

Table 15: Summary of seepage encountered and expected groundwater conditions at test pit and borehole positions.

Borehole or Test Pit No.	Some Degree of Pedogenic Formation		Seepage at Time of Investigation	Seasonal Shallow Seepage or Saturation Expected?	Seepage Water or Water Rest Level		Notes
Ref. No.	From	To	Yes/No	Likelyhood	mbgl	mamsl	Short Description
TP01	0.20	3.00	No	Expected	-	--	TLB excavated test pit
TP02	0.10	3.00	No	Expected	-	--	TLB excavated test pit
TP03	0.50	3.00	Yes	Expected	1.90	--	TLB excavated test pit
TP04	0.10	1.60	Yes	Expected	1.20	--	TLB excavated test pit
TP05	0.50	3.00	Yes	Expected	1.20	--	TLB excavated test pit
TP06	1.15	2.90	Yes	Expected	2.20	--	TLB excavated test pit
TP07	0.50	3.00	Yes	Expected	1.00	--	TLB excavated test pit
TP08	0.50	3.20	Yes	Expected	2.10	--	TLB excavated test pit
TP09	0.40	3.05	Yes	Expected	2.30	--	TLB excavated test pit
TP10	0.40	2.90	Yes	Expected	2.30	--	TLB excavated test pit
TP11	0.40	3.10	Yes	Expected	1.80	--	TLB excavated test pit
BH01	-	-	n/a	Expected	0.03	--	Rotary core borehole
BH02	-	-	n/a	Expected	-	--	Rotary core borehole
BH03	-	-	n/a	Expected	-	--	Rotary core borehole
BH04	-	-	n/a	Expected	-	--	Rotary core borehole
BH05	-	-	n/a	Expected	0.71	--	Rotary core borehole
BH06	-	-	n/a	Expected	-	--	Rotary core borehole
BH07	-	-	n/a	Expected	-	--	Rotary core borehole
BH08	-	-	n/a	Expected	-	--	Rotary core borehole
BH09	-	-	n/a	Expected	-	--	Rotary core borehole
BH10	-	-	n/a	Expected	0.53	--	Rotary core borehole
BH11	-	-	n/a	Expected	-	--	Rotary core borehole
BH12	-	-	n/a	Expected	-	--	Rotary core borehole
BH13	-	-	n/a	Expected	0.09	--	Rotary core borehole
BH14	-	-	n/a	Expected	-	--	Rotary core borehole
BH15	-	-	n/a	Expected	-	--	Rotary core borehole
BH16	-	-	n/a	Expected	-	--	Rotary core borehole
BH17	-	-	n/a	Expected	-	--	Rotary core borehole
Min:	0.10	1.60	-	-	0.03	0.00	-
Max:	1.15	3.20	-	-	2.30	0.00	-
Mean:	0.43	2.89	-	-	1.34	-	-
Stdev:	0.28	1.46	-	-	0.87	0.00	-
CoV:	0.64	0.51	-	-	0.65	--	-

5.4. Excavatibility and stability of excavations

A summary of excavation conditions encountered and perceived excavation classes at all test pits and borehole positions are summarised in the table below.

Table 16: Summary of excavation conditions encountered and perceived excavation classes at all test pit and borehole positions.

Borehole or Test Pit No.	Termination Depth	Excavation Down to Termination Depth	TLB Excavation Conditions at Termination Depth	SANS Expected Excavatability at Termination Depth (Restricted)	Generalised Formation Encountered at Termination Depth	Notes
Ref. No.	mbgl	Description	Description	Class	Description	Short Description
TP01	3.00	Easy excavation	Soft	Soft	Transported	TLB excavated test pit
TP02	3.00	Easy excavation	Soft	Soft	Transported	TLB excavated test pit
TP03	3.00	Easy excavation	Soft	Soft	Transported	TLB excavated test pit
TP04	1.60	Easy excavation	Terminated	Soft	Transported	TLB excavated test pit
TP05	3.00	Easy excavation	Soft	Soft	Residual Granite	TLB excavated test pit
TP06	2.90	Easy excavation	Soft	Soft	Residual Granite	TLB excavated test pit
TP07	3.00	Easy excavation	Soft	Soft	Residual Granite	TLB excavated test pit
TP08	3.20	Easy excavation	Soft	Soft	Transported	TLB excavated test pit
TP09	3.05	Easy excavation	Soft	Soft	Transported	TLB excavated test pit
TP10	2.90	Easy excavation	Soft	Soft	Residual Granite	TLB excavated test pit
TP11	3.10	Easy excavation	Soft	Soft	Residual Granite	TLB excavated test pit
BH01	20.32	n/a	n/a	Hard	Granite	Rotary core borehole
BH02	12.30	n/a	n/a	Hard	Granite	Rotary core borehole
BH03	16.10	n/a	n/a	Hard	Granite	Rotary core borehole
BH04	10.71	n/a	n/a	Hard	Diabase	Rotary core borehole
BH05	15.04	n/a	n/a	Hard	Granite	Rotary core borehole
BH06	12.11	n/a	n/a	Hard	Granite	Rotary core borehole
BH07	12.00	n/a	n/a	Hard	Granite	Rotary core borehole
BH08	8.86	n/a	n/a	Hard	Granite	Rotary core borehole
BH09	9.07	n/a	n/a	Hard	Granite	Rotary core borehole
BH10	9.05	n/a	n/a	Hard	Granite	Rotary core borehole
BH11	7.87	n/a	n/a	Hard	Granite	Rotary core borehole
BH12	8.55	n/a	n/a	Hard	Granite	Rotary core borehole
BH13	10.50	n/a	n/a	Hard	Venetersdorp Lava	Rotary core borehole
BH14	9.50	n/a	n/a	Hard	Venetersdorp Lava	Rotary core borehole
BH15	9.78	n/a	n/a	Hard	Venetersdorp Lava	Rotary core borehole
BH16	5.20	n/a	n/a	Hard	Venetersdorp Lava	Rotary core borehole
BH17	20.00	n/a	n/a	Hard	Granite	Rotary core borehole
Min:	1.60	-	-	-	-	-
Max:	20.32	-	-	-	-	-
Mean:	8.17	-	-	-	-	-
Stdev:	5.38	-	-	-	-	-
CoV:	0.66	-	-	-	-	-

5.4.1. General

Generally, 'soft' and potentially unstable excavation conditions must be expected due to low shear strength soils (at or near surface), in conjunction with probable shallow ground water levels. As such all but the shallowest of excavations (say less than 1.0m deep), will require some form of shoring and/or lateral support. Shoring can comprise vertical steel members supported horizontally by steel props or a *slide rail system* (steel panels and vertical steel posts sliding along tracked rails as earth is excavated). Alternatively, any of the lateral support measures mentioned in the sections below can be considered.

5.4.2. Culvert structures

Generally, 'soft' excavation conditions will be encountered to at least 3.0 m deep (from current ground levels), at all areas where culverts will require widening. Most of these excavations will be in transported alluvium soils. These transported soils are mostly fine-grained with a low shear strength and sometimes with a discontinuous soil fabric (frequently contains desiccation cracks and/or slickensided surfaces). In conjunction with shallow ground water levels, all surface excavations must be considered highly unstable, requiring extensive remedial measures to provide stable and safe working conditions for personnel (for short-term construction activities only). Remedial measures that can be considered may entail all or a combination of the following 1) flattening of cut slopes to no steeper than say 1(v):1(h), 2) steel mesh reinforced shotcrete, 3) soil nails (most likely in conjunction with shotcrete), 4) drainage of cut slopes. *(It must be noted that partially saturated, fine-grained, clayey soils with an apparent high cohesion can sometimes be cut vertically to some depth and appear to be stable for some time if left standing unsupported. However, this phenomenon is due to soil 'suction' or negative cohesion which very quickly dissipates upon any soil moisture increase with possible sudden catastrophic consequences).*

5.4.3. Bridge structures

As will be recommended later, piled foundation systems are proposed for the planned widening of the bridge structures. Auger excavations for the installation of piles are considered marginally stable for the following reasons:

- Potentially unstable, near-surface transported and residual soils (see section above),
- Sometimes a deeply weathered and discontinuous rock profile,
- Probable shallow (perched) ground water levels.

For the reasons listed above and postulating potentially unstable auger excavations, it will be recommended below that temporary cased Auger and/or Continuous Flight Auger (CFA) type piles be considered for the widening of the bridge structures.

5.5. Potentially expansive soils

Foundation Indicator tests comprising sieve and hydrometer analyses plus the determination of the Atterberg Limits were undertaken on samples extracted during test pitting and core drilling to determine the composition and potential heave characteristics of these soils. The following table summarises the results.

Table 17: Summary of foundation indicator results.

Test number	Sample depth (m)	Material	Plasticity Index	Liquid Limit	Grading Modulus	Percentage clay	Potential Expansiveness
TP 01	0.5 - 1.5	Alluvium	12	49	0.29	46	Very High
TP 02	1.5 - 2.5	Alluvium	17	35	0.61	26	Medium
TP 03	2.0	Alluvium	26	45	1.23	24	Low/medium
TP 04	1.5	Alluvium	19	34	0.7	36	Low/medium
TP 05	2.0	Reworked residual granite	22	38	0.65	33	Medium
TP 06	0.7 - 1.1	Colluvium	11	17	0.83	11	Low
TP 07	1.5	Reworked residual granite	19	33	0.79	34	Low/medium
TP 07	1.0 - 2.5	Reworked residual granite	19	35	0.9	22	Medium
TP 08	1.9	Alluvium	35	52	1.23	25	Medium
TP 09	2.0	Alluvium	36	58	0.93	29	Medium/high
TP 10	1.6	Alluvium	28	43	0.81	30	Medium
TP 11	1.5 - 2.2	Alluvium	22	37	0.82	25	Medium
BH 01	2.5 - 3.0	Reworked residual granite	18	31	1.37	13	Low/medium
BH 02	1.2 - 1.5	Alluvium	13	31	1.06	13	Low
BH 02	5.8 - 6.0	Residual granite	SP	-	1.72	3	Low
BH 03	4.0 - 4.5	Very soft rock granite	9	26	2.13	2	Low
BH 04	1.0 - 1.5	Residual granite	23	39	0.72	23	Medium
BH 05	0.3 - 0.6	Alluvium	32	47	0.41	35	High
BH 05	1.3 - 1.5	Reworked residual granite	26	37	1.28	16	Low/medium
BH 06	0.75 - 1.25	Alluvium	19	37	0.4	25	Medium
BH 07	0.6 - 0.9	Alluvium	15	31	1.02	12	Low/medium
BH 08	2.7 - 2.95	Alluvium	27	41	0.49	28	Medium/high
BH 10	1.2 - 1.5	Alluvium	31	47	0.63	27	High
BH 11	3.5 - 4.0	Reworked residual granite	31	49	1.11	23	Medium
BH 12	2.0 - 2.6	Reworked residual granite	16	29	0.72	17	Low/medium
BH 12	3.45 - 4.45	Residual granite	21	35	1.23	14	Low/medium
BH 13	2.1 - 2.6	Reworked residual Lava	40	73	0.66	42	High/Very high
BH 14	2.0 - 2.3	Reworked residual Lava	36	56	0.97	32	Medium/high
BH 15	0.5 - 0.9	Alluvium	26	46	0.8	33	Medium
BH 16	0.7 - 1.4	Alluvium	20	37	1.08	18	Low/medium
BH 17	1.0 - 1.5	Alluvium	25	43	0.38	30	Medium/high
Min			***9***	***17***	***0.3***	***2***	
Average			***23***	***40***	***0.9***	***24***	
Max			***40***	***73***	***2.1***	***46***	

SP = Slightly plastic; PI - Plasticity Index; LL = Liquid Limit.

Generally (based on the information contained in the table above), the areas investigated are underlain by a cohesive (average PI of 23 and LL of 40), fine-grained (average GM of 0.9), clayey (average % clay 24%) soil with at least a *low/medium* to *medium* potential expansiveness.

Transported alluvium soils are particularly fine grained (GM values between 0.3 and 1.2) and at least *medium* to *highly* expansive with correspondingly high PI and LL values.

Reworked residual granite soils are all *low/medium* to *medium* in potential expansiveness with PI values ranging from around 16 to 31. This soil material contains variable percentages of clayey sized soil particles (ranging from 13% to 34%). This soil material is relatively fine grained with GM values mostly below 1.0.

Reworked residual lava soils are at least *medium* to *high* in potential expansiveness with PI values ranging from around 40. This soil material contains high percentages of clayey sized soil particles (ranging from 32% to 42%). This soil material is fine grained with GM values below 1.0.

5.6. Swell pressure of soils

The following table summarises the measured swell pressure values.

Table 18: Summary of swell pressure values.

Test pit number	Sample depth (mbgl)	Material	Degree of saturation (initial)	Swell pressure (kPa)
3	2.0	Alluvium	72.8	7.0
4	1.5	Alluvium	73.6	11.5
5	2.0	Reworked residual granite	70.0	6.1
7	1.5	Reworked residual granite	72.0	7.8
8	1.9	Alluvium	89.0	18.7
9	2.0	Alluvium	88.9	17.4
10	1.6	Alluvium	84.3	24.6

All reported swell pressure values for alluvium soils are mostly within the range 11.5 to 24.6 kPa (ignoring the TP 03 value). However, these low swell pressure values are correlated with correspondingly high 'degree of saturation' values ranging from 72.8 to 89.0 % (for alluvium soils).
The in-situ moisture content of the alluvium soils is thus relatively high with a narrow 'window' for the generation of swell pressures (from current in -situ soil moisture content to 100% saturated). As such, if these clayey soils are allowed to dry out significantly with the possible formation of desiccation cracks, eventual swell pressures can reasonably be expected to be much higher than the values reported in the table above.

5.7. Potentially compressible soils

Standard consolidation tests were undertaken to quantify the compressibility of the in-situ soils, particularly the surface layer of alluvium soils that will need to support the widening of the culvert structures.

Table 19: Summary of consolidation test results.

TP No.	Sample depth	Dry density	Dry unit weight	Initial M/C	Unit weight at initial m/c	Effective overburden stress	Preconsolidation pressure	Over consolidation ratio	Sigmo 0	Sigma 1 (+ 150 kPa)	e0	e1	Mv (for + 150 kPa)	Rated compressibility	Oedometer settlement	Ug (normally consolidated)	Consolidation settlement
	(m)	(kg/m3)	(kN/m3)	(%)	(kN/m3)	(kN/m2)	(kN/m2)	OCR							(mm)		(mm)
3	2.0	1819	17.8	13.3	20.2	40.4	70	1.7	40.4	190.4	0.432	0.345	0.41	High	100	1	100
4	1.5	1473	14.5	19	17.2	25.8	25	1.0	25.8	175.8	0.892	0.67	0.78	High	194	1	194
5	2.0	1513	14.8	19.1	17.7	35.4	68	1.9	35.4	185.4	0.825	0.65	0.64	High	158	1	158
7	1.5	1558	15.3	17.3	17.9	26.9	35	1.3	26.9	176.9	0.658	0.46	0.80	High	197	1	197
8	1.9	1789	17.6	17.3	20.6	39.1	75	1.9	39.1	189.1	0.493	0.41	0.37	Medium to high	92	1	92
9	2.0	1456	14.3	21.6	17.4	34.7	45	1.3	34.7	184.7	0.825	0.66	0.60	High	149	1	149
10	1.6	1760	17.3	16	20.0	32.0	60	1.9	32.0	182.0	0.528	0.4	0.43	Medium to high	106	1.0	106

Notes:

Asssume 3000mm wide strip footing ('B'), imparting a net foundation pressure of 150kPa.

Thickness of potentially compressible layer taken as 3.0m

For strip footing : Oedometer settlement = mv x 0.55qn x 3.0

(qn = net foundation pressure = 150kPa ; B = width of strip footing)

The values of the pre-consolidation pressures (the maximum effective stresses that have acted on the clay in the past), were graphically determined from the laboratory reported void ratio versus Log stress plots after a method proposed by Casagrande. Comparing these pre-consolidation pressure with the current effective overburden stress gives the Over-consolidation Ratio (OCR) values as listed in the table above. OCR values ranging from 1.0 to 1.9 were calculated (recently deposited, in geological terms, alluvium soils are typically normally consolidated i.e. OCR values around 1.0). The slightly higher than expected OCR values reported in the table above may be due to sampling disturbances/error. Theoretically, OCR values exceeding 1.0 indicate slightly to over-consolidated soils.

The calculations in the table above also include the hypothetical case of a precast concrete culvert in effect modelled by a 3.0 m wide strip footing under a uniformly distributed load of 150 kPa. Based on the laboratory test results, consolidation settlements (than can occur over many years), of between 100 mm and 200 mm were calculated (see last column of table above). These high settlement values are considered excessive, and some remedial works to culvert foundations will be required as given in the Recommendations section below (based on the simplified calculations included in the table above, it can be readily shown that the replacement of the upper 1.0 m of compressible clays with a rockfill material will reduce long term consolidations to less than about 75 mm).

5.8. Potentially collapsible soils

The site is not underlain by any highly collapsible soils such as to necessitate extensive remedial measures.

5.9. Rock hardness

The following table summarises the UCS test results undertaken on rock core samples taken from the core boxes.

Table 20: Summary of UCS test results on rock core samples

Borehole number	Sample depth (mbgl)	Density *(g/cm3)*	UCS value *(MPa)*	Rated Rock hardness
2	9.42	2.56	24.8	Medium hard to hard
2	11.7	2.63	121.2	Very hard
3	13.9	2.78	19.7	Medium hard

Borehole number	Sample depth (mbgl)	Density *(g/cm3)*	UCS value *(MPa)*	Rated Rock hardness
4	5.75	2.65	16.5	Medium hard
5	5.5	2.63	186.9	Very hard
5	9.55	2.66	201.7	Very to extremely hard
6	4.45	2.63	148.5	Very hard
7	7.62	2.63	173.6	Very hard
7	11.5	2.79	25.7	Medium hard to hard
8	6.45	2.63	134.8	Very hard
9	6.55	2.65	73.0	Hard to very hard
10	7.4	2.64	167.7	Very hard
11	4.4	2.47	20.8	Medium hard
12	6.3	2.6	58.6	Hard
13	6.75	2.86	24.5	Medium hard to hard
14	8.8	3.01	253.6	Extremely hard
15	7.25	2.78	101.8	Very hard
16	2.45	2.86	148.6	Very hard
17	19.0	2.51	0.7	Less than very soft
Min	*2.5*	*2.47*	*0.7*	*Less than very soft*
Average	*8.1*	*2.7*	*100.1*	*Very hard*
Max	*19.0*	*3.0*	*253.6*	*Extremely hard*

Rock samples tested on average have a density of 2.7 g/cm3 with an average UCS of 100 MPa which can be described as a very hard rock. Minimum and maximum UCS values of 16.5 MPa and 253.6 MPa were recorded (ignoring the value of 0.7 MPa which is considered an anomaly). Piling auger rigs with a torque of at least 125 kNm can be expected to penetrate very soft, soft and to some degree medium hard rock profiles.

5.10. SPT test results

The following table summarises the measured SPT test results. SPT testing was not particularly effective in quantifying in-situ soil consistencies since relatively hard (weathered rock) formations were encountered at relatively shallow depths which mostly resulted in premature refusal (indicated by '**R'** in the table below), at 16 test positions.

Table 21: Summary of SPT test results

Borehole number	Test depth (mbgl)	SPT 'N'	Cohesive / Non cohesive	Rated in-situ consistency
1	2.0	26	Mixed	Very stiff / Medium dense
1	3.1	**R**	Non cohesive	Very dense and harder
2	1.95	8	Non cohesive	Loose
2	4.6	**R**	Non cohesive	Very dense and harder
2	7.5	**R**	Non cohesive	Very dense and harder
3	2.0	4	Cohesive	Soft to firm
3	3.1	**R**	Non cohesive	Very dense and harder
4	2.0	20	Non cohesive	Medium Dense
5	2.0	30	Non cohesive	Medium dense to dense
6	1.8	**R**	Non cohesive	Very dense and harder
7	1.4	9	Non cohesive	Loose
7	2.1	10	Non cohesive	Loose to medium dense

Borehole number	Test depth (mbgl)	SPT 'N'	Cohesive / Non cohesive	Rated in-situ consistency
8	3.6	8	Cohesive	Firm to Stiff
8	4.8	**R**	Non cohesive	Very dense and harder
8	5.6	**R**	Non cohesive	Very dense and harder
9	2.8	10	Non cohesive	Loose to medium dense
9	4.3	**R**	Non cohesive	Very dense and harder
10	2.0	4	Non cohesive	Very loose to loose
10	3.5	10	Non cohesive	Loose to medium dense
10	4.8	**R**	Non cohesive	Very dense and harder
10	5.8	**R**	Non cohesive	Very dense and harder
11	2.0	4	Cohesive	Soft to firm
11	3.5	11	Mixed	Medium dense/ Stiff
12	2.0	6	Non cohesive	Loose
12	3.6	9	Non cohesive	Loose
12	4.8	**R**	Non cohesive	Very dense and harder
13	2.0	8	Cohesive	Firm to Stiff
14	2.0	14	Cohesive	Stiff
15	2.0	**R**	Mixed	Very dense and harder
16	2.0	59	Non cohesive	Very dense and harder
17	2.0	21	Cohesive	Very Stiff
17	3.0	34	Non cohesive	Dense
17	3.6	**R**	Non cohesive	Very dense and harder
17	3.8	**R**	Non cohesive	Very dense and harder
17	7.6	**R**	Non cohesive	Very dense and harder
17	9.0	**R**	Non cohesive	Very dense and harder

5.11. DPSH test results

The results of DPSH testing at the various culvert structures are graphically summarised in the following figures. (As a first approximation, DPSH 'N' values are considered equal to SPT 'N' values which are used for the consistency correlation).

5.11.1. Culvert 39.654

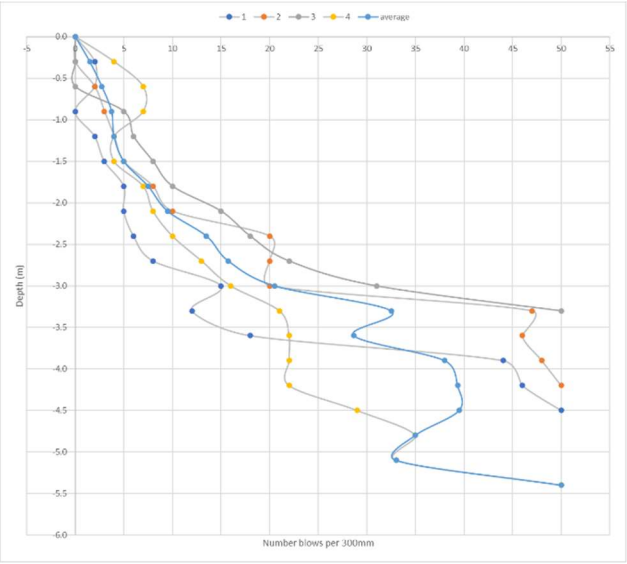


Figure 19: Summary of DPSH test results at Culvert 39.654.

In terms of cohesive soils, the following average consistencies with depth are inferred from this graph:
0 m – 1.5 m: Very soft to soft,
1.5 m – 2.0 m: Firm,
2.0 m – 2.8 m: Stiff,
2.8 m + : Very stiff.

5.11.2. Culvert 41.824

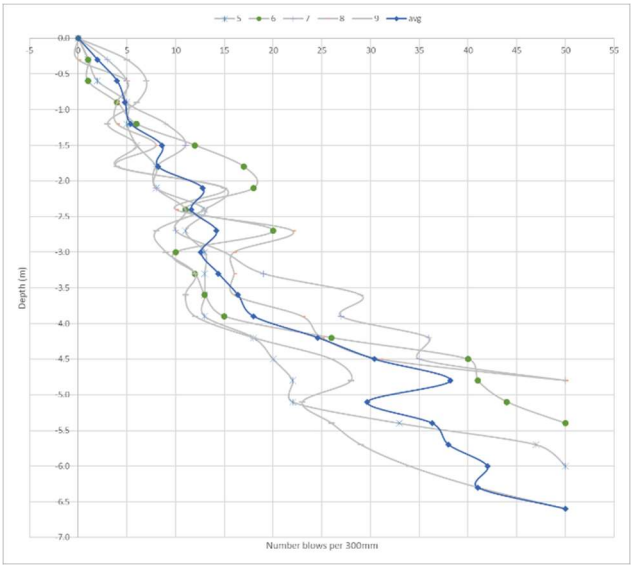


Figure 20: Summary of DPSH test results at Culvert 41.824.

In terms of cohesive soils, the following average consistencies with depth are inferred from this graph:
0 m – 1.0 m: Very soft to soft,
1.0 m – 2.0 m: Firm,
2.0 m – 3.5 m: Stiff,
3.5 m + : Very stiff.

5.11.3. Culvert 44.577

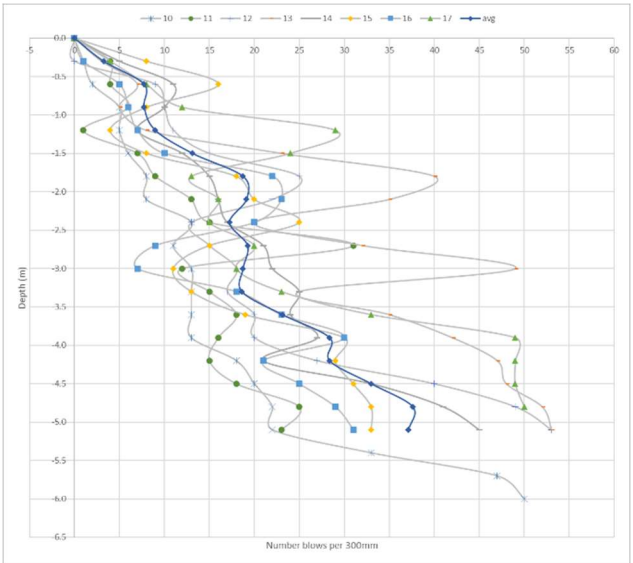


Figure 21: Summary of DPSH test results at Culvert 44.577.

In terms of cohesive soils, the following average consistencies with depth are inferred from this graph:
0 m – 0.5 m: Very soft to soft,
0.5 m – 1.2 m: Firm,
1.2 m – 1.6 m: Stiff,
1.6 m + : Very stiff.

5.11.4. Culvert 47.257

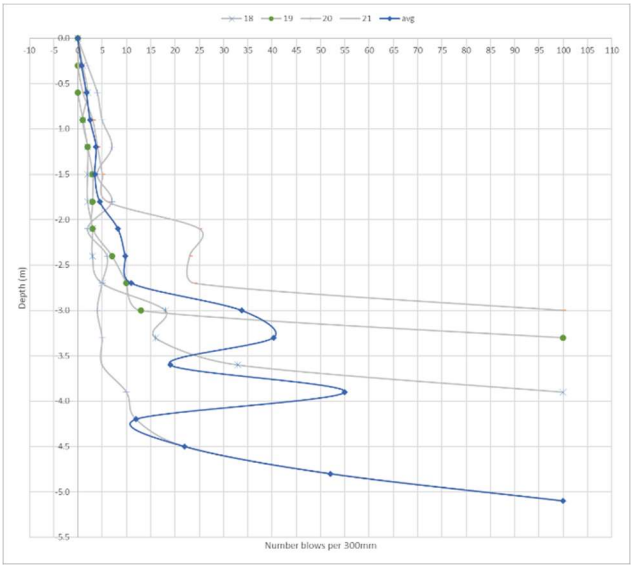


Figure 22: Summary of DPSH test results at Culvert 47.257.

In terms of cohesive soils, the following average consistencies with depth are inferred from this graph:
0 m – 1.2 m: Very soft to soft,
1.2 m – 2.3 m: Firm,
2.3 m – 2.8 m: Stiff,
2.8 m + : Very stiff.

5.11.5. Culvert 65.971

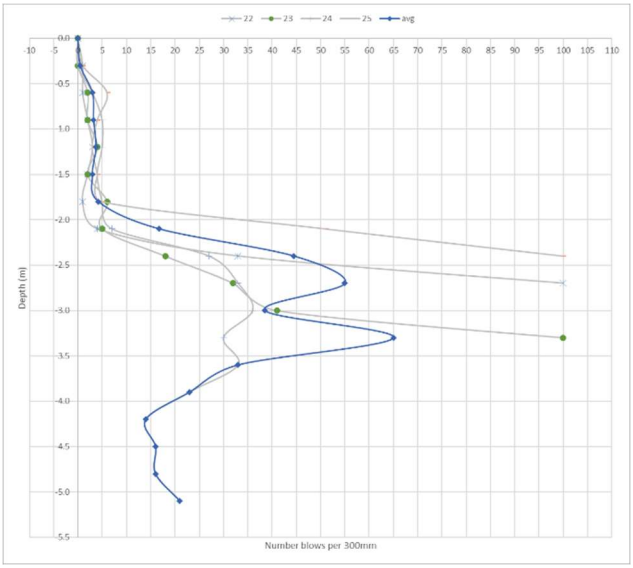


Figure 23: Summary of DPSH test results at Culvert 65.971.

In terms of cohesive soils, the following average consistencies with depth are inferred from this graph:
0 m – 1.75 m: Very soft to soft,
1.75 m – 2.0 m: Firm,
2.0 m – 2.1 m: Stiff,
2.1 m + : Very stiff.

Across all the culvert structures investigated and on average, '*Very soft'* to '*soft*' soils will be encountered to about 1.0m deep, underlain by '*firm'* soils to about 2.0 m deep, which is in turn underlain by '*stiff*' to '*very stiff*' soils for depths more than 2.0 m deep.

5.12. Problems encountered during investigation and foreseen during construction.

5.12.1. Possible flooding and accessibility problems

During the week of 12 to 18 November 2022, heavy rainfall occurred and the level of water within most of the river channels increased significantly. Drilling operations at the Strydfontein River and Schoonspruit River bridges were especially severely impacted (see photograph below).
During the construction phase within the rainy season, adequate measures will have to be implemented to ensure the safety of personnel, construction equipment and plant during possible flash flooding events. This may include the construction of diversion berms and platforms, raising of working platform levels protruding a sufficient height above surrounding ground and water levels, excavation of temporary sumps, pumping and the constructed of elevated temporary roadways to reach required areas.

5.12.2. Deeply fractured and discontinuous granite rock profile

The granite rock mass encountered during the core drilling operation is in some cases highly fractured and jointed to some depth. Although the intact rock material is hard (high UCS values), the rock mass in some cases is highly discontinuous. This physical attribute of the rock mass caused some debate about core drilling termination depths. Similarly, this aspect will require careful consideration during the design of piles and required rock socket lengths.



Figure 24: Flooding of Borehole 17 position (Strydfontein River bridge) on 17 November 2023.

5.13. Evaluation of alternative foundation systems

5.13.1. Relative movements between existing and new foundations

The systems used for the founding of the existing bridge and culvert structures are unknown. Based on a visual inspection of the bridge and culvert structures, the existing foundations appear to provide adequate support to the top structures without any major structural distress or excessive movements. Also, these foundations have been in place for some time and have almost certainly 'stabilised' with little or no continued (long term) settlement/movement still expected. The newly constructed foundations must tie into these (apparently stable) existing foundations implying that the new foundation elements must have a similarly limited range of allowable total and differential settlements. Considering the discussion here, a piled foundation system seems to be the obvious choice as foundations for the widening of the existing bridge structures.

It is considered likely that the existing culverts were founded on spread footing type foundations (and not piled). The culvert structures are also probably more '*settlement tolerant*' (than the bridge structures), and hence spread footing type foundations may also be considered for the culvert widenings.

5.13.2. Restricted foundation excavations and stability of excavations

Anticipated excavation conditions are summarised in Table 16 above.

Spread footing type foundations will require relatively deep restricted excavations, mostly into a relatively thick layer of transported alluvium soils (a possible exception may be the Culvert at km 44.577 where the transported alluvium layer is only about 0.7m thick). Transported alluvium soils are mostly fine-grained, clayey and potentially 'unstable' with a low shear strength and high propensity for continued long term consolidation settlements. Excavations into these geo-materials may thus be potentially unstable, requiring very flat excavation slopes and/or shoring. The stability of excavations into the alluvium soils will furthermore be very negatively influenced by the interception of any ground or surface water.

Much deeper auger excavations will be required to reach a suitable hardness of rock material (at least very soft to soft rock) to be considered as a rock 'socket' with adequate side friction generated between concrete and rock material. Generally, relatively stable auger excavations (i.e. only standing open and unsupported for a short period), are expected in all highly to completely weathered rock and harder. This implies that temporary casings to piles may be required for auger excavations within all fill, transported and residual soils, especially in the presence of groundwater. Overall, more stable excavation conditions are anticipated within the more granular and coarse-grained granite soils/rock materials than the finer-grained lava soils/rock.

Only short sections of what can be described as 'gravel' and 'cobble' materials were encountered over short sections at Boreholes 8 (600 mm long) and 9 (400 mm long), both which were drilled on the western bank of the Ratsegaai River bridge. These short sections of gravel and cobble materials are not considered to be a major obstruction for the installation of piles.

5.14. Preferred foundation systems

Based on the discussions above, the preferred foundation systems for the widening of the bridge and culvert structures are summarised in the following table. The table was compiled with the view that a single structure will comprise only one foundation system and not a 'hybrid' system of shallow spread footings in conjunction with piles (to limit differential movements).

Table 22: Preferred foundation systems for widening of bridge structures.

Site	Foundation type	Probable average pile length (note 1)	Pile terminates in geo-material
Strydfontein River bridge	Temporary or permanent cased auger pile or CFA type pile	Less than 20m	Completely to highly weathered granite
Schoonspruit River bridge	Temporary or permanent cased auger pile or CFA type pile	Between 7.5 m and 13.5m	Moderately weathered granite
Ratsegaai River bridge	Temporary or permanent cased auger pile or CFA type pile	Between 8.0 m and 9.0 m	Slightly to unweathered granite
Elandskuil River bridge	Temporary or permanent cased auger pile or CFA type pile	Between 3.6 m and 8.8 m	Moderately to unweathered lava

CFA = Continuous Flight Auger (CFA) pile

Note 1: As measured from borehole collar level at time of investigation.

Table 23: Preferred foundation systems for widening of culvert structures including wing walls.

Site	Foundation type	Probable founding depth (note 1)	Material in which spread footing foundation will be established
Culvert 39.654	Spread footings	Between 1.0 m and 3.0 m	Transported alluvium
Culvert 41.824	Spread footings	Between 1.0 m and 2.5 m	Transported alluvium
Culvert 44.577	Spread footings	Between 1.0 m and 3.0 m	Residual granite
Culvert 47.257	Spread footings	Between 1.0 m and 3.0 m	Transported alluvium and colluvium
Culvert 65.971	Spread footings	Between 2.5 m and 3.0 m	Residual granite

Note 1: As measured from current ground levels (at time of investigation).

The recommendations in the two tables above are subject to the remedial measures given in the Recommendations section below.

5.15. Foundation design parameters

5.15.1. Spread footing foundations founded within alluvium soils

Culverts must be founded utilising conventional spread footing foundations (as recommended below). This type of foundation will most likely be supported by transported alluvium soils. DPSH testing suggested that the upper 1.0m from existing ground level comprises a *soft*, clayey material. Culverts must not be founded within this *soft* material implying that this surface layer must be removed (and replaced with rockfill as recommended below).

The following material parameters of the alluvium soils are recommended for use in the design of foundations:

- *Firm* alluvium soils (generally encountered at 1.0 m to 2.0 m below current ground levels).
  Unsaturated and saturated densities at 18 kN/m^3,
  Effective cohesion at 5 kPa,
  Effective friction angle at 22.5 degrees.
- *Stiff* alluvium soils (generally encountered at 2.0 m to 3.0 m + below current ground levels).
  Unsaturated and saturated densities at 20 kN/m^3,
  Effective cohesion at 10 kPa,
  Effective friction angle at 22.5 degrees.

Allowable stress design methodologies must consider a minimum factor of safety value of 3.0. Limit State design methodologies must be undertaken according to the specifications given in SANS 10160-5:2010 '*Basis of structural design and actions for buildings and industrial structures Part 5: Basis for geotechnical design and actions'.*

The information included in Section 5.6 above must be used to estimate long term consolidation settlements. The foundation design must entail the required remedial measures to ensure total and differential movements are within the specifications of the structural engineer (see Recommendations section below).

5.15.2. Piled foundations with rock sockets

Piled foundations will require a suitably long rock socket into at least a soft to medium hard rock material (range of UCS values 3 to 25 MPa). Side friction generated within these rock sockets will

provide most of the resistance against compressive and pull-out forces working in on the piles. As it will most probably not be possible to clean out pile excavations by hand, it is recommended that only side friction (and no end bearing) be considered in calculating pile load capacities. The following table gives recommended *ultimate* unit frictional capacity values for rock sockets established within different rock materials (granite or lava), and rock harnesses (very soft or soft rock).

Table 24: Recommended ultimate unit friction capacity in rock sockets for piled foundations.

Rock type	**Ultimate unit friction capacity in rock socket (kPa)**	
	Very soft rock (UCS 1 to 3 MPa)	**Soft rock** (UCS 3 to 10MPa)
Lava	350	600
Granite	400	700

Piles must preferably be designed using a Limit State design approach as specified in SANS 10160-5: 2010. '*Basis of structural design and actions for buildings and industrial structures Part 5: Basis for geotechnical design and actions.'*
Alternatively, if an Allowable Stress Design methodology is used, a minimum factor of safety of 2.0 on side friction is recommended (no end bearing capacity to be used).

6. Recommendations

6.1. Recommended foundation systems.

The recommended foundations systems for the widening of the bridge and culvert structures are given in Tables 22 and 23 above. These tables also given probable pile lengths and founding depths for spread footing type foundations (at culvert structures).

6.1.1. Piled foundations (bridge structures).

If piles are augered to refusal within a medium hard rock (UCS of 10 to 25 MPa) with a modern piling rig capable of a minimum torque of 125 kNm (such as Casagrande B125), piles can provisionally be designed to a maximum shaft stress (of pile cross sectional area), of around 4.5 MPa in lava rock and 5.0 MPa in granite rock. Under these loads and founding conditions, settlement at the pile head is expected to be less than 7.5 mm. Auger excavations must be cleaned out as best as possible with a cleaning bucket (it is assumed that it will not be allowable for a person to enter the auger hole to clean out the bottom on the excavation). In some cases, it may be helpful to pour a bag of dry cement powder down the auger hole during cleaning to 'bind' all unwanted material for easier removal. This will assist in cleaning out the bottom of the auger excavation as best as possible.
It must be noted that in some cases a deeply weathered granite profile may be encountered where the auger rig may not reach definite refusal conditions as defined above. In these instances, it will be required to specify a minimum pile length based on shaft friction developed along the length of the pile within residual soils and weathered granite or lava materials. In this case end bearing may possibly be considered but then with a suitably high factor of safety of at least 3.0. No shaft friction should be considered for elevations where the pile traverses transported soils. As the pile will not be affixed at its bottom end in a rock socket, it will be required to considered possible uplift forces generated by surface layers of potentially expansive alluvium soils. Cognisance must however be taken about the low swell pressures and high degrees of saturation reported by the soils laboratory.

Longitudinal steel reinforcement must be full pile length to assist in dissipating possible tensile loads on piles (both due to structural 'interactions' as well as heaving of the near surface alluvial soils), and/or high moments and/or horizontal shear forces. Long steel must not be less than 0.8% of pile cross sectional area which will allow for an 'eccentricity' moment generated by a vertical load no more than 75 mm out of position (for piles less than 450 mm diameter), and D/6 for piles with a diameter exceeding 450 mm (D = pile diameter). A bigger positional tolerance on vertical load and/or the presence of a substantial horizontal load and/or moment working in on the pile will require a higher percentage long steel. Spiral reinforcement must not be spaced more than 12 x long steel diameter. Minimum concrete cover to steel (outside of spiral) must be 50 mm complying with '*severe*' exposure conditions using 25 MPa concrete as stated in Table 3 of SABS 1200-G Concrete (Structural).
Piles must be designed by an experienced geotechnical engineer using load cases provided by the structural engineer. Piles must be designed to SANS 1200-F : Piling (1983), SANS 10160-5:2010 and SANS 10160-1 (the SANS 10160 suit of codes advocates a limit-state design philosophy after Eurocode 7). In addition, auger excavations must be inspected by the design engineer at the onset of works to confirm design assumptions.

6.1.2. Spread footing foundations (culverts).

Laboratory testing confirmed excessive, long-term consolidation settlements for culverts founded within the (mostly) thick surface layers of alluvium soils, using conventional spread footing type foundations. As such the following remedial measures are recommended for this type of foundation: Remove the upper at least 1.0 m thick layer of *soft* alluvium soils across the footprint area of the culvert and wing walls. If a deeper founding level is required, remove all *firm to stiff* alluvium soils to a depth of at least 1.0 m below underside of spread footings/culvert floor slabs. These restricted excavations may be problematic in terms of stability and groundwater inflow. See recommendations in this regard above.

Flatten as best as possible the base of the excavation and cover the entire base of the foundation excavation with a composite geogrid / geotextile of at least 50 kN per m width strength (such as RockGrid PC 50/50). The grid component will act as a basal reinforcement limiting both total and differential movements whilst the geotextile component will act as separation layer between soft, in-situ clayey soils and overlying structural fill material. Depending on the nature of the compacted backfill (for example sharp angular material), it may be required to cover the geo-composite with a sufficiently thick geotextile layer to prevent mechanical damage of the geogrid. Backfill the deeper 700 mm deep over-excavation with a coarse rock fill material in 2 x 350 mm thick layers. The rock fill must be from an igneous origin and must comprise hard, unweathered rock fragments not exceeding the thickness of the compacted layers (350 mm). The rock fill must preferably contain sufficient fine material to fill the voids between the rock particles to form a dense layer with minimum voids between the rock. If the rock fill does not contain sufficient fine material, the surface of the rock fill must be covered by a layer of sand and worked into the rock fill by brooming and/or watering and finally using a smooth drum roller operating in vibratory mode to work the sand into the rockfill until a stable platform is created. The rock fill must be off-loaded by end tipping and spread open by bulldozer. Individual layers must be compacted with suitable vibratory rollers to achieve a good mechanical interlock of the rock fragments and the best possible compaction and interlock of the finer material.
The upper 300 mm of the compacted rock fill zone must be constructed with at least a G5 material, placed and compacted in maximum 2 x 150 mm thick layers, each layer compacted to at least 95% of Maximum Dry Density (MDD), at +/- 2% of Optimum moisture content (OMC), using a smooth drum roller operating in vibratory mode.

The precast culvert units or cast in situ floor slabs of the culvert units can be founded directly on top of the compacted imported fill at an allowable bearing capacity not exceeding 150 kPa. Similarly, the wing walls to either precast or cast in situ culverts can be founded using suitably sized strip footings directly constructed on the compacted fill at an allowable bearing capacity not exceeding 150 kPa.

6.2. Recommended supplementary geotechnical investigations during construction phase

No additional geotechnical investigations during the construction phase are anticipated for the areas covered by this investigation. The successful piling contractor may opt to drill further exploratory auger holes at the onset of the construction phase to refine pile lengths, diameters, concrete grades and layout of steel and spiral reinforcement.

7. Concluding remarks

A geotechnical investigation of this nature must by necessity has to rely on some interpolation between relatively widely spaced test positions and limited laboratory testing. As such it is possible that actual geological/geotechnical conditions encountered on site during the construction phase may be at variance to those described and assumed in this report. Should this situation occur, this office must be informed immediately for a re-assessment of our conclusions and recommendations. Some of the provisional recommendations given are also subject to verification by additional geotechnical investigative operations.

8. References

- *A Guide to Practical Geotechnical Engineering in Southern Africa* - Fourth Edition 2008, Franki Africa (Pty) Ltd.
- Jennings, J. E., Brink, A., & Williams, A. (1973, January). Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa. *The Civil Engineer in South Africa, 15*(1), 263-246.
- SABS 1200 G - 1982 - Concrete (Structural), South African National Standard.
- SAICE. (2010). *Site Investigation Code of Practice.* The South African Institution of Civil Engineering - The Geotechnical Division of SAICE.
- SANS 1200-F : Piling (1983), South African National Standard.
- SANS 10160-5:2010 '*Basis of structural design and actions for buildings and industrial structures Part 5: Basis for geotechnical design and actions.'*
- SANS10160-4. (2017). *Basis of structural design and actions for buildings and industrial structures. Part 4: Seismic actions and general requirements for buildings.* South African National Standard.
- SANS10400-H. (2012). *The application of the National Building Regulations Part H: Foundations.* South African National Standard.
- Standard Specifications for Roads and Bridge Works for South African Road Authorities : Chapter 5 - Earthworks and pavement layers: Construction. Committee of Transport Officials (COTO). Published by the South African National Roads Agency SOC Limited.

APPENDIX A

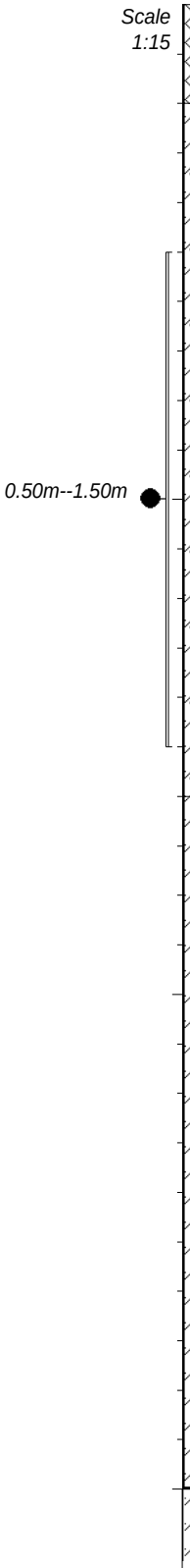
TEST PIT PROFILES

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS

Scale 1:15



0.00 — Moist to very moist, brown to red brown mottled grey to orange, loose to medium dense, **open structured**, gravelly clayey silty SAND with minor amounts of sub-angular aggregates and asphalt, **INTERPRETED AS DISTURBED ENGINEERED FILL MATERIAL**. Fine roots.

0.20 — Moist, black to dark grey speckled brown to red, firm to soft with depth, **slightly open to shattered to slickensided**, (gravelly) silty sandy CLAY with traces of sub-angular to rounded fine gravel of mixed origin, **ALLUVIUM**. Scattered fine roots to top of horizon.

Note: Desiccation cracks to the top of horizon.

1.60 — Moist, light greyish brown speckled red to grey mottled black to orange, soft, **slightly slickensided to open structured and shattered**, sandy silty CLAY to silty sandy CLAY with traces of sub-angular to rounded quartz fine gravel, **ALLUVIUM**. With scattered fine roots.

3.00 — As above.

NOTES

1) Terminated at 3.00mbgl.
2) Soft excavation conditions at termination depth.
3) No water seepage encountered during time of inspection.
4) No sidewall instability encountered during the time of inspection.
5) Excavated next to drainage and culvert.
6) Disturbed sample retrieved at 0.50m--1.50m.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION : Vertical
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1356
X-COORD : 26.649718
Y-COORD : -26.506124

HOLE No: TP01

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00

Moist to very moist, brown to red brown mottled grey to orange, loose to medium dense, **open structured**, gravelly clayey silty SAND with minor amounts of sub-angular aggregates and asphalt, **ENGINEERED FILL MATERIAL**. Fine roots.

0.10

Moist, black becoming dark grey speckled brown to red, firm to soft with depth, **slightly open to shattered and slickensided**, (gravelly) silty sandy CLAY with traces of sub-angular to rounded fine gravel of mixed origin, **ALLUVIUM**. Scattered fine roots to top of horizon.

1.30

Moist, light greyish brown speckled red to grey mottled black to orange, soft, **slightly slickensided to open structured and shattered**, sandy silty CLAY to silty sandy CLAY with traces of sub-angular to rounded quartz fine gravel, **ALLUVIUM** with scattered fine roots.

3.00

As above.

NOTES

1) Terminated at 3.00mbgl.
2) Soft excavation conditions at termination depth.
3) No water seepage encountered during time of inspection.
4) No sidewall instability encountered during the time of inspection.
5) Excavated next to drainage feature.
6) Disturbed sample retrieved at 1.50m--2.50m.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1355
X-COORD : 26.649698
Y-COORD : -26.505911

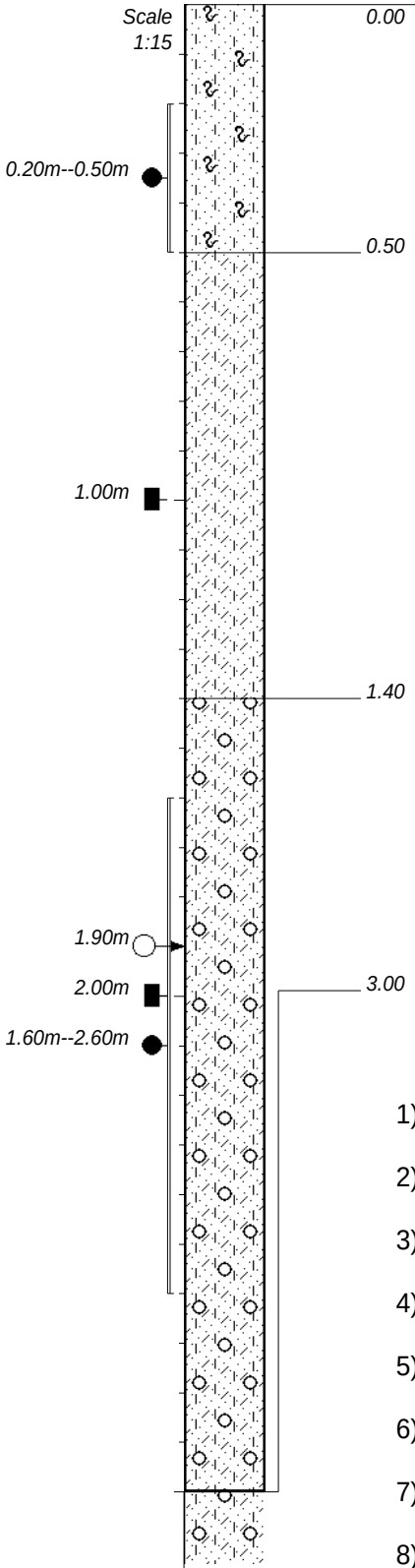
HOLE No: TP02

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET
DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00 — Moist, brown interlayered thickly streaked dark grey, loose to firm, **intact to open structured**, silty SAND to silty sandy CLAY, **ALLUVIUM**. Scattered fine roots to top of horizon.

Note: Clay lenses present in horizon.

0.50 — Moist to very moist, dark grey speckled orange to red, soft to firm, **intact to slightly open and slightly shattered**, silty clayey sand with traces of sub-rounded quartz gravel, **ALLUVIUM**. Scattered fine roots.

1.40 — Moist to very moist, light greyish brown mottled orange to black, firm to stiff with depth, **intact to slightly open and slightly shattered**, silty gravelly clayey sand with traces of sub-angular to rounded gravel to occasional cobbles of mixed origin (mostly quartz), **ALLUVIUM**.

3.00 — As above.

NOTES

1) Terminated near maximum reach.
2) Soft excavation conditions at termination depth.
3) Slow water seepage encountered at 1.90m.
4) Slightly unstable at the bottom of the excavation.
5) Disturbed sample retrieved at 0.20m--0.50m.
6) Disturbed sample retrieved at 1.60m--2.60m.
7) Undisturbed sample retrieved at 1.00m.
8) Undisturbed sample retrieved at 2.00m.
9) Excavated next to drainage feature.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1359
X-COORD : 26.659415
Y-COORD : -26.489262

HOLE No: TP03

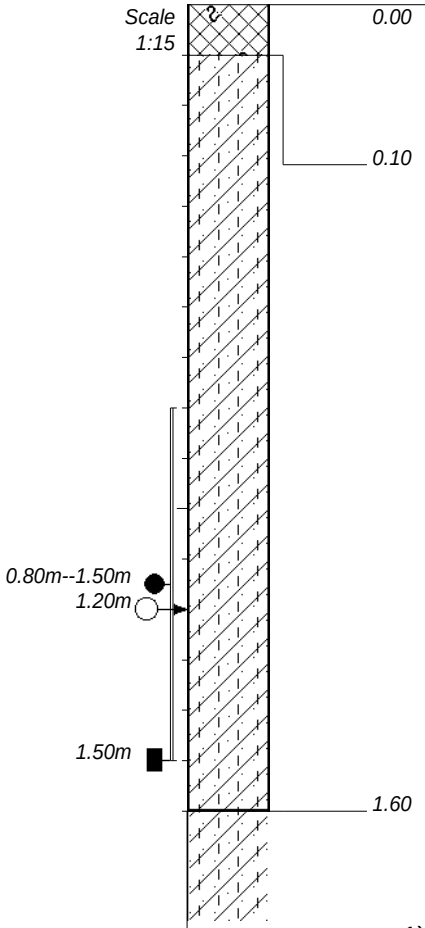
TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP04
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00 – 0.10: Moist to very moist, brown to red brown mottled grey to orange, medium dense, **open structured**, gravelly clayey silty SAND with minor amounts of sub-angular aggregates and asphalt, **DISTURBED TOPSOIL MIXED WITH ENGINEERED FILL MATERIAL**. Fine roots.

0.10 – 1.60: Moist to wet, grey to dark grey mottled white speckled black, firm to soft with depth, **open to slightly shattered**, silty sandy clay to silty clayey SAND with sub-angular to rounded quartz gravel to fine gravel, **ALLUVIUM**.

1.60: As above.

NOTES

1) Stopped due to fiber cable.
2) Soft excavation conditions at termination depth.
3) Water seepage encountered at 1.20m due to stream.
4) Unstable sidewalls encountered during time of investigation.
5) Disturbed sample retrieved at 0.80m--1.50m.
6) Undisturbed sample retrieved at 1.50m.
7) Excavated next to drainage feature.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1362
X-COORD : 26.659318
Y-COORD : -26.489071

HOLE No: TP04

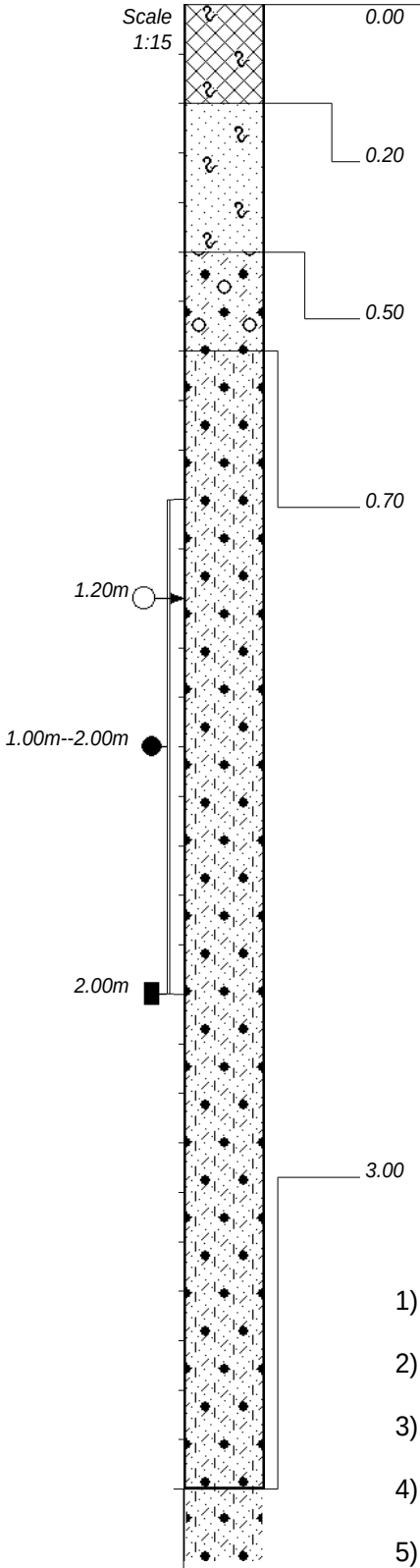
TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP05
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00 – 0.20: Moist to very moist, brown to red brown mottled grey to orange, medium dense, **open structured**, gravelly clayey silty SAND with minor amounts of sub-angular aggregates and asphalt, **DISTURBED TOPSOIL MIXED WITH ENGINEERED FILL MATERIAL**. Fine roots.

0.20 – 0.50: Moist, brown interlayered thickly streaked dark grey, loose to firm, **intact to open structured**, silty SAND to silty sandy CLAY interlayered, **ALLUVIUM**. Scattered fine roots to top of horizon.
Note: Interlayered sand and clay lenses present.

0.50 – 0.70: Moist, dark brown mottled black to orange and grey, medium dense to stiff, **open soil structure to slightly shattered**, silty clayey gravelly SAND with minor amounts of sub-angular to sub-rounded gravel to cobbles of quartz and granite with Fe concretions, **SLIGHTLY FERRUGINISED PEBBLE MARKER ZONE**.

0.70 – 3.00: Moist to very moist with depth, grey mottled orange to black, medium dense to firm and dense to stiff with depth, **fissured and slightly open structured**, silty clayey sand with minor amounts of weakly to strongly cemented Fe concretions, **SLIGHTLTY FERRUGINISED REWORKED RESIDUAL GRANITE**.

3.00: As above.

NOTES

1) TLB terminated at 3.00mbgl.
2) Soft excavation conditions at termination depth.
3) Slow water seepage encountered at 1.20m.
4) No sidewall instability encountered during the time of inspection.
5) Disturbed sample retrieved at 1.00m--2.00m.
6) Undisturbed sample retrieved at 2.00m.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION :
X-COORD : 26.677329
Y-COORD : -26.470804

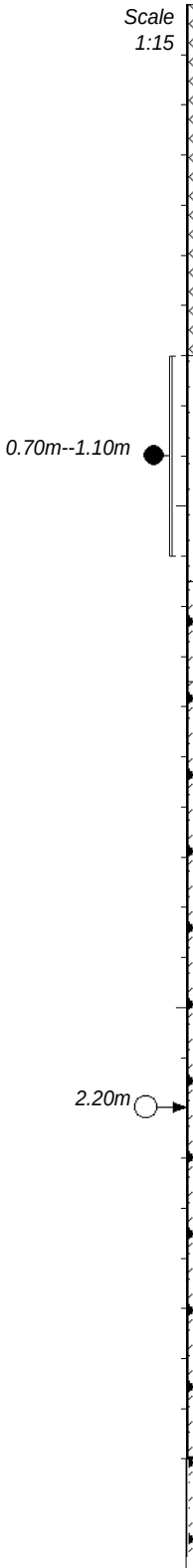
HOLE No: TP05

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET
DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP06
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00

Moist to very moist, dark brown to red brown mottled grey to orange, loose to medium dense, **open structured**, gravelly silty SAND with minor amounts of sub-angular aggregates and asphalt, **DISTURBED TOPSOIL MIXED WITH ENGINEERED FILL MATERIAL**. Fine roots.

0.70

Moist, dark brown, loose to medium dense, **pinholed**, silty SAND, **COLLUVIUM**. Scattered fine roots to top of horizon.

1.15

Moist, dark brown mottled black to orange and grey, medium dense, **open soil structure to slightly shattered**, silty clayey gravelly SAND with minor amounts of sub-angular to sub-rounded gravel of quartz and granite with Fe concretions, **SLIGHTLY FERRUGINISED PEBBLE MARKER ZONE**.

1.35

Moist to very moist with depth, grey mottled orange to black, soft to firm with depth, **fissured and slightly open structured**, silty clayey SAND with minor amounts of weakly to strongly cemented Fe concretions, **SLIGHTLTY FERRUGINISED REWORKED RESIDUAL GRANITE**.

2.90

As above.

NOTES

1) TLB terminated at 2.90mbgl.
2) Soft excavation conditions at termination depth.
3) Slow water seepage encountered at 2.20m.
4) No sidewall instability encountered during the time of inspection.
5) Disturbed sample retrieved at 0.70m--1.10m.
6) Termite burrows present in horizon.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1365
X-COORD : 26.677277
Y-COORD : -26.470617

HOLE No: TP06

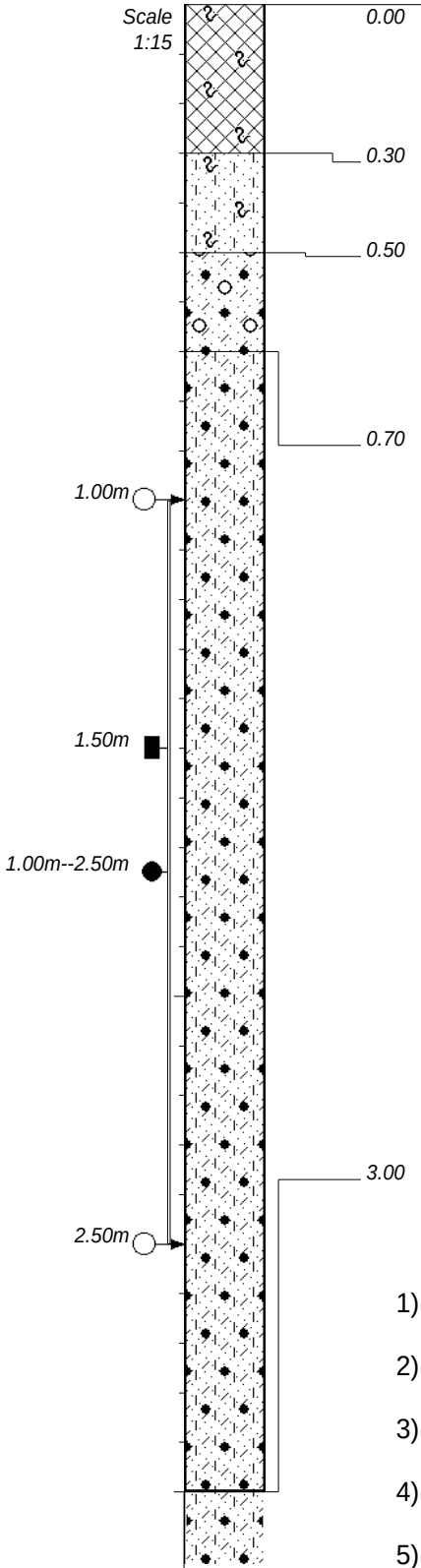
TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP07
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00 – 0.30: Moist to very moist, dark brown to red brown mottled grey to orange, loose to medium dense, **open structured**, gravelly silty SAND with minor amounts of sub-angular aggregates and asphalt, **DISTURBED TOPSOIL MIXED WITH ENGINEERED FILL MATERIAL**. Fine roots.

0.30 – 0.50: Moist, dark brown mottled brown, loose to medium dense, **pinholed**, silty SAND, **COLLUVIUM**. With scattered fine roots to top of horizon.

0.50 – 0.70: Moist, dark brown mottled black to orange and grey, medium dense to dense, **open soil structure to slightly shattered**, silty clayey gravelly SAND with minor amounts of sub-angular to sub-rounded gravel of quartz and granite with Fe concretions, **FERRUGINISED PEBBLE MARKER ZONE**.

0.70 – 3.00: Moist to very moist to wet, medium dense to firm and dense to stiff with depth, **fissured and slightly open structured**, silty clayey SAND with minor amounts of weakly to strongly cemented Fe concretions, **SLIGHTLTY FERRUGINISED REWORKED RESIDUAL GRANITE**.

3.00: As above.

NOTES

1) TLB terminated at 3.00mbgl.
2) Soft excavation conditions at termination depth.
3) Slow water seepage encountered between 1.00m and 2.50m.
4) No sidewall instability encountered during the time of inspection.
5) Two disturbed sample retrieved at 1.00m--2.50m.
6) Undisturbed sample retrieved at 1.50m.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1365
X-COORD : 26.677617
Y-COORD : -26.470600

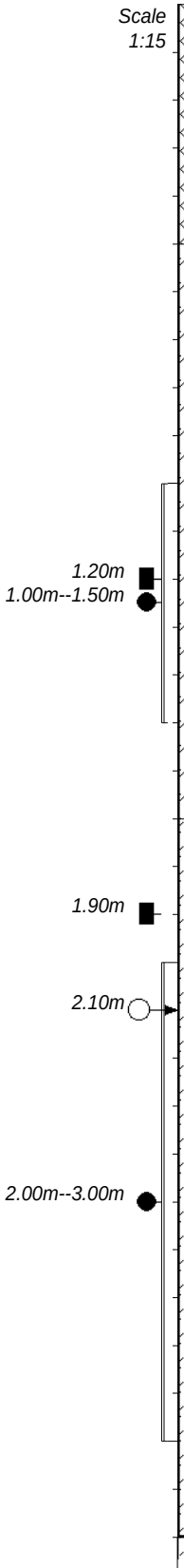
HOLE No: TP07

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET
DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP08
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00 — Moist, orange brown to red brown layered, loose to medium dense, **open structured**, silty gravelly clayey SAND to silty gravelly SAND with asphalt to the top with gravel of mixed origin and aggregates, **DISTURBED TOPSOIL MIXED WITH ENGINEERED FILL MATERIAL**. Fine roots to the top.

0.50 — Moist, dark grey mottled white, stiff to soft with depth, **slightly open to shattered to slickensided**, (gravelly) silty sandy CLAY with occasional traces of gravel present, **ALLUVIUM**.

1.70 — Moist, light brown mottled black, white and blue grey, firm, **open to slightly shut**, (gravelly) (gravelly) silty clayey SAND with traces of sub-rounded quartz gravel to cobble sized graments, **ALLUVIUM**.

3.20 — As above.

NOTES

1) TLB terminated near maximum reach.
2) Soft excavation conditions at termination depth.
3) Slow water seepage encountered at 2.10m.
4) No sidewall instability encountered during the time of inspection.
5) Disturbed sample retrieved at 1.00m--1.50m.
6) Disturbed sample retrieved at 2.00m--3.00m.
7) Undisturbed sample retrieved at 1.20m
8) Undisturbed sample retrieved at 1.90m

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1367
X-COORD : 26.701786
Y-COORD : -26.460747

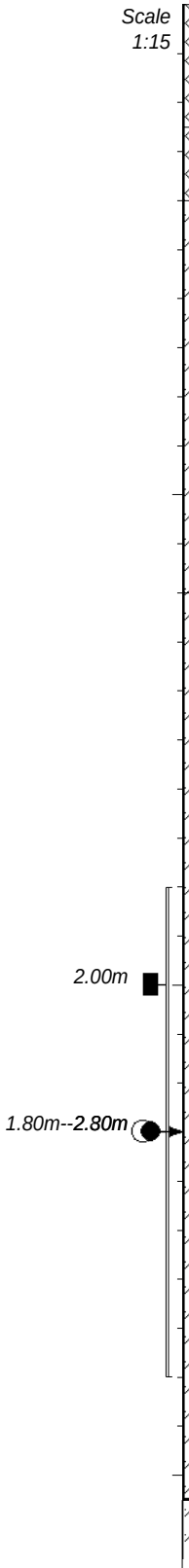
HOLE No: TP08

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET
DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP09
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00	Moist, orange brown to red brown layered, loose to medium dense, **open structured**, silty gravelly clayey SAND to silty gravelly SAND with asphalt to the top with gravel of mixed origin and aggregates, **DISTURBED TOPSOIL MIXED WITH ENGINEERED FILL MATERIAL**. Roots present.
0.25	Moist to very moist, brown to red brown mottled grey to orange, loose to medium dense, **open structured**, gravelly clayey silty SAND with minor amounts of sub-angular aggregates and asphalt, **INTERPRETED AS ENGINEERED FILL MATERIAL**.
0.40	Moist, dark grey mottled white, stiff to soft with depth, **slightly open to shattered**, (gravelly) silty sandy CLAY with occasional traces of gravel present, **ALLUVIUM**.
1.20	Moist, dark grey mottled white, firm, **slightly open to shattered**, (gravelly) silty sandy clay with gravel to cobbles present of mixed origin (predominantly quartz), **ALLUVIUM**.
3.05	As above.

NOTES

1) TLB terminated at 3.05mbgl near maximum reach.
2) Soft excavation conditions at termination depth.
3) Slow water seepage encountered at 2.30m.
4) No sidewall instability encountered during the time of inspection.
5) Disturbed sample retrieved at 1.80m--2.80m.
6) Undisturbed sample retrieved at 2.00m.
7) Excavated next to drainage feature.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1365
X-COORD : 26.701782
Y-COORD : -26.460514

HOLE No: TP09

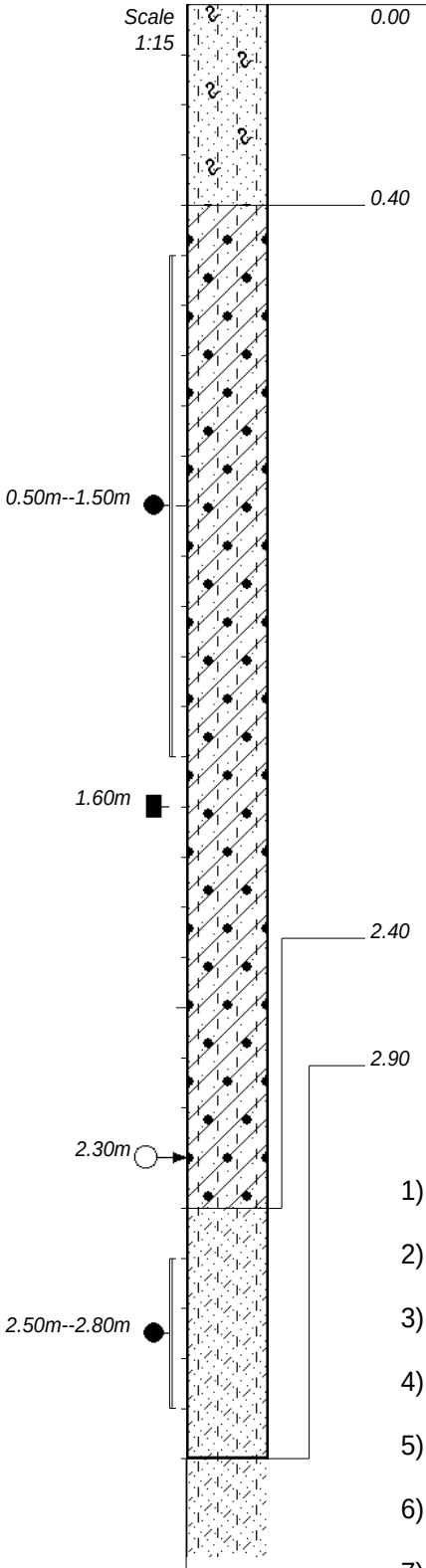
TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET

DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00 – 0.40: Moist, dark brown, loose to medium dense, **open to pinholed**, clayey silty SAND with occasional traces of sub-rounded gravel of mixed origin, **TOPSOIL**. Scattered fine roots.

0.40 – 2.40: Moist, light brown mottled orange, grey, black and white, firm, **fissured to shattered**, silty sandy CLAY with traces of sub-angular to sub-rounded gravel of mixed origin with Fe concretions and occasional Calcrete concretions, **SLIGHTLY FERRUGINISED ALLUVIUM**.

2.40 – 2.90: Moist to very moist, greyish white mottled pink to orange, firm to medium dense, **relict structured**, clayey silty SAND with occasional fine plagioclase fragments, **INTERPRETED AS RESIDUAL GRANITE**.

2.90+: As above.

NOTES

1) TLB terminated at 2.90mbgl due to slight sidewall collapse.
2) Soft excavation conditions at termination depth.
3) Water seepage encountered at 2.30m.
4) Sidewall slightly unstable during the time of inspection.
5) Disturbed sample retrieved at 0.50m--1.50m.
6) Disturbed sample retrieved at 2.50m--2.80m.
7) Undisturbed sample retrieved at 1.60m.
8) Excavated next to drainage feature.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1446
X-COORD : 26.802502
Y-COORD : -26.325684

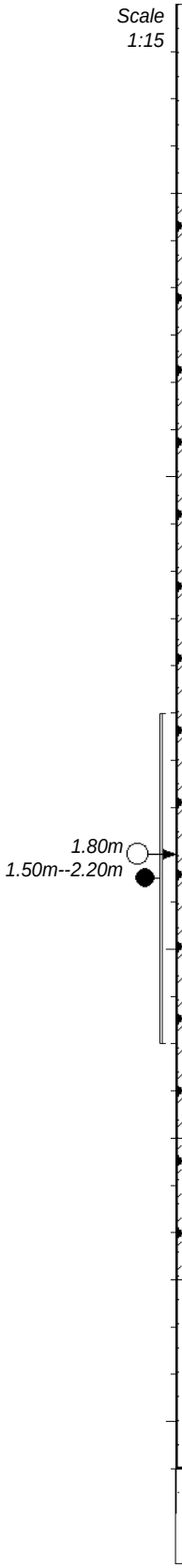
HOLE No: TP10

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET
DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

SANRAL SOC LTD
R30 Section 8 from km 36.8 to km 68.646 (Ventersdorp)

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1 D-SS



0.00 Moist, dark brown, loose to medium dense, **open to pinholed**, clayey silty SAND with occasional traces of sub-rounded gravel of mixed origin, **TOPSOIL**. With scattered fine roots.

0.40 Moist, light brown mottled orange, grey, black and white, firm, **fissured to shattered**, gravelly silty sandy CLAY with traces of sub-angular to sub-rounded gravel of mixed origin with Fe concretions and occasional Calcrete concretions, **SLIGHTLY FERRUGINISED ALLUVIUM**.

2.40 Moist to very moist, greyish white mottled pink to orange brown, firm, **slightly open structured to shattered**, clayey silty SAND with occasional fine plagioclase fragments, **SLIGHTLY FERRUGINISED REWORKED RESIDUAL GRANITE**.

2.70 Moist to very moist, greyish white mottled pink to orange, firm to medium dense, **relict structured**, clayey silty SAND with occasional fine plagioclase fragments, **RESIDUAL GRANITE**.

3.10 As above.

NOTES

1) TLB terminated at 3.10mbgl.
2) Soft excavation conditions at termination depth.
3) Water seepage encountered at 1.80m.
4) No sidewall instability encountered during the time of inspection.
5) Disturbed sample retrieved at 1.50m--2.20m.
6) Excavated next to drainage feature.

CONTRACTOR : Big 5 Plant Hire
MACHINE : CAT 422E (4x2) TLB
DRILLED BY : RockSoil Consult (Pty) Ltd.
PROFILED BY : JI Roux

INCLINATION :
DIAM : 600mm
DATE : 2022-11-10
DATE : 2022-11-15

ELEVATION : 1449
X-COORD : 26.802477
Y-COORD : -26.325791

HOLE No: TP11

TYPE SET BY : JI Roux
SETUP FILE : STANDARD.SET
DATE : 08/12/2022 12:31
TEXT : ..tsSoilProfiles(V1.1).txt

APPENDIX B

TEST PIT PHOTOGRAPHS

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP01	Test Pit no: TP01
	
Note: Soil profile down to 3.00 mbgl.	Note: Upper alluvium.
Test Pit no: TP01	Test Pit no: TP01
	
Note: Remolded lower alluvium.	Note: Lower alluvium.

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP02	Test Pit no: TP02
	
Note: Soil profile down to 3.00 mbgl.	Note: Upper alluvium.
Test Pit no: TP02	Test Pit no: TP02
	
Note: Engineered fill material.	Note: Engineered fill material.

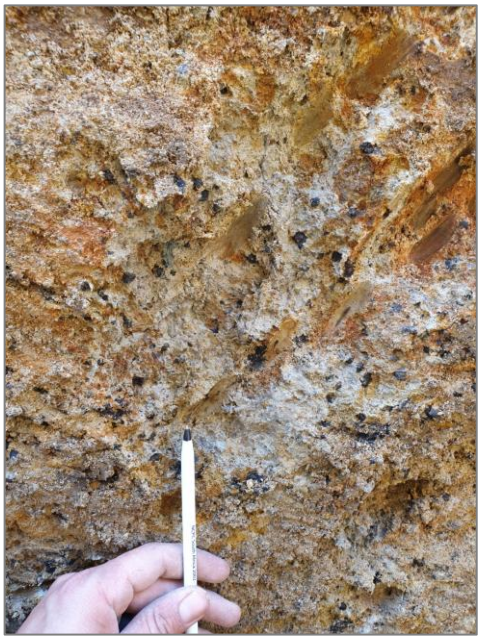
Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP03	Test Pit no: TP03
	
Note: Soil profile down to 3.00 mbgl.	Note: Upper clayey sand alluvium.
Test Pit no: TP03	Test Pit no: TP03
	
Note: Lower alluvium with transported gravel.	Note: Sand and clay bands.

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP04	Test Pit no: TP04
	
Note: Soil profile down to 1.60 mbgl.	Note: Engineered fill material.
Test Pit no: TP04	Test Pit no: TP04
	
Note: Lower alluvium	Note: Lower alluvium.

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP05  Note: Soil profile down to 3.00 mbgl.	Test Pit no: TP05  Note: Slightly ferruginised reworked residual granite.
Test Pit no: TP05  Note: Slightly ferruginised reworked residual granite.	Test Pit no: TP05  Note: Pebble marker

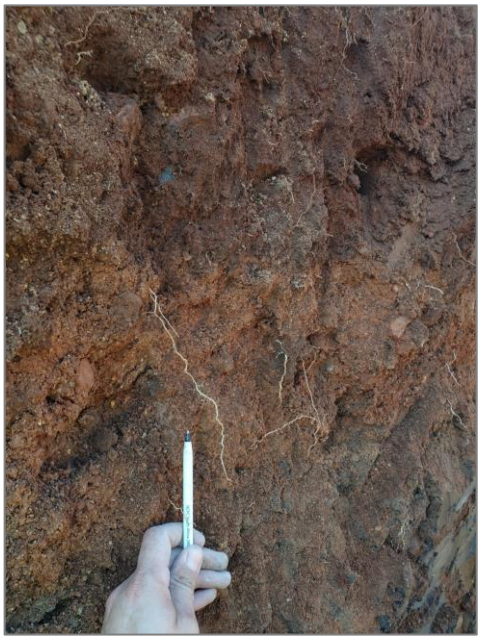
Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP06	Test Pit no: TP06
	
Note: Soil profile down to 2.90 mbgl.	Note: Asphalt in the upper topsoil.
Test Pit no: TP06	Test Pit no: TP06
	
Note: Asphalt	Note: Upper colluvium and pebble marker.

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP07	Test Pit no: TP07
	
Note: Soil profile down to 3.00 mbgl.	Note: Upper disturbed topsoil and engineered fill material.
Test Pit no: TP07	Test Pit no: TP07
	
Note: Slightly ferruginised reworked residual granite.	Note: Slightly ferruginised pebble marker.

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP08	Test Pit no: TP08
	
Note: Soil profile down to 3.20 mbgl.	Note: Upper engineered fill material.
Test Pit no: TP08	Test Pit no: TP08
	
Note: Alluvium.	Note: Clay lumps.

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP09	Test Pit no: TP09
	
Note: Soil profile down to 3.05 mbgl.	Note: Upper engineered fill material.
Test Pit no: TP09	Test Pit no: TP09
	
Note: Lower alluvium.	Note: Upper alluvium.

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP10	Test Pit no: TP10
	
Note: Soil profile down to 2.90 mbgl.	Note: Lower residual granite.
Test Pit no: TP10	Test Pit no: TP10
	
Note: upper clayey alluvium.	Note: Lower residual granite.

Project reference number: RS22047
Project name: R30 Ventersdorp

Test Pit no: TP11



Note: Soil profile down to 3.10 mbgl.

Test Pit no: TP11



Note: Clay lumps.

Test Pit no: TP11



Note: Reworked residual granite.

Test Pit no: TP11



Note: Remolded reworked residual granite.

Project reference number: RS22047
Project name: R30 Ventersdorp

TLB: CAT 422 E



Note: TLB used during time of investigation.

Site Scenery - TP01



Note: On-site conditions.

Project reference number: RS22047
Project name: R30 Ventersdorp

Site Scenery - TP03



Note: On-site conditions.

Site Scenery - TP04



Note: On-site conditions.

Project reference number: RS22047
Project name: R30 Ventersdorp

Site Scenery - TP05



Note: On-site conditions.

Site Scenery - TP07



Note: On-site conditions.

Project reference number: RS22047
Project name: R30 Ventersdorp

Site Scenery - TP08



Note: On-site conditions.

Site Scenery - TP09



Note: On-site conditions.

Project reference number: RS22047
Project name: R30 Ventersdorp

Site Scenery - TP10



Note: On-site conditions.

Site Scenery - TP11



Note: On-site conditions.

APPENDIX C

BOREHOLE LOGS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH01
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1365	NXC	98	--	--	--	
	NXC	103	--	--	--	
	SPT	100	--	--	--	26
1364	NWD4	100	--	--	--	
1363	SPT	100	--	--	--	Ref
	NWD4	--	14	--	14	
1362						
	NWD4	--	10	--	20	
1361						
	NWD4	--	30	--	FZ?	
1360	NWD4	--	36	--	FZ?	
	NWD4	--	60	--	FZ?	
1359	NWD4	--	70	--	18	
	NWD4	--	84	43	12	
1358	NWD4	--	52	--	FZ?	
	NWD4	--	40	--	FZ?	
1357	NWD4	--	40	--	FZ?	
	NWD4	--	60	37	18	
1356	NWD4	--	126	--	28	
	NWD4	--	70	--	FZ?	
1355	NWD4	--	80	25	14	

DEPTH Scale 1:50: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

Scale 1:50

0.03

0.00 — Black speckled red to grey, firm to soft with depth, **shattered to slightly open structured**, (gravelly) silty clayey SAND to silty sandy CLAY interlayered with traces of subangular to rounded gravel of mixed origin, **ALLUVIUM**. Scattered fine roots present to the top.

2.40 — Grey speckled white to pink red and black, soft to firm, **slightly open structured to slightly shattered**, silty sandy clay with traces of plagioclase fine gravel and subrounded gravel of mixed origin, **INTERPRETED AS REWORKED RESIDUAL GRANITE**.

2.50--3.00

3.03 — White to pink speckled to mottled black to grey, **completely to highly weathered and moderately to slightly weathered in places**, coarse grained, very highly to highly fractured, very soft to medium hard rock in places, **GRANITE**.

Note: Prominent shearing and fractures present. Prominent slightly weathered core section between at 9.50 to 11.50 m.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH01
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50
1354	NWD4	--	94	--	FZ?		12
	NWD4	--	38	--	FZ?		
1353	NWD4	--	--	--	--		13
1352	NWD4	--	--	--	--		14
	NWD4	--	66	--	FZ?		
	NWD4	--	--	--	--		
1351	NWD4	--	--	--	--		15
	NWD4	--	--	--	--		
1350	NWD4	--	32	--	FZ?		16
	NWD4	--	--	--	--		
1349	NWD4	--	--	--	--		17
	NWD4	--	40	--	FZ?		
1348	NWD4	--	60	--	FZ?		18
1347	NWD4	--	30	--	FZ?		19
	NWD4	--	44	--	FZ?		
1346	NWD4	--	--	--	--		20
							20.32

As above. EOH.

NOTES

1) Hole terminated at 20.32 mbgl.
2) Disturbed sample retrieved at 2.50--3.00 m.
3) Water table level measured at 0.03 mbgl, two weeks after drilling.
4) Material and core recoveries > 100 are due to sample retrieval method.
5) SPT refusal considered >50 blows for 15 cm.
6) FZ? - Potential Fracture Zone, partial core loss and broken core, difficult to measure realistic fracture frequency.
7) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.
8) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R & YWE D45
DRILLED BY : Willie & Samson
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/10/31-2022/11/08
DATE : 30/11/2022

ELEVATION : 1366m
X-COORD : 26.703458
Y-COORD : -26.456903

HOLE No: BH01

TYPE SET BY : JI Roux (Review DH Wessels)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

HOLE No: BH02
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH02
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1365	NXC	89	--	--	--	
	NXC	92	--	--	--	
	SPT	73	--	--	--	8
1364	NWD4	9	--	--	--	
1363	NWD4	37	--	--	--	
1362	NWD4	40	--	--	--	
	SPT	100	--	--	--	Ref
1361	NWD4	16	--	--	--	
1360	NWD4	--	--	--	--	
	NWD4	--	--	--	--	
1359	NWD4	--	--	--	--	
	SPT	100	--	--	--	Ref
	NWD4	--	--	--	--	
1358	NWD4	67	--	--	--	
	NWD4	--	107	27	13	
1357	NWD4	--	93	36	13	
1356	NWD4	--	110	84	4	
1355	NWD4	--	68	78	5	

DEPTH Scale 1:50

Scale 1:50

1.20--1.50

5.80--6.00

9.42

0.00 Dark brown to black speckled white, soft to firm, **intact**, (gravelly) silty clayey SAND with traces of subrounded quartz gravel, **INTERPRETED AS ALLUVIUM**.

1.95 Core loss due to wash boring. **INTERPRETED AS ALLUVIUM**.

2.81 Grey, **CONCRETE**. Seemingly part of bridge.

3.00 Light brown to brown and grey speckled red to green and white, loose to medium dense, **relict structured to slightly open**, (clayey) gravelly silty SAND with traces of subangular plagioclase fine gravel, **RESIDUAL GRANITE**.

6.00 Core loss due to wash boring. **INTERPRETED AS RESIDUAL GRANITE**.

7.50 Greenish grey speckled white to red, firm, **relict structured**, (clayey) gravelly silty SAND with subangular plagioclase gravel, **INTERPRETED AS RESIDUAL GRANITE**.

8.30 Grey speckled green to black mottled red, **moderately to slightly unweathered**, coarse grained, highly fractured, soft to medium hard rock, **GRANITE**.

Note: Joints are inclined at approx. 45 degrees and stained green to black. Joints are planar rough to undulating rough.

9.00 Grey speckled green to black mottled red, **slightly to unweathered**, coarse grained and massive, highly to moderately fractured, medium hard to hard rock, **GRANITE**.

Note: Joints are inclined at approx. 45 degrees and stained green to black. Joints are planar rough to undulating rough.

JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH02
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50
1354							12
							11.70
							12.30

As above. EOH.

NOTES

1) Hole terminated at 12.30 mbgl.
2) Disturbed sample retrieved at 1.20--1.50 m and 5.80--6.00 m.
3) Undisturbed samples retrieved at 9.42 m and 11.70 m.
4) No piezometer installed.
5) Material and core recoveries > 100 are due to sample retrieval method.
6) SPT refusal considered >50 blows for 15 cm.
7) Coordinates measured out (GE image 2021/03/05).
8) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/03-2022/11/07
DATE : 01/11/2022

ELEVATION : 1366m
X-COORD : 26.728728
Y-COORD : -26.421329

HOLE No: BH02

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

HOLE No: BH03
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

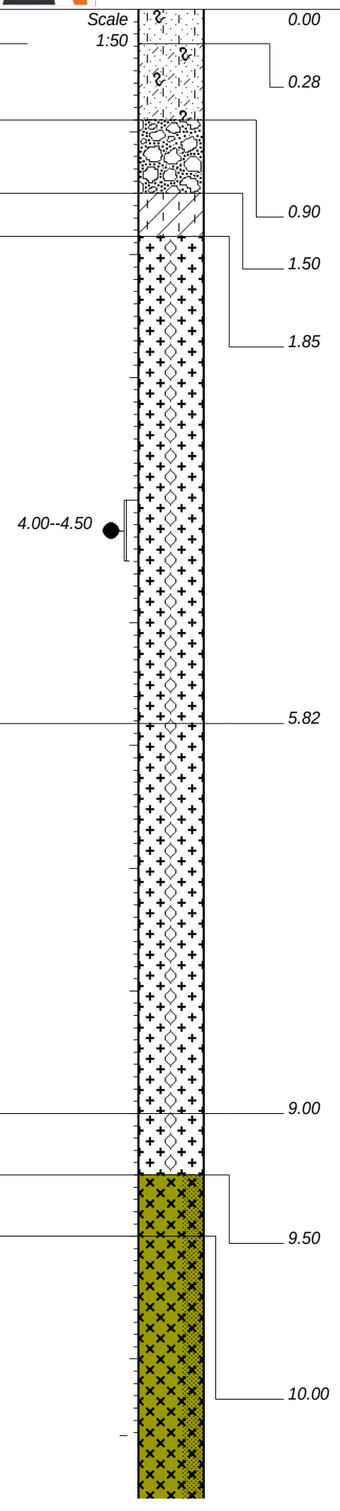
SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH03
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1371	NXC	100	--	--	--	
	NXC	--	--	--	--	
	SPT	100	--	--	--	4
1370	NWD4	38	--	--	--	
1369	SPT	92	--	--	--	Ref
	NWD4	--	--	--	--	
1368	NWD4	82	--	--	--	
1367	NWD4	--	10	--	FZ?	
1366	NWD4	--	86	26	16	
	NWD4	--	50	--	18	
1365	NWD4	--	22	--	FZ?	
	NWD4	--	30	--	FZ?	
1364	NWD4	--	32	--	FZ?	
	NWD4	--	40	--	FZ?	
1363	NWD4	--	88	39	16	
	NWD4	--	60	--	FZ?	
1362	NWD4	--	52	--	FZ?	
	NWD4	--	60	33	6	
1361	NWD4	--	62	44	14	

DEPTH Scale 1:50



Dark brown, clayey silty SAND, **INTERPRETED AS ALLUVIUM (TOPSOIL)**. Scattered fine roots present with organic material.

Dark grey streaked black to speckled to mottled white and orange, firm, (gravelly) silty clayey SAND with traces of subrounded gravel of mixed origin (predominantly quartz), **INTERPRETED AS ALLUVIUM**. Roots present.

Grey with pink to blueish grey aggregate, **CONCRETE**.

Dark brown to black, very soft to soft, **intact**, (sandy) silty CLAY with occasional organic material, **ALLUVIUM**.

Grey mottled pink/red to black, **completely weathered**, coarse grained, very soft rock, **GRANITE** (ISRM1981 rock class R0 (possibly very dense)).

Note: Easily scrapable by scrapper/knife. Grey speckled green mottled white to pink, medium dense to dense, relict structured, residual zones present. Joints not clearly visible.

Grey speckled to mottled pink to white and green, **completely to highly weathered**, coarse grained, very highly to highly fractured, very soft to soft rock, **GRANITE**.

Note: Core loss present due to completely weathered or residual zone. Joints typically 45 degrees. Green staining on joints with <1mm sandy silty clay infill. Joints are typically planar rough to undulating rough.

Grey (glassy) speckled green mottled white to pink/red, **moderately to slightly weathered**, coarse grained, very highly to highly fractured, medium hard to hard rock, **GRANITE**.

Note: Alteration present due to intrusion below.

Khaki green speckled to mottled grey occasionally stained orange, **completely to highly weathered** fine grained, very highly fractured, very soft to soft rock, **DIABASE INTRUSION?**.

Note: Sheared top contact zone. Occasional residual zones between intact blocks.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH03
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50
1360							12
1359	NWD4	--	104	46	11		13
							13.43
1358	NWD4	--	105	54	6	13.90	14
							14.53
1357	NWD4	--	98	69	11		15
1356							16
							16.10

Khaki green becoming purple streaked orange to white, **highly to moderately weathered**, fine grained and flow banded, very highly to highly fractured, soft rock, **DIABASE INTRUSION?**.

Note: Scratches with nail on joint edges. Joint edges are very soapy. Joints are approx. 30 degrees to subvertical, stained orange, planar rough to undulating slickensided with occasional sandy clayey silt infill of <1mm.

Dark greenish grey streaked orange to white, **slightly weathered**, fine grained with flow bands, highly fractured, soft rock to medium hard rock (lower bound), **DIABASE INTRUSION?**.

Note: Very highly fractured on basal contact with granite and sheared.

Dark to light grey speckled to mottled white to pinkish red and green, **slightly to unweathered**, coarse grained, massive, very highly to moderately fractured, medium to hard rock, **GRANITE**.

Note: Joints are approx. 40-50 degrees, planar rough and stained greenish black. Matrix to the top at intrusion is more dark grey. Occasional subvertical joint sets present.

As above. EOH.

NOTES

1) Hole terminated at 16.10 mbgl.
2) Disturbed sample retrieved at 4.00--4.50 m.
3) Undisturbed sample retrieved at 13.90 m.
4) No piezometer installed.
5) Material and core recoveries > 100 are due to sample retrieval method.
6) SPT refusal considered >50 blows for 15 cm.
7) FZ? - Potential Fracture Zone, partial core loss and broken core, difficult to measure realistic fracture frequency.
8) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.
9) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)
TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/07-2022/11/09
DATE : 23/11/2022
DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

ELEVATION : 1372m
X-COORD : 26.728552
Y-COORD : -26.421321

HOLE No: BH03

HOLE No: BH04
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH04
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1370	NXC	59	--	--	--	
	NXC	80	--	--	--	
	SPT	100	--	--	--	20
1369	NWD4	91	--	--	--	
	NWD4	73	--	--	--	
1368	NWD4	48	--	42	--	
1367	NWD4	--	70	29	9	
1366	NWD4	--	100	67	11	
1365	NWD4	--	100	97	4	
1364	NWD4	--	90	56	8	
1363	NWD4	--	100	75	6	
1362	NWD4	--	101	77	6	
1361						

DEPTH Scale 1:50

Scale 1:50

1.00--1.50

5.75

0.00 Dark brown mottled grey to black, soft to firm, **intact**, silty sandy CLAY with traces of subrounded gravel of mixed origin, **ALLUVIUM**. Scattered fine roots present.

0.85 Light brown speckled to mottled white to orange and grey, soft to firm, **intact to occasionally slightly open structured**, silty clayey SAND to clayey gravelly silty SAND with depth with minor amounts of subangular to subrounded plagioclase and quartz gravel fragments, **INTERPRETED AS RESIDUAL GRANITE**.

Note: Zone is reworked at the top.

2.52 Light brown to grey to khaki brown mottled white to red and pink, **completely to highly weathered**, coarse grained, highly fractured, very soft rock, **GRANITE**.

Note: Extremely weak to very weak rock with depth (ISRM 1981 rock class, R0 (dense to very dense?) to R1 with depth).

5.20 Khaki green to blueish grey streaked white, **moderately to unweathered**, fine grained and flow banded, very soft rock to soft rock occasionally medium hard rock, **DIABASE INTRUSION?**.

Note: Highly weathered, very soft rock, fracture zones from 5.25 to 5.50m and 7.50 to 7.80m. Undulating rough joints, stained orange. Possible sheared towards the base and the top contact?.

7.80 Grey to dark grey mottled white and streaked red, **slightly to unweathered**, coarse grained, highly to moderately fractured, medium hard rock, **GRANITE**.

Note: Alteration by intrusion. Subvertical joints with khaki brown, sandy silty clay infill <1mm in some joints. Joints are undulating rough.

9.67 Khaki green to dark grey streaked white, **unweathered**, fine grained and flow banded, highly to moderately fractured, **DIABASE**.

Note: Joints are planar smooth to undulating rough, orientated approx. 45 degrees with staining.

10.71 As above. EOH.

NOTES

1) Hole terminated at 10.71 mbgl.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH04
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

2) Disturbed sample retrieved at 1.00--1.50 m.

3) Undisturbed sample retrieved at 5.75 m.

4) No piezometer installed.

5) Material and core recoveries > 100 are due to sample retrieval method.

6) SPT refusal considered >50 blows for 15 cm.

7) Coordinates measured out (GE image 2021/03/05).

8) Elevation data from GPS data.

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Mzambia
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/10/29-2022/10/31
DATE : 01/11/2022

ELEVATION : 1371m
X-COORD : 26.728772
Y-COORD : -26.421194

HOLE No: BH04

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

HOLE No: BH05
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH05
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1377	NXC	92	--	--	--	
	NXC	112	--	--	--	
	SPT	100	--	--	--	30
1376	NWD4	--	47	--	FZ?	
1375	NWD4	--	80	--	FZ?	
1374	NWD4	--	89	--	FZ?	
1373	NWD4	--	100	65	10	
	NWD4	--	104	46	12	
1372	NWD4	--	95	42	13	
1371	NWD4	--	99	77	5	
1370	NWD4	--	99	75	3	
1369	NWD4	--	101	89	2	
1368	NWD4	--	96	100	1	
1367						

DEPTH Scale 1:50

Scale 1:50

0.30--0.60
0.71
1.30--1.50
5.50
9.55

0.00 Dark brown mottled grey to black, soft to firm, **intact**, silty sandy CLAY with traces of subrounded gravel of mixed origin, **ALLUVIUM**. Scattered fine roots present.

0.60 Dark brown speckled white to grey, loose to medium dense, **intact**, silty clayey SAND with traces of subrounded to rounded gravel of mixed origin, **ALLUVIUM**. Scattered fine roots present.

0.90 Light brown to grey speckled white to red and orange, firm, **relict structured to slightly open**, gravelly silty clayey SAND with traces of subangular plagioclase and quartz. **INTERPRETED AS REWORKED RESIDUAL GRANITE**.
Note: Light brown, silty sandy clay, infill. Infilling occasionally <2mm.

1.80 Khaki brown to khaki green stained orange, **completely to highly weathered**, fine grained, very highly fractured, very soft rock, **DIABASE**.
Note: Extremely weak to very weak rock (ISRM 1981 rock class, R0 (very dense?) to R1). Potential fracture zone?.

4.78 Pinkish red speckled green and black mottled grey, **slightly to unweathered**, coarse grained and massive, highly to slightly fractured, medium hard to hard rock, **GRANITE**.
Note: Joints are undulating rough. Joints generally approx. 30 to 70 degrees and stained brownish green.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH05
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50
			100	100	--		12
1366	NWD4	--	105	76	8		
			100	--	FZ?		12.33
1365	NWD4	--	109	86	2		13
1364	NWD4	--	95	90	3		14
1363							15
							15.04

11.73

Dark greenish grey, **unweathered**, fine grained, very highly to highly fractured, hard rock, **DIABASE**.

Pinkish red speckled green and black mottled grey, **unweathered**, coarse grained and massive, moderately to slightly fractured, medium hard to hard rock, **GRANITE**.

Note: Joints are undulating rough. Joints generally approx. 30 to 70 degrees and stained brownish green.

As above. EOH.

NOTES

1) Hole terminated at 15.04 mbgl.
2) Disturbed samples retrieved at 0.30--0.60 m and 1.30--1.50 m.
3) Undisturbed samples retrieved at 5.50 m and 9.55 m.
4) Water table level measured at 0.71 mbgl, seven days after drilling.
5) Material and core recoveries > 100 are due to sample retrieval method.
6) SPT refusal considered >50 blows for 15 cm.
7) FZ? - Potential Fracture Zone, partial core loss and broken core, difficult to measure realistic fracture frequency.
8) Coordinates measured out (GE image 2021/03/05).
9) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Mzambia
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)
TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/10/26-2022/10/28
DATE : 01/11/2022
DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

ELEVATION : 1378m
X-COORD : 26.728627
Y-COORD : -26.421138

HOLE No: BH05

HOLE No: BH06
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH06
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1366	NXC	68	--	--	--	
	NXC	93	--	--	--	
	SPT	100	--	--	--	
1365	NWD4	100	--	--	--	Ref
	NWD4	--	90	47	10	
1364	NWD4	--	88	38	12	
1363	NWD4	--	97	45	12	
1362	NWD4	--	66	34	9	
1361	NWD4	--	83	--	18	
1360	NWD4	--	104	18	15	
1359	NWD4	--	101	88	4	
1358	NWD4	--	102	100	1	
1357						
1356						

DEPTH Scale 1:50

Scale 1:50

0.75--1.25

4.48

0.00 Dark brown speckled white, soft to firm, **intact**, silty clayey SAND with traces of subrounded gravel of mixed origin, **ALLUVIUM**.

1.40 Light brown mottled blueish green to grey and orange, medium dense to dense, **relict structured**, silty clayey SAND with traces of subrounded gravel of mixed origin, **ALLUVIUM**.

1.82 Khaki brown to grey speckled to mottled whitish green and red, **highly to slightly weathered**, coarse grained, massive to sheared (hydrothermal bands), very highly to moderately fractured, soft to medium hard rock, **GRANITE**.

Note: Random to near vertical orientated joints, stained orange with occasional sandy clay infill with a thickness of <1mm. Joints are undulating rough.

5.57 Khaki green to blueish grey streaked white, **highly to slightly weathered**, fine grained and flow banded, very highly to highly fractured, soft rock, **DIABASE INTRUSION?**.

Note: Possible shearing. Random oriented joints, stained orange to occasionally khaki green with silty clayey sand infill up to <2mm. Joints are undulating rough.

7.94 Pinkish red speckled green and black mottled to streaked grey to red, **slightly to unweathered**, coarse grained and flow banded, very highly to slightly fractured, medium hard to hard rock, **GRANITE**.

Note: Alteration due to intrusion. Near vertical joints, stained khaki green, clean and undulating rough.

JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH06
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50
1355	NWD4	--	97	82	3		12
							12.11

As above. EOH.

NOTES

1) Hole terminated at 12.11 mbgl.
2) Disturbed sample retrieved at 0.75--1.25 m.
3) Undisturbed sample retrieved at 4.48 m.
4) No piezometer installed.
5) Material and core recoveries > 100 are due to sample retrieval method.
6) SPT refusal considered >50 blows for 15 cm.
7) Coordinates measured out (GE image 2021/03/05).
8) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Mzambia & Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/10/26-2022/10/28
DATE : 01/11/2022

ELEVATION : 1367m
X-COORD : 26.728805
Y-COORD : -26.421121

HOLE No: BH06

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

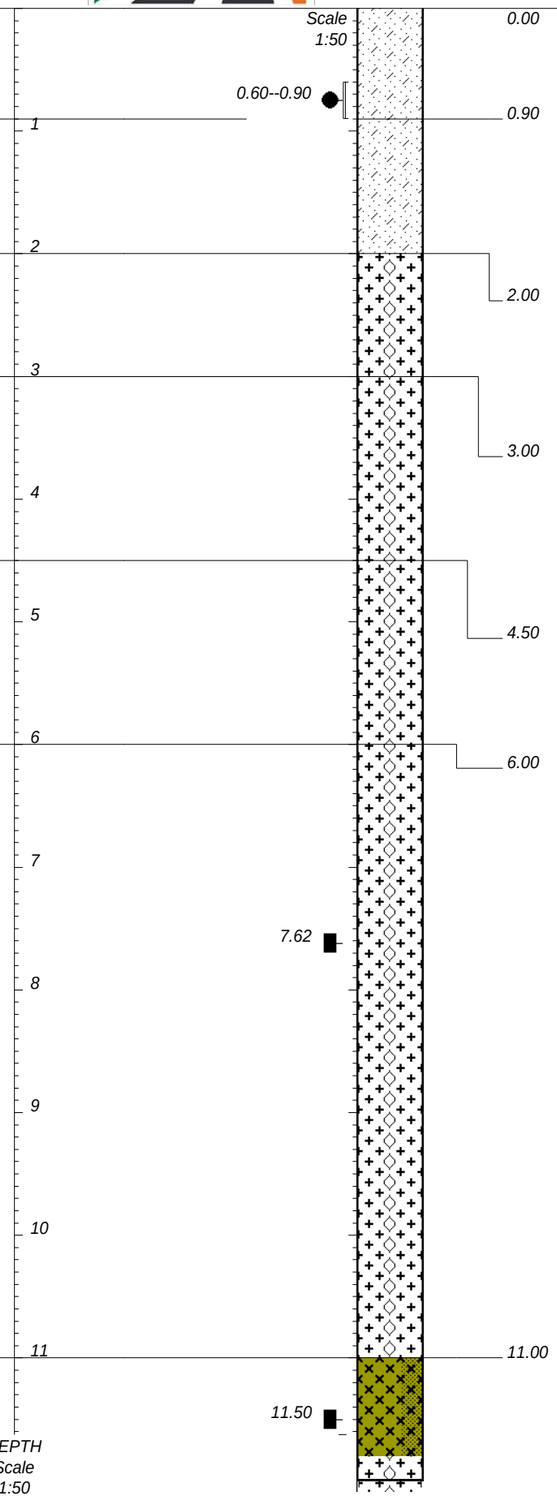
DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH07
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1378	NXC	44	--	--	--	
	SPT	100	--	--	--	9
	NXC	100	--	--	--	
	SPT	100	--	--	--	10
1377	NWD4	--	57	17	6	
1376	NWD4	--	50	13	11	
1375	NWD4	--	75	--	FZ?	
1374	NWD4	--	75	27	7	
1373	NWD4	--	103	45	8	
1372	NWD4	--	103	36	10	
1371	NWD4	--	87	42	11	
1370						
1369						
1368						



Dark brown to red brown, medium dense, **slightly open to slightly shattered**, (gravelly) silty clayey SAND with traces of subrounded gravel of mixed origin, **ALLUVIUM**.

Light brown speckled to mottled white to orange and grey, soft to firm, **intact to occasionally slightly open structured**, silty clayey SAND to clayey gravelly silty SAND with depth with minor amounts of subangular to subrounded plagioclase and quartz gravel fragments, **INTERPRETED AS RESIDUAL GRANITE**.

Note: Zone is reworked at the top.

Light brown to grey to khaki brown mottled white to red and pink, **completely to highly weathered**, coarse grained, highly fractured, very soft to soft rock, **GRANITE**.

Note: Extremely weak to very weak rock with depth (ISRM 1981 rock class, R0 (dense to very dense) to R1 with depth).

Light brown to grey to khaki brown mottled white to red and pink, **highly to moderately weathered**, coarse grained, very highly to highly fractured, soft to medium hard rock, **GRANITE**.

Note: Very weak to weak rock with depth (ISRM 1981 rock class, R1 to R2 with depth). Orange staining on joints with <1 mm silty clayey sand infill.

Pinkish white mottled green and grey, **moderately to slightly weathered**, coarse grained, very highly to highly fractured, medium hard rock to occasionally soft rock, **GRANITE**.

Note: Joints are subvertical to vertical and stained khaki to orange.

Pinkish white mottled green and grey, **slightly to unweathered**, coarse grained and massive, very highly to highly fractured, medium hard to hard rock, **GRANITE**.

Note: Joints are stained green at angles of approx. 45 to 85 degrees.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH07
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50
1367							0
							12
							11.80
							12.00

Khaki green to dark grey, **unweathered**, fine grained, massive, very highly to moderately fractured, medium hard rock, **DIABASE**

Pinkish white mottled green and grey, **slightly to unweathered**, coarse grained, massive, highly fractured, hard rock, **GRANITE**.
Note: Joints are stained green and inclined at approx. 45 to 85 degrees.

As above. EOH.

NOTES

1) Hole terminated at 12.00 mbgl.
2) Disturbed sample retrieved at 0.60--0.90 m.
3) Undisturbed samples retrieved at 7.62 m and 11.50 m.
4) No piezometer installed.
5) Material and core recoveries > 100 are due to sample retrieval method.
6) SPT refusal considered >50 blows for 15 cm.
7) FZ? - Potential Fracture Zone, partial core loss and broken core, difficult to measure realistic fracture frequency.
8) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.
9) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Willie
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/10/26-2022/10/27
DATE : 01/11/2022

ELEVATION : 1379m
X-COORD : 26.728664
Y-COORD : -26.421026

HOLE No: BH07

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

HOLE No: BH08
Sheet 1 of 2

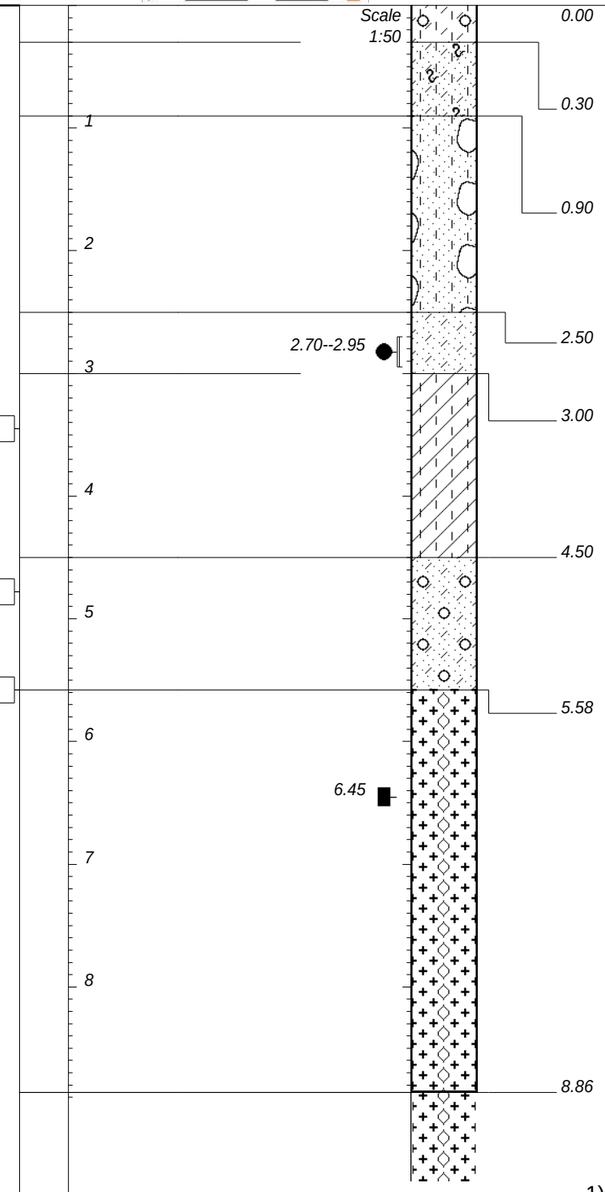
JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH08
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1380	NXC	100	--	--	--	
	NXC	80	--	--	--	
1379	NWD4	22	--	--	--	
	NWD4	16	--	--	--	
1378	NWD4	96	--	--	--	
	SPT	89	--	--	--	8
1377	NWD4	10	--	--	--	
	SPT	71	--	--	--	Ref
1376	NWD4	--	--	--	--	
	SPT	--	--	--	--	Ref
1375	NWD4	--	87	60	9	
	NWD4	--	77	74	5	
1374	NWD4	--	147	84	13	
	NWD4	--	89	100	3	
1373	NWD4	--	168	100	--	
	NWD4	--	85	38	7	
	NWD4	--	113	100	2	



0.00 – 0.30 m: Brown, medium dense, **structureless to slightly open?**, clayey gravelly silty SAND with angular to subrounded gravel of mixed origin, **INTERPRETED AS TOPSOIL**.

0.30 – 0.90 m: Dark brown to brown mottled white, firm, **intact to slightly shattered**, (sandy) silty clay to clayey silty fine SAND, **ALLUVIUM**. Scattered roots present.

0.90 – 2.50 m: Matrix washed out due to wash boring. Occasional black, silty SAND present with gravel to cobble size fragments, **ALLUVIUM**.

Note: Angular to subrounded chert, quartzite and quartz cobbles to gravel present.

2.50 – 3.00 m: Grey speckled white to orange, firm, **slightly shattered to open structured**, silty clayey SAND, **ALLUVIUM**.

3.00 – 4.50 m: Dark brown to black speckled to mottled orange and brown, soft to firm, **intact to slightly shattered**, (sandy) silty CLAY to silty sandy CLAY, **INTERPRETED AS ALLUVIUM**.

Note: Scattered subrounded quartz gravels of mixed origin present.

4.50 – 5.58 m: Core loss, from SPT sample.Grey speckled purple to orange and red, loose to medium dense, **structureless**, clayey gravelly SAND with minor amounts of subrounded fine gravels of mixed origin (contamination), **INTERPRETED AS RESIDUAL TO COMPLETELY WEATHERED GRANITE?**.

5.58 – 8.86 m: Greenish grey speckled green mottled pink to white, **slightly weathered**, coarse grained and flow banded, very highly to moderately fractured, medium hard to hard rock, **GRANITE**.

Note: Joints are approx. 20 degrees to subvertical, clean, stained orange and planar rough. Prominent tension joints with green to greenish blue hydrothermal infilling?

8.86 m: As above. EOH.

NOTES

1) Hole terminated at 8.86 mbgl.
2) Disturbed sample retrieved at 2.70--2.95 m.
3) Undisturbed sample retrieved at 6.45 m.
4) No piezometer installed.
5) Material and core recoveries > 100 are due to sample retrieval method.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH08
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

6) SPT refusal considered >50 blows for 15 cm.

7) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.

8) Elevation data from GPS data.

9) High core recoveries possible due to incorrect stick-up.

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/10-2022/11/15
DATE : 23/11/2022

ELEVATION : 1381m
X-COORD : 26.736497
Y-COORD : -26.407211

HOLE No: BH08

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

HOLE No: BH09
Sheet 1 of 2

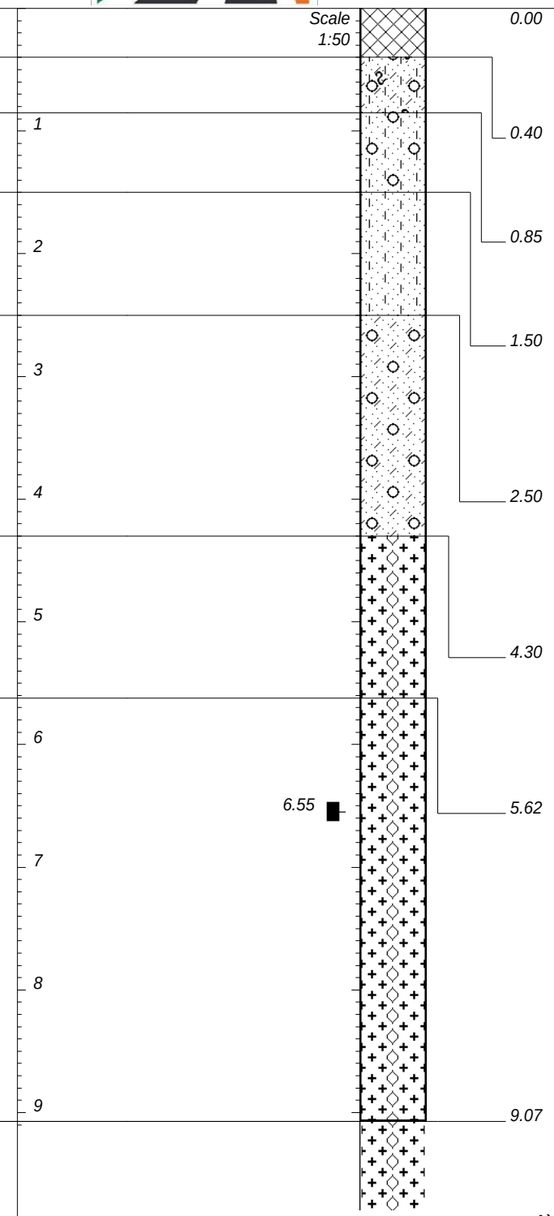
JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH09
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
	NXC	100	--	--	--	
1381	NXC	46	--	--	--	
	NWD4	--	--	--	--	
1380	NWD4	--	--	--	--	
	SPT	78	--	--	--	10
1379	NWD4	33	--	--	--	
	NWD4	9	--	--	--	
1378	NWD4	--	--	--	--	
	SPT	100	--	--	--	Ref
	NWD4	83	--	--	--	
	NWD4	72	--	--	--	
1377	NWD4	18	--	--	--	
	NWD4	--	27	--	9	
1376	NWD4	--	61	65	15	
	NWD4	--	96	71	9	
1375	NWD4	--	92	100	3	
1374	NWD4	--	94	98	2	
1373						



Brown to red brown mottled white to orange and grey, medium dense to dense, silty gravelly clayey SAND with minor amounts of angular gravels of quartz, chert and granite, **INTERPRETED AS ENGINEERD FILL MATERIAL**.

Dark brown mottled white to grey, firm, gravelly silty clayey SAND with traces of subrounded gravel of mixed origin, **TOPSOIL**. Scattered fine roots present.

Brown to light brown, loose to medium dense? **pinholed to open structured?**, (clayey) silty gravelly SAND with minor amounts of gravel to cobble sized quartz to quartzite/sandstone fragments, **ALLUVIUM**.

Core loss due to wash boring. Material described from SPT. Light brown speckled black to orange and grey, loose to medium dense, **structureless**, (clayey) silty SAND with traces of subrounded to rounded fine gravel of mixed origin, **ALLUVIUM**.

Note: Occasional grey silty clay lenses present.

Khaki brown mottled grey to white blotched blueish grey, firm? to stiff, silty gravelly clayey SAND with minor amounts of subangular quartz and plagioclase gravel, **INTERPRETED AS REWORKED RESIDUAL GRANITE**.

Note: Contamination (quartzite fragments) from above.

Light brown speckled to mottled pinkish red to white and grey, **completely weathered**, coarse grained, very soft rock, **GRANITE**.

Note: Extremely weak rock (ISRM 1981 rock class, R0 (dense to very dense?). Core loss in places. Fragments from SPT can be broken by hard pressure between thumb and index finger.

Whitish grey speckled to mottled pinkish red to green and black, **slightly to unweathered**, coarse grained and flow banded, very highly to slightly fractured with depth, hard to very hard rock, **GRANITE**.

Note: Joints are clean, planar rough to undulating smooth, stained brown to black and typically 30 to 70 degrees.

As above. EOH.

NOTES

1) Hole terminated at 9.07 mbgl.
2) No disturbed sample retrieved.
3) Undisturbed sample retrieved at 6.55 m.
4) No piezometer installed.
5) SPT refusal considered >50 blows for 15 cm.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH09
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

6) FZ? - Potential Fracture Zone, partial core loss and broken core, difficult to measure realistic fracture frequency.

7) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.

8) Elevation data from GPS data.

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D45
DRILLED BY : Willie
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/14-2022/11/17
DATE : 29/11/2022

ELEVATION : 1382m
X-COORD : 26.736411
Y-COORD : -26.406985

HOLE No: BH09

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

HOLE No: BH10
Sheet 1 of 2

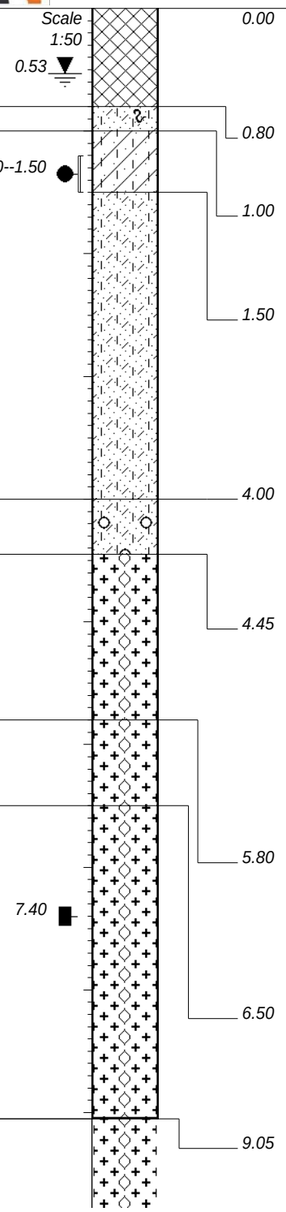
JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH10
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1382	NXC	99	--	--	--	
	NXC	100	--	--	--	
	SPT	89	--	--	--	
1381	NWD4	95	--	--	--	4
	NWD4	100	--	--	--	
1380	SPT	76	--	--	--	
	NWD4	96	--	--	--	10
1379	NWD4	82	--	--	--	
	SPT	95	--	--	--	Ref
1378	NWD4	--	4	--	--	
	NWD4	--	--	--	--	
	SPT	--	--	--	--	Ref
1377	NWD4	--	88	59	12	
1376	NWD4	--	89	100	2	
	NWD4	--	88	100	3	
1375	NWD4	--	111	100	1	
1374						



Red brown speckled to mottled grey to white and brown, medium dense, **structureless**, gravelly clayey silty SAND with traces of subangular to subrounded gravel of mixed origin, **ENGINEERD FILL MATERIAL**.
Note: Organic material also present.

Brown, medium dense, **structureless**, clayey silty SAND, **TOPSOIL**. Scattered fine roots present.

Dark brown to black speckled white to grey, soft to firm, **slightly open to slightly shattered**, silty fine sandy CLAY, **INTERPRETED AS ALLUVIUM**. Scattered fine roots present.

Light grey to light brown/khaki brown streaked blueish grey, very soft to soft with depth, **intact to slightly open**, gravelly silty clayey SAND with minor amounts of subangular quartz and plagioclase gravel and Fe concretions, **RESIDUAL GRANITE**.

Khaki brown, firm, **relict structured**, gravelly silty clayey SAND with minor amounts of subangular quartz and plagioclase gravel and Fe concretions, **RESIDUAL GRANITE**.
Note: Contamination of quartz and quartzite fragments from above.

Light brown to grey mottled white to pink, **completely weathered**, coarse grained, massive, very soft rock, **GRANITE**.
Note: Extremely weak rock (ISRM 1981 rock class, R0(dense to very dense?). Moderately to slightly weathered fragments retrieved from 4.70 to 5.20 m. Washed sample collected from 4.70 to 5.20 and 5.20 to 5.70 m. Completely weathered material potentially grinded up by occasional moderately to slightly weathered fragments? SPT from 5.70 to 5.80 m had no sample.

Light brown to grey mottled white to pink, **slightly weathered**, coarse grained and massive, very highly to highly fractured, hard rock, **GRANITE**.
Note: Joints are clean, stained light brown, planar rough and typically approx. 70 degrees to fairly horizontal.

Light brown to grey mottled white to pink, **unweathered**, coarse grained and massive, moderately to slightly fractured, very hard rock, **GRANITE**.
Note: Joints are clean, stained light brown, planar smooth and typically approx. 20 degrees. Less tension joints present.

As above. EOH.

NOTES

1) Hole terminated at 9.05 mbgl.
2) Disturbed sample retrieved at 1.20--1.50 m.
3) Undisturbed sample retrieved at 7.40 m.
4) Water table level measured at 0.53 mbgl, five days after drilling.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH10
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

5) Material and core recoveries > 100 are due to sample retrieval method.

6) SPT refusal considered >50 blows for 15 cm.

7) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.

8) Elevation data from GPS data.

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/16-2022/11/17
DATE : 29/11/2022

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

ELEVATION : 1383m
X-COORD : 26.736716
Y-COORD : -26.406897

HOLE No: BH10

HOLE No: BH11
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1D-SS

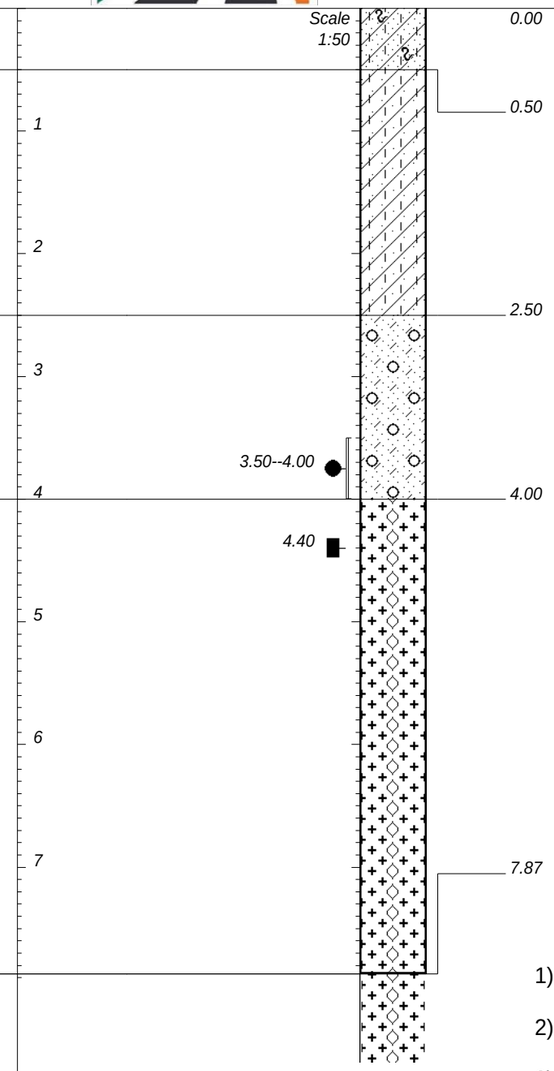
SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH11
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1383	NXC	99	--	--	--	
	NXC	112	--	--	--	
1382	SPT	98	--	--	--	4
	NWD4	98	--	--	--	
1381	NWD4	98	--	--	--	
	SPT	84	--	--	--	11
1380	NWD4	109	--	--	--	
	NWD4	--	100	81	8	
1379	NWD4	--	88	50	11	
1378	NWD4	--	100	86	9	
1377	NWD4	--	104	85	4	

DEPTH Scale 1:50



0.00 – 0.50: Dark brown to black, firm, **intact to slightly shattered**, sandy silty CLAY to clayey silty fine SAND, **ALLUVIUM**. Scattered fine roots present.
Note: Material very organic rich.

0.50 – 2.50: Grey mottled to orange white to black, soft to firm, **shattered**, sandy silty CLAY to (sandy) clayey SILT with calcrete and occasional Fe concretions, **ALLUVIUM**.

2.50 – 4.00: Light brown speckled pink to orange mottled white, soft to firm, **slightly shattered to relict structured with depth**, sandy silty CLAY to clayey gravelly SAND with depth (last 0.50m), **REWORKED RESIDUAL GRANITE**.

4.00 – 7.87: Pinkish red mottled grey to greenish black, **slightly to unweathered**, coarse grained and massive, highly to moderately fractured, medium hard to hard rock, **GRANITE**.
Note: Medium strong to very strong rock (ISRM 1981 rock class, R3 to <R5). Joints are approx. 20 to 70 degrees and planar rough.

7.87: As above. EOH.

NOTES

1) Hole terminated at 7.87 mbgl.
2) Disturbed sample retrieved at 3.50--4.00 m.
3) Undisturbed sample retrieved at 4.40 m.
4) No piezometer installed.
5) Material and core recoveries > 100 are due to sample retrieval method.
6) SPT refusal considered >50 blows for 15 cm.
7) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.
8) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)
TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/18-2022/11/18
DATE : 23/11/2022
DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

ELEVATION : 1384m
X-COORD : 26.736949
Y-COORD : -26.406847

HOLE No: BH11

HOLE No: BH12
Sheet 1 of 2

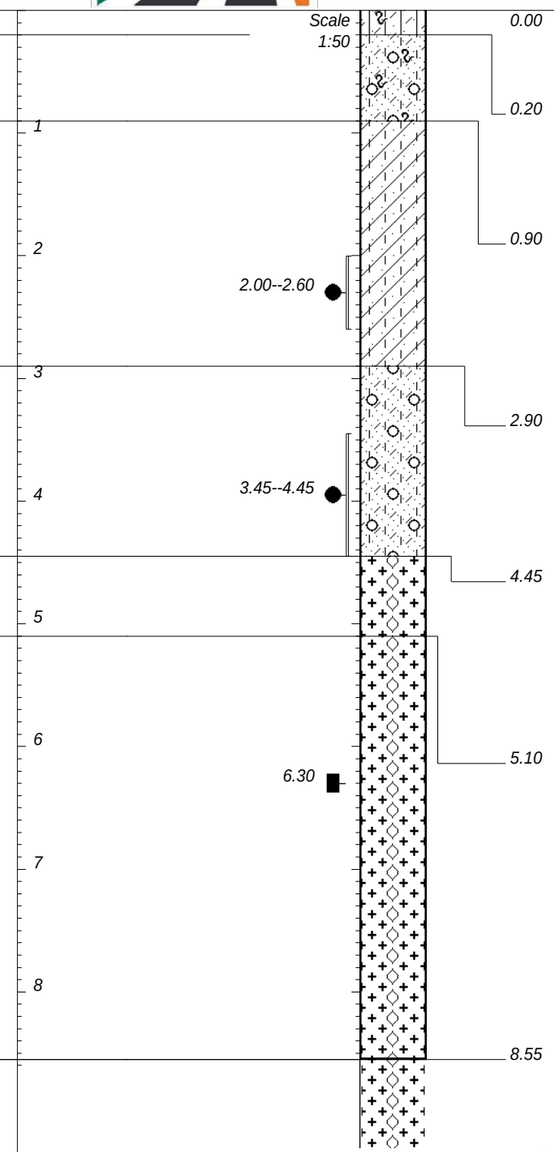
JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH12
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1379	NXC	76	--	--	--	
	NXC	127	--	--	--	
	SPT	--	--	--	--	
1378	NWD4	99	--	--	--	6
1377	SPT	73	--	--	--	
	NWD4	98	--	--	--	9
1376	SPT	80	--	--	--	Ref
1375	NWD4	48	10	--	6	
	NWD4	--	96	--	18	
1374	NWD4	--	54	59	6	
	NWD4	--	101	59	10	
1373	NWD4	--	96	96	6	
1372	NWD4	--	97	95	3	



Light grey to dark brown mottled white and black, firm, **intact**, sandy clayey SILT with traces of Fe and calcrete concretions, **TOPSOIL**. Scattered fine roots present.

Dark brown speckled white mottled orange, firm, **shattered to slightly open structured**, gravelly silty clayey SAND with traces of subrounded quartz gravel, **INTERPRETED AS ALLUVIUM**. Scattered fine roots present.

Grey speckled black to white mottled orange brown, soft to firm, **slightly open structured to slightly shattered**, silty clayey fine SAND to silty fine sandy CLAY with traces of angular to subrounded quartz and plagioclase fine gravel, **INTERPRETED AS HIGHLY REWORKED RESIDUAL GRANITE**. Scattered fine roots present.

Note: Desiccation cracks on drying.

Light grey to light brown/khaki brown with depth speckled to mottled white to black and pink, soft to firm, **intact to slightly open**, gravelly silty clayey SAND with minor amounts of subangular quartz and plagioclase gravel and Fe concretions, **RESIDUAL GRANITE**.

Note: Soft to very soft zone with gravel from 3.90 to 4.40 m.

Light brown to grey mottled white to pink, **completely weathered**, coarse grained, very soft rock, **GRANITE**.

Note: Extremely weak rock (ISRM 1981 rock class, R0(very dense to dense in residual areas). Not all joints are clearly visible. Potential residual zones that wash out during drilling. Can be crushed with force between thumb and index finger.

Light brown to grey mottled white to pink, **slightly to unweathered**, coarse grained, very highly to moderately fractured, medium hard rock (5.10 to 5.65 m) to hard rock, **GRANITE**.

Note: Joints contain thin light brown to orange sandy silty clayey <1 mm cohesive infilling. Joints generally 50 to 70 degrees to occasionally approx. 30 degrees. Slight alteration on joints. Prominent tension joints present with pitted structure to hydrothermal infilling.

As above. EOH.

NOTES

1) Hole terminated at 8.55 mbgl.
2) Disturbed samples retrieved at 2.00--2.60 m and 3.45--4.45 m.
3) Undisturbed samples retrieved at 6.30 m.
4) No piezometer installed.
5) Material and core recoveries > 100 are due to sample retrieval method.
6) SPT refusal considered >50 blows for 15 cm.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH12
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

7) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.

8) Elevation data from GPS data.

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D45
DRILLED BY : Mzambia
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/18-2022/11/19
DATE : 29/11/2022

ELEVATION : 1380m
X-COORD : 26.737015
Y-COORD : -26.407063

HOLE No: BH12

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

HOLE No: BH13
Sheet 1 of 2

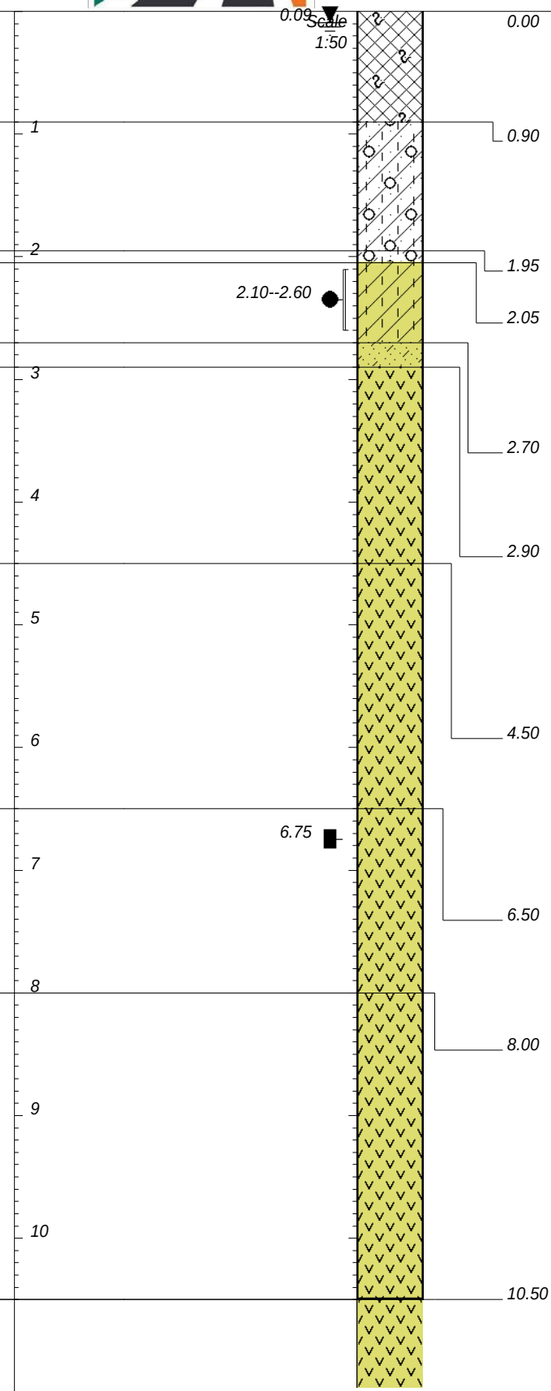
JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH13
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1421	NXC	100	--	--	--	
	NXC	100	--	--	--	
	SPT	100	--	--	--	8
1420	NWD4	85	11	--	6	
1419	NWD4	--	96	--	20	
1418	NWD4	--	83	--	FZ?	
1417	NWD4	--	90	--	29	
1416	NWD4	--	100	17	28	
1415	NWD4	--	84	--	18	
1414	NWD4	--	105	69	8	
1413	NWD4	--	100	100	3	
1412						



DEPTH Scale 1:50

Brown to black speckled to mottled white and orange red, firm, **intact**, silty gravelly clayey SAND to gravelly silty sandy CLAY with occasional seemingly shale fragments, **INTERPRETED AS FILL MATERIAL TO DISTURBED TOPSOIL**. Scattered fine roots present.

Black speckled grey to red, soft to very soft with depth, **slightly open structured to shattered**, gravelly sandy silty CLAY with traces of subangular to rounded predominantly quartz gravel, **ALLUVIUM**. Scattered fine roots.

As above but, silty sandy clayey GRAVEL, **GRAVELLY ALLUVIUM**.

Grey to khaki brown mottled orange to white and blotched blue green, soft to firm, (gravelly) sandy silty CLAY with traces of subangular to rounded quartz and amygdaloidal lava fragments, **REWORKED RESIDUAL AMYGDALOIDAL LAVA**.

Light to khaki brown mottled to blotched black to orange and blueish grey, firm to stiff, **relict structure**, silty clayey fine SAND, **INTERPRETED AS RESIDUAL AMYGDALOIDAL LAVA**.

Brown to blueish grey speckled to mottled blueish grey and black, **highly weathered**, fine grained, very highly to highly fractured (fracture zone), very soft to soft rock (lower bound), **AMYGDALOIDAL LAVA**.

Note: Potential fracture zone. Randomly oriented fractures. Fractures are stained black or grey with sandy silty clay cohesive infilling (<1 mm). Potential completely weathered zone to the base with residuum.

Brownish green to blueish grey mottled white to dark blue occasionally streaked white, **moderately to slightly weathered**, fine grained, very highly to highly fractured (occasional fracture zone areas), soft to medium hard, **AMYGDALOIDAL LAVA**.

Note: Orange brown sandy silty clay cohesive infilling (<2 mm) on joints.

Blueish grey speckled to mottled white to dark blue to black (amygdales), **slightly weathered** fine grained, very highly to highly fractured, medium to hard rock, **AMYGDALOIDAL LAVA**.

Note: Orange sandy clayey silt (<2 mm) infilling.

Blue to greenish grey mottled to blotched dark blue slightly streaked white, **unweathered**, fine grained, moderately to very slightly fractured with depth, hard to very hard rock, **AMYGDALOIDAL LAVA**.

Note: Joints are clean or stained orange, planar smooth and typically 20 to 25 degrees. Sulphide minerals (pyrite) present.

As above. EOH.

NOTES

1) Hole terminated at 10.50 mbgl.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH13
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

2) Disturbed sample retrieved at 2.10--2.60 m.

3) Undisturbed sample retrieved at 6.75 m.

4) Water table level measured at 0.09 mbgl, two days after drilling.

5) Material and core recoveries > 100 are due to sample retrieval method.

6) SPT refusal considered >50 blows for 15 cm.

7) FZ? - Potential Fracture Zone, partial core loss and broken core, difficult to measure realistic fracture frequency.

8) Coordinates measured out (GE image 2021/03/05).

9) Elevation data from GPS data.

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D45
DRILLED BY : Mzambia
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/22-2022/11/22
DATE : 30/11/2022

ELEVATION : 1422m
X-COORD : 26.784207
Y-COORD : -26.354578

HOLE No: BH13

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

HOLE No: BH14
Sheet 1 of 2

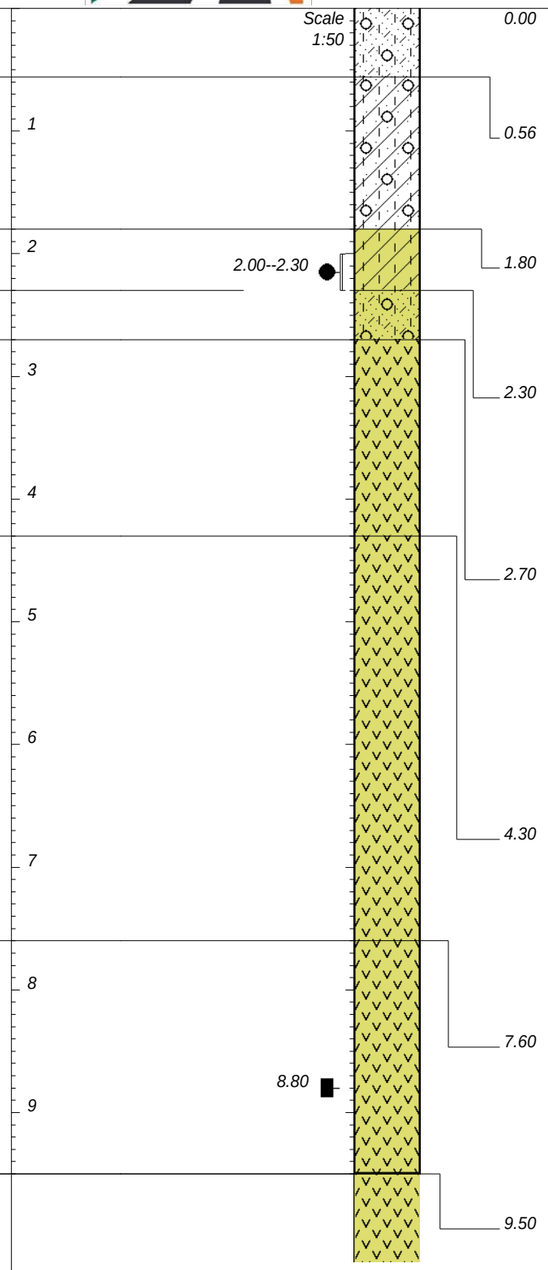
JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH14
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1422	NXC	99	--	--	--	
	NXC	97	--	--	--	
1421	SPT	100	--	--	--	14
	NWD4	100	--	--	--	
1420	NWD4	35	65	--	15	
	NWD4	--	88	23	16	
1419	NWD4	--	96	42	28	
	NWD4	--	89	18	16	
1418	NWD4	--	81	25	14	
	NWD4	--	101	37	13	
1417	NWD4	--	87	60	20	
	NWD4	--	101	100	2	
1416	NWD4	--	100	100	--	
1415						
1414						



Brown speckled white and orange to black, firm, **slightly open structured**, gravelly silty clayey SAND with traces of subangular to rounded gravel of mixed origin (predominantly quartz and lava fragments, **ALLUVIUM**.

Black speckled grey to red, firm to soft with depth, **slightly open structured to shattered**, gravelly sandy silty CLAY with traces of subangular to rounded predominantly quartz gravel, **ALLUVIUM**. Scattered fine roots.

Grey to khaki brown mottled orange to white and blotched blue green, firm, (gravelly) sandy silty CLAY with traces of subangular to rounded quartz and amygdaloidal lava fragments, **REWORKED RESIDUAL AMYGDALOIDAL LAVA**.

Khaki brown speckled to mottled black to brown and greenish blue, firm, **relict structure**, silty clayey gravelly SAND to gravelly sandy silty CLAY with minor amounts of completely weathered to highly weathered amygdaloidal lava fragments set between the matrix, **INTERPRETED AS RESIDUAL TO COMPLETELY WEATHERED AMYGDALOIDAL LAVA**.

Brown to blueish grey speckled to mottled blueish grey and black, **highly to moderately weathered**, fine grained, very highly to highly fractured (fracture zone), soft rock to occasionally medium hard rock, **AMYGDALOIDAL LAVA**.

Note: Highly fractured with occasional residual to completely weathered zones between intact pieces. Fractures are stained black or with khaki grey clayey silt cohesive infilling up to 10 mm. Possible shear zone? Core loss to the base. Subvertical to near horizontal fractures to base.

Blueish grey speckled to mottled white to dark blue to black (amygdales), **slightly weathered** fine grained, highly to moderately fractured to occasionally very highly fractured, medium to hard rock, **AMYGDALOIDAL LAVA**.

Note: Joints are clean, stained black to orange with occasional khaki grey, sandy clayey silt (<2 mm) cohesive infilling. Amygdales and hydrothermal veins are present which are occasionally pitted in places.

Blueish to greenish grey speckled to blotched dark blue occasionally streaked light green (hydrothermal veins), **unweathered** fine grained, moderately to slightly fractured, hard to very hard rock, **AMYGDALOIDAL LAVA**.

Note: Joints are clean, stained black, planar rough to undulating smooth/rough and typically 60 to 70 degrees.

As above. EOH.

NOTES

1) Hole terminated at 9.50 mbgl.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH14
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

2) Disturbed sample retrieved at 2.00--2.30 m.

3) Undisturbed sample retrieved at 8.80 m.

4) No piezometer installed.

5) Material and core recoveries > 100 are due to sample retrieval method.

6) SPT refusal considered >50 blows for 15 cm.

7) Coordinates measured out (GE image 2021/03/05).

8) Elevation data from GPS data.

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/21-2022/11/22
DATE : 30/11/2022

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

ELEVATION : 1423m
X-COORD : 26.784376
Y-COORD : -26.354654

HOLE No: BH14

HOLE No: BH15
Sheet 1 of 2

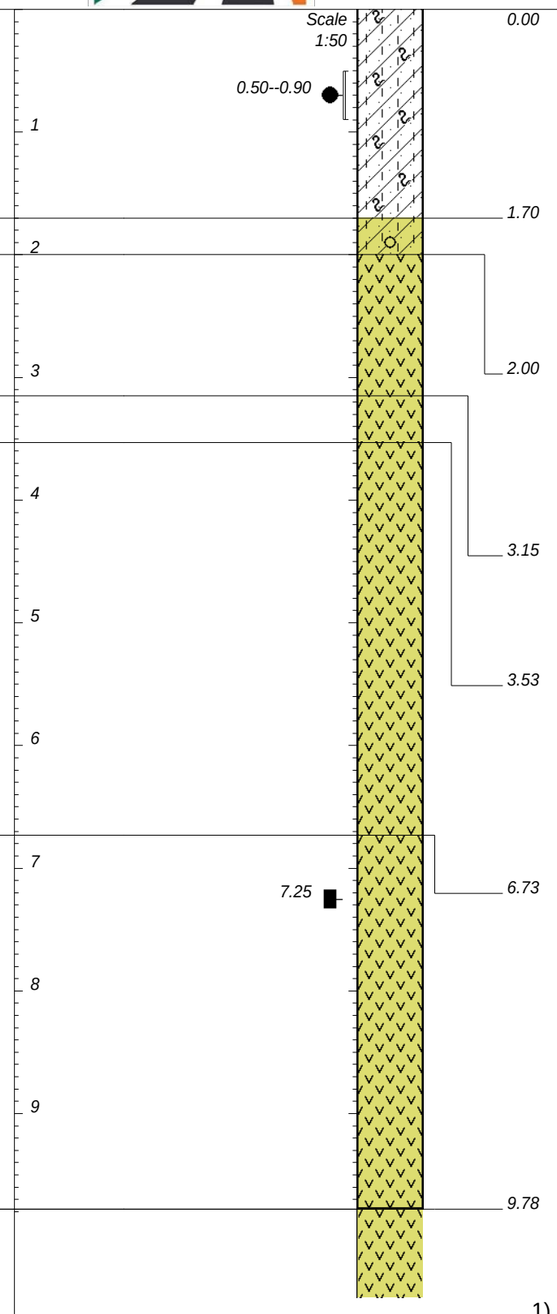
JOB NUMBER: R.030-080-2016/1D-SS

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH15
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
	NXC	104	--	--	--	
	NXC	83	--	--	--	
1421	NXC	--	--	--	--	
	SPT	95	--	--	--	Ref
1420	NWD4	22	78	--	13	
	NWD4	--	100	20	20	
1419	NWD4	--	43	49	6	
1418	NWD4	--	104	94	12	
	NWD4	--	100	32	22	
1417	NWD4	--	102	20	18	
	NWD4	--	110	50	35	
1416	NWD4	--	106	55	22	
	NWD4	--	78	--	22	
1415	NWD4	--	101	100	3	
1414	NWD4	--	100	82	9	
1413	NWD4	--	103	88	6	



DEPTH	
0.00	Black blotched reddish brown, soft to firm, **slightly shattered to open structured**, gravelly silty sandy CLAY with traces of subangular to rounded gravel to small cobbles of mixed origin (predominantly quartz), **INTERPRETED AS ALLUVIUM**. Scattered fine roots.
1.70	Light brown to khaki brown speckled to mottled black to red and orange, firm to stiff, **slightly open to shattered structure**, gravelly silty sandy CLAY with traces of subrounded gravel of mixed origin and completely to highly weathered amygdaloidal lava fragments and Fe concretions, **INTERPRETED AS REWORKED RESIDUAL AMYGDALOIDAL LAVA**.
2.00	Brown speckled black, **highly weathered**, fine grained, very highly to highly fractured, very soft to soft rock, **AMYGDALOIDAL LAVA**. **Note**: Orange to khaki grey sandy clayey silt cohesive infilling (<2 mm) on joints. Randomly orientated fractures. Occasional completely weathered to residual zones at 2.73 to 2.53 m and 2.92 to 2.97 m with highly weathered fragments in between.
3.15	Brown to blueish grey, **highly weathered**, fine grained, very highly to highly fractured, very soft to soft rock, **AMYGDALOIDAL LAVA**. **Note**: Orange sandy clayey silt cohesive infilling (<2 mm) on joints. Potential fracture zone at the base.
3.53	Brownish green to blueish grey mottled white to dark blue occasionally streaked white, **moderately to slightly weathered**, fine grained, very highly to highly fractured (occasional fracture zone areas), medium hard to hard rock, **AMYGDALOIDAL LAVA**. **Note**: Subvertical to sub/horizontal joints with orange to khaki grey sandy silty clay cohesive infilling on joints (<5 mm). Potential fracture/shear zone. Friable/pitted hydrothermal veins present.
6.73	Blueish to greenish grey mottled white to dark blue with randomly oriented white streaks (flows bands), **slightly to unweathered**, fine grained, moderately to occasionally highly fractured (8.50 to 9.15 m), hard to very hard rock, **AMYGDALOIDAL LAVA**. **Note**: Joints are clean, stained, planar smooth and typically 20 to 45 degrees. Occasional highly fractured zones from 8.60 to 9.15 m with orange, sandy clayey silt (<1 mm) cohesive infilling. Tension joints present.
9.78	As above. EOH.

NOTES

1) Hole terminated at 9.78 mbgl.
2) Disturbed sample retrieved at 0.50--0.90 m.
3) Undisturbed sample retrieved at 7.25 m.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH15
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

4) No piezometer installed.

5) Material and core recoveries > 100 are due to sample retrieval method.

6) SPT refusal considered >50 blows for 15 cm.

7) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.

8) Elevation data from GPS data.

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D45
DRILLED BY : Mzambia
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/23-2022/11/23
DATE : 30/11/2022

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

ELEVATION : 1422m
X-COORD : 26.784296
Y-COORD : -26.354406

HOLE No: BH15

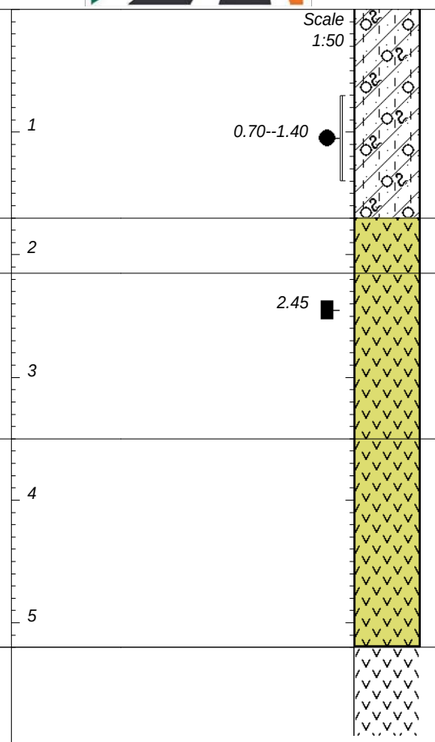
SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH16
Sheet 1 of 1

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1413	NXC	100	--	--	--	
	NXC	93	--	--	--	
	SPT	73	--	--	--	59
1412	NWD4	--	91	75	3	
1411	NWD4	--	68	79	4	
1410	NWD4	--	99	100	1	
1409	NWD4	--	98	100	--	

DEPTH Scale 1:50



Dark brown to black speckled orange to the base, soft to firm, **slightly shattered to open structured**, gravelly silty sandy CLAY with traces of subangular to rounded gravel to small cobbles of mixed origin (predominantly quartz), **INTERPRETED AS ALLUVIUM**. Scattered fine roots.

Green to blueish green, **highly to slightly weathered**, fine grained, very highly fractured (fracture zone to shear zone), soft to medium hard rock, **AMYGDALOIDAL LAVA**.

Note: greenish grey to greenish brown sandy silty clay infilling between fractures.

Greenish grey speckled white to streaked white, **slightly weathered**, fine grained to flow banded, highly to moderately fractured, hard rock, **AMYGDALOIDAL LAVA**.

Note: Joints are approx. 30 to 45 degrees with khaki brown sandy silty clay (<1 mm) cohesive infilling. Potential fracture zone at the base.

Greenish grey streaked white, **unweathered**, fine grained and flow banded, slightly to very slightly fractured, hard to very hard rock, **AMYGDALOIDAL LAVA**.

As above. EOH.

NOTES

1) Hole terminated at 5.20 mbgl.
2) Disturbed sample retrieved at 0.70--1.40 m.
3) Undisturbed samples retrieved at 2.45 m.
4) No piezometer installed.
5) SPT refusal considered >50 blows for 15 cm.
6) Coordinates measured out (GE image 2021/03/05).
7) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R
DRILLED BY : Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)
TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/11/23-2022/11/23
DATE : 29/11/2022
DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

ELEVATION : 1414m
X-COORD : 26.784451
Y-COORD : -26.354535

HOLE No: BH16

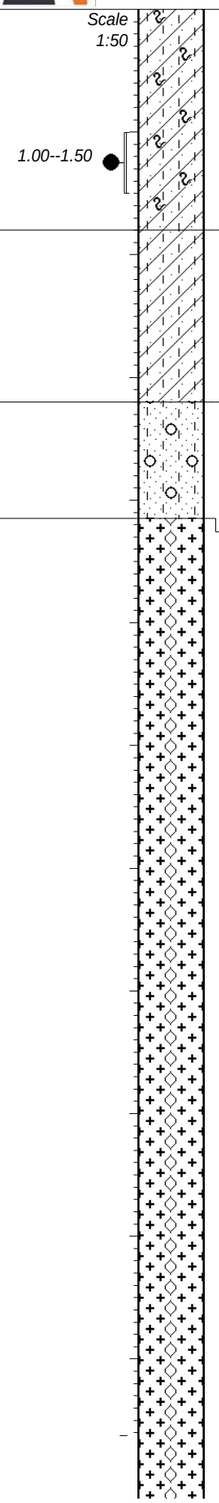
SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH17
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N
1365	NXC	93	--	--	--	
	NXC	96	--	--	--	
	SPT	100	--	--	--	21
1364	NWD4	102	--	--	--	
	NWD4	27	--	--	--	
1363	SPT	96	--	--	--	34
	SPT	--	--	--	--	Ref
	SPT	95	--	--	--	Ref
1362	NWD4	42	16	--	10	
	NWD4	--	34	--	16	
1361	NWD4	--	--	--	--	
	NWD4	--	40	--	FZ?	
1360	NWD4	--	52	--	FZ?	
	NWD4	--	48	--	FZ?	
1359	NWD4	--	--	--	--	
	SPT	--	--	--	--	Ref
1358	NWD4	--	22	--	FZ?	
	NWD4	--	--	--	--	
	NWD4	--	--	--	--	
1357	SPT	--	--	--	--	Ref
	NWD4	--	40	--	16	
1356	NWD4	--	52	--	FZ?	
	NWD4	--	40	50	FZ?	
1355	NWD4	--	60	--	FZ?	
	NWD4	--	46	--	FZ?	

DEPTH Scale 1:50: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11



Black speckled red to grey, firm to soft with depth, **shattered to slightly open structured**, (gravelly) silty clayey SAND to silty sandy CLAY interlayered with traces of subangular to rounded gravel of mixed origin, **ALLUVIUM**. Scattered fine roots to the top.

Grey speckled white to pink red and black, soft to firm, **slightly open structured to slightly shattered**, silty sandy clay with traces of plagioclase fine gravel and subrounded gravel of mixed origin, **INTERPRETED AS REWORKED RESIDUAL GRANITE**.

Khaki brown to light brown mottled white grey to pink, firm to stiff, **relict to slightly open structured**, clayey gravelly silty SAND with minor amounts of subangular plagioclase and quartz gravel, **INTERPRETED AS RESIDUAL GRANITE**.

Light brown to grey mottled white to orange and pink, **completely to highly weathered and moderately to slightly weathered**, coarse grained, massive, very highly to highly fractured (shear zone), very soft to medium hard rock in places, **GRANITE**.

Note: Potential highly sheared zone or close to a fault zone. Core is highly broken. Joints are clean, randomly orientated, stained orange brown to black with occasional silty sand infill <1mm thick. Prominent wash boring and sample loss. Completely to highly weathered with moderately to slightly weathered bands or intact blocks. Most representative zone is between 18.50 and 19.50 m and is highly weathered with slightly weathered portions. Potential residual zones may also exist.

SANRAL
R30-8 Geotechnical Drilling

HOLE No: BH17
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

REDUCED LEVEL	DRILLING METHOD	% MATERIAL RECOVERY	% CORE RECOVERY	% RQD	FRACTURE FREQUENCY	SPT N	DEPTH Scale 1:50
1354	NWD4	--	50	--	FZ?		12
	NWD4	--	44	--	FZ?		
1353	NWD4	--	54	--	18		13
	NWD4	--	44	64	8		
1352	NWD4	--	60	--	24		14
	NWD4	--	12	--	FZ?		
1351	NWD4	--	42	--	FZ?		15
	NWD4	--	64	--	18		
1350	NWD4	--	90	--	42		16
	NWD4	--	40	28	8		
1349	NWD4	--	130	--	30		17
	NWD4	--	--	--	--		
1348	NWD4	--	20	--	10		18
	NWD4	--	79	52	14		
1347							19
	NWD4	--	68	--	24		
1346							20

19.00

20.00

As above. EOH.

NOTES

1) Hole terminated at 20.00 mbgl.
2) Disturbed sample retrieved at 1.00--1.50 m.
3) Undisturbed sample retrieved at 19.00 m.
4) No piezometer installed.
5) Material and core recoveries > 100 are due to sample retrieval method.
6) SPT refusal considered >50 blows for 15 cm.
7) FZ? - Potential Fracture Zone, partial core loss and broken core, difficult to measure realistic fracture frequency.
8) Coordinates retrieved with a Garmin e-Trex 10 handheld GPS.
9) Elevation data from GPS data.

CONTRACTOR : Terra Monitoring (Pty) Ltd.
MACHINE : YWE D90R & YWE D45
DRILLED BY : Willie & Takalani
PROFILED BY : JI Roux (Pri. Sci. Nat -118640)

INCLINATION : Vertical
DIAM : 75.3mm and 51.3mm
DATE : 2022/01/09-2022/11/21
DATE : 30/11/2022

ELEVATION : 1366m
X-COORD : 26.703770
Y-COORD : -26.456795

HOLE No: BH17

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

SANRAL
R30-8 Geotechnical Drilling

LEGEND
Sheet 1 of 2

JOB NUMBER: R.030-080-2016/1D-SS

	SCATTERED BOULDERS/occasional boulders	{SA48}
	GRAVEL	{SA02}
	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILT	{SA06}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	PLUTONIC/norite/syenite	{SA17}
	HYPABYSSAL/anorthosite/syenite aplite	{SA18}
	LAVA	{SA19}
	DIORITE FAMILY	{SA41}
	FREE QUARTZ/visible quartz	{SA44}
	GRANITE	{SA17}{SA44}
	DIABASE	{SA18}{SA41}
	FILL	{SA32}
	CONCRETE	{SA34}
18.5	PERMANENT WATER TABLE	{SA35}
Name	UNDISTURBED SAMPLE	{SA37}
Name	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}

SANRAL
R30-8 Geotechnical Drilling

LEGEND
Sheet 2 of 2

JOB NUMBER: R.030-080-2016/1D-SS

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

TYPE SET BY : JI Roux (Pri. Sci. Nat -118640)
SETUP FILE : SANR2.SET

DATE : 08/12/2022 16:46
TEXT : ..22047BHLogs(V1.7)DHW.txt

APPENDIX D

BOREHOLE PHOTOGRAPHS

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH01		
Box No.	1	Of	4
Core Size:	NXC & NWD4		
BH Depth (m):	20.32		
Piezo Installed:	Yes		
Water Level:	22-11-22 at 0.03mbgl		

Notes:
1) Sample taken at 2.50--3.00m.
2) Refer to final detailed borehole log.



BH No.	BH01		
Box No.	2	Of	4
Core Size:	NWD4		
BH Depth:	20.32		
Piezo Installed:	Yes		
Water Level:	22-11-22 at 0.03mbgl		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH01		
Box No.	3	of	4
Core Size:	NWD4		
BH Depth (m):	20.32		
Piezo Installed:	Yes		
Water Level:	22-11-22 at 0.03mbgl		

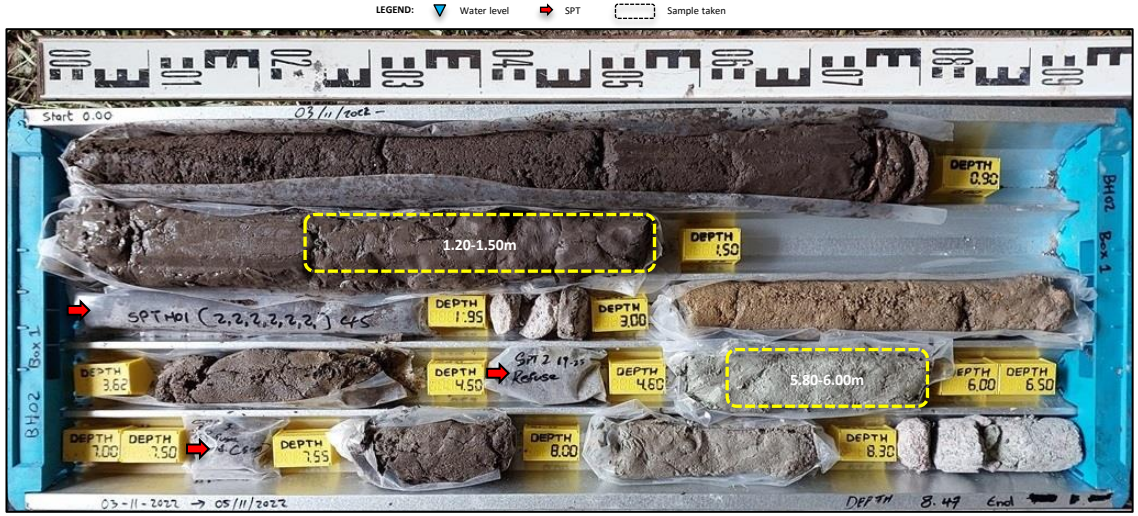
Notes:
1) Refer to final detailed borehole log.



BH No.	BH01		
Box No.	4	of	4
Core Size:	NWD4		
BH Depth:	20.32		
Piezo Installed:	Yes		
Water Level:	22-11-22 at 0.03mbgl		

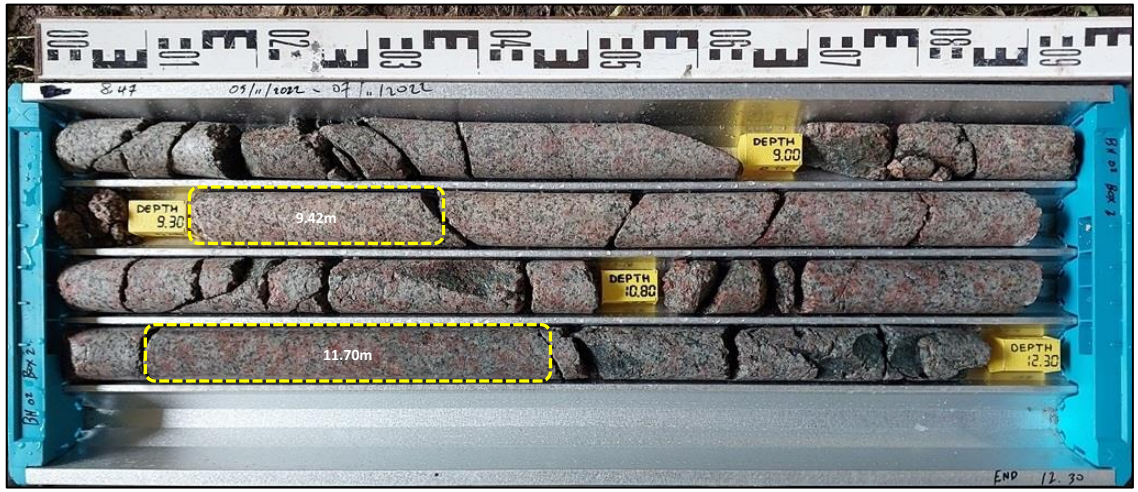
Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH02		
Box No.	1	of	2
Core Size:	NXC & NWD4		
BH Depth (m):	12.30		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Samples taken at 1.20--1.50m and 5.80--6.00m.
2) Refer to final detailed borehole log.



BH No.	BH02		
Box No.	2	of	2
Core Size:	NWD4		
BH Depth:	12.30		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Samples taken at 9.42m and 11.70m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH03		
Box No.	1	of	2
Core Size:	NXC & NWD4		
BH Depth (m):	16.10		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 4.00--4.50m.
2) Refer to final detailed borehole log.



BH No.	BH03		
Box No.	2	of	2
Core Size:	NWD4		
BH Depth:	16.10		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH03		
Box No.	3	of	3
Core Size:	NWD4		
BH Depth (m):	16.10		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 13.90m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling

LEGEND: Water level SPT Sample taken



BH No.	BH04		
Box No.	1	of	3
Core Size:	NXC & NWD4		
BH Depth (m):	10.71		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 1.00--1.50m.
2) Refer to final detailed borehole log.



BH No.	BH04		
Box No.	2	of	3
Core Size:	NWD4		
BH Depth:	10.71		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 5.75m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling

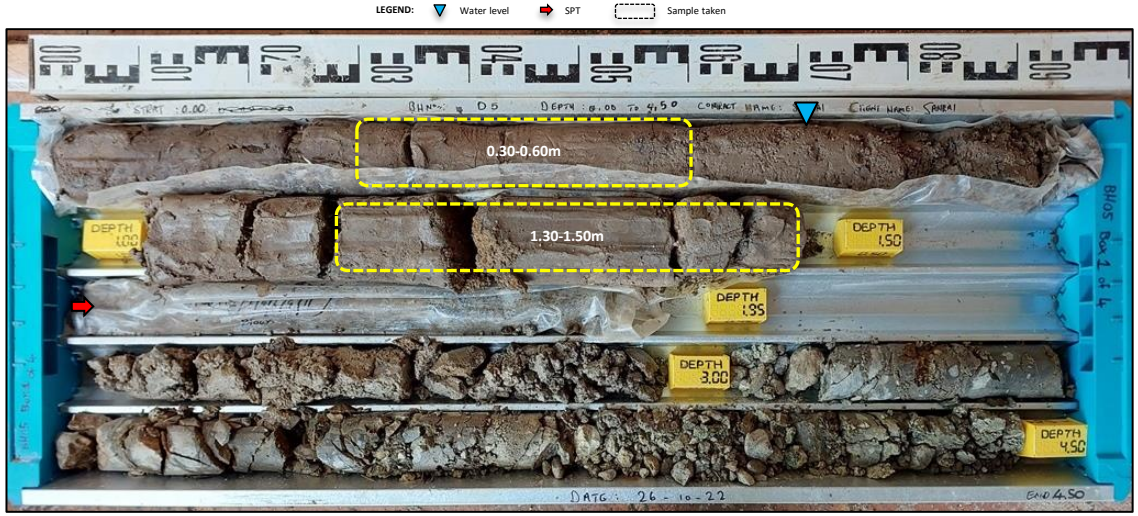
LEGEND: Water level SPT Sample taken



BH No.	BH04		
Box No.	3	of	3
Core Size:	NWD4		
BH Depth (m):	10.71		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH05		
Box No.	1	of	4
Core Size:	NXC & NWD4		
BH Depth (m):	15.04		
Piezo Installed:	Yes		
Water Level:	22-11-04 at 0.71mbgl		

Notes:
1) Samples taken at 0.30--0.60m and 1.30--1.50m.
2) Refer to final detailed borehole log.



BH No.	BH05		
Box No.	2	of	4
Core Size:	NWD4		
BH Depth:	15.04		
Piezo Installed:	Yes		
Water Level:	22-11-04 at 0.71mbgl		

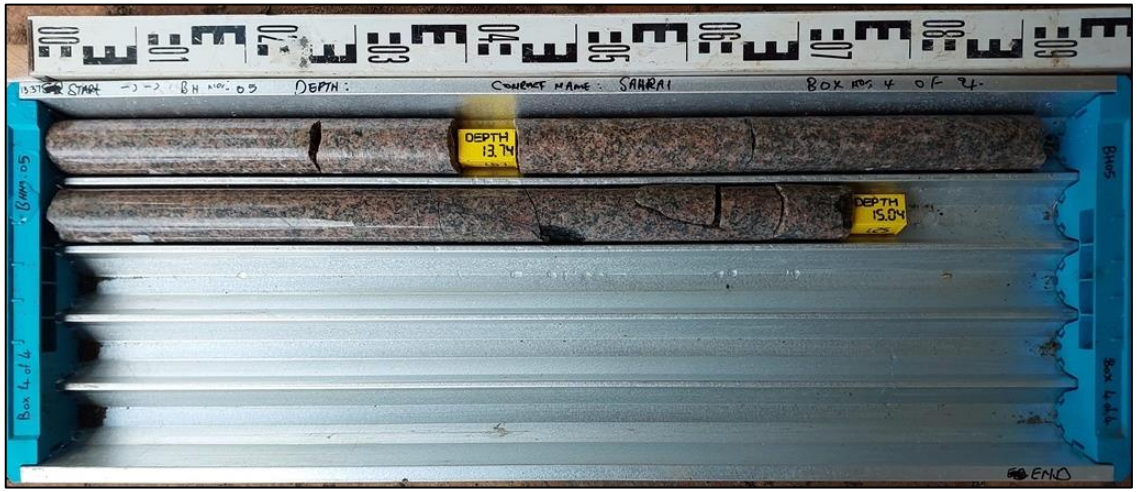
Notes:
1) Sample taken at 5.50m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH05		
Box No.	3	of	4
Core Size:	NWD4		
BH Depth (m):	15.04		
Piezo Installed:	Yes		
Water Level:	22-11-04 at 0.71mbgl		

Notes:
1) Sample taken at 9.55m.
2) Refer to final detailed borehole log.



BH No.	BH05		
Box No.	4	of	4
Core Size:	NWD4		
BH Depth:	15.04		
Piezo Installed:	Yes		
Water Level:	22-11-04 at 0.71mbgl		

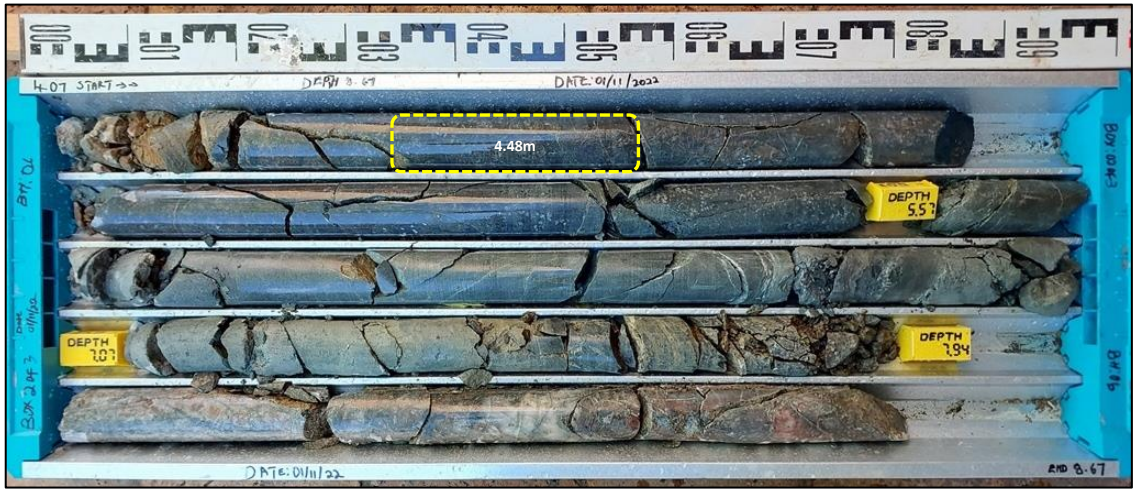
Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH06		
Box No.	1	of	3
Core Size:	NXC & NWD4		
BH Depth (m):	12.11		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 0.75--1.25m.
2) Refer to final detailed borehole log.



BH No.	BH06		
Box No.	2	of	3
Core Size:	NWD4		
BH Depth:	12.11		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 4.48m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling

LEGEND: Water level SPT Sample taken



BH No.	BH06		
Box No.	3	of	3
Core Size:	NWD4		
BH Depth (m):	12.11		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH07		
Box No.	1	of	3
Core Size:	NXC & NWD4		
BH Depth (m):	12.00		
Piezo Installed:	No		
Water Level:	n/a		

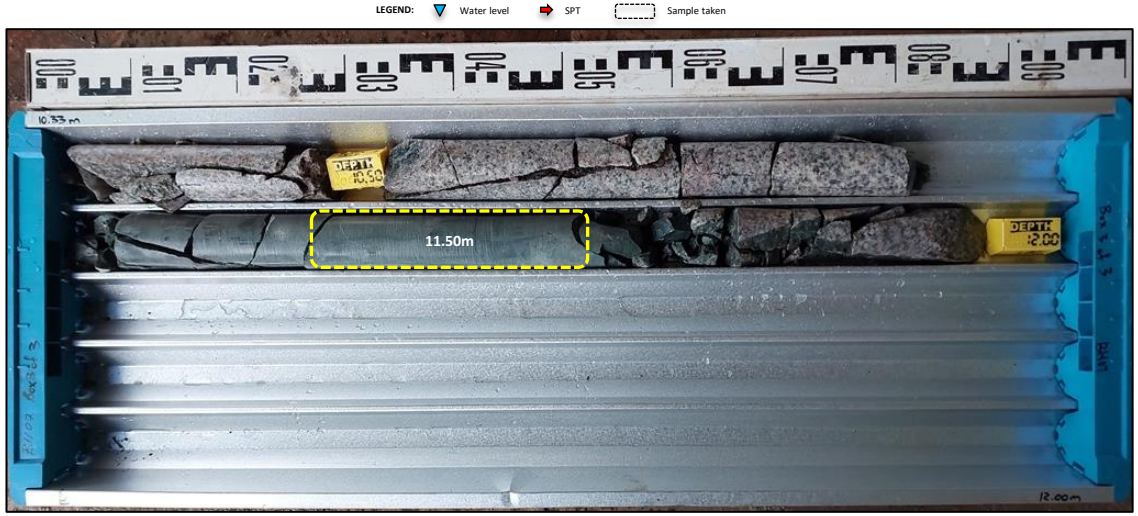
Notes:
1) Sample taken at 0.60--0.90m.
2) Refer to final detailed borehole log.



BH No.	BH07		
Box No.	2	of	3
Core Size:	NWD4		
BH Depth:	12.00		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 7.62m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH07		
Box No.	3	of	3
Core Size:	NWD4		
BH Depth (m):	12.00		
Piezo Installed:	No		
Water Level:	n/a		

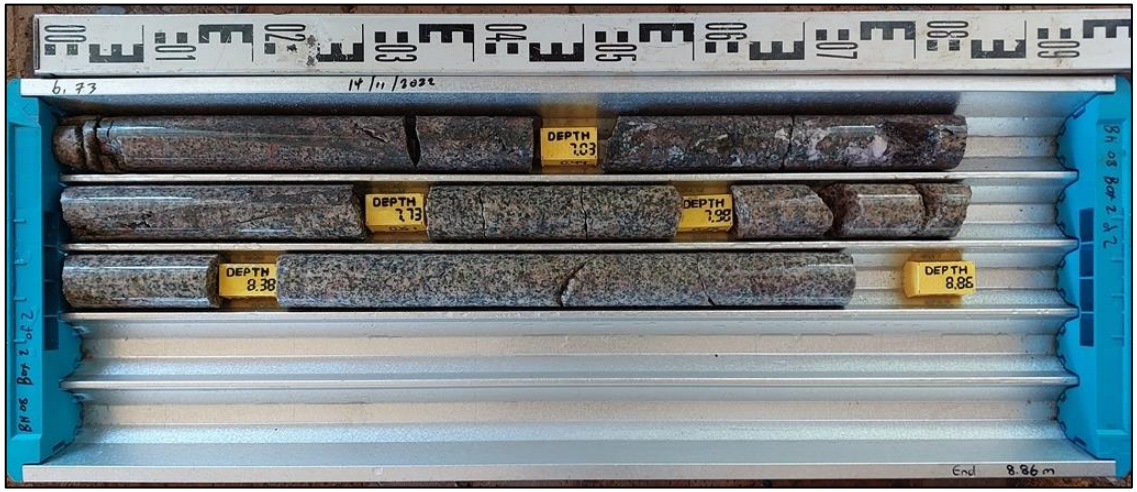
Notes:
1) Sample taken at 11.50m
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH08		
Box No.	1	of	2
Core Size:	NXC & NWD4		
BH Depth (m):	8.86		
Piezo Installed:	No		
Water Level:	n/a		

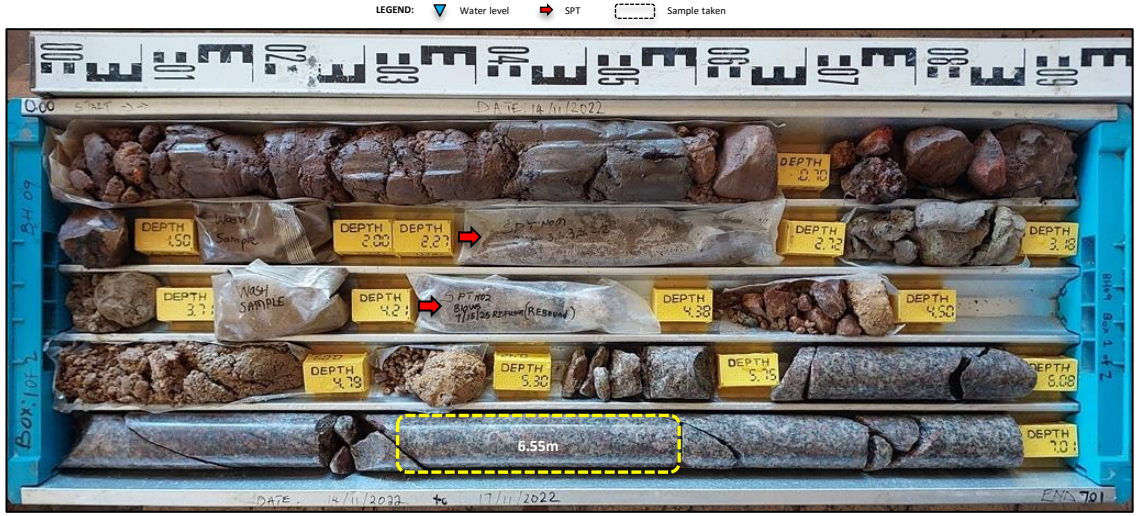
Notes:
1) Samples taken at 2.70--2.95m and 6.45m.
2) Refer to final detailed borehole log.



BH No.	BH08		
Box No.	2	of	2
Core Size:	NWD4		
BH Depth:	8.86		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH09		
Box No.	1	of	2
Core Size:	NXC & NWD4		
BH Depth (m):	9.07		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 6.55m
2) Refer to final detailed borehole log.



BH No.	BH09		
Box No.	2	of	2
Core Size:	NWD4		
BH Depth:	9.07		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH10		
Box No.	1	of	2
Core Size:	NXC & NWD4		
BH Depth (m):	9.05		
Piezo Installed:	Yes		
Water Level:	2022-11-22 at 0.53mbgl		

Notes:
1) Sample taken at 1.20--1.50m.
2) Refer to final detailed borehole log.



BH No.	BH10		
Box No.	2	of	2
Core Size:	NWD4		
BH Depth:	9.05		
Piezo Installed:	Yes		
Water Level:	2022-11-22 at 0.53mbgl		

Notes:
1) Sample taken at 7.40m.
2) Refer to final detailed borehole log.
3) No sample from SPT.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH11		
Box No.	1	of	2
Core Size:	NXC & NWD4		
BH Depth (m):	7.87		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.



BH No.	BH11		
Box No.	2	of	2
Core Size:	NWD4		
BH Depth:	7.87		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Samples taken at 3.50--4.00m and 4.40m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH12		
Box No.	1	of	2
Core Size:	NXC & NWD4		
BH Depth (m):	8.55		
Piezo Installed:	No		
Water Level:	n/a		

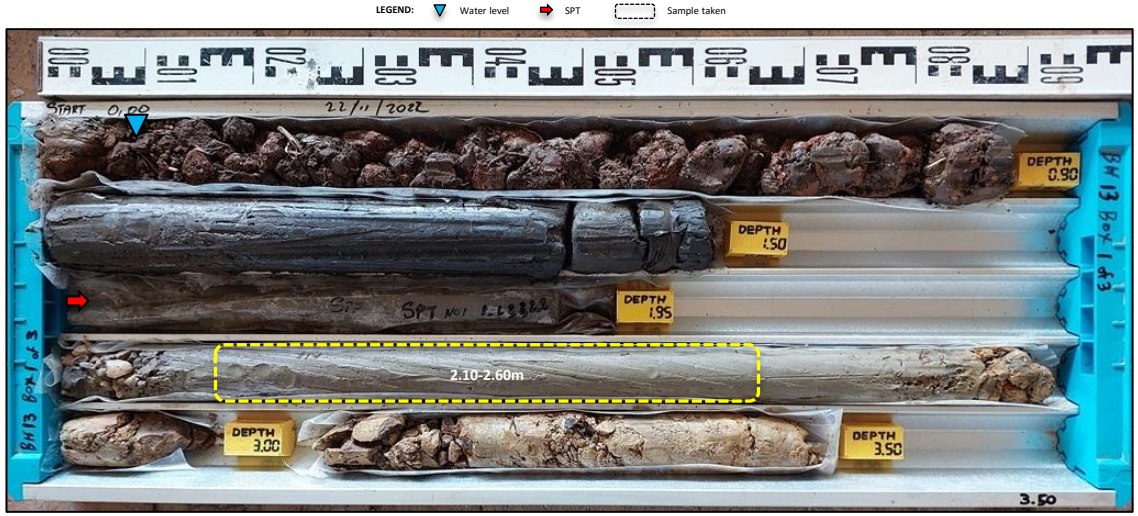
Notes:
1) Samples taken at 2.00--2.60m and 3.45--4.45m.
2) Refer to final detailed borehole log.
3) No sample from SPT.



BH No.	BH12		
Box No.	2	of	2
Core Size:	NWD4		
BH Depth:	8.55		
Piezo Installed:	No		
Water Level:	n/a		

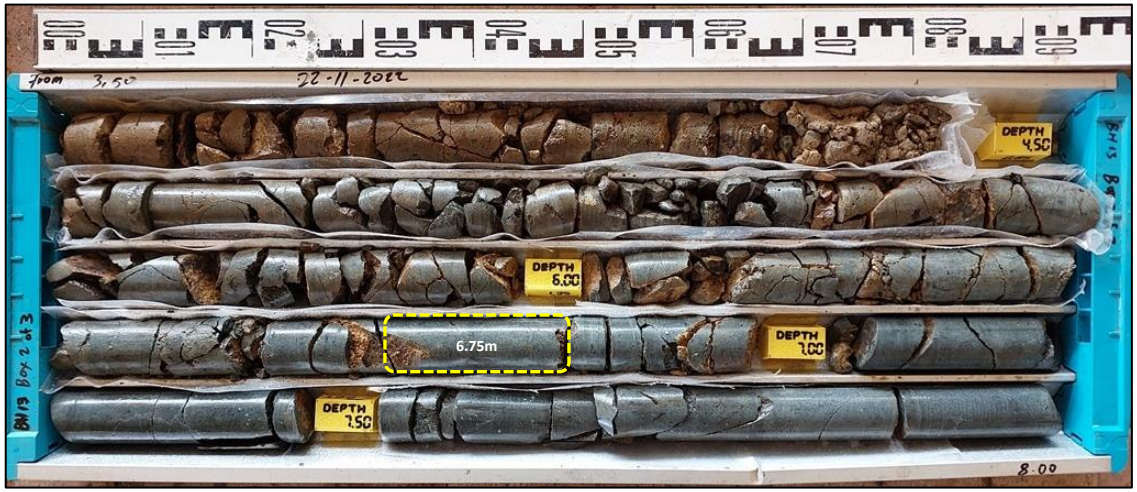
Notes:
1) Sample taken at 6.30m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH13		
Box No.	1	of	3
Core Size:	NXC & NWD4		
BH Depth (m):	10.50		
Piezo Installed:	Yes		
Water Level:	2022-11-24 at 0.09mbgl		

Notes:
1) Sample taken at 2.10--2.60m.
2) Refer to final detailed borehole log.

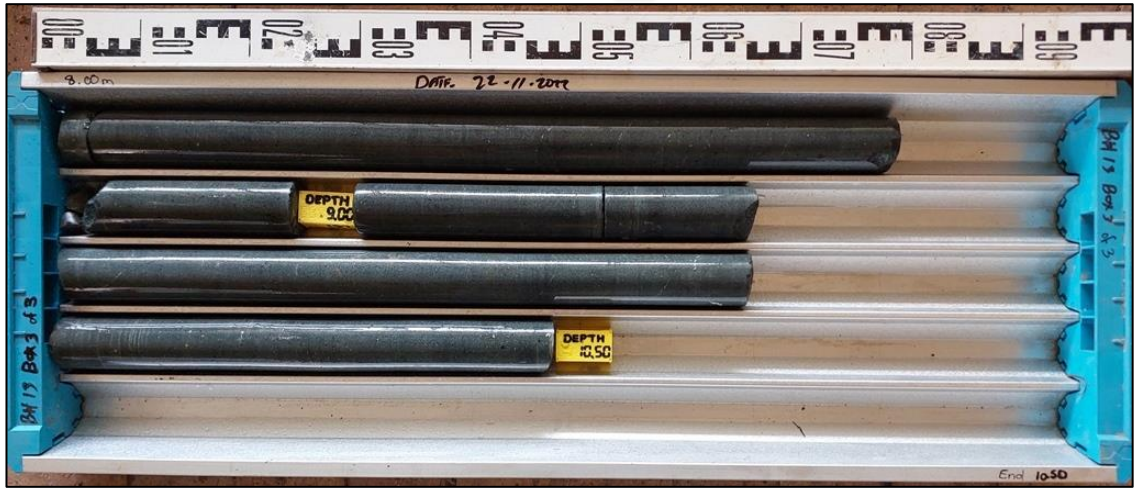


BH No.	BH13		
Box No.	2	of	3
Core Size:	NWD4		
BH Depth:	10.50		
Piezo Installed:	Yes		
Water Level:	2022-11-24 at 0.09mbgl		

Notes:
1) Sample taken at 6.75m
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling

LEGEND: Water level SPT Sample taken



BH No.	BH13		
Box No.	3	of	3
Core Size:	NWD4		
BH Depth (m):	10.50		
Piezo Installed:	Yes		
Water Level:	2022-11-24 at 0.09mbgl		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH14		
Box No.	1	of	3
Core Size:	NXC & NWD4		
BH Depth (m):	9.50		
Piezo Installed:	No		
Water Level:	n/a		

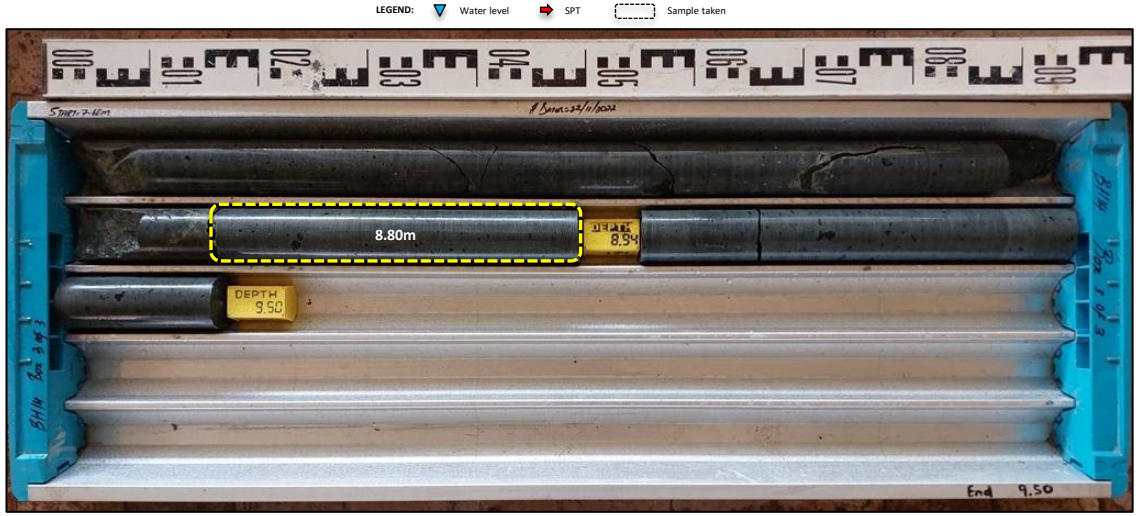
Notes:
1) Sample taken at 2.00--2.30m.
2) Refer to final detailed borehole log.



BH No.	BH14		
Box No.	2	of	3
Core Size:	NWD4		
BH Depth:	9.50		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.

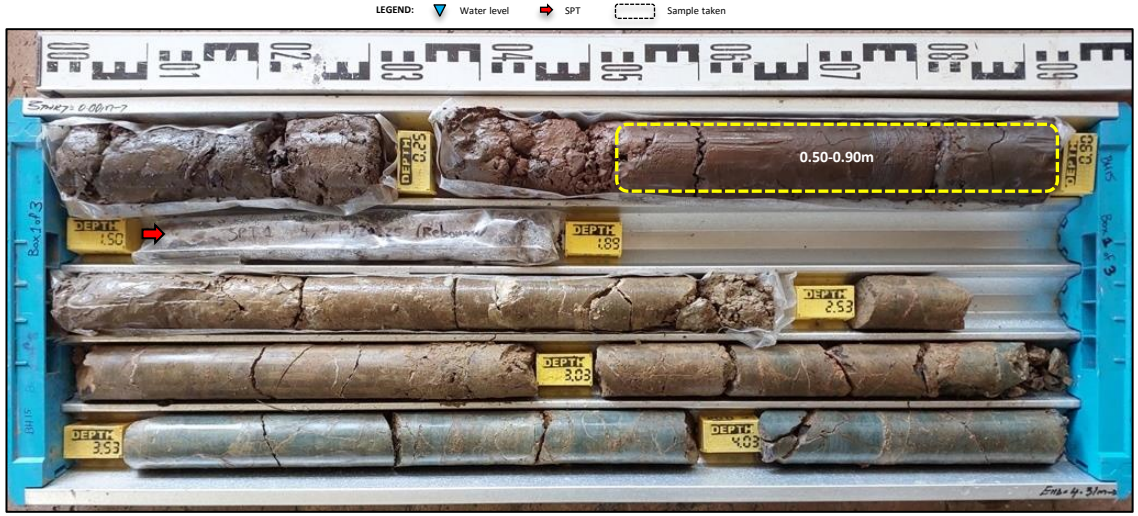
Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH14		
Box No.	3	of	3
Core Size:	NWD4		
BH Depth (m):	9.50		
Piezo Installed:	No		
Water Level:	n/a		

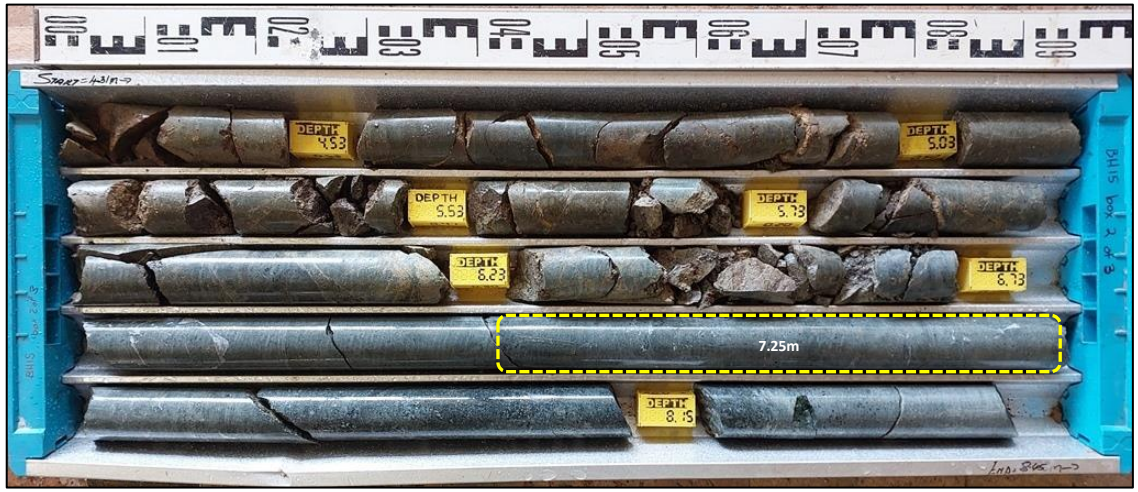
Notes:
1) Sample taken at 8.80m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH15		
Box No.	1	of	3
Core Size:	NXC & NWD4		
BH Depth (m):	9.78		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 0.50--0.90m.
2) Refer to final detailed borehole log.



BH No.	BH15		
Box No.	2	of	3
Core Size:	NWD4		
BH Depth:	9.78		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 7.25m.
2) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling

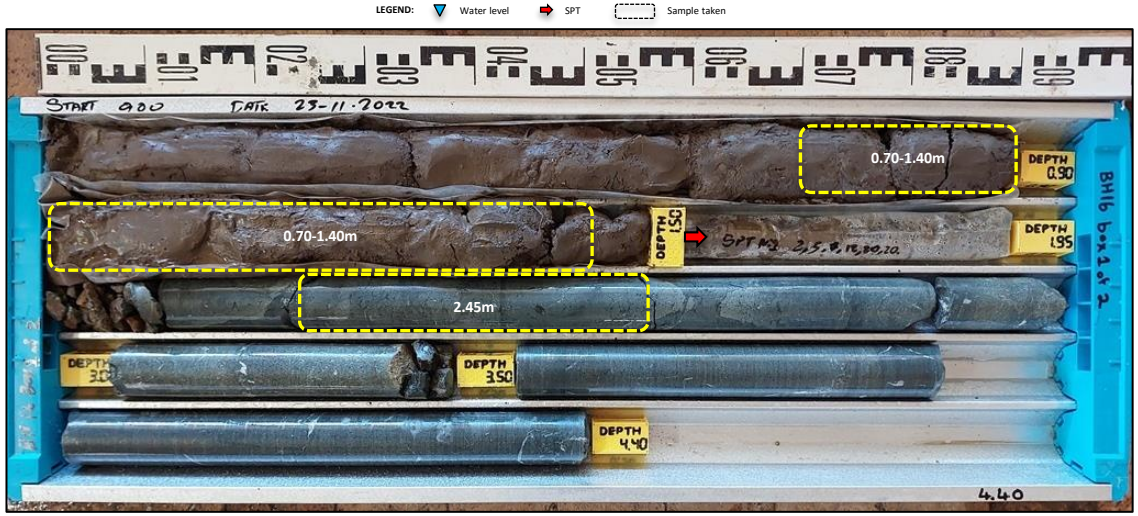
LEGEND: Water level SPT Sample taken



BH No.	BH15		
Box No.	3	of	3
Core Size:	NWD4		
BH Depth (m):	9.78		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH16		
Box No.	1	of	2
Core Size:	NXC & NWD4		
BH Depth (m):	5.20		
Piezo Installed:	No		
Water Level:	n/a		

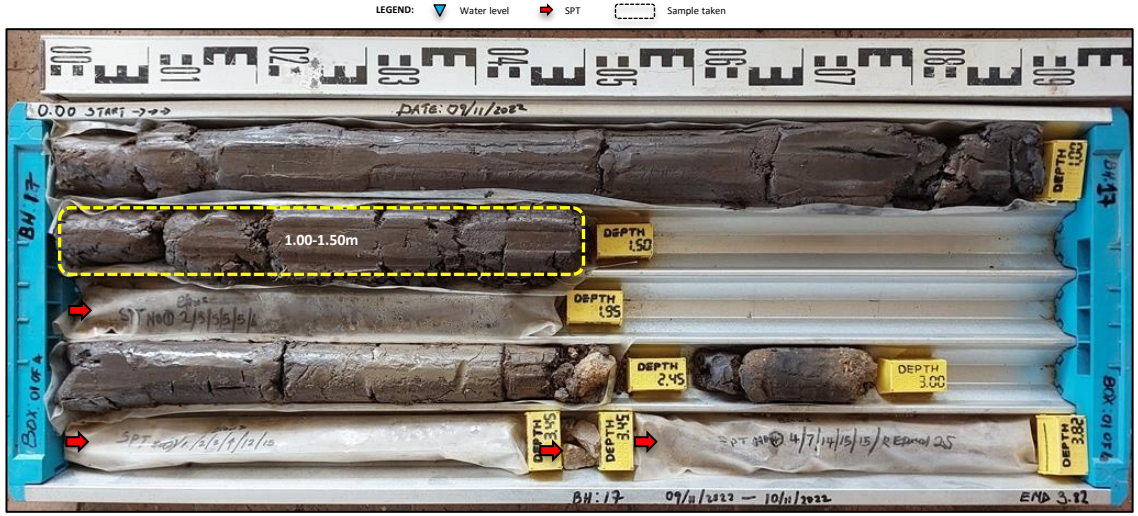
Notes:
1) Samples taken at 0.70--1.40m and 2.45m.
2) Refer to final detailed borehole log.



BH No.	BH16		
Box No.	2	of	2
Core Size:	NWD4		
BH Depth:	5.20		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH17		
Box No.	1	of	4
Core Size:	NXC & NWD4		
BH Depth (m):	20.00		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 1.00--1.50m.
2) Refer to final detailed borehole log.
3) No sample from SPT.



BH No.	BH14		
Box No.	2	of	4
Core Size:	NWD4		
BH Depth:	20.00		
Piezo Installed:	No		
Water Level:	n/a		

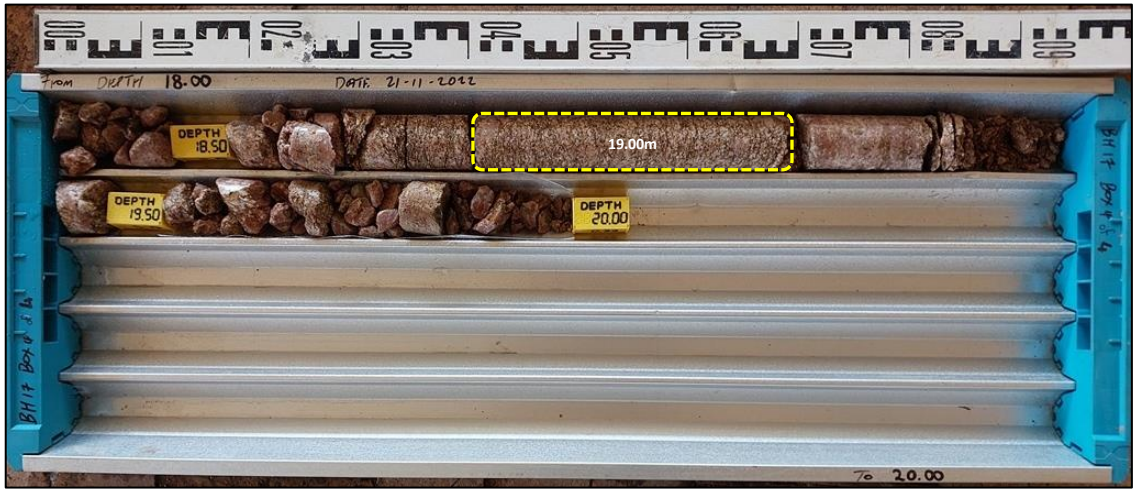
Notes:
1) Refer to final detailed borehole log.
2) No sample from SPT.

Project reference number: R.030-080-2016/1D-SS
Project name: R30-8 Geotech Drilling



BH No.	BH17		
Box No.	3	of	4
Core Size:	NWD4		
BH Depth (m):	20.00		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Refer to final detailed borehole log.



BH No.	BH17		
Box No.	4	of	4
Core Size:	NWD4		
BH Depth:	20.00		
Piezo Installed:	No		
Water Level:	n/a		

Notes:
1) Sample taken at 19.00m.
2) Refer to final detailed borehole log.

APPENDIX E.1

DPSH TEST RESULTS

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 01
DATE OF TEST: 25/10/2022
OPERATOR: Bongani

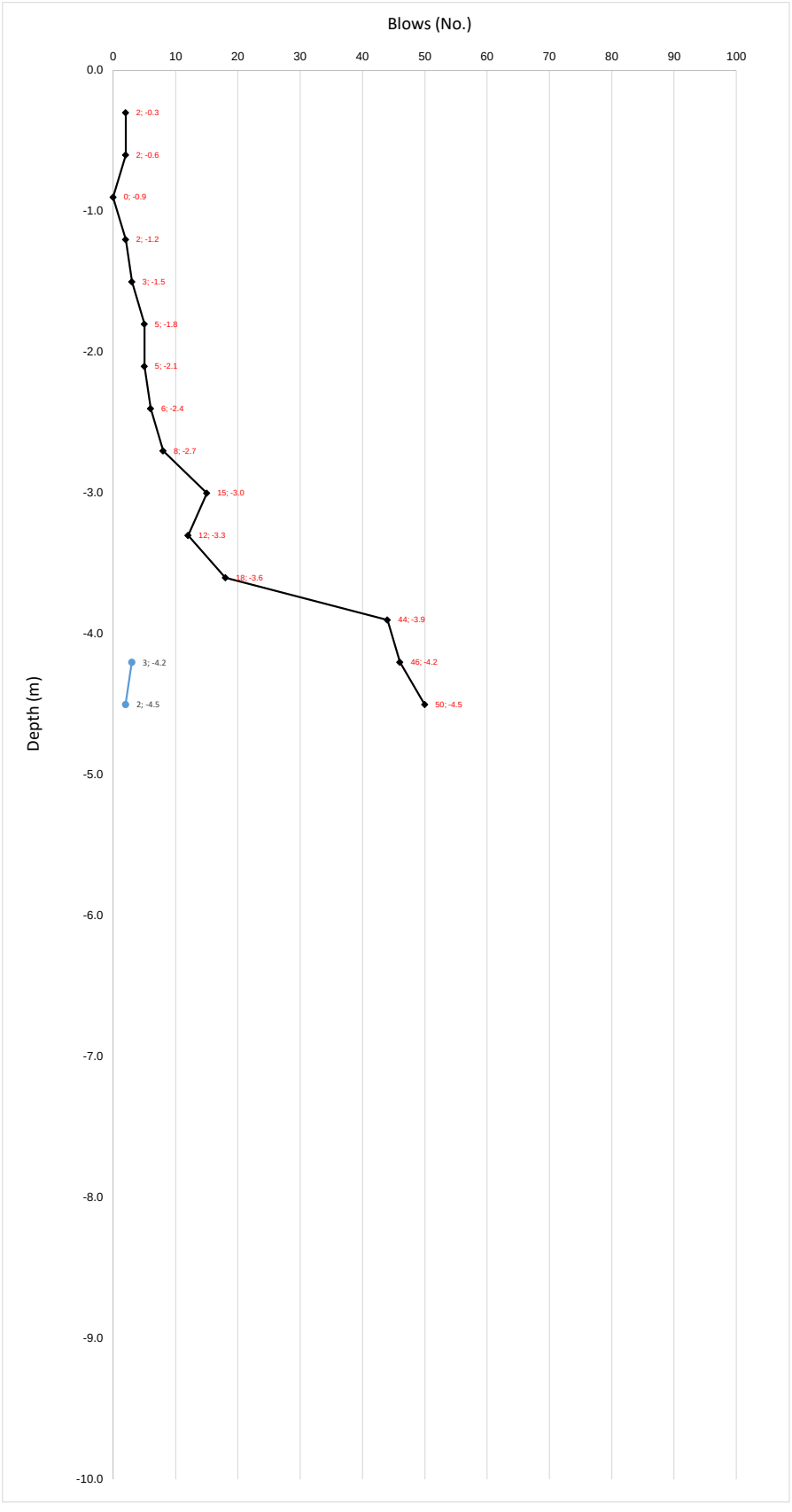
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	2		
-0.6	2		
-0.9	0		
-1.2	2		
-1.5	3		
-1.8	5		
-2.1	5		
-2.4	6		
-2.7	8		
-3.0	15		
-3.3	12		
-3.6	18		
-3.9	44		
-4.2	46	-4.2	3
-4.5	50	-4.5	2
-4.8			
-5.1			
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 4.50
REDRIVE FROM: -3.90 TO: -4.20 BLOWS: 3
FROM: -4.20 TO: -4.50 BLOWS: 2

COMMENTS: Termination due to refusal.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 02
DATE OF TEST: 25/10/2022
OPERATOR: Bongani

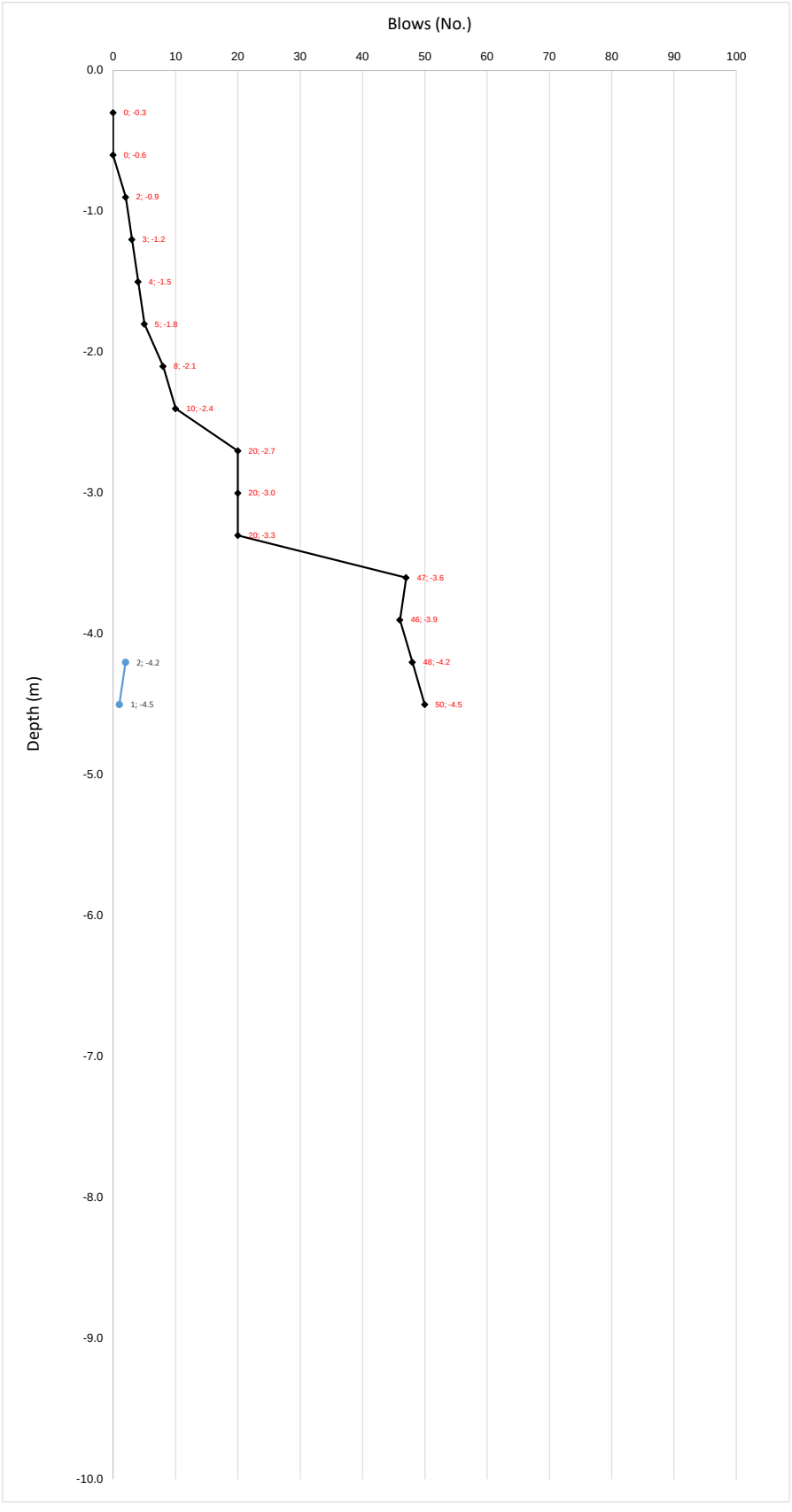
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	0		
-0.9	2		
-1.2	3		
-1.5	4		
-1.8	5		
-2.1	8		
-2.4	10		
-2.7	20		
-3.0	20		
-3.3	20		
-3.6	47		
-3.9	46		
-4.2	48	-4.2	2
-4.5	50	-4.5	1
-4.8			
-5.1			
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 4.40
REDRIVE
FROM: -3.90
TO: -4.20 **BLOWS:** 2
FROM: -4.20
TO: -4.50 **BLOWS:** 1

COMMENTS: Termination due to refusal.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 03
DATE OF TEST: 26/10/2022
OPERATOR: Bongani

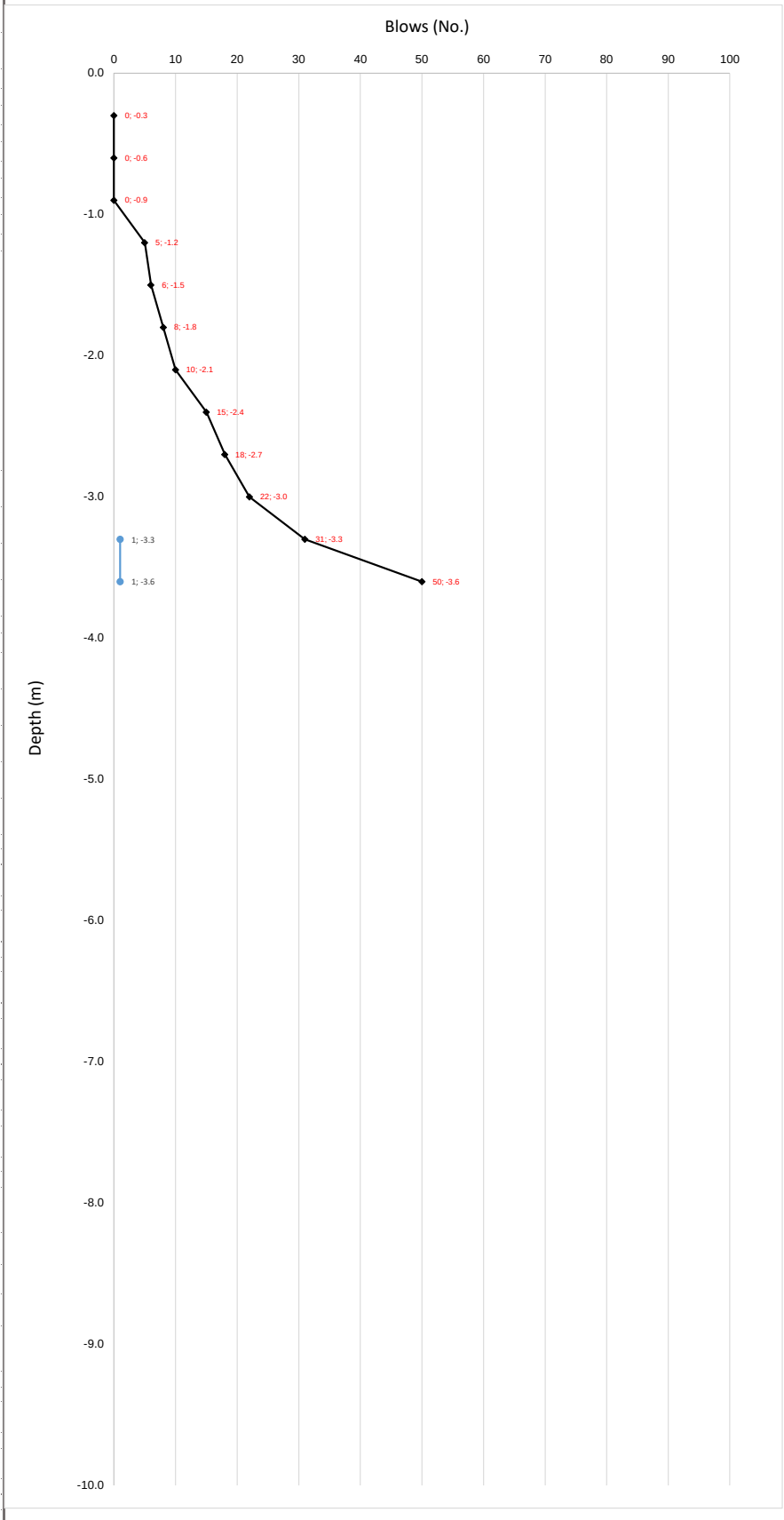
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	0		
-0.9	0		
-1.2	5		
-1.5	6		
-1.8	8		
-2.1	10		
-2.4	15		
-2.7	18		
-3.0	22		
-3.3	31	-3.3	1
-3.6	50	-3.6	1
-3.9			
-4.2			
-4.5			
-4.8			
-5.1			
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 3.6
REDRIVE
FROM: -3.00
TO: -3.30 **BLOWS:** 1
FROM: -3.30
TO: -3.60 **BLOWS:** 1

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 04
DATE OF TEST: 26/10/2022
OPERATOR: Bongani

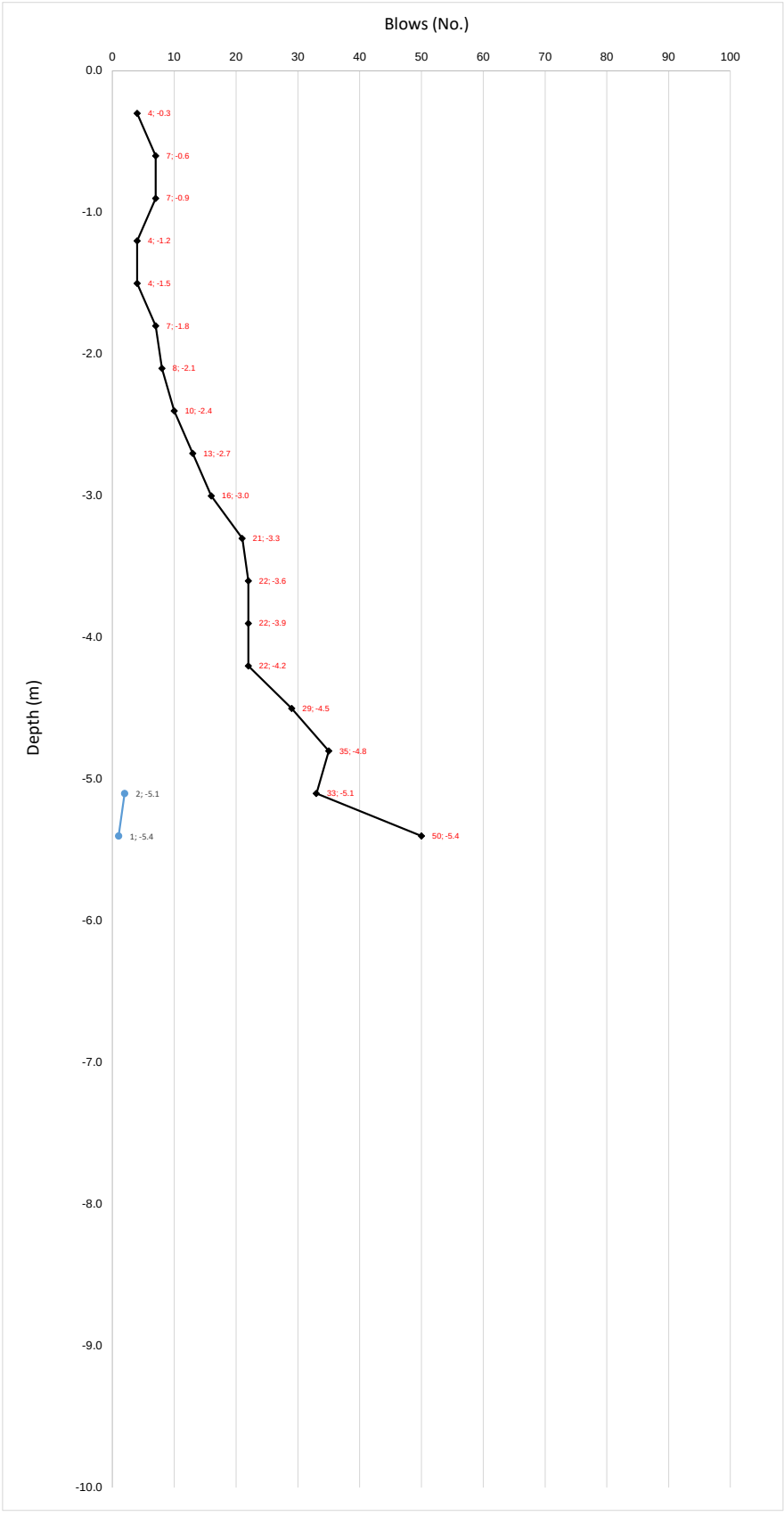
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	4		
-0.6	7		
-0.9	7		
-1.2	4		
-1.5	4		
-1.8	7		
-2.1	8		
-2.4	10		
-2.7	13		
-3.0	16		
-3.3	21		
-3.6	22		
-3.9	22		
-4.2	22		
-4.5	29		
-4.8	35		
-5.1	33	-5.1	2
-5.4	50	-5.4	1
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.3
REDRIVE
FROM: -4.80
TO: -5.10 **BLOWS:** 2
FROM: 5.10
TO: -5.40 **BLOWS:** 1

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 05
DATE OF TEST: 26/10/2022
OPERATOR: Bongani

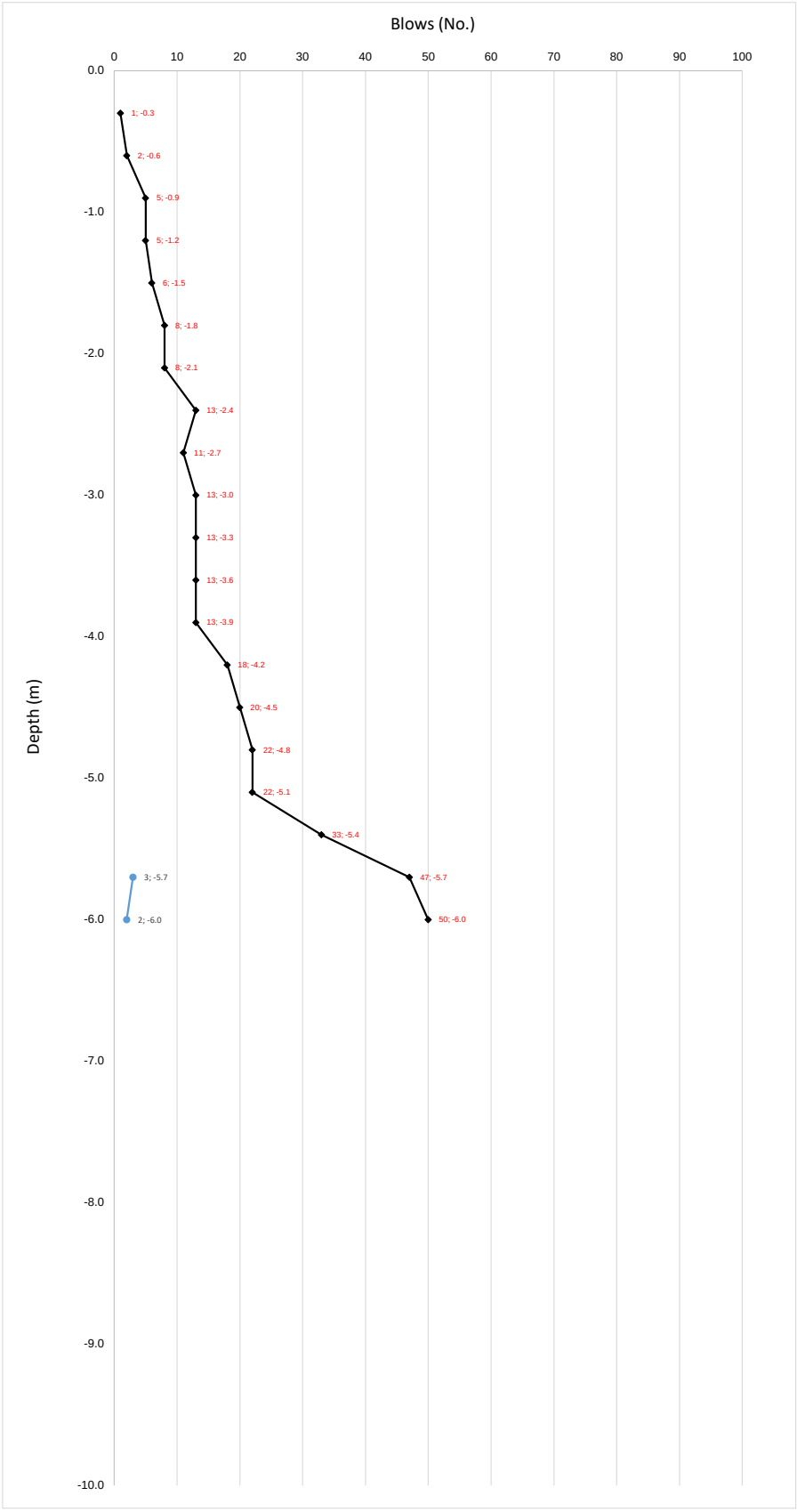
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	1		
-0.6	2		
-0.9	5		
-1.2	5		
-1.5	6		
-1.8	8		
-2.1	8		
-2.4	13		
-2.7	11		
-3.0	13		
-3.3	13		
-3.6	13		
-3.9	13		
-4.2	18		
-4.5	20		
-4.8	22		
-5.1	22		
-5.4	33		
-5.7	47	-5.7	3
-6.0	50	-6.0	2

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.80
REDRIVE
FROM: -5.40 **TO:** -5.70 **BLOWS:** 3
FROM: -5.70 **TO:** -6.00 **BLOWS:** 2

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 06
DATE OF TEST: 26/10/2022
OPERATOR: Bongani

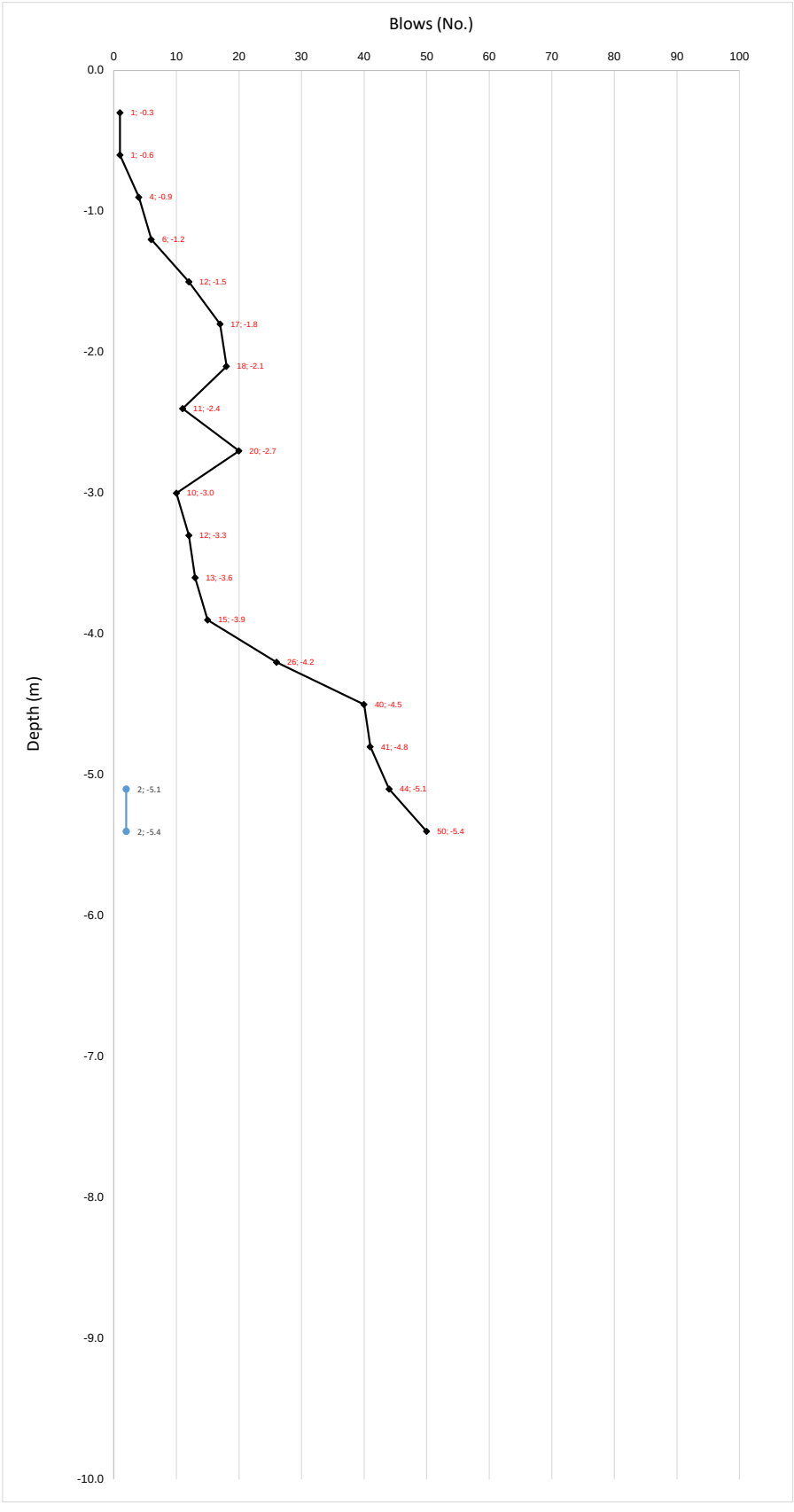
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	1		
-0.6	1		
-0.9	4		
-1.2	6		
-1.5	12		
-1.8	17		
-2.1	18		
-2.4	11		
-2.7	20		
-3.0	10		
-3.3	12		
-3.6	13		
-3.9	15		
-4.2	26		
-4.5	40		
-4.8	41		
-5.1	44	-5.1	2
-5.4	50	-5.4	2
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.40
REDRIVE
FROM: -4.80
TO: -5.10 **BLOWS:** 2
FROM: -5.10
TO: -5.40 **BLOWS:** 2

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 07
DATE OF TEST: 26/10/2022
OPERATOR: Bongani

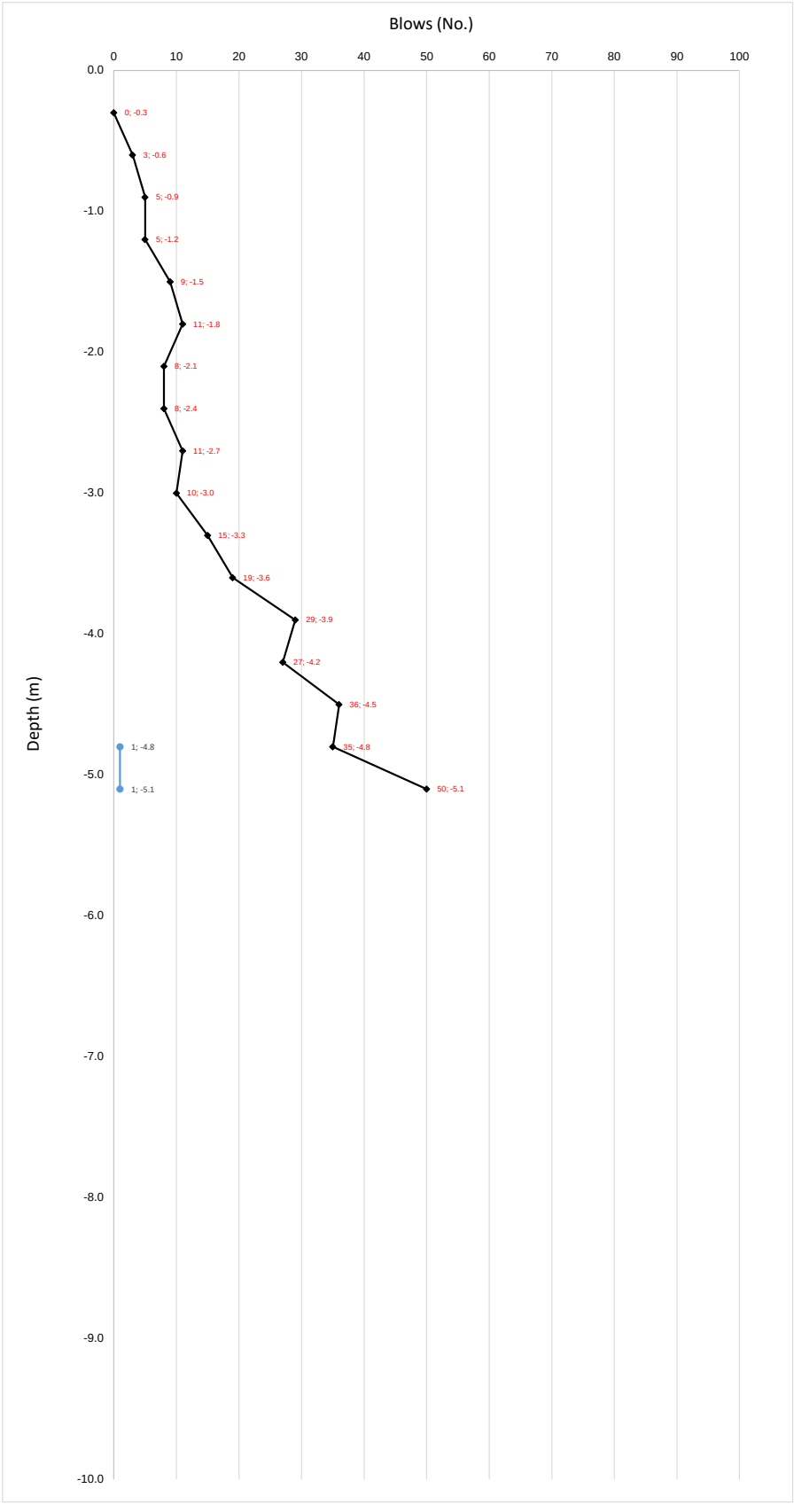
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	3		
-0.9	5		
-1.2	5		
-1.5	9		
-1.8	11		
-2.1	8		
-2.4	8		
-2.7	11		
-3.0	10		
-3.3	15		
-3.6	19		
-3.9	29		
-4.2	27		
-4.5	36		
-4.8	35	-4.8	1
-5.1	50	-5.1	1
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.00
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 1
FROM: -4.80
TO: -5.10 **BLOWS:** 1

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 08
DATE OF TEST: 26/10/2022
OPERATOR: Bongani

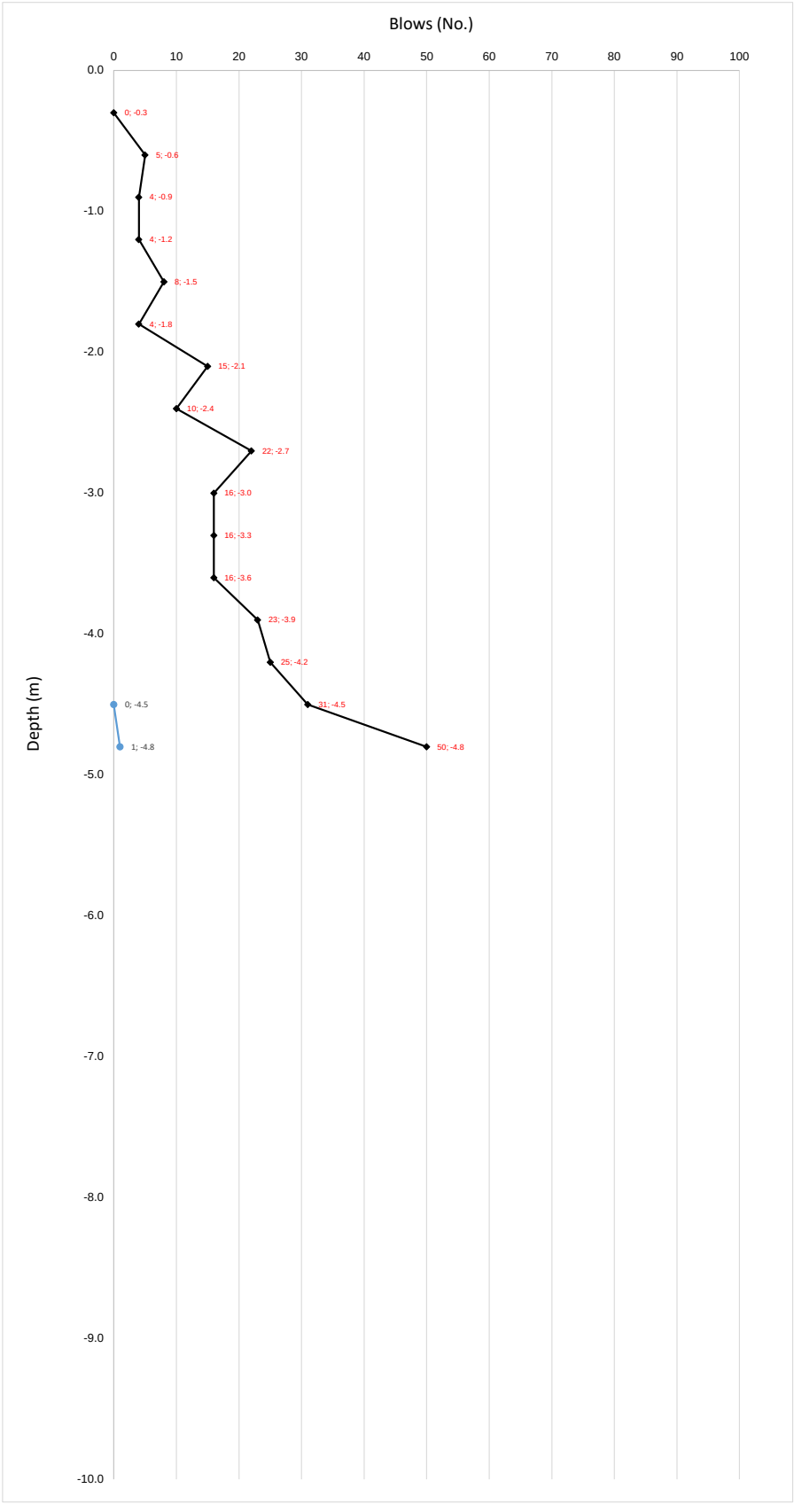
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	5		
-0.9	4		
-1.2	4		
-1.5	8		
-1.8	4		
-2.1	15		
-2.4	10		
-2.7	22		
-3.0	16		
-3.3	16		
-3.6	16		
-3.9	23		
-4.2	25		
-4.5	31	-4.5	0
-4.8	50	-4.8	1
-5.1			
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 4.80
REDRIVE
FROM: -4.20
TO: -4.50 **BLOWS:** 0
FROM: -4.50
TO: -4.80 **BLOWS:** 1

COMMENTS: Termination due to refusal.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 09
DATE OF TEST: 26/10/2022
OPERATOR: Bongani

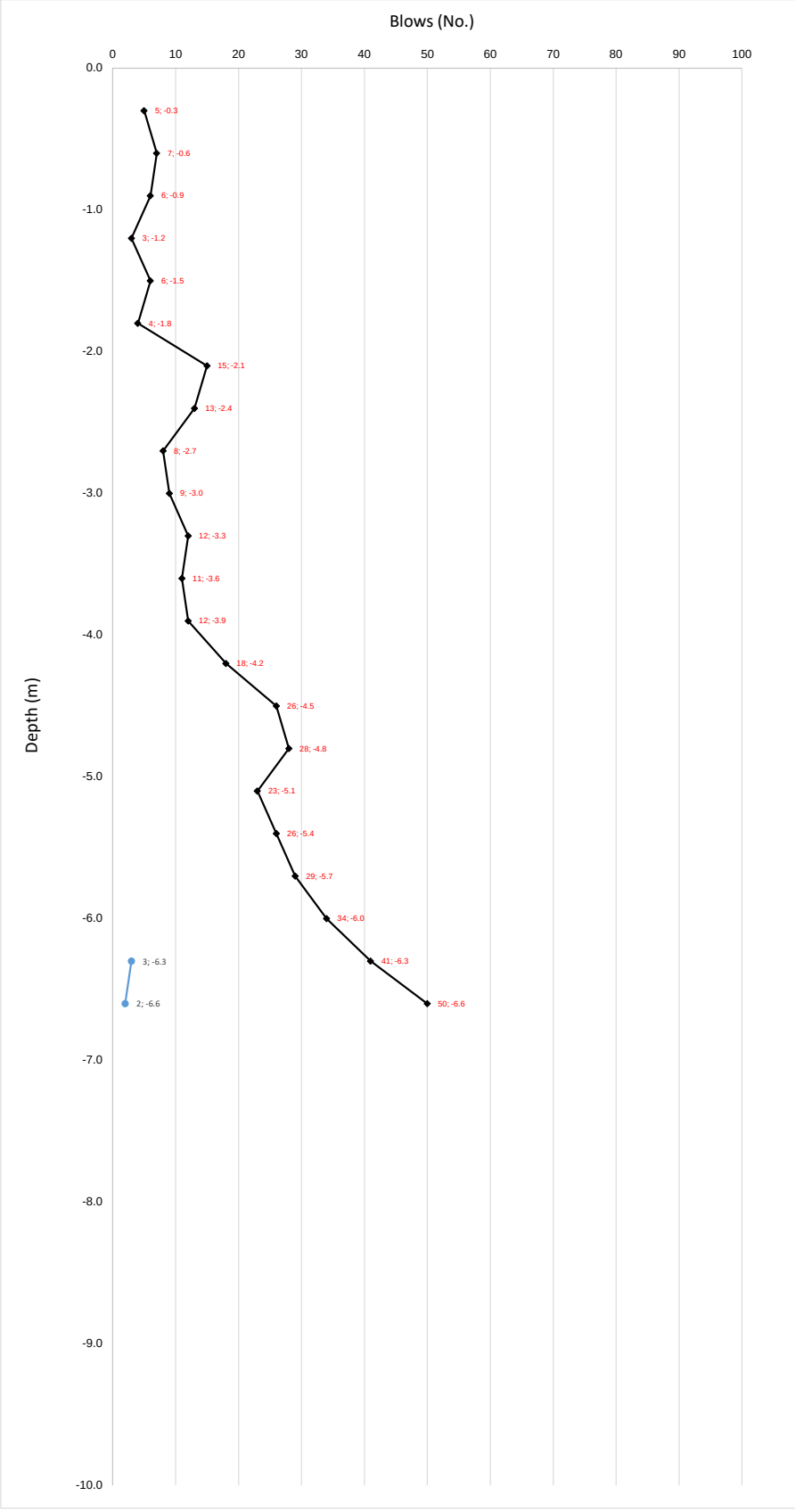
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	5		
-0.6	7		
-0.9	6		
-1.2	3		
-1.5	6		
-1.8	4		
-2.1	15		
-2.4	13		
-2.7	8		
-3.0	9		
-3.3	12		
-3.6	11		
-3.9	12		
-4.2	18		
-4.5	26		
-4.8	28		
-5.1	23		
-5.4	26		
-5.7	29		
-6.0	34		
-6.3	41	-6.3	3
-6.6	50	-6.6	2

ADDITIONAL INFORMATION

TERMINATION DEPTH: 6.60
REDRIVE
FROM: -6.00
TO: -6.30 **BLOWS:** 3
FROM: -6.30
TO: -6.60 **BLOWS:** 2

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 10
DATE OF TEST: 27/10/2022
OPERATOR: Bongani

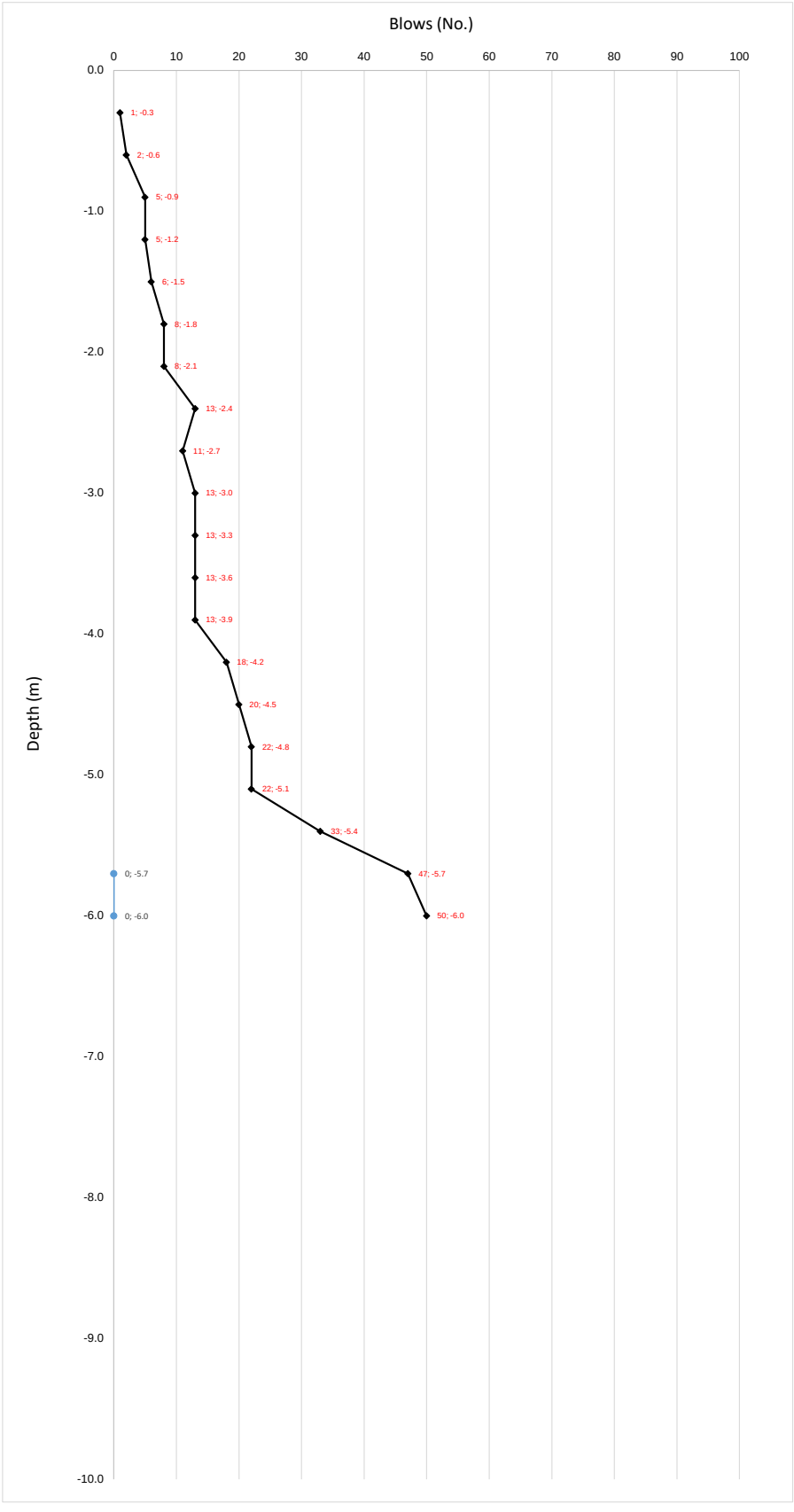
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	1		
-0.6	2		
-0.9	5		
-1.2	5		
-1.5	6		
-1.8	8		
-2.1	8		
-2.4	13		
-2.7	11		
-3.0	13		
-3.3	13		
-3.6	13		
-3.9	13		
-4.2	18		
-4.5	20		
-4.8	22		
-5.1	22		
-5.4	33		
-5.7	47	-5.7	0
-6.0	50	-6.0	0

ADDITIONAL INFORMATION

TERMINATION DEPTH: 3.80
REDRIVE
FROM: -3.30
TO: -3.60 **BLOWS:** 0
FROM: -3.60
TO: -3.90 **BLOWS:** 0

COMMENTS: Termination due to refusal.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 11
DATE OF TEST: 27/10/2022
OPERATOR: Bongani

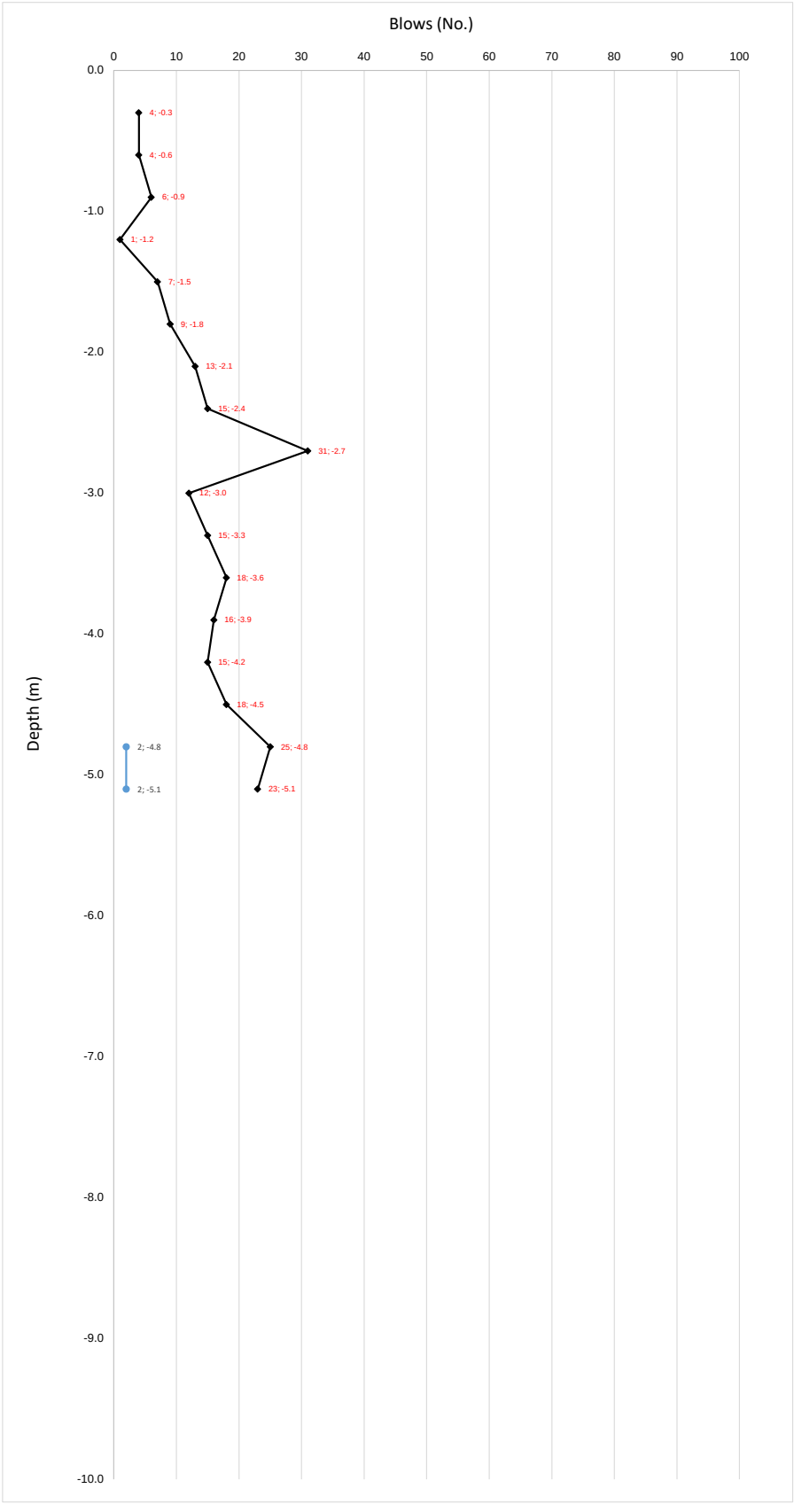
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	4		
-0.6	4		
-0.9	6		
-1.2	1		
-1.5	7		
-1.8	9		
-2.1	13		
-2.4	15		
-2.7	31		
-3.0	12		
-3.3	15		
-3.6	18		
-3.9	16		
-4.2	15		
-4.5	18		
-4.8	25	-4.8	2
-5.1	23	-5.1	2
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.10
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 2
FROM: -4.80
TO: -5.10 **BLOWS:** 2

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 12
DATE OF TEST: 27/10/2022
OPERATOR: Bongani

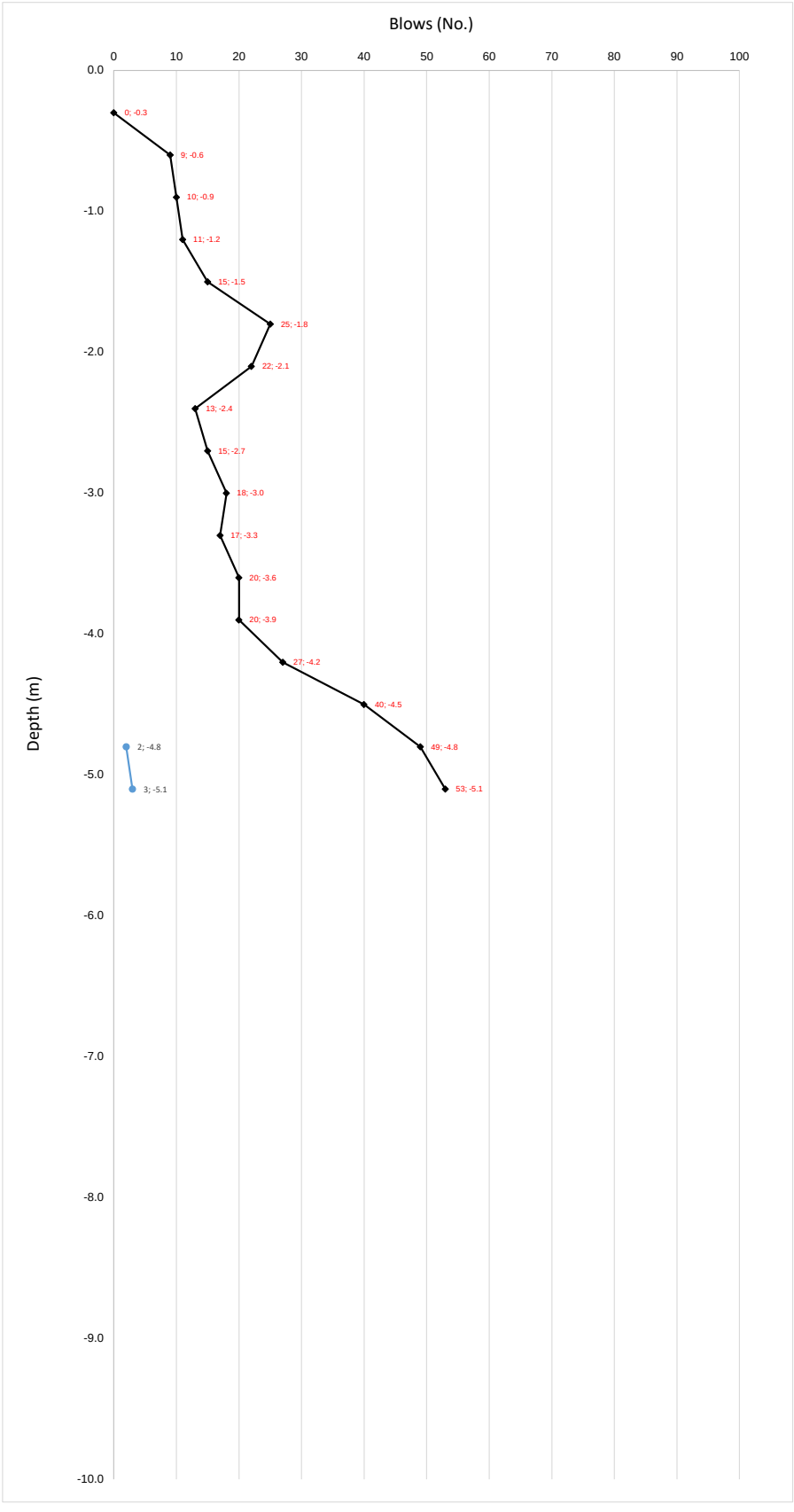
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	9		
-0.9	10		
-1.2	11		
-1.5	15		
-1.8	25		
-2.1	22		
-2.4	13		
-2.7	15		
-3.0	18		
-3.3	17		
-3.6	20		
-3.9	20		
-4.2	27		
-4.5	40		
-4.8	49	-4.8	2
-5.1	53	-5.1	3
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.10
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 2
FROM: -4.80
TO: -5.10 **BLOWS:** 3

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 13
DATE OF TEST: 27/10/2022
OPERATOR: Bongani

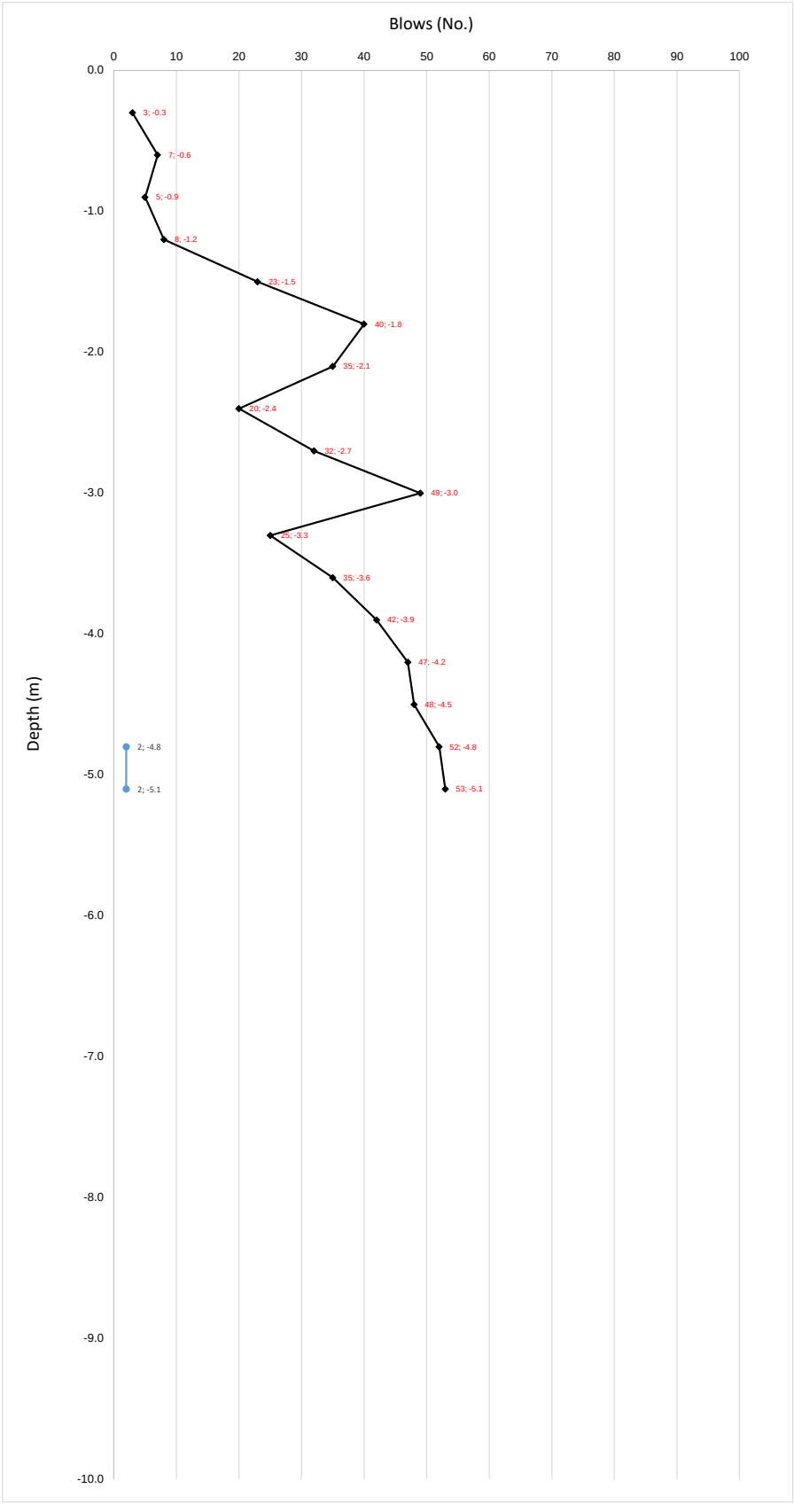
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	3		
-0.6	7		
-0.9	5		
-1.2	8		
-1.5	23		
-1.8	40		
-2.1	35		
-2.4	20		
-2.7	32		
-3.0	49		
-3.3	25		
-3.6	35		
-3.9	42		
-4.2	47		
-4.5	48		
-4.8	52	-4.8	2
-5.1	53	-5.1	2
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.10
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 2
FROM: -4.80
TO: -5.10 **BLOWS:** 2

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 14
DATE OF TEST: 27/10/2022
OPERATOR: Bongani

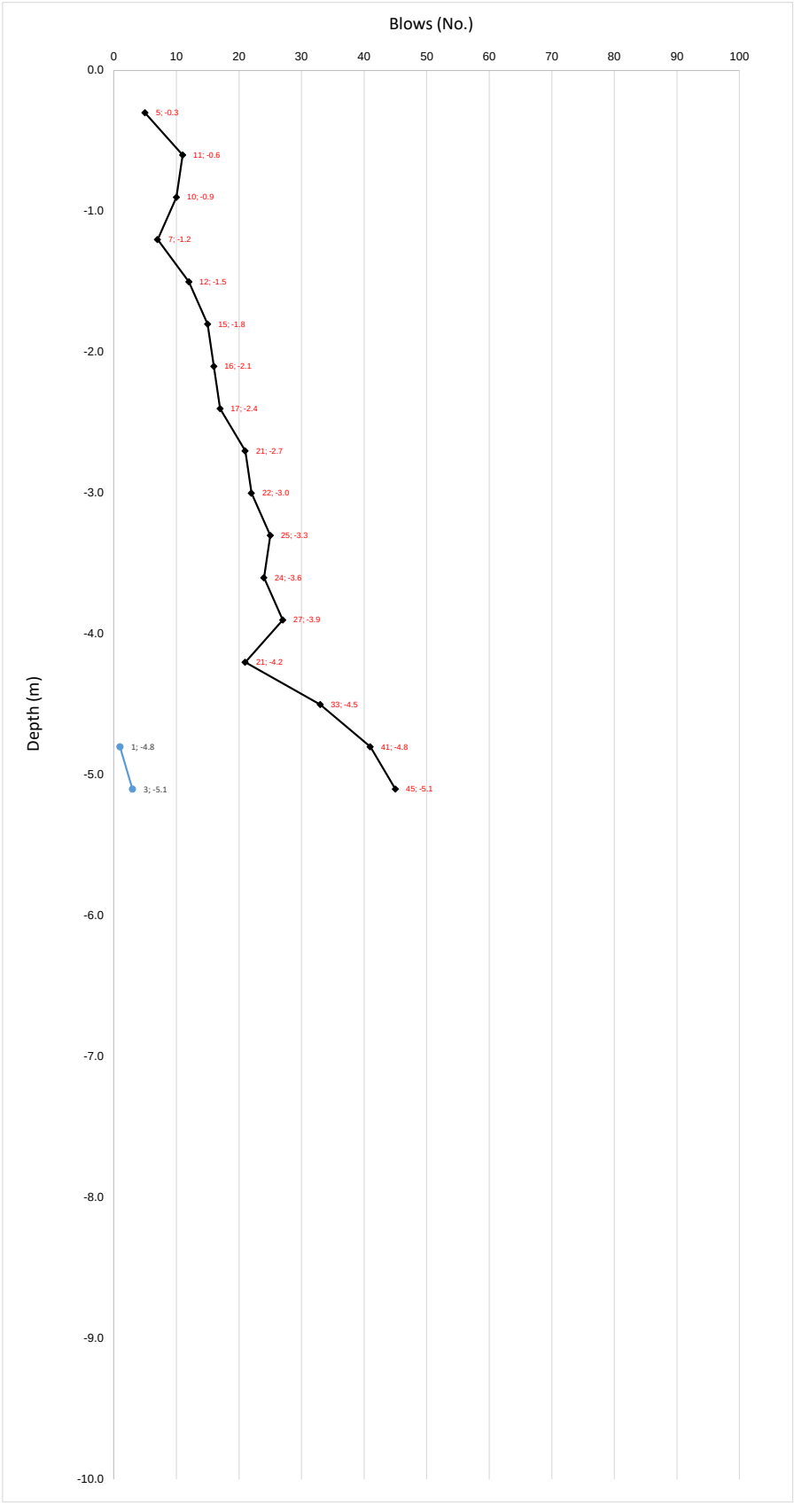
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	5		
-0.6	11		
-0.9	10		
-1.2	7		
-1.5	12		
-1.8	15		
-2.1	16		
-2.4	17		
-2.7	21		
-3.0	22		
-3.3	25		
-3.6	24		
-3.9	27		
-4.2	21		
-4.5	33		
-4.8	41	-4.8	1
-5.1	45	-5.1	3
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.10
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 1
FROM: -4.80
TO: -5.10 **BLOWS:** 3

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 15
DATE OF TEST: 28/10/2022
OPERATOR: Bongani

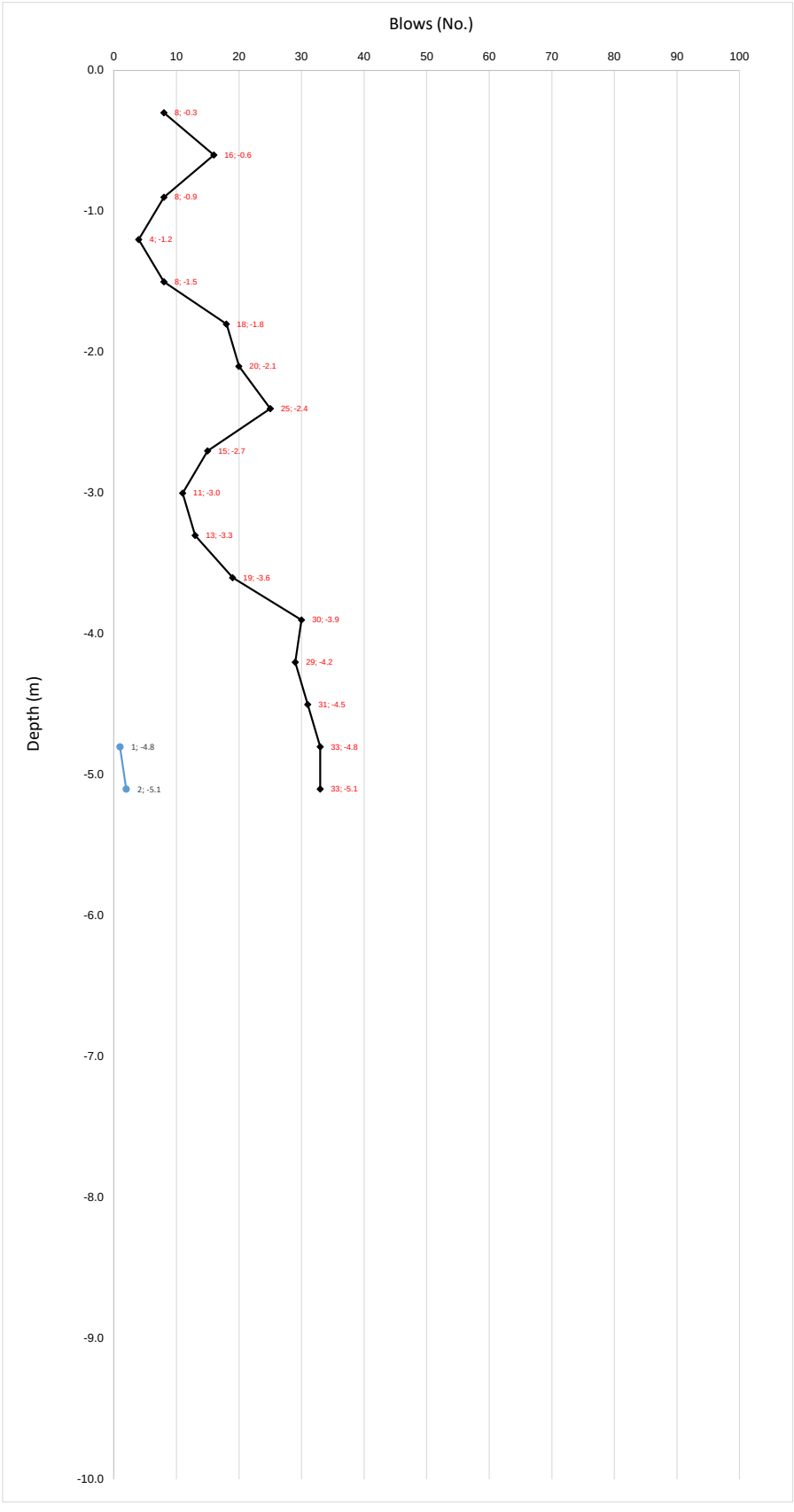
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	8		
-0.6	16		
-0.9	8		
-1.2	4		
-1.5	8		
-1.8	18		
-2.1	20		
-2.4	25		
-2.7	15		
-3.0	11		
-3.3	13		
-3.6	19		
-3.9	30		
-4.2	29		
-4.5	31		
-4.8	33	-4.8	1
-5.1	33	-5.1	2
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.10
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 1
FROM: -4.80
TO: -5.10 **BLOWS:** 2

COMMENTS: Termination due to refusal.
Redrive not possible because refusal depth too shallow.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 16
DATE OF TEST: 28/10/2022
OPERATOR: Bongani

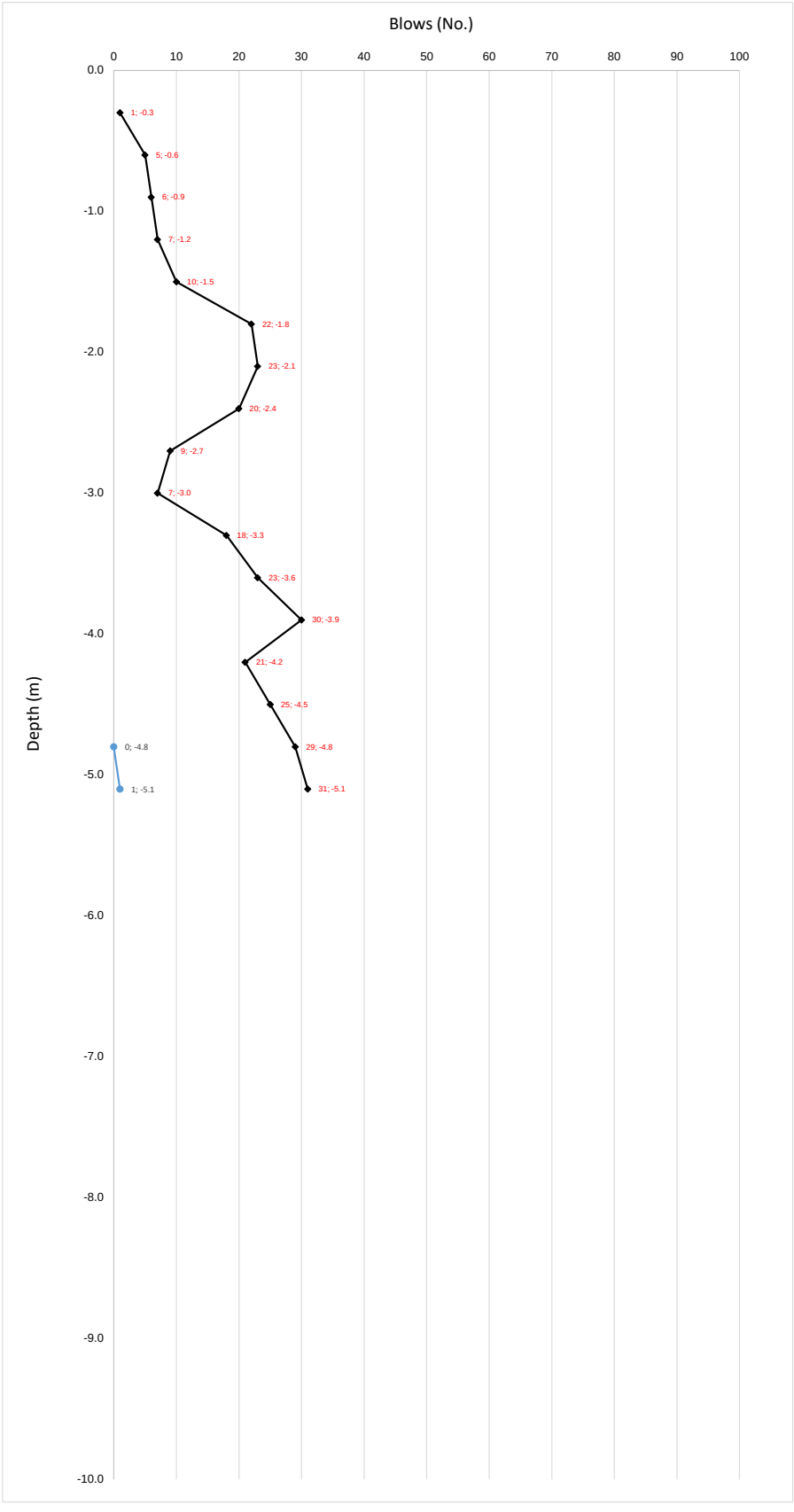
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	1		
-0.6	5		
-0.9	6		
-1.2	7		
-1.5	10		
-1.8	22		
-2.1	23		
-2.4	20		
-2.7	9		
-3.0	7		
-3.3	18		
-3.6	23		
-3.9	30		
-4.2	21		
-4.5	25		
-4.8	29	-4.8	0
-5.1	31	-5.1	1
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.10
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 0
FROM: -4.80
TO: -5.10 **BLOWS:** 1

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 17
DATE OF TEST: 27/10/2022
OPERATOR: Bongani

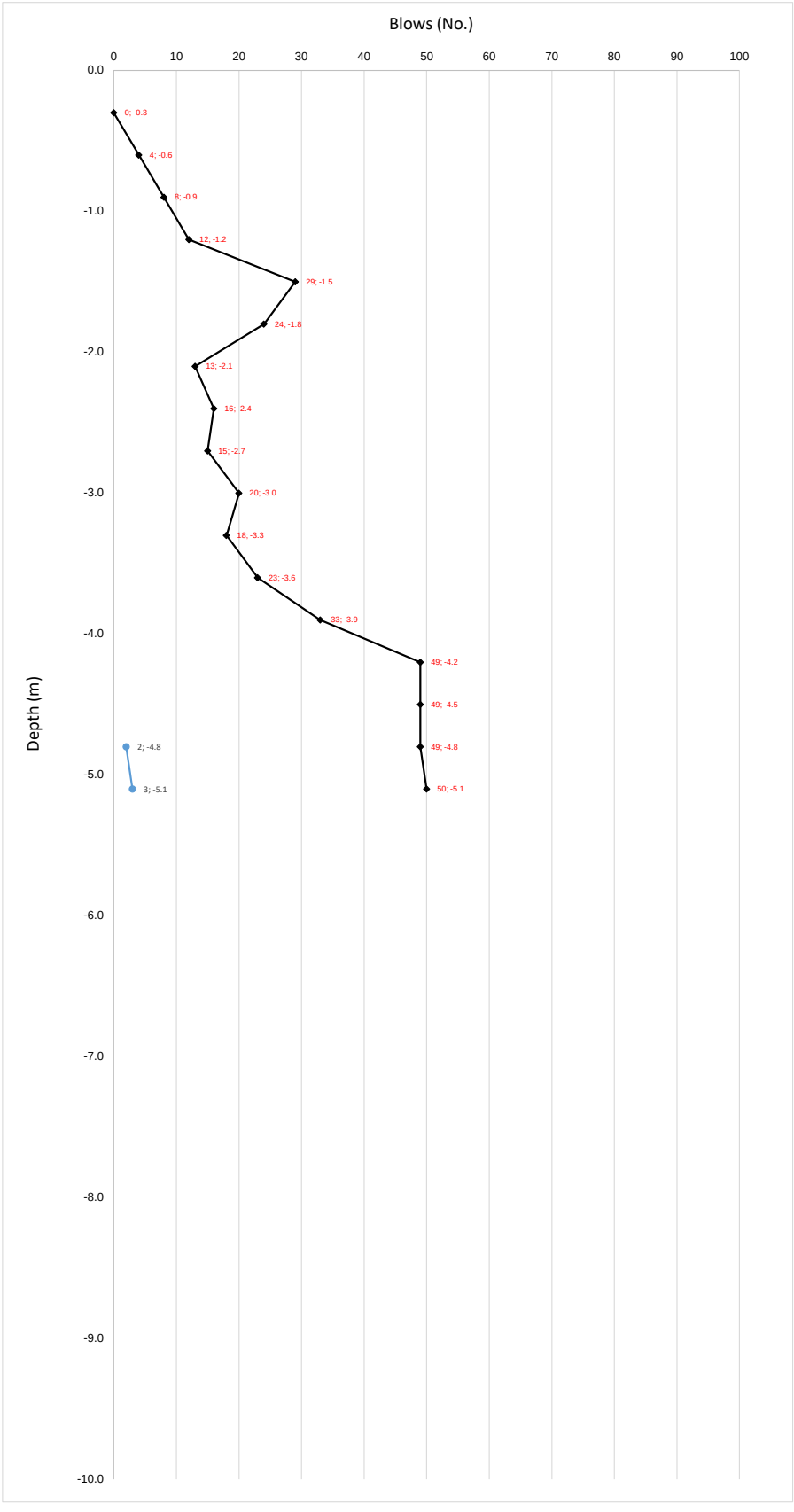
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	4		
-0.9	8		
-1.2	12		
-1.5	29		
-1.8	24		
-2.1	13		
-2.4	16		
-2.7	15		
-3.0	20		
-3.3	18		
-3.6	23		
-3.9	33		
-4.2	49		
-4.5	49		
-4.8	49	-4.8	2
-5.1	50	-5.1	3
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.10
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 2
FROM: -4.80
TO: -5.10 **BLOWS:** 3

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 18
DATE OF TEST: 28/10/2022
OPERATOR: Bongani

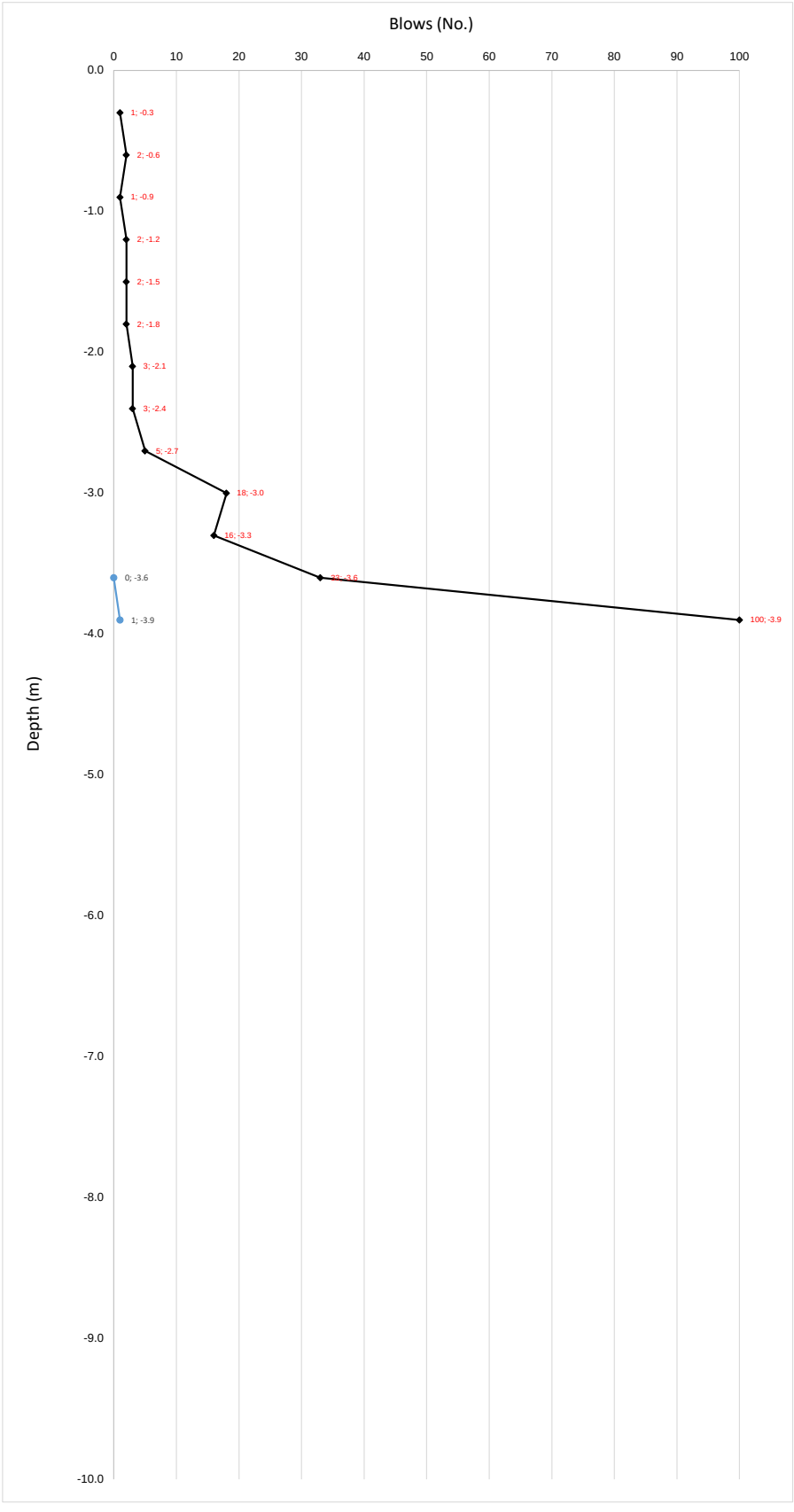
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	1		
-0.6	2		
-0.9	1		
-1.2	2		
-1.5	2		
-1.8	2		
-2.1	3		
-2.4	3		
-2.7	5		
-3.0	18		
-3.3	16		
-3.6	33	-3.6	0
-3.9	100	-3.9	1
-4.2			
-4.5			
-4.8			
-5.1			
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 3.80
REDRIVE
FROM: -3.30
TO: -3.60 **BLOWS:** 0
FROM: -3.60
TO: -3.90 **BLOWS:** 1

COMMENTS: Termination due to refusal.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 15
DATE OF TEST: 28/10/2022
OPERATOR: Bongani

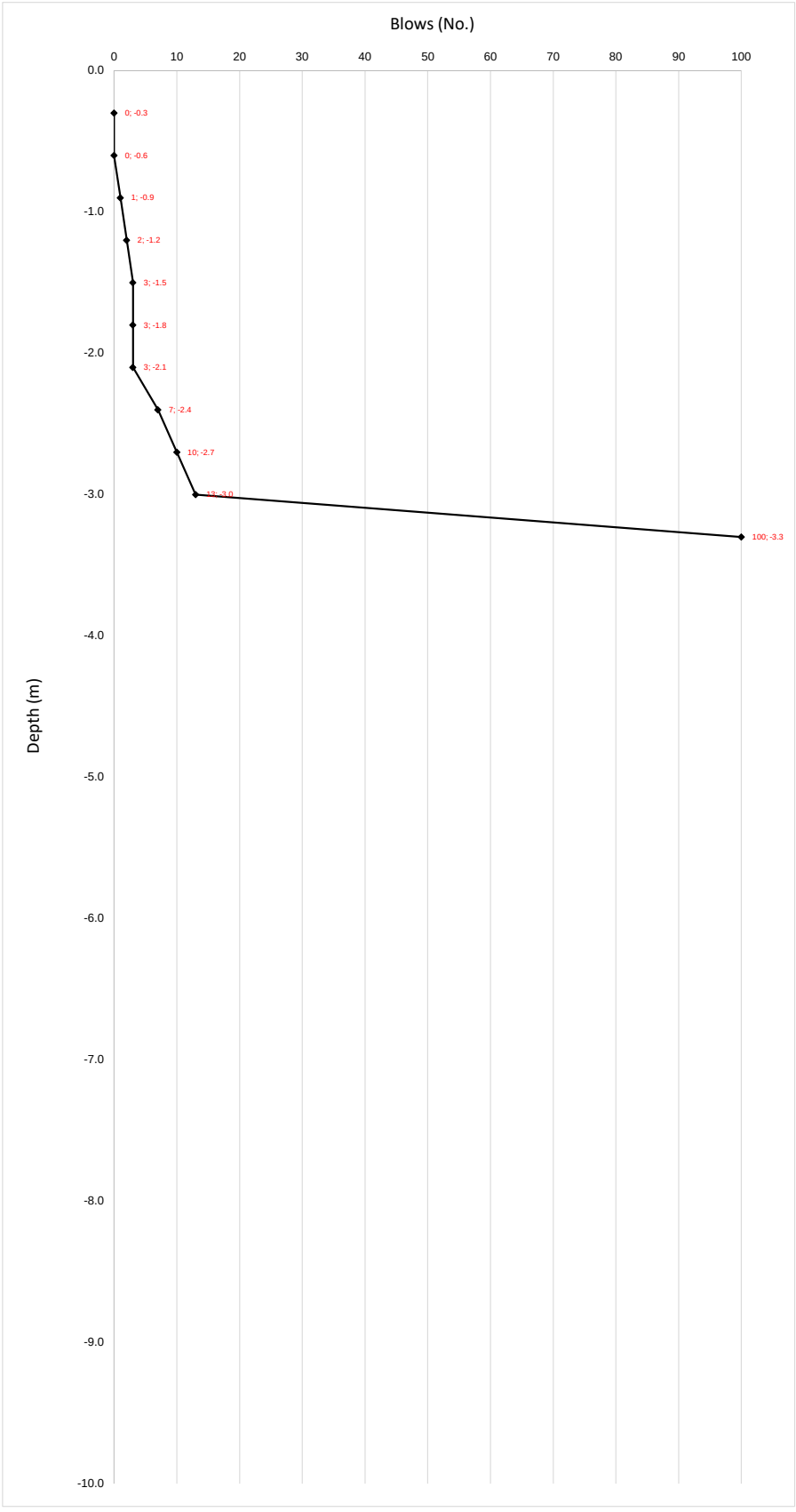
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	0		
-0.9	1		
-1.2	2		
-1.5	3		
-1.8	3		
-2.1	3		
-2.4	7		
-2.7	10		
-3.0	13		
-3.3	100		
-3.6			
-3.9			
-4.2			
-4.5			
-4.8			
-5.1			
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 3.1
REDRIVE
FROM: -2.70
TO: -3.00 **BLOWS:** 0
FROM: -3.00
TO: -3.30 **BLOWS:** 0

COMMENTS: Termination due to refusal.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 20
DATE OF TEST: 28/10/2022
OPERATOR: Bongani

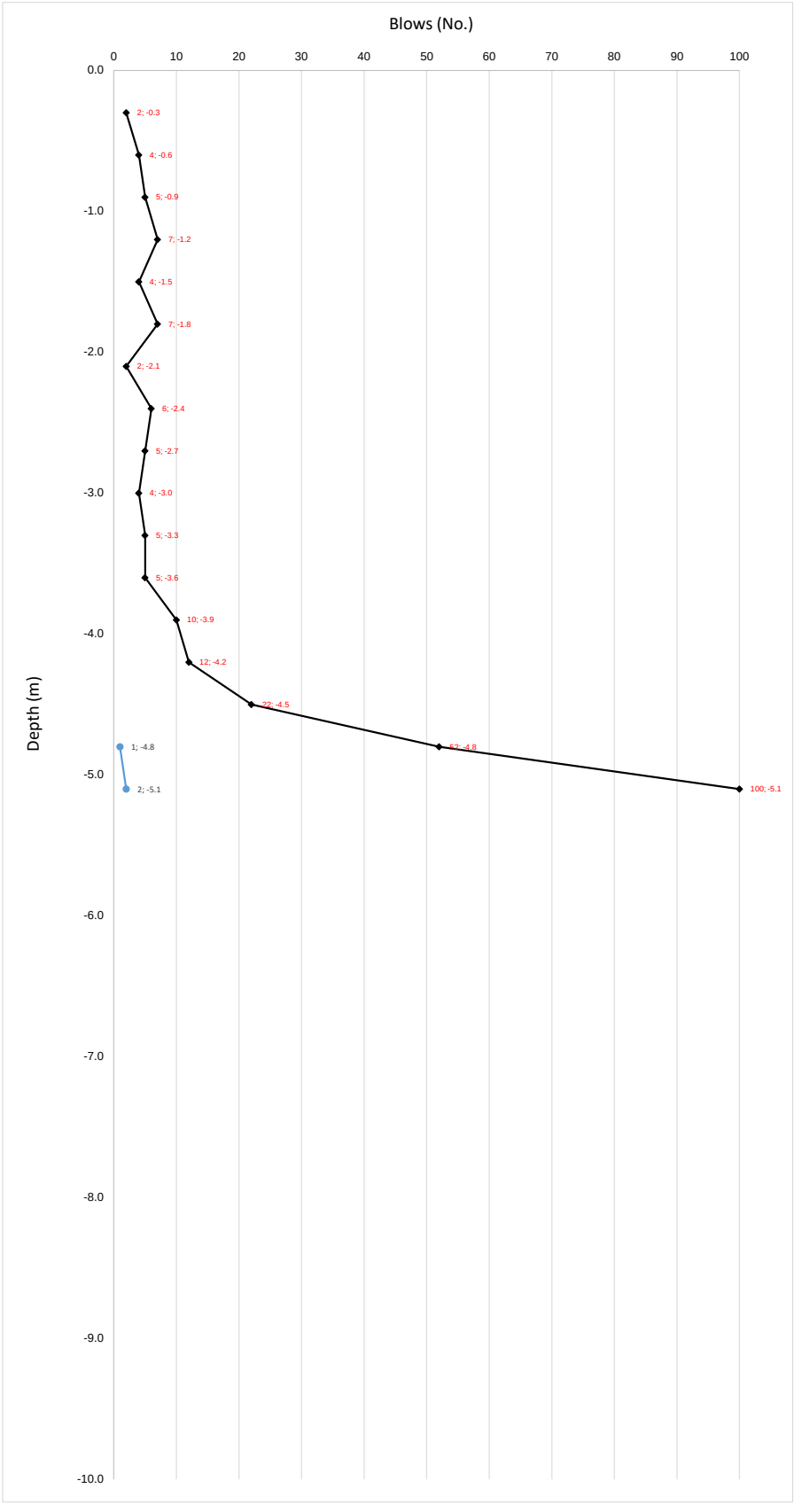
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	2		
-0.6	4		
-0.9	5		
-1.2	7		
-1.5	4		
-1.8	7		
-2.1	2		
-2.4	6		
-2.7	5		
-3.0	4		
-3.3	5		
-3.6	5		
-3.9	10		
-4.2	12		
-4.5	22		
-4.8	52	-4.8	1
-5.1	100	-5.1	2
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 4.90
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 1
FROM: -4.80
TO: -5.10 **BLOWS:** 2

COMMENTS: Termination due to refusal.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 21
DATE OF TEST: 28/10/2022
OPERATOR: Bongani

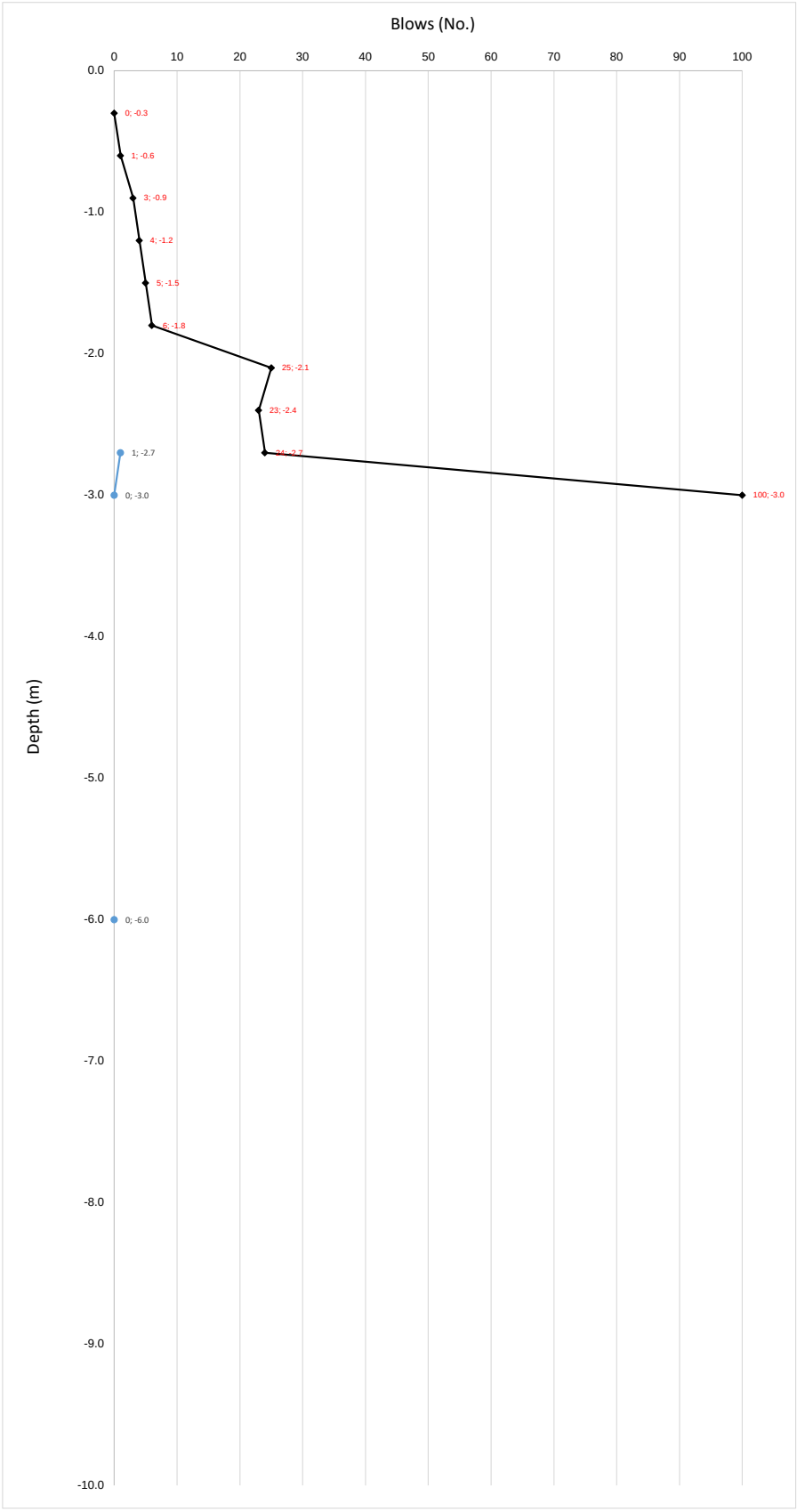
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	1		
-0.9	3		
-1.2	4		
-1.5	5		
-1.8	6		
-2.1	25		
-2.4	23		
-2.7	24	-2.7	1
-3.0	100	-3.0	0
-3.3			
-3.6			
-3.9			
-4.2			
-4.5			
-4.8			
-5.1			
-5.4			
-5.7			
-6.0		-6.0	0

ADDITIONAL INFORMATION

TERMINATION DEPTH: 2.80
REDRIVE
FROM: -2.40
TO: -2.70 BLOWS: 0
FROM: -2.70
TO: -3.00 BLOWS: 0

COMMENTS: Termination due to refusal.



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 22
DATE OF TEST: 29/10/2022
OPERATOR: Bongani

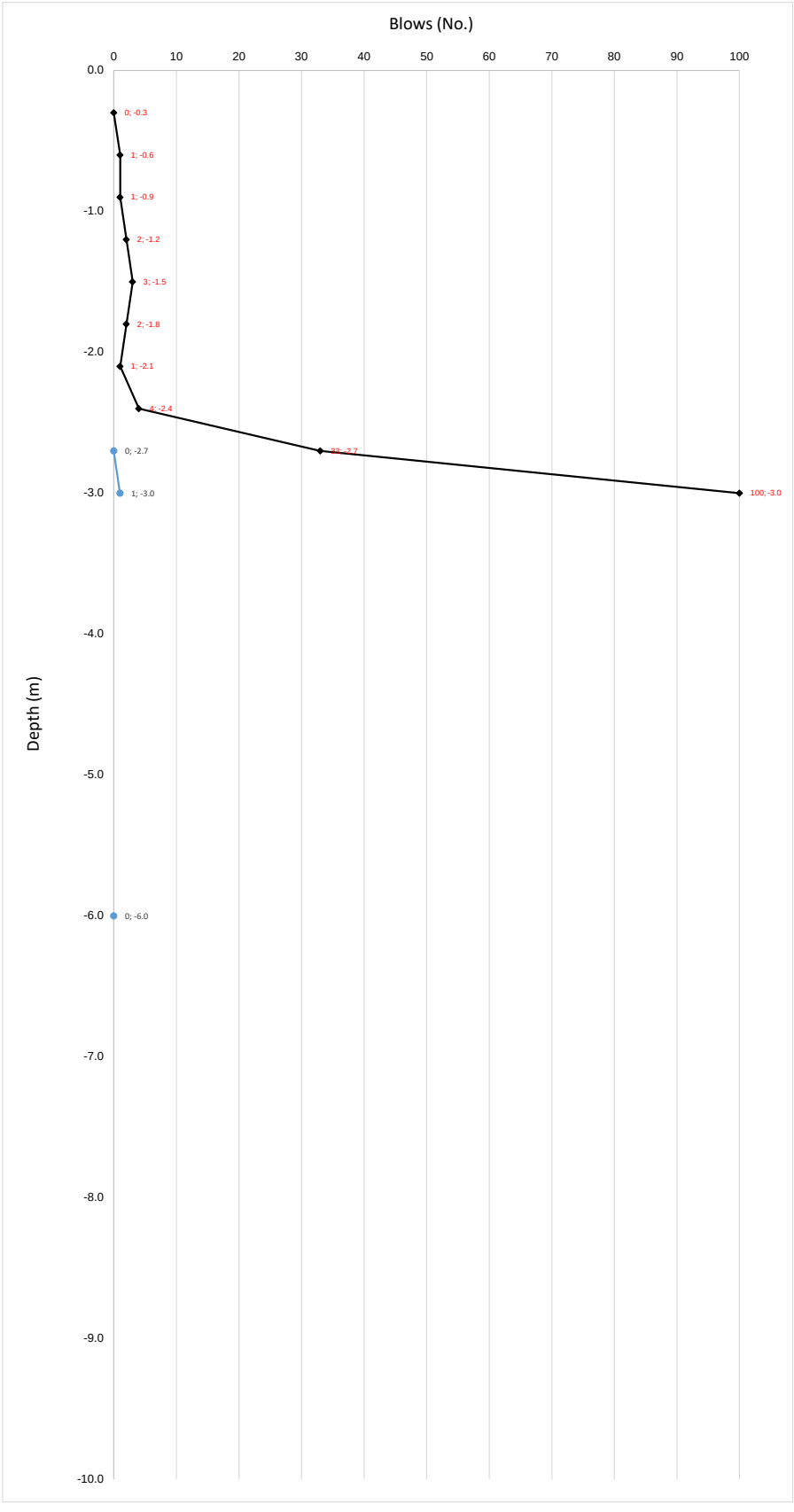
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	1		
-0.9	1		
-1.2	2		
-1.5	3		
-1.8	2		
-2.1	1		
-2.4	4		
-2.7	33	-2.7	0
-3.0	100	-3.0	1
-3.3			
-3.6			
-3.9			
-4.2			
-4.5			
-4.8			
-5.1			
-5.4			
-5.7			
-6.0		-6.0	0

ADDITIONAL INFORMATION

TERMINATION DEPTH: 3.00
REDRIVE
FROM: -2.40
TO: -2.70 **BLOWS:** 0
FROM: -2.70
TO: -3.00 **BLOWS:** 1

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 23
DATE OF TEST: 29/10/2022
OPERATOR: Bongani

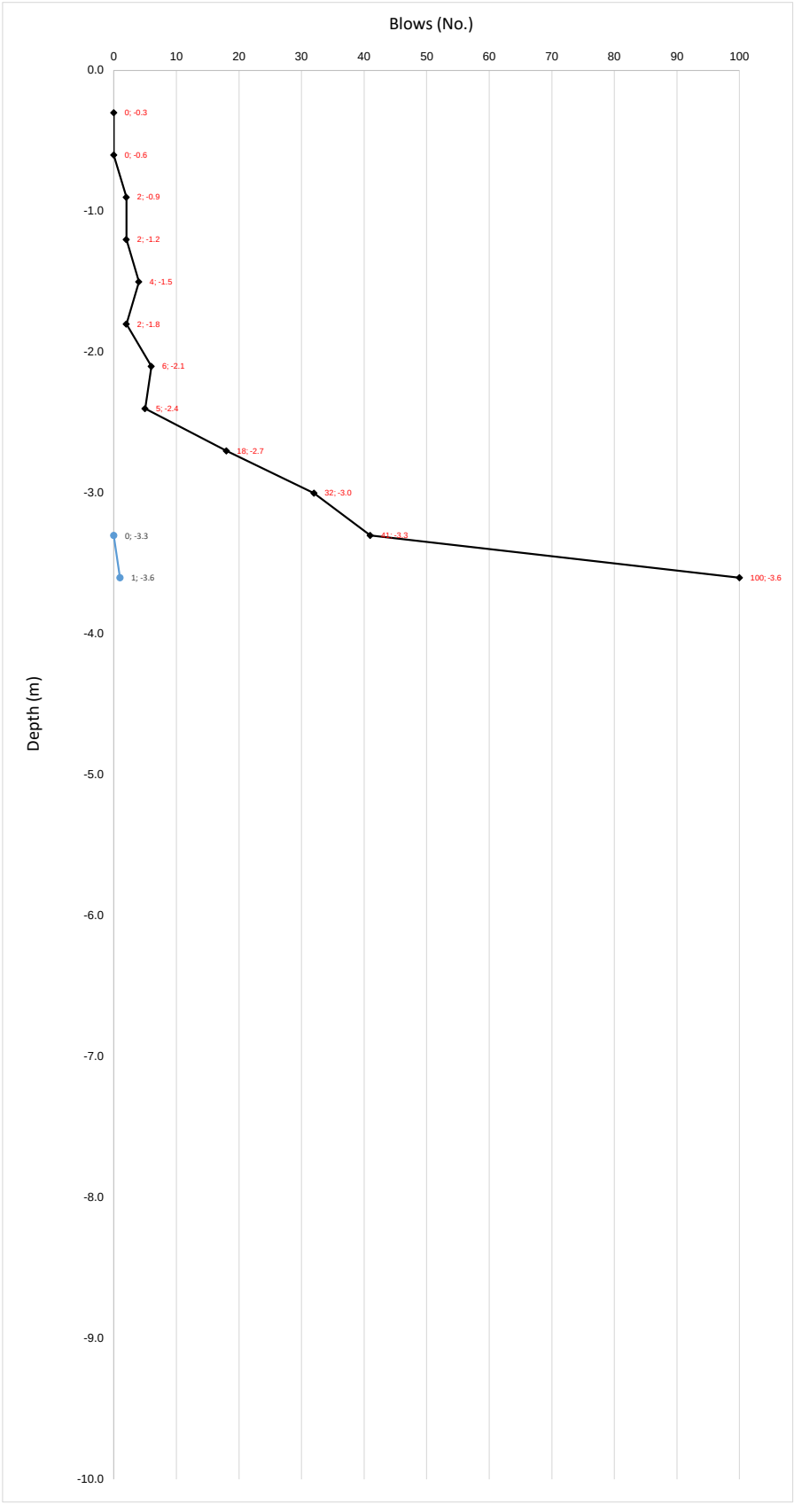
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	0		
-0.9	2		
-1.2	2		
-1.5	4		
-1.8	2		
-2.1	6		
-2.4	5		
-2.7	18		
-3.0	32		
-3.3	41	-3.3	0
-3.6	100	-3.6	1
-3.9			
-4.2			
-4.5			
-4.8			
-5.1			
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 2.50
REDRIVE
FROM: -3.00
TO: -3.30 **BLOWS:** 0
FROM: -3.30
TO: -3.60 **BLOWS:** 1

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 24
DATE OF TEST: 28/10/2022
OPERATOR: Bongani

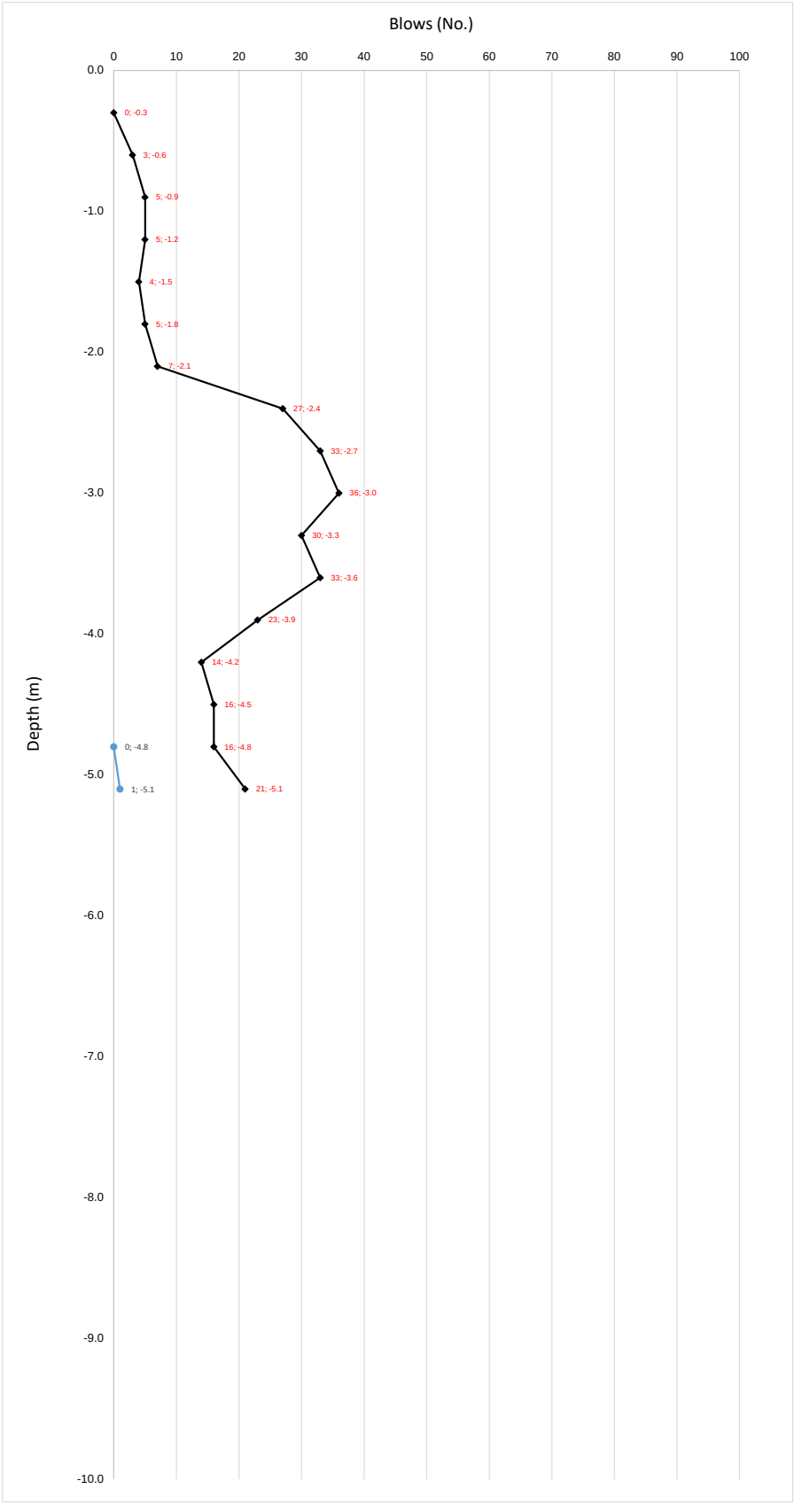
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	3		
-0.9	5		
-1.2	5		
-1.5	4		
-1.8	5		
-2.1	7		
-2.4	27		
-2.7	33		
-3.0	36		
-3.3	30		
-3.6	33		
-3.9	23		
-4.2	14		
-4.5	16		
-4.8	16	-4.8	0
-5.1	21	-5.1	1
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 5.10
REDRIVE
FROM: -4.50
TO: -4.80 **BLOWS:** 0
FROM: -4.80
TO: -5.10 **BLOWS:** 1

COMMENTS:



The Blue line represents the 600mm re-drive to check rod friction

DYNAMIC PROBE SUPER HEAVY (DPSH)

PROJECT NAME: Geotechnical Drilling Services of The Improvement of National Road R30 Section 8 from 36,80 KM to 68,646 KM Ventersdorp.
PROJECT NUMBER: GA/C/880
TEST NUMBER: DPSH 25
DATE OF TEST: 29/10/2022
OPERATOR: Bongani

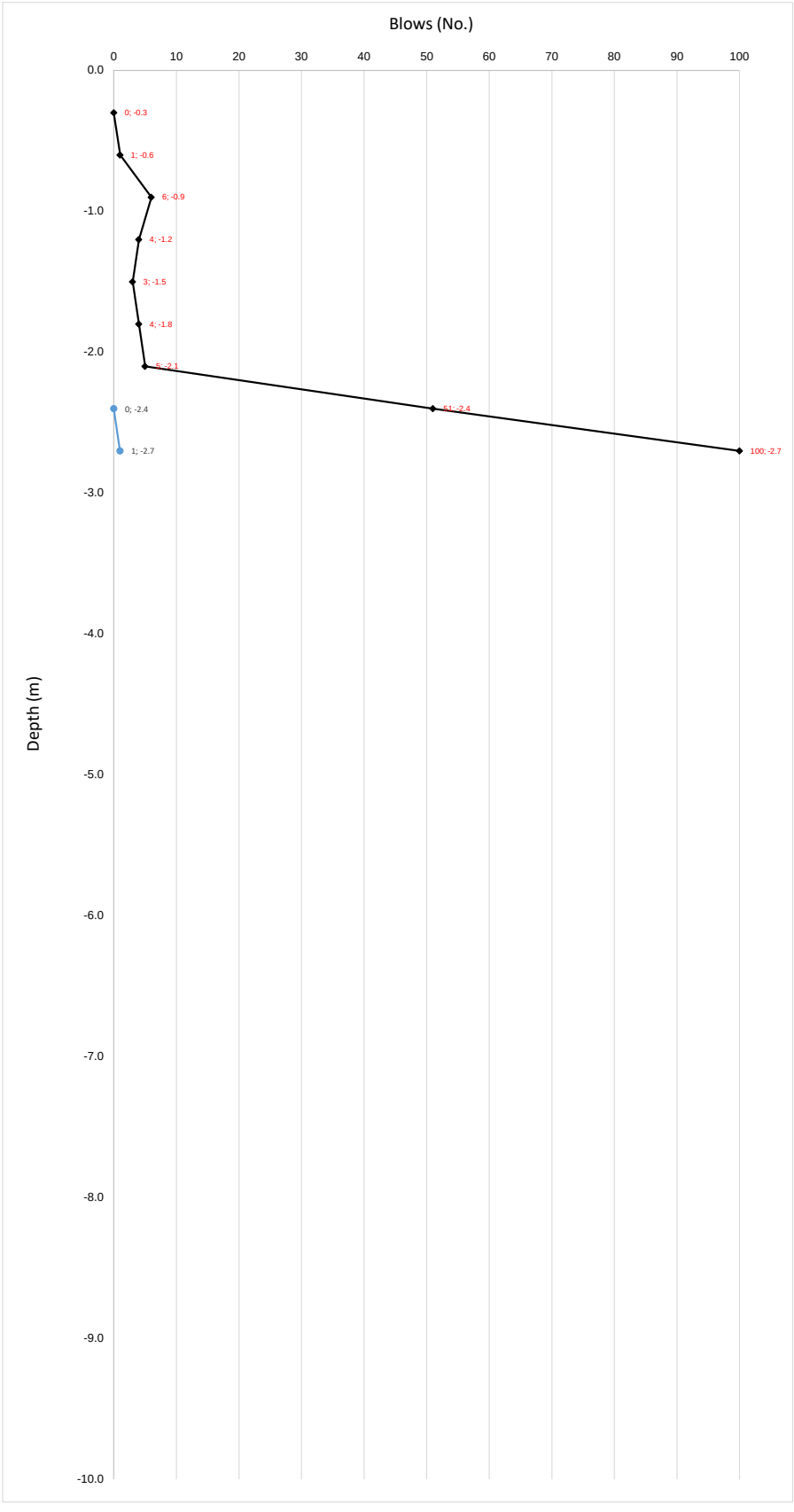
TEST RESULT

Depth (m)	Number of Blows	Redrive Depth (m)	Redrive Number of Blows
0.0			
-0.3	0		
-0.6	1		
-0.9	6		
-1.2	4		
-1.5	3		
-1.8	4		
-2.1	5		
-2.4	51	-2.4	0
-2.7	100	-2.7	1
-3.0			
-3.3			
-3.6			
-3.9			
-4.2			
-4.5			
-4.8			
-5.1			
-5.4			
-5.7			
-6.0			

ADDITIONAL INFORMATION

TERMINATION DEPTH: 2.60
REDRIVE
FROM: -2.10
TO: -,2,4 **BLOWS:** 0
FROM: -2.40
TO: -2.70 **BLOWS:** 1

COMMENTS: Termination due to refusal.
Redrive not possible because refusal depth too shallow.



The Blue line represents the 600mm re-drive to check rod friction

APPENDIX E.2

DPSH TEST POSITIONS



Figure E.2 – 1: DPSH test positions at Culvert 39.654

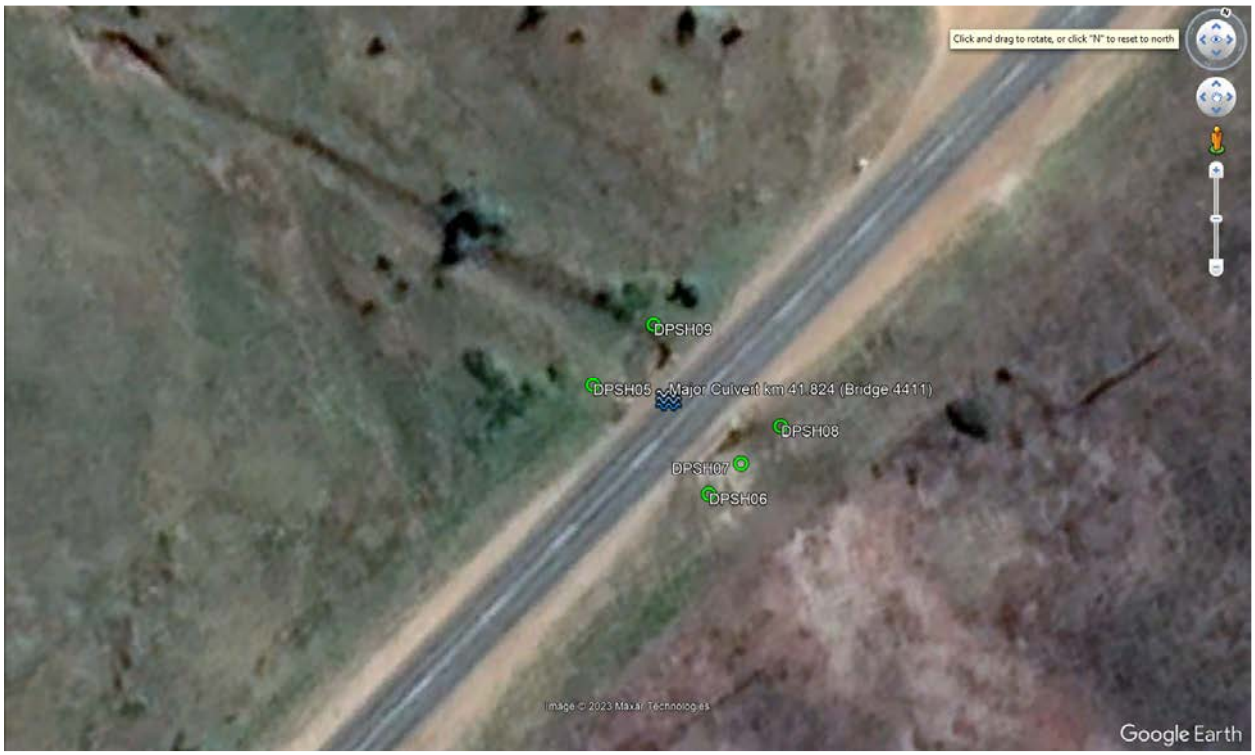


Figure E.2 – 2: DPSH test positions at Culvert 41.824



Figure E.2 – 3: DPSH test positions at Culvert 44.577



Figure E.2 – 4: DPSH test positions at Culvert 47.257



Figure E.2 – 5: DPSH test positions at Culvert 65.971

APPENDIX F

LABORATORY TEST RESULTS - SOIL

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TP1	TP2	TP6	Sample	TP1	TP2	TP6
Depth (m)	0.5 - 1.5	1.5 - 2.5	0.7 - 1.1	Depth (m)	0.5 - 1.5	1.5 - 2.5	0.7 - 1.1
Lab No	SGE-20-81	SGE-20-82	SGE-20-87	Lab No	SGE-20-81	SGE-20-82	SGE-20-87
53.0	**100**	**100**	**100**	Liquid Limit (%)	**49**	**35**	**17**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**12**	**17**	**11**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**37**	**18**	**6**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**26.0**	**9.0**	**3.0**
13.2	**100**	**100**	**100**	PI of whole sample	**36**	**16**	**5**
9.5	**100**	**100**	**100**				
6.7	**100**	**100**	**100**	% Gravel	**0**	**1**	**0**
4.75	**100**	**100**	**100**	% Sand	**35**	**54**	**71**
2.00	**100**	**99**	**100**	% Silt	**19**	**19**	**18**
1.00	**99**	**96**	**94**	% Clay	**46**	**26**	**11**
0.425	**96**	**89**	**77**	Activity	**0.8**	**0.7**	**0.6**
0.250	**90**	**75**	**66**				
0.150	**85**	**66**	**58**	% Soil Mortar	**100**	**99**	**100**
0.075	**75**	**51**	**40**				
0.060	**65**	**45**	**29**	Grading Modulus	**0.29**	**0.61**	**0.83**
0.050	**62**	**42**	**26**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**56**	**36**	**22**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**52**	**31**	**19**				
0.006	**48**	**28**	**15**	Unified (ASTM D2487)	**CL**	**CL**	**SC-SM**
0.002	**46**	**26**	**11**	AASHTO (M145-91)	**A - 7 - 6**	**A - 6**	**A - 4**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

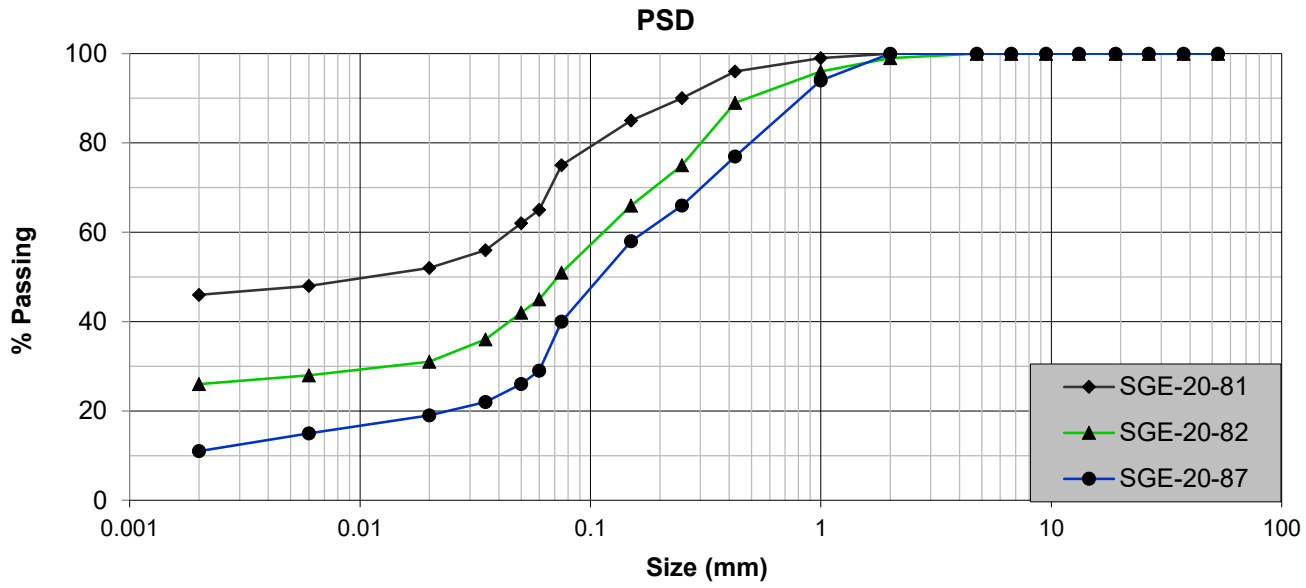
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

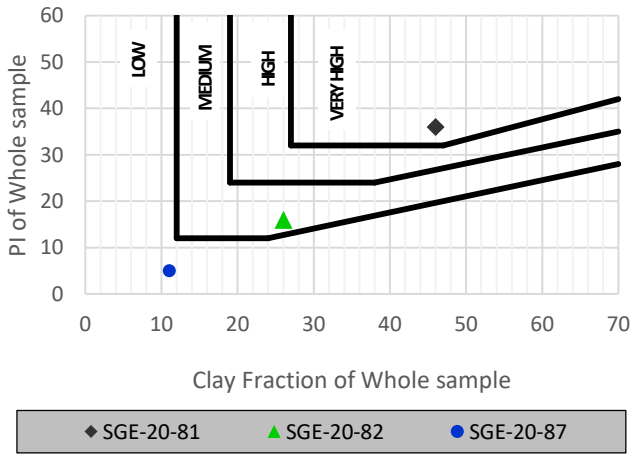
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

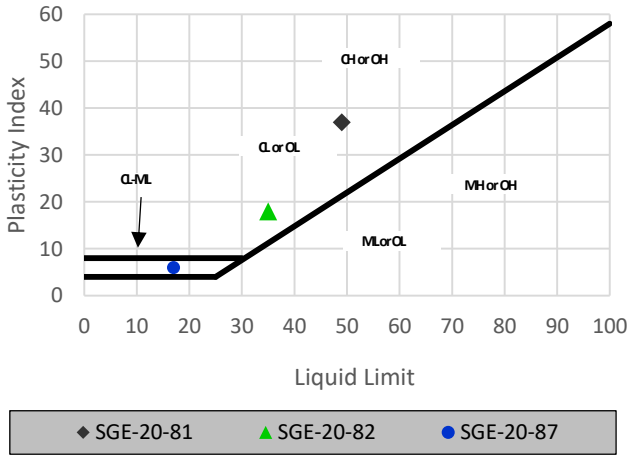
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	TP11	TP3	TP4	Sample	TP11	TP3	TP4
Depth (m)	1.5 - 2.2	2.0	1.5	Depth (m)	1.5 - 2.2	2.0	1.5
Lab No	SGE-20-93	SGE-20-94	SGE-20-95	Lab No	SGE-20-93	SGE-20-94	SGE-20-95
53.0	**100**	**100**	**100**	Liquid Limit (%)	**37**	**45**	**34**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**15**	**19**	**15**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**22**	**26**	**19**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**11.5**	**13.5**	**10.0**
13.2	**100**	**100**	**100**	PI of whole sample	**16**	**13**	**15**
9.5	**100**	**100**	**100**				
6.7	**100**	**100**	**99**	% Gravel	**3**	**7**	**6**
4.75	**100**	**99**	**98**	% Sand	**57**	**61**	**42**
2.00	**97**	**93**	**94**	% Silt	**15**	**8**	**16**
1.00	**89**	**71**	**88**	% Clay	**25**	**24**	**36**
0.425	**74**	**50**	**79**	Activity	**0.9**	**1.1**	**0.5**
0.250	**62**	**44**	**73**				
0.150	**55**	**39**	**67**	% Soil Mortar	**97**	**93**	**94**
0.075	**47**	**34**	**57**				
0.060	**40**	**32**	**52**	Grading Modulus	**0.82**	**1.23**	**0.70**
0.050	**38**	**31**	**49**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**35**	**29**	**45**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**31**	**27**	**42**				
0.006	**27**	**25**	**39**	Unified (ASTM D2487)	**SC**	**SC**	**CL**
0.002	**25**	**24**	**36**	AASHTO (M145-91)	**A - 6**	**A - 2 - 7**	**A - 6**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

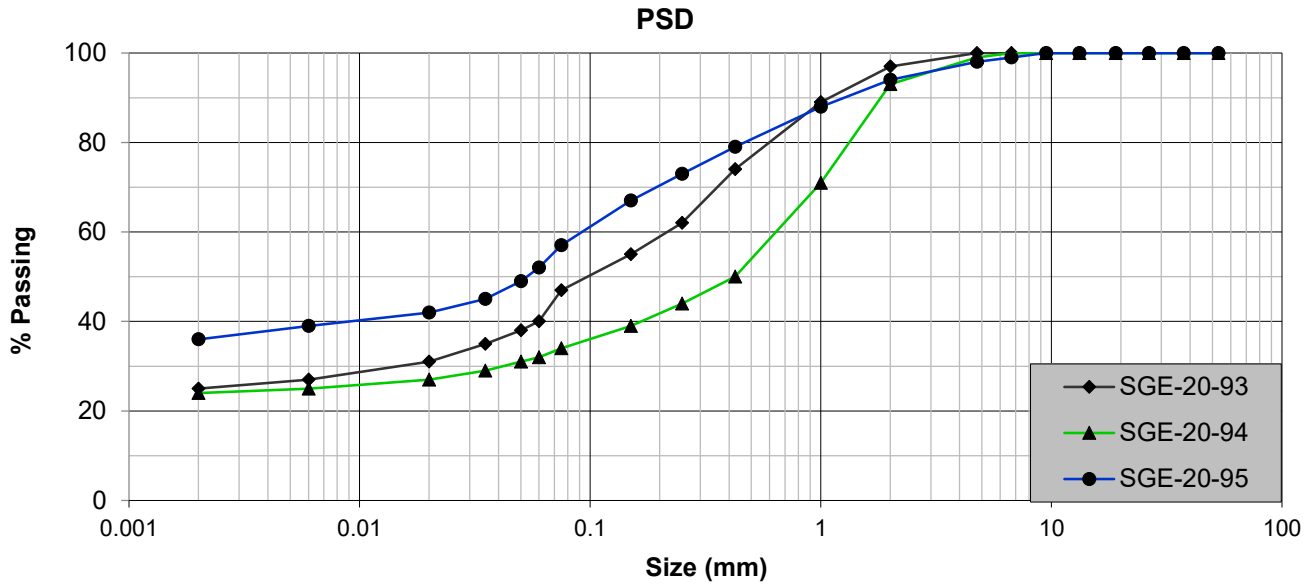
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

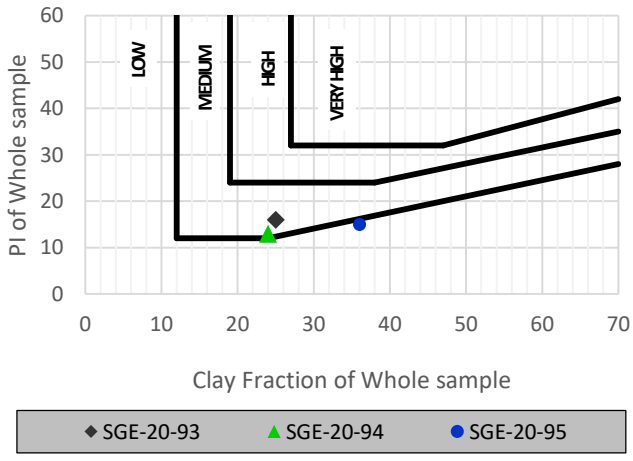
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

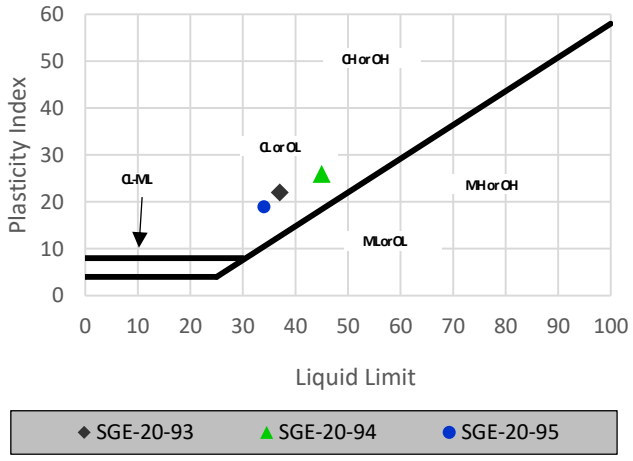
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	TP5	TP7	TP8	Sample	TP5	TP7	TP8
Depth (m)	2.0	1.5	1.9	Depth (m)	2.0	1.5	1.9
Lab No	SGE-20-96	SGE-20-97	SGE-20-98	Lab No	SGE-20-96	SGE-20-97	SGE-20-98
53.0	**100**	**100**	**100**	Liquid Limit (%)	**38**	**33**	**52**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**16**	**14**	**17**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**22**	**19**	**35**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**11.5**	**9.5**	**23.0**
13.2	**100**	**100**	**100**	PI of whole sample	**18**	**14**	**20**
9.5	**100**	**100**	**100**				
6.7	**99**	**99**	**100**	% Gravel	**6**	**9**	**14**
4.75	**99**	**97**	**99**	% Sand	**40**	**43**	**54**
2.00	**94**	**91**	**86**	% Silt	**21**	**14**	**7**
1.00	**88**	**85**	**70**	% Clay	**33**	**34**	**25**
0.425	**80**	**76**	**56**	Activity	**0.7**	**0.6**	**1.4**
0.250	**75**	**69**	**46**				
0.150	**71**	**65**	**40**	% Soil Mortar	**94**	**91**	**86**
0.075	**61**	**54**	**35**				
0.060	**54**	**48**	**32**	Grading Modulus	**0.65**	**0.79**	**1.23**
0.050	**51**	**46**	**31**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**46**	**41**	**29**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**42**	**39**	**27**				
0.006	**36**	**36**	**26**	Unified (ASTM D2487)	**CL**	**CL**	**SC**
0.002	**33**	**34**	**25**	AASHTO (M145-91)	**A - 6**	**A - 6**	**A - 2 - 7**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

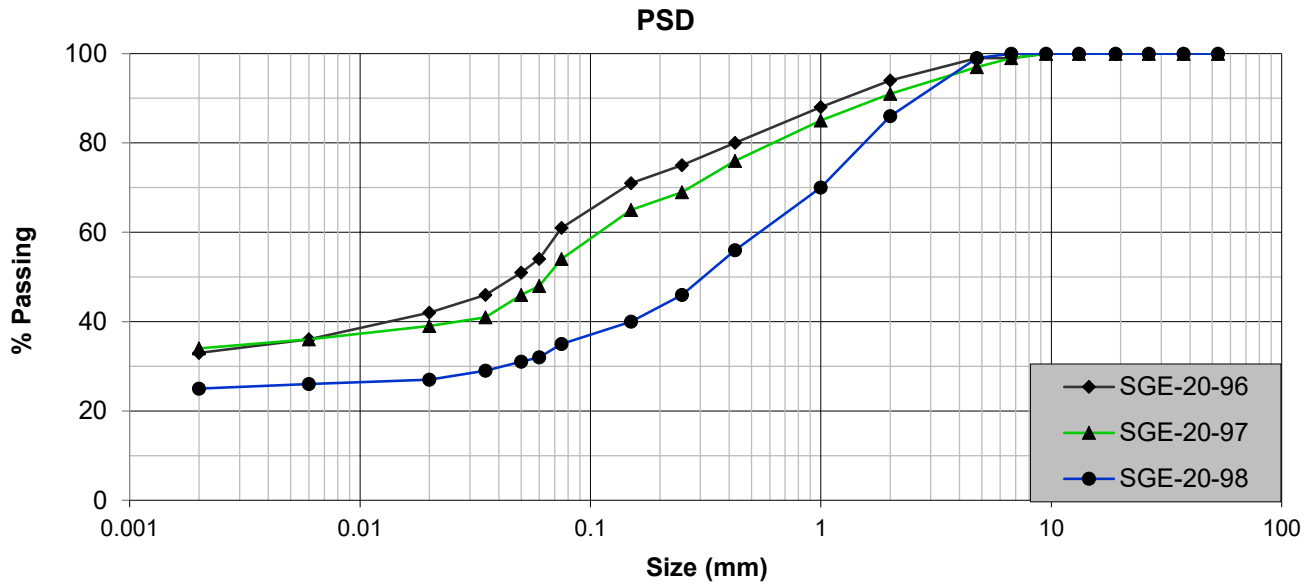
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

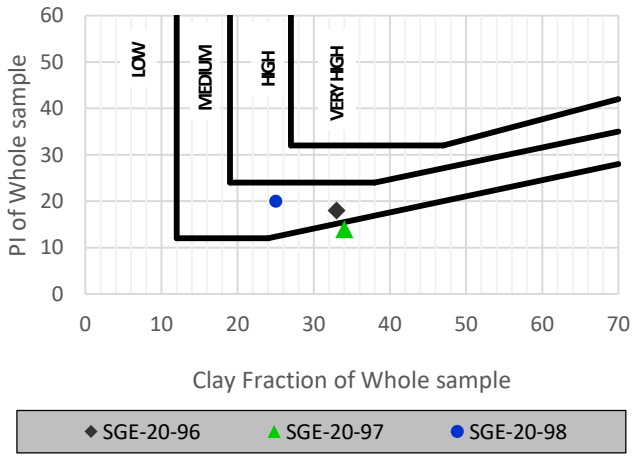
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

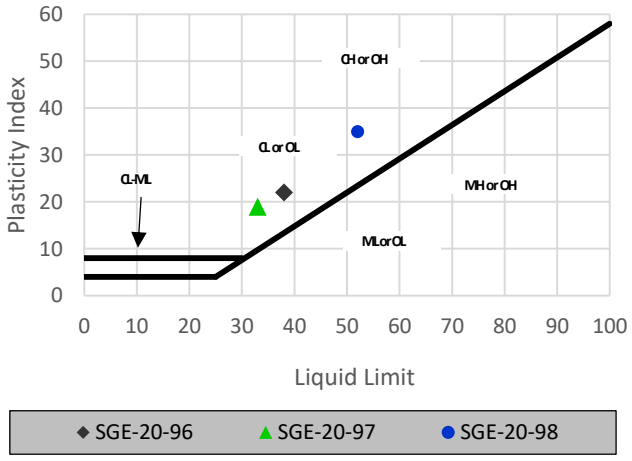
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TP9	TP10	TP7	Sample	TP9	TP10	TP7
Depth (m)	2.0	1.6	1.0 - 2.5	Depth (m)	2.0	1.6	1.0 - 2.5
Lab No	SGE-20-99	SGE-20-100	SGE-20-101	Lab No	SGE-20-99	SGE-20-100	SGE-20-101
53.0	**100**	**100**	**100**	Liquid Limit (%)	**58**	**43**	**35**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**22**	**15**	**16**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**36**	**28**	**19**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**23.5**	**13.0**	**10.0**
13.2	**100**	**100**	**100**	PI of whole sample	**25**	**21**	**14**
9.5	**100**	**100**	**100**				
6.7	**99**	**100**	**98**	% Gravel	**7**	**8**	**13**
4.75	**99**	**99**	**95**	% Sand	**51**	**47**	**45**
2.00	**93**	**92**	**87**	% Silt	**13**	**15**	**20**
1.00	**83**	**85**	**80**	% Clay	**29**	**30**	**22**
0.425	**69**	**75**	**72**	Activity	**1.2**	**0.9**	**0.9**
0.250	**61**	**69**	**65**				
0.150	**56**	**63**	**60**	% Soil Mortar	**93**	**92**	**87**
0.075	**45**	**52**	**51**				
0.060	**42**	**45**	**42**	Grading Modulus	**0.93**	**0.81**	**0.90**
0.050	**40**	**43**	**40**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**36**	**39**	**35**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**34**	**36**	**31**				
0.006	**31**	**32**	**24**	Unified (ASTM D2487)	**SC**	**CL**	**CL**
0.002	**29**	**30**	**22**	AASHTO (M145-91)	**A - 7 - 6**	**A - 7 - 6**	**A - 6**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

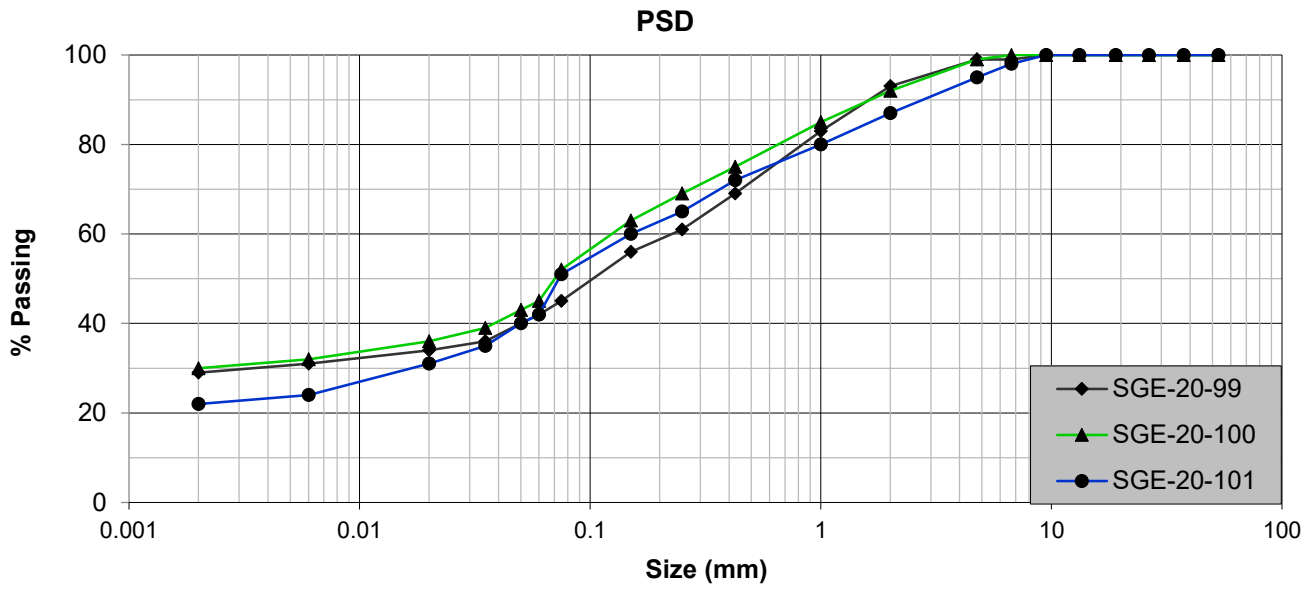
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

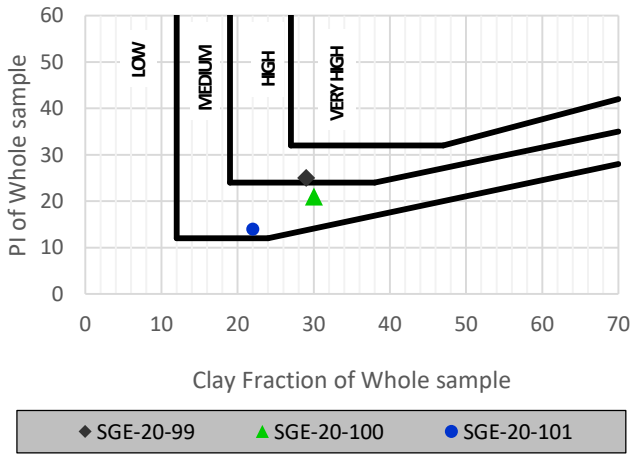
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

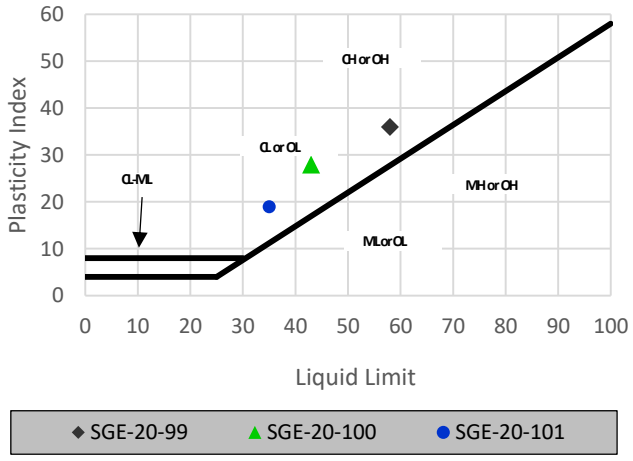
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	BH2	BH2	BH4	Sample	BH2	BH2	BH4
Depth (m)	1.2 - 1.5	5.8 - 6.0	1.0 - 1.5	Depth (m)	1.2 - 1.5	5.8 - 6.0	1.0 - 1.5
Lab No	SGE-20-102	SGE-20-103	SGE-20-104	Lab No	SGE-20-102	SGE-20-103	SGE-20-104
53.0	**100**	**100**	**100**	Liquid Limit (%)	**31**	**-**	**39**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**18**	**-**	**16**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**13**	**SP**	**23**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**7.0**	**0.5**	**11.5**
13.2	**100**	**99**	**100**	PI of whole sample	**9**	**-**	**19**
9.5	**100**	**99**	**100**				
6.7	**100**	**95**	**100**	% Gravel	**9**	**31**	**4**
4.75	**99**	**88**	**100**	% Sand	**61**	**53**	**54**
2.00	**91**	**69**	**96**	% Silt	**17**	**13**	**19**
1.00	**81**	**52**	**91**	% Clay	**13**	**3**	**23**
0.425	**67**	**39**	**82**	Activity	**1.0**	**0.0**	**1.0**
0.250	**57**	**30**	**73**				
0.150	**49**	**25**	**63**	% Soil Mortar	**91**	**69**	**96**
0.075	**36**	**20**	**50**				
0.060	**30**	**16**	**42**	Grading Modulus	**1.06**	**1.72**	**0.72**
0.050	**27**	**14**	**38**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**23**	**12**	**32**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**20**	**9**	**30**				
0.006	**16**	**5**	**26**	Unified (ASTM D2487)	**SC**	**SM**	**CL**
0.002	**13**	**3**	**23**	AASHTO (M145-91)	**A - 6**	**A - 1 - b**	**A - 6**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

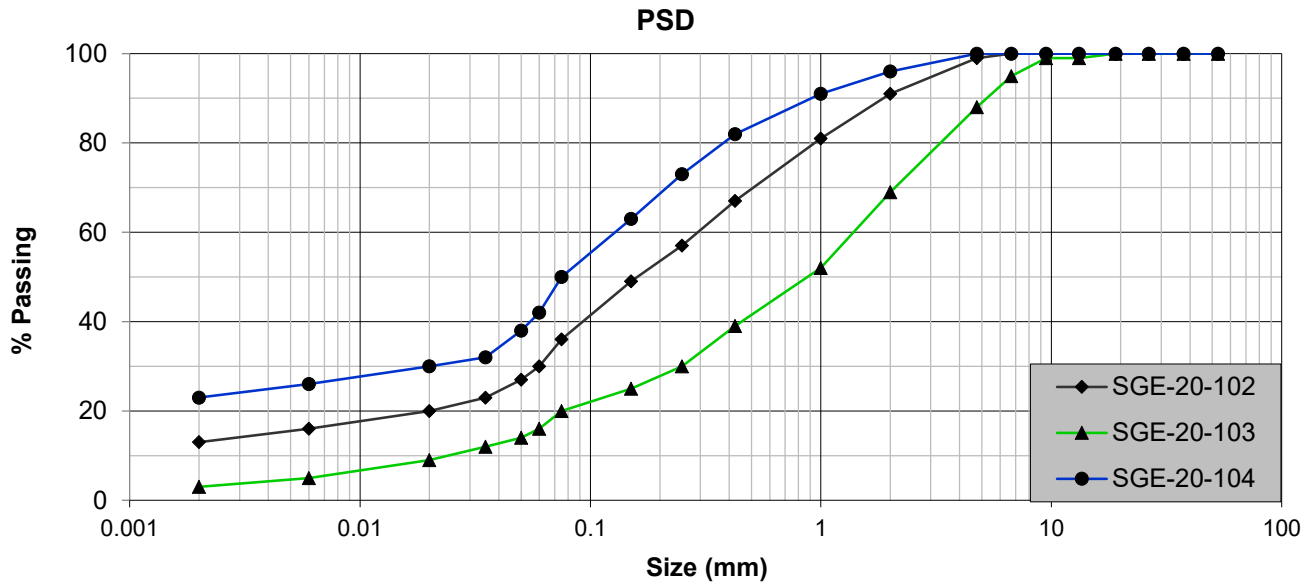
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

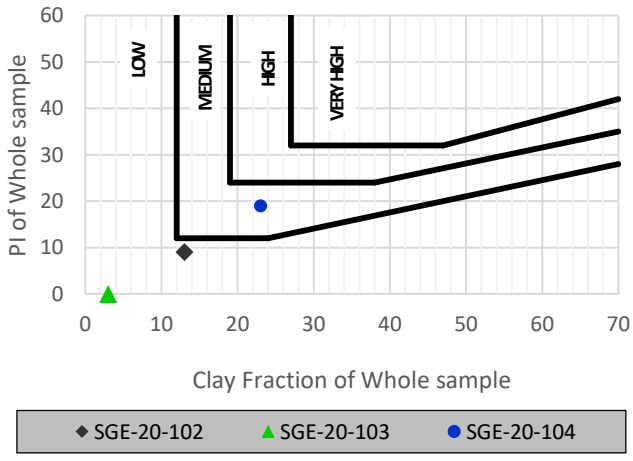
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

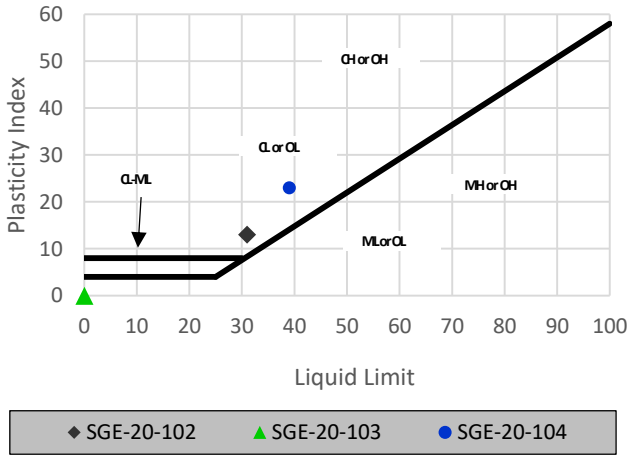
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	BH5	BH5	BH6	Sample	BH5	BH5	BH6
Depth (m)	0.3 - 0.6	1.3 - 1.5	0.75 - 1.25	Depth (m)	0.3 - 0.6	1.3 - 1.5	0.75 - 1.25
Lab No	SGE-20-105	SGE-20-106	SGE-20-107	Lab No	SGE-20-105	SGE-20-106	SGE-20-107
53.0	**100**	**100**	**100**	Liquid Limit (%)	**47**	**37**	**37**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**15**	**11**	**18**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**32**	**26**	**19**
19.0	**100**	**98**	**100**	Linear Shrinkage (%)	**22.5**	**11.5**	**9.5**
13.2	**100**	**98**	**100**	PI of whole sample	**30**	**14**	**18**
9.5	**100**	**97**	**100**				
6.7	**100**	**96**	**100**	% Gravel	**1**	**17**	**1**
4.75	**100**	**95**	**100**	% Sand	**40**	**55**	**41**
2.00	**99**	**83**	**99**	% Silt	**24**	**12**	**33**
1.00	**97**	**68**	**98**	% Clay	**35**	**16**	**25**
0.425	**94**	**55**	**94**	Activity	**0.9**	**1.6**	**0.8**
0.250	**87**	**45**	**85**				
0.150	**79**	**40**	**79**	% Soil Mortar	**99**	**83**	**99**
0.075	**66**	**34**	**67**				
0.060	**59**	**28**	**58**	Grading Modulus	**0.41**	**1.28**	**0.40**
0.050	**56**	**26**	**55**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**51**	**23**	**48**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**47**	**21**	**42**				
0.006	**40**	**18**	**31**	Unified (ASTM D2487)	**CL**	**SC**	**CL**
0.002	**35**	**16**	**25**	AASHTO (M145-91)	**A - 7 - 6**	**A - 2 - 6**	**A - 6**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

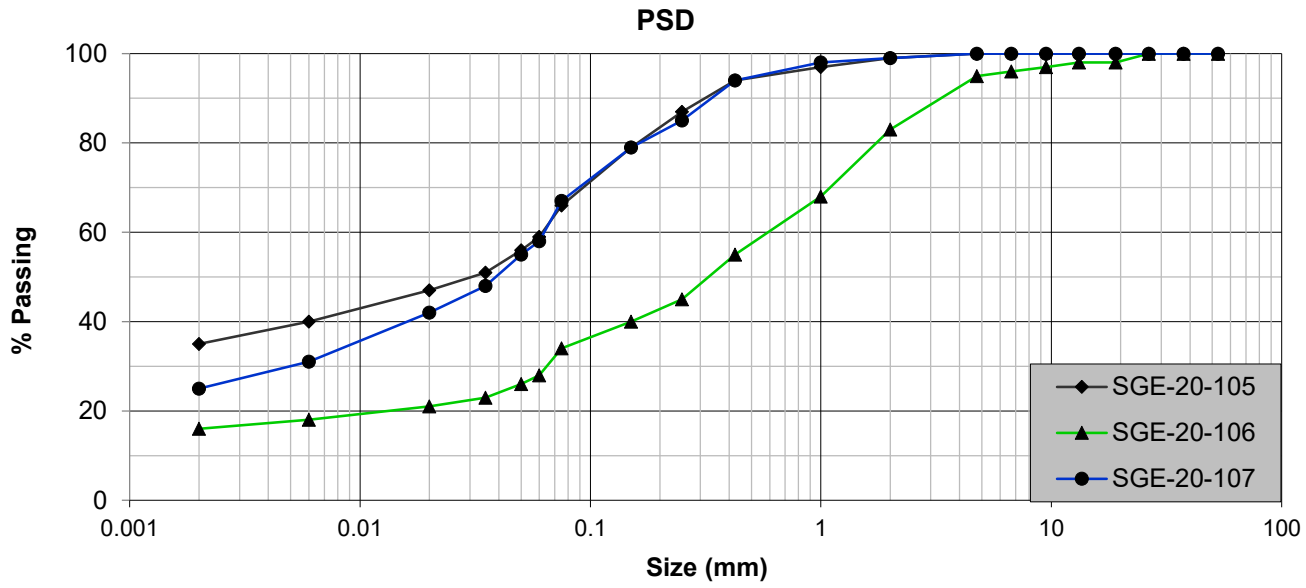
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

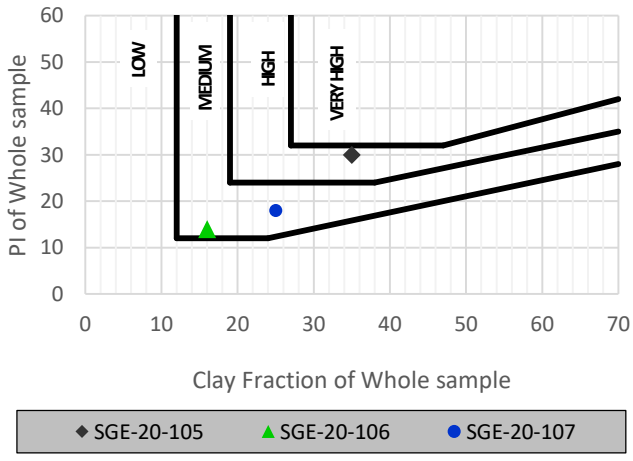
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

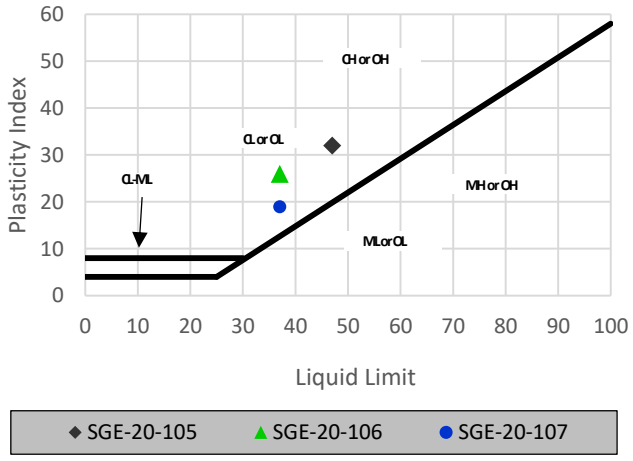
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	BH7	BH16	BH15	Sample	BH7	BH16	BH15
Depth (m)	0.6 - 0.9	0.7 - 1.4	0.5 - 0.9	Depth (m)	0.6 - 0.9	0.7 - 1.4	0.5 - 0.9
Lab No	SGE-20-108	SGE-20-109	SGE-20-110	Lab No	SGE-20-108	SGE-20-109	SGE-20-110
53.0	**100**	**100**	**100**	Liquid Limit (%)	**31**	**37**	**46**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**16**	**17**	**20**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**15**	**20**	**26**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**7.5**	**11.5**	**15.5**
13.2	**100**	**99**	**100**	PI of whole sample	**11**	**13**	**19**
9.5	**99**	**99**	**100**				
6.7	**96**	**97**	**99**	% Gravel	**12**	**12**	**8**
4.75	**94**	**95**	**97**	% Sand	**57**	**53**	**43**
2.00	**88**	**88**	**92**	% Silt	**19**	**17**	**16**
1.00	**82**	**78**	**86**	% Clay	**12**	**18**	**33**
0.425	**72**	**64**	**74**	Activity	**1.3**	**1.1**	**0.8**
0.250	**56**	**50**	**66**				
0.150	**48**	**45**	**61**	% Soil Mortar	**88**	**88**	**92**
0.075	**38**	**40**	**54**				
0.060	**31**	**35**	**49**	Grading Modulus	**1.02**	**1.08**	**0.80**
0.050	**29**	**33**	**47**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**26**	**30**	**43**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**23**	**27**	**40**				
0.006	**17**	**22**	**36**	Unified (ASTM D2487)	**SC**	**SC**	**CL**
0.002	**12**	**18**	**33**	AASHTO (M145-91)	**A - 6**	**A - 6**	**A - 7 - 6**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

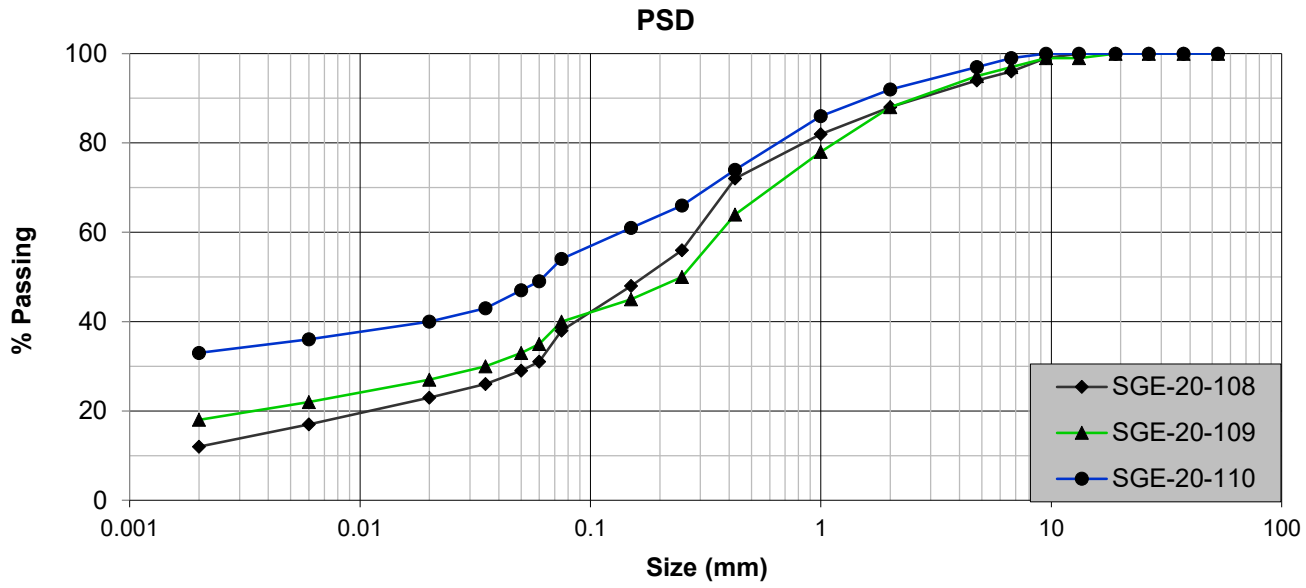
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

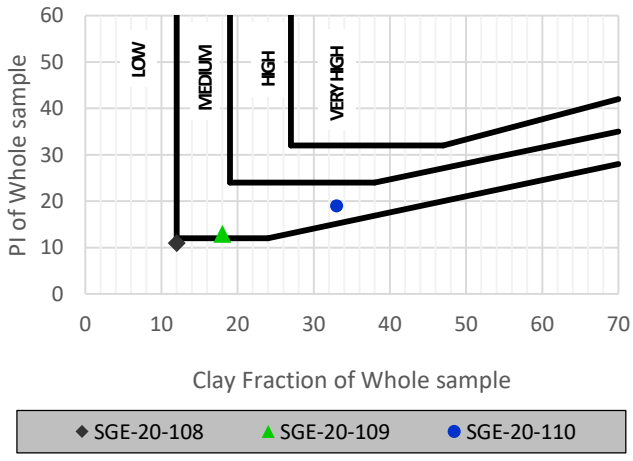
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

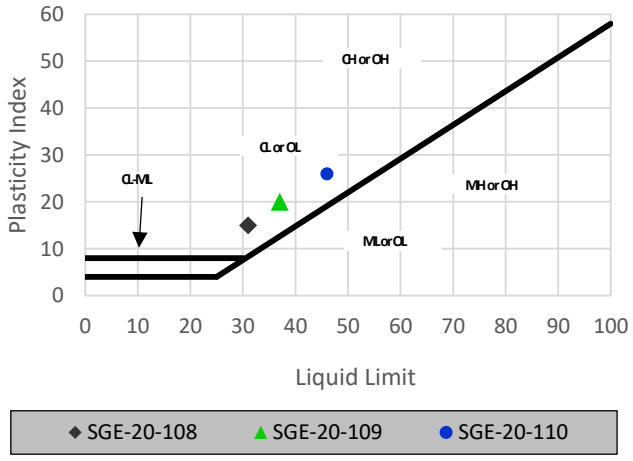
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	BH17	BH12	BH13	Sample	BH17	BH12	BH13
Depth (m)	1.0 - 1.5	2.0 - 2.6	2.1 - 2.6	Depth (m)	1.0 - 1.5	2.0 - 2.6	2.1 - 2.6
Lab No	SGE-20-111	SGE-20-112	SGE-20-113	Lab No	SGE-20-111	SGE-20-112	SGE-20-113
53.0	**100**	**100**	**100**	Liquid Limit (%)	**43**	**29**	**73**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**18**	**13**	**33**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**25**	**16**	**40**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**13.0**	**8.0**	**24.0**
13.2	**100**	**100**	**100**	PI of whole sample	**23**	**13**	**32**
9.5	**100**	**100**	**100**				
6.7	**100**	**100**	**99**	% Gravel	**1**	**4**	**6**
4.75	**100**	**100**	**98**	% Sand	**34**	**59**	**39**
2.00	**99**	**96**	**94**	% Silt	**35**	**20**	**13**
1.00	**96**	**91**	**88**	% Clay	**30**	**17**	**42**
0.425	**91**	**82**	**80**	Activity	**0.8**	**0.9**	**1.0**
0.250	**85**	**73**	**73**				
0.150	**80**	**66**	**68**	% Soil Mortar	**99**	**96**	**94**
0.075	**72**	**50**	**60**				
0.060	**65**	**37**	**55**	Grading Modulus	**0.38**	**0.72**	**0.66**
0.050	**62**	**34**	**53**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**57**	**28**	**50**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**51**	**23**	**47**				
0.006	**40**	**19**	**44**	Unified (ASTM D2487)	**CL**	**CL**	**CH**
0.002	**30**	**17**	**42**	AASHTO (M145-91)	**A - 7 - 6**	**A - 6**	**A - 7 - 5**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

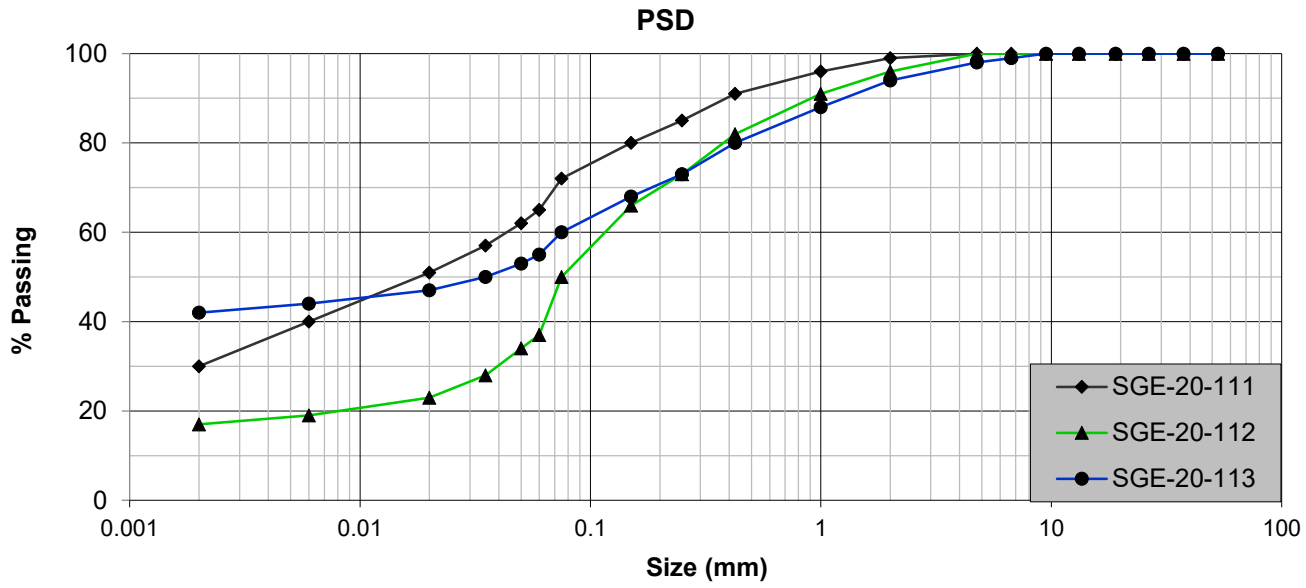
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

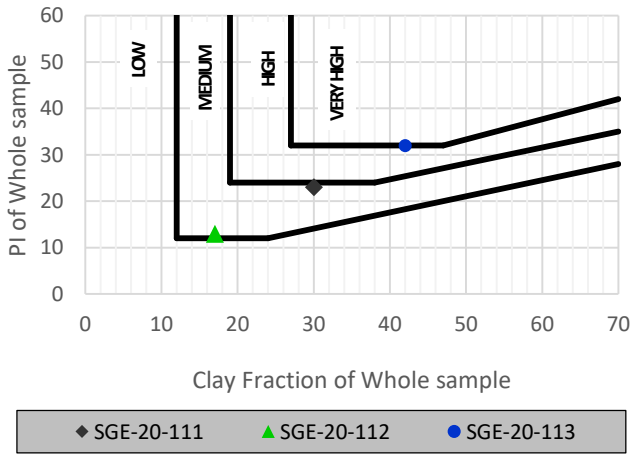
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

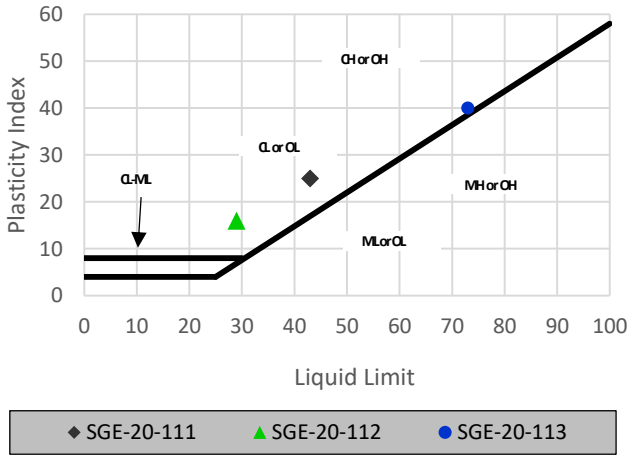
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	BH01	BH12	BH10	Sample	BH01	BH12	BH10
Depth (m)	2.5 - 3.0	3.45 - 4.45	1.2 -1.5	Depth (m)	2.5 - 3.0	3.45 - 4.45	1.2 -1.5
Lab No	SGE-20-114	SGE-20-115	SGE-20-116	Lab No	SGE-20-114	SGE-20-115	SGE-20-116
53.0	**100**	**100**	**100**	Liquid Limit (%)	**32**	**35**	**47**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**14**	**14**	**16**
26.5	**98**	**100**	**100**	Plasticity Index (%)	**18**	**21**	**31**
19.0	**93**	**100**	**100**	Linear Shrinkage (%)	**9.0**	**10.0**	**21.5**
13.2	**91**	**100**	**100**	PI of whole sample	**10**	**12**	**26**
9.5	**90**	**100**	**100**				
6.7	**88**	**100**	**100**	% Gravel	**16**	**15**	**5**
4.75	**87**	**98**	**99**	% Sand	**62**	**55**	**49**
2.00	**84**	**85**	**95**	% Silt	**9**	**16**	**19**
1.00	**76**	**72**	**92**	% Clay	**13**	**14**	**27**
0.425	**53**	**58**	**85**	Activity	**1.4**	**1.5**	**1.2**
0.250	**39**	**49**	**78**				
0.150	**33**	**42**	**71**	% Soil Mortar	**84**	**85**	**95**
0.075	**26**	**34**	**57**				
0.060	**22**	**30**	**46**	Grading Modulus	**1.37**	**1.23**	**0.63**
0.050	**20**	**28**	**43**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**17**	**24**	**39**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**16**	**21**	**35**				
0.006	**14**	**17**	**29**	Unified (ASTM D2487)	**SC**	**SC**	**CL**
0.002	**13**	**14**	**27**	AASHTO (M145-91)	**A - 2 - 6**	**A - 2 - 6**	**A - 7 - 6**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

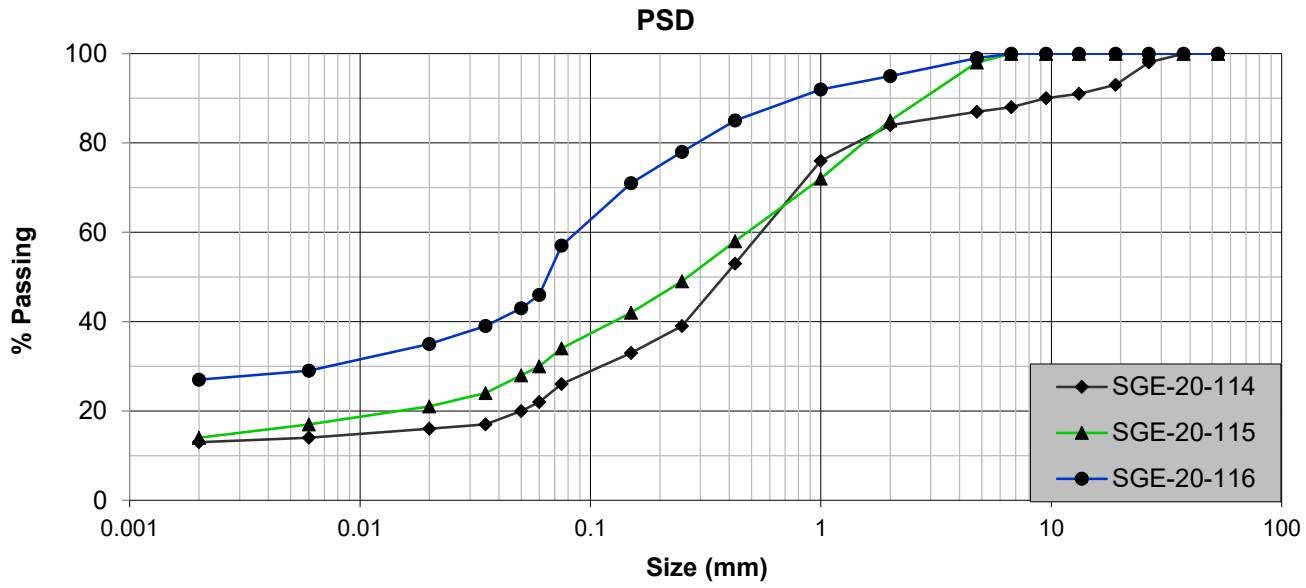
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

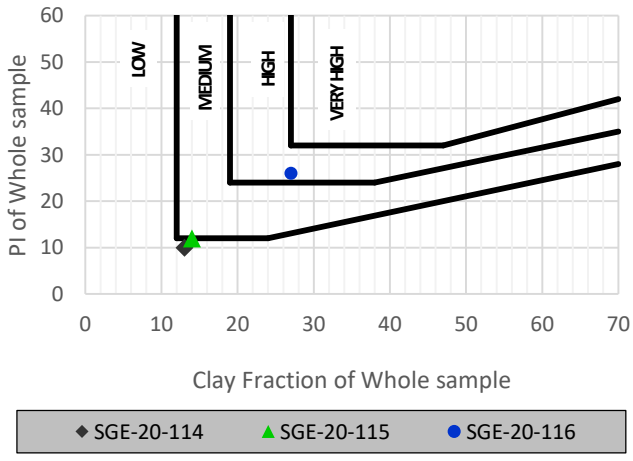
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

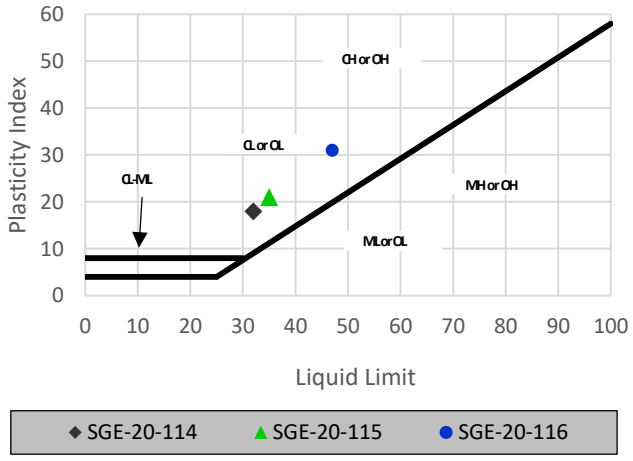
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	BH03	BH08	BH14	Sample	BH03	BH08	BH14
Depth (m)	4.0 - 4.5	2.7 - 2.95	2.0 - 2.3	Depth (m)	4.0 - 4.5	2.7 - 2.95	2.0 - 2.3
Lab No	SGE-20-117	SGE-20-118	SGE-20-119	Lab No	SGE-20-117	SGE-20-118	SGE-20-119
53.0	**100**	**100**	**100**	Liquid Limit (%)	**26**	**41**	**56**
37.5	**100**	**100**	**100**	Plastic Limit (%)	**17**	**14**	**20**
26.5	**100**	**100**	**100**	Plasticity Index (%)	**9**	**27**	**36**
19.0	**100**	**100**	**100**	Linear Shrinkage (%)	**4.5**	**13.5**	**26.5**
13.2	**100**	**100**	**97**	PI of whole sample	**2**	**25**	**24**
9.5	**100**	**100**	**96**				
6.7	**99**	**100**	**93**	% Gravel	**43**	**0**	**15**
4.75	**92**	**100**	**91**	% Sand	**50**	**51**	**37**
2.00	**57**	**100**	**85**	% Silt	**5**	**21**	**16**
1.00	**35**	**98**	**76**	% Clay	**2**	**28**	**32**
0.425	**21**	**93**	**67**	Activity	**4.5**	**1.0**	**1.1**
0.250	**15**	**85**	**61**				
0.150	**12**	**75**	**56**	% Soil Mortar	**57**	**100**	**85**
0.075	**9**	**58**	**51**				
0.060	**7**	**49**	**48**	Grading Modulus	**2.13**	**0.49**	**0.97**
0.050	**6**	**46**	**47**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.035	**5**	**40**	**44**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**4**	**36**	**41**				
0.006	**3**	**32**	**35**	Unified (ASTM D2487)	**SW-SC**	**CL**	**CH**
0.002	**2**	**28**	**32**	AASHTO (M145-91)	**A - 2 - 4**	**A - 7 - 6**	**A - 7 - 6**

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

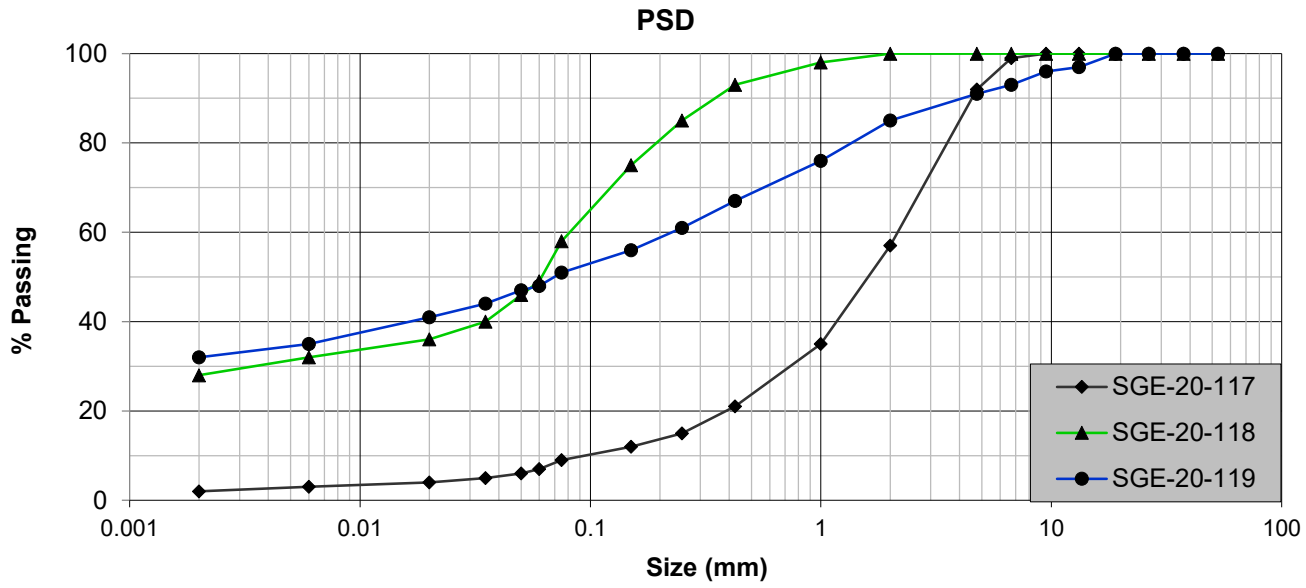
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

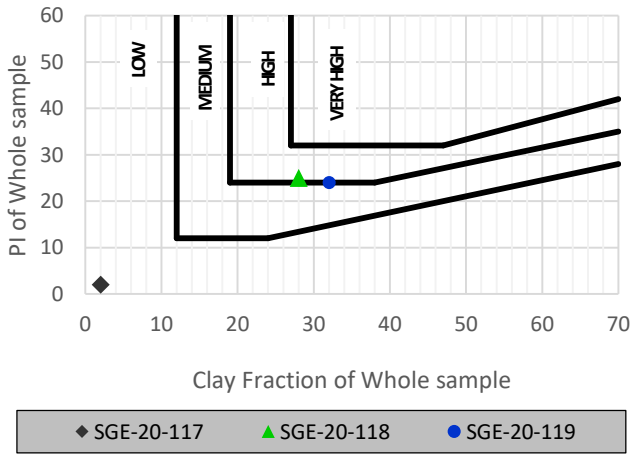
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

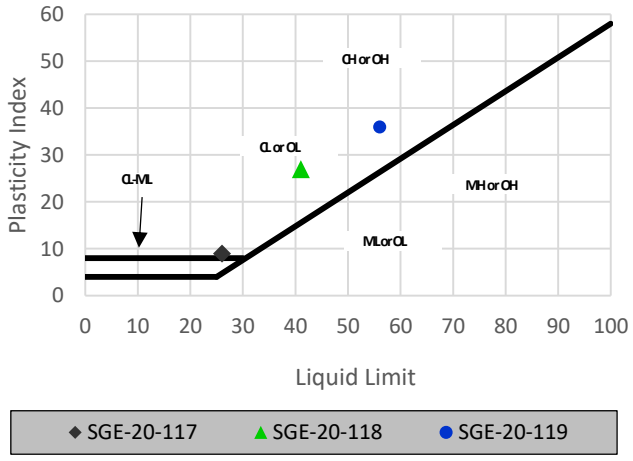
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

Sheet Reference: R-STL-011 Rev02

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	BH11			Sample	BH11		
Depth (m)	3.5- 4.0			Depth (m)	3.5- 4.0		
Lab No	SGE-20-120			Lab No	SGE-20-120		
53.0	**100**			Liquid Limit (%)	**49**		
37.5	**100**			Plastic Limit (%)	**18**		
26.5	**100**			Plasticity Index (%)	**31**		
19.0	**94**			Linear Shrinkage (%)	**21.5**		
13.2	**94**			PI of whole sample	**19**		
9.5	**94**						
6.7	**94**			% Gravel	**12**		
4.75	**93**			% Sand	**53**		
2.00	**88**			% Silt	**12**		
1.00	**77**			% Clay	**23**		
0.425	**61**			Activity	**1.4**		
0.250	**51**						
0.150	**47**			% Soil Mortar	**88**		
0.075	**40**						
0.060	**35**			Grading Modulus	**1.11**		
0.050	**33**			Moisture Content (%)	**N / T**		
0.035	**29**			Relative Density (SG)*	**2.65**		
0.020	**27**						
0.006	**25**			Unified (ASTM D2487)	**SC**		
0.002	**23**			AASHTO (M145-91)	**A - 7 - 6**		

Remarks: *: Assumed
N / T: Not Tested

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

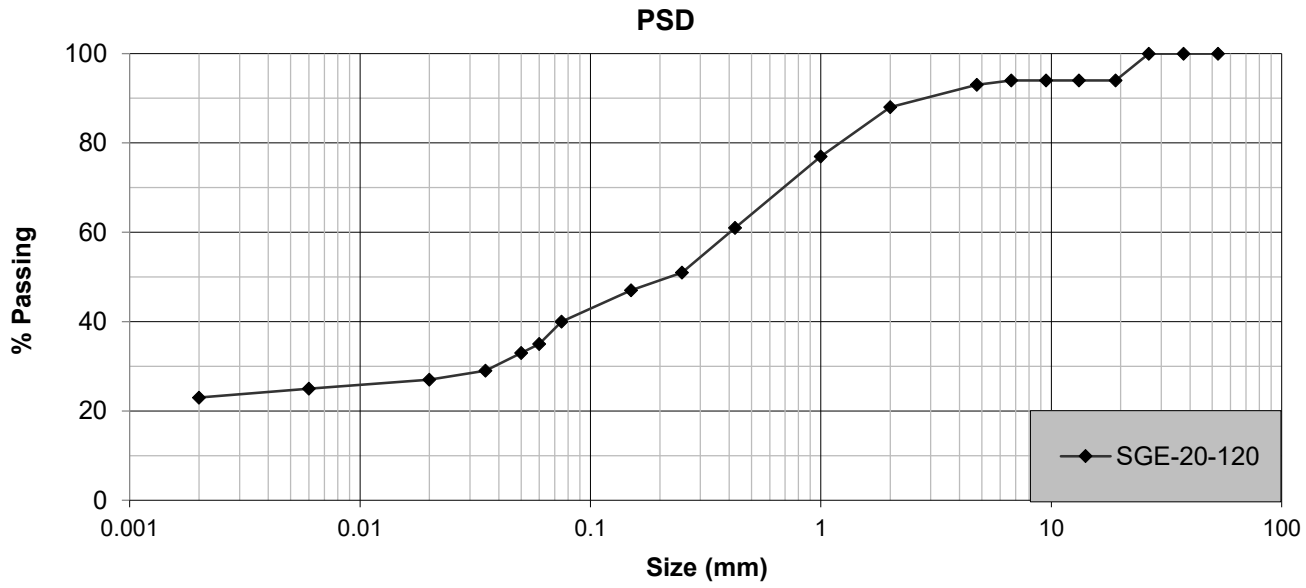
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

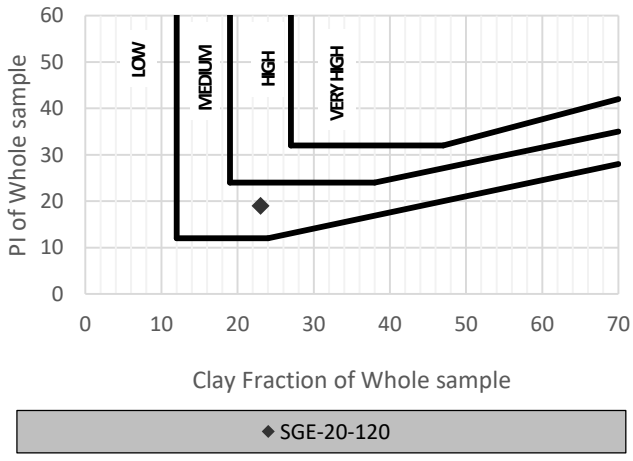
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 2023-02-14
Method: SANS 3001 GR1, GR3, GR10 GR12 & BS 1377 (where applicable)

FOUNDATION INDICATOR

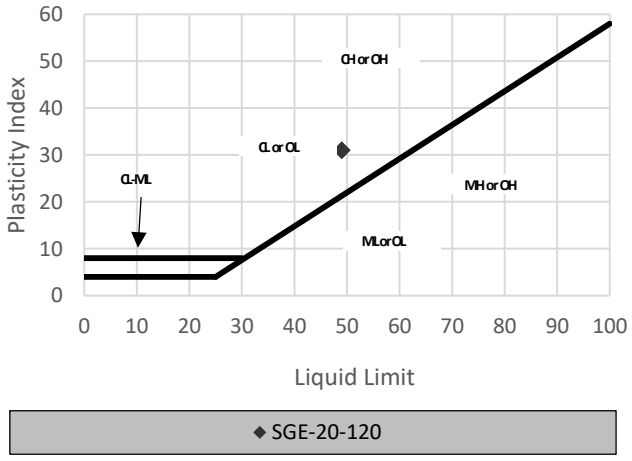
Sheet Reference: R-STL-011 Rev02



Potential Expansiveness



Casagrande Plasticity Chart



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

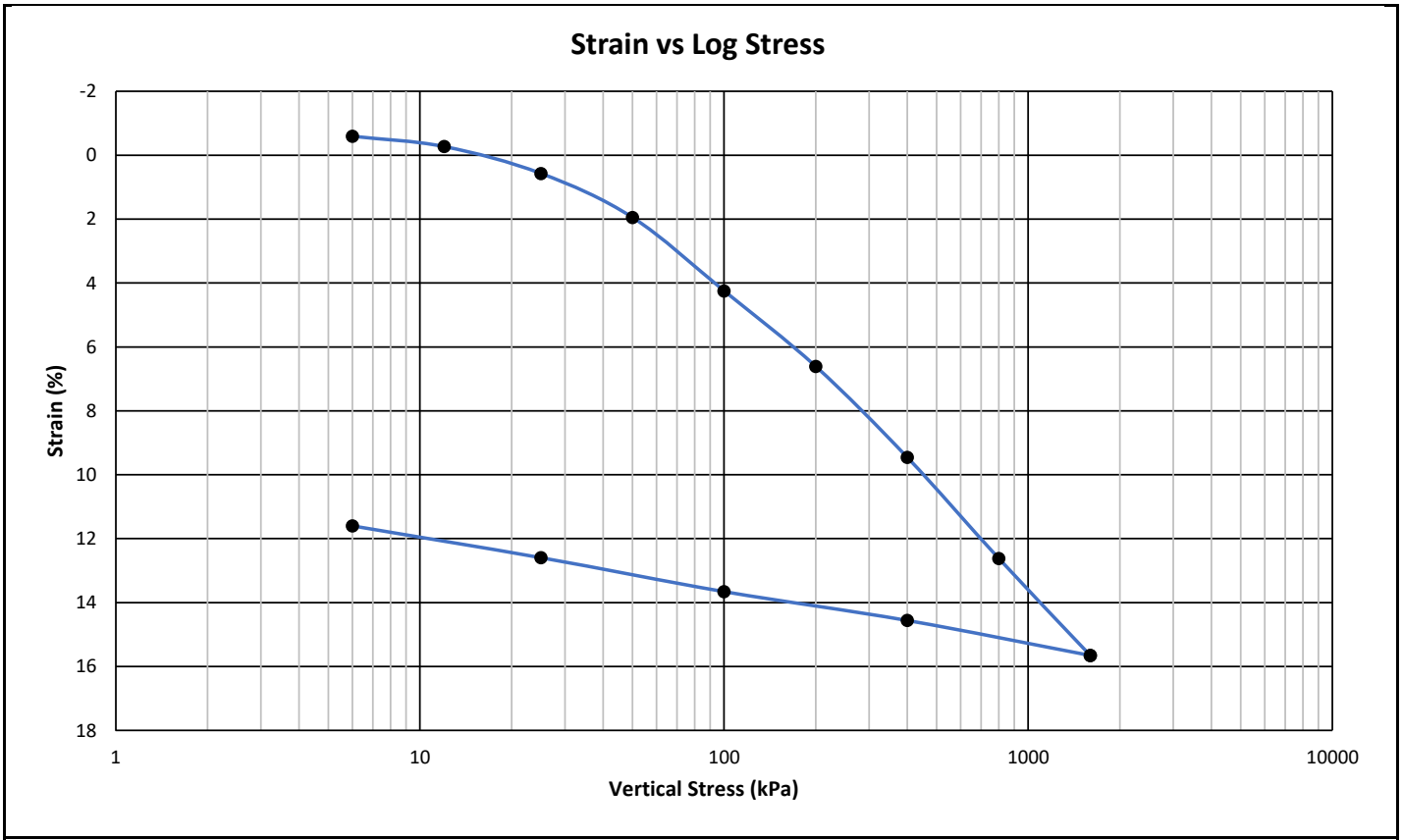
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Sample: TP3
Depth: (m) 2.00

Job Number: SGE-20
Lab Number: SGE-20-94
Method: BS 1377 Part 5
Date: 14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	13.3	
	Final	%	12.5	
Dry Density		kg/m³	1819	
Void Ratio		-	0.432	
Degree of Saturation		%	80.3	
Relative Density (SG)		-	2.605	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.55	25.47	25.25	24.91	24.32	23.72	23.00	22.20	21.42	21.70	21.93	22.20	22.45
Total Strain	%	-0.59	-0.27	0.57	1.95	4.25	6.61	9.45	12.62	15.65	14.56	13.66	12.60	11.60
Void Ratio	-	0.441	0.436	0.424	0.404	0.371	0.338	0.297	0.252	0.208	0.224	0.237	0.252	0.266
Mv (1/Mpa)	-	-	0.533	0.646	0.554	0.468	0.246	0.152	0.087	0.043	0.011	0.035	0.164	0.599



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

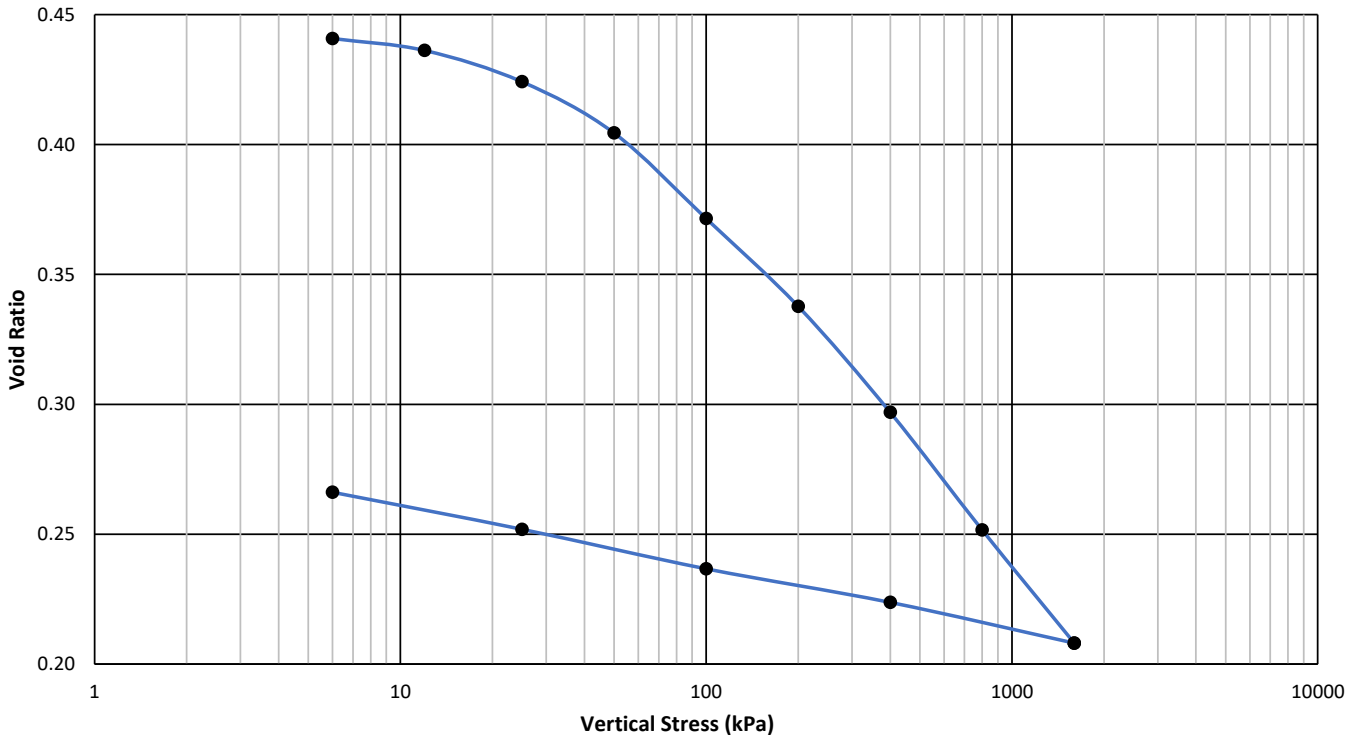
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-94
Sample:	TP3	**Method:**	BS 1377 Part 5
Depth: (m)	2.00	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	13.3	
	Final	%	12.5	
Dry Density		kg/m³	1819	
Void Ratio		-	0.432	
Degree of Saturation		%	80.3	
Relative Density (SG)		-	2.605	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.55	25.47	25.25	24.91	24.32	23.72	23.00	22.20	21.42	21.70	21.93	22.20	22.45
Total Strain	%	-0.59	-0.27	0.57	1.95	4.25	6.61	9.45	12.62	15.65	14.56	13.66	12.60	11.60
Void Ratio	-	0.441	0.436	0.424	0.404	0.371	0.338	0.297	0.252	0.208	0.224	0.237	0.252	0.266
Mv (1/Mpa)	-	-	0.533	0.646	0.554	0.468	0.246	0.152	0.087	0.043	0.011	0.035	0.164	0.599



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

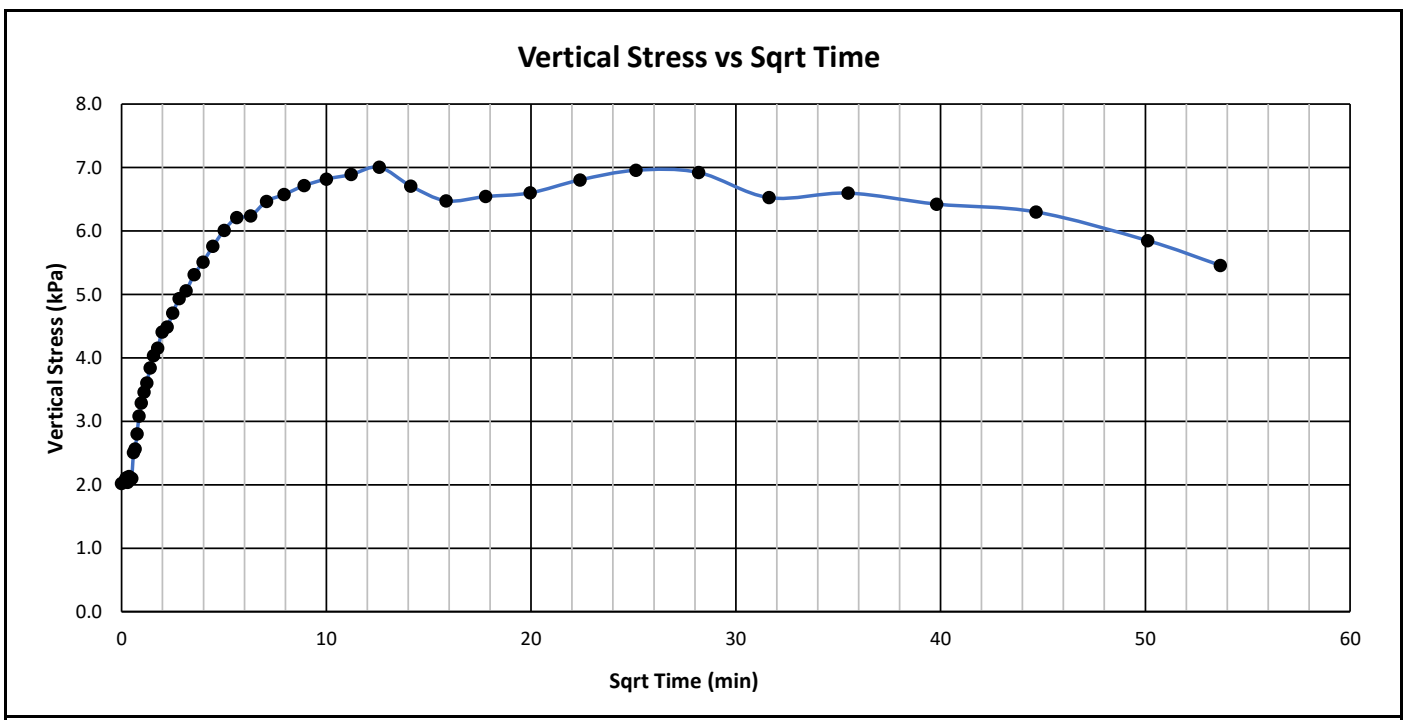
Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-94
Sample:	TP3	**Method:**	BS 1377 Part 5
Depth: (m)	2.00	**Date:**	14-Feb-23

SWELL PRESSURE TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	13.7	
	Final	%	18.3	
Dry Density		kg/m³	1747	
Void Ratio		-	0.491	
Degree of Saturation		%	72.8	
Relative Density (SG)		-	2.605	Determined

Swell Pressure	kPa	7.0

Vertical Stress	kPa	2.02	2.08	2.11	2.04	2.13	2.09	2.10	2.51	2.57	2.80	3.08	3.29	3.46
		3.60	3.84	4.04	4.15	4.41	4.49	4.70	4.93	5.06	5.31	5.51	5.76	6.01
		6.21	6.24	6.47	6.57	6.71	6.82	6.89	7.00	6.71	6.5	6.5	6.6	6.8
		7.0	6.9	6.5	6.6	6.4	6.3	5.8	5.5					
Time	Sqrt min	0.00	0.18	0.22	0.29	0.37	0.43	0.50	0.58	0.66	0.75	0.86	0.97	1.10
		1.23	1.39	1.57	1.76	1.98	2.22	2.50	2.81	3.15	3.54	3.97	4.46	5.01
		5.62	6.31	7.08	7.94	8.91	10.00	11.22	12.59	14.12	15.85	17.78	19.95	22.39
		25.12	28.18	31.62	35.48	39.81	44.66	50.11	53.67					



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

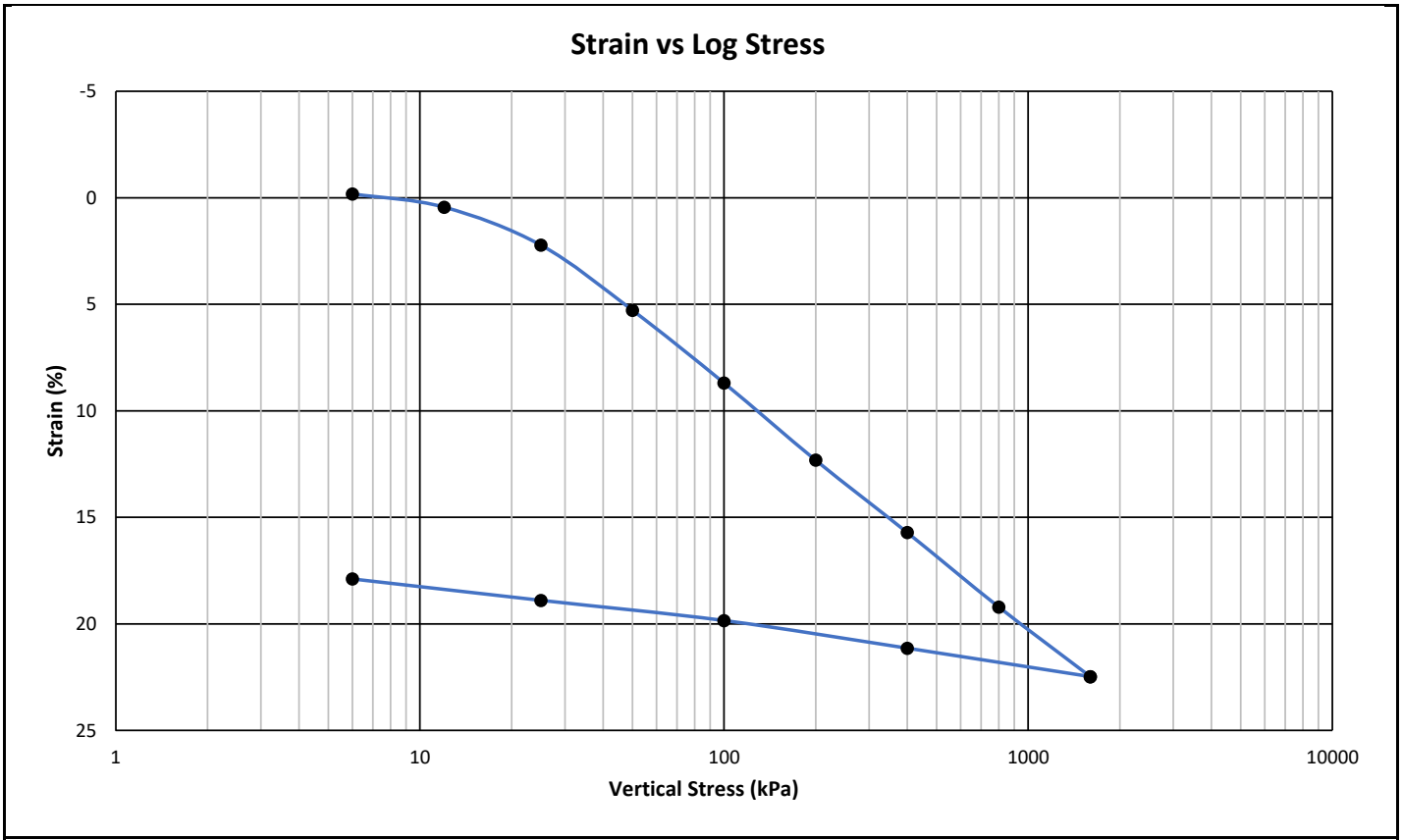
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-95
Sample:	TP4	**Method:**	BS 1377 Part 5
Depth: (m)	1.50	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	19.0	
	Final	%	20.3	
Dry Density		kg/m³	1473	
Void Ratio		-	0.892	
Degree of Saturation		%	59.3	
Relative Density (SG)		-	2.787	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	12	12	12	12	12	12	12	12	12	3	3	3	3
Height after increment	mm	25.45	25.29	24.84	24.06	23.19	22.27	21.41	20.52	19.69	20.03	20.36	20.60	20.86
Total Strain	%	-0.18	0.44	2.22	5.28	8.70	12.32	15.71	19.21	22.48	21.14	19.84	18.90	17.89
Void Ratio	-	0.895	0.884	0.850	0.792	0.727	0.659	0.595	0.528	0.467	0.492	0.516	0.534	0.553
Mv (1/Mpa)	-	-	1.033	1.380	1.251	0.721	0.397	0.194	0.104	0.051	0.014	0.055	0.157	0.652



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

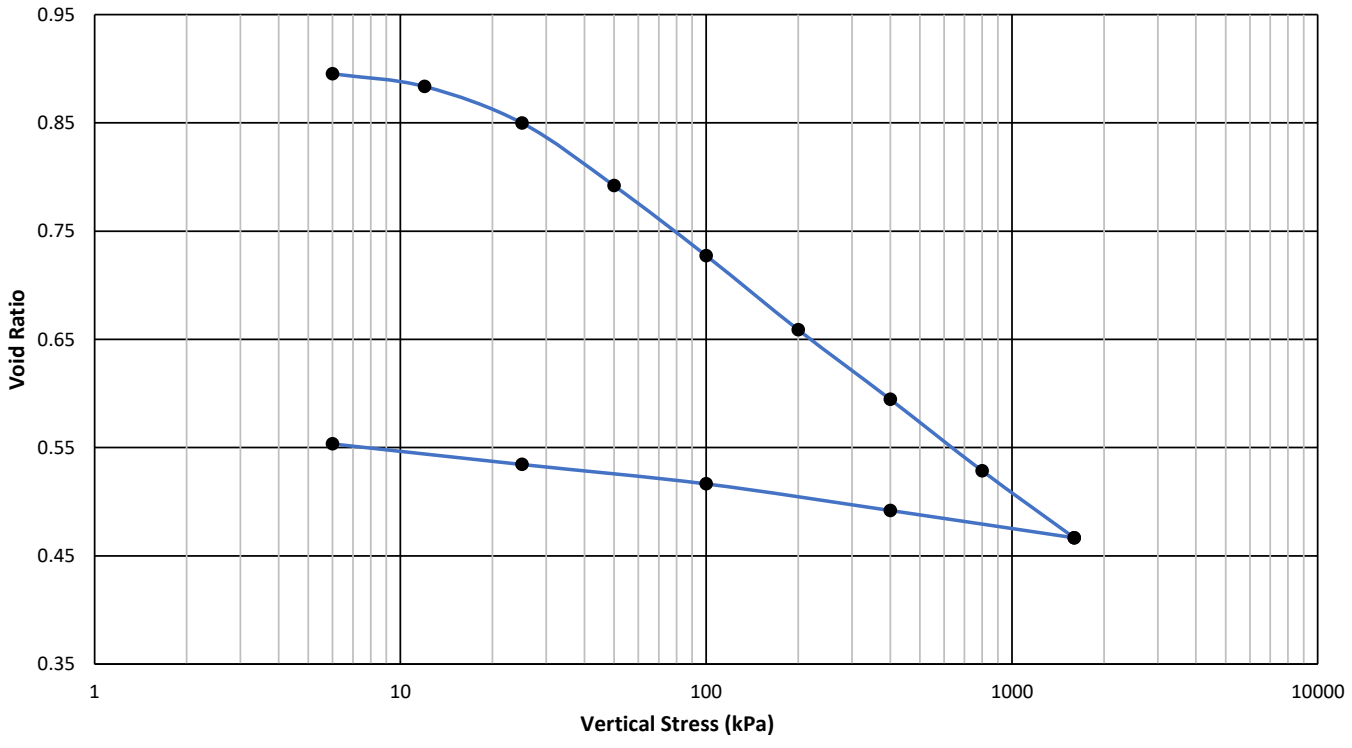
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-95
Sample:	TP4	**Method:**	BS 1377 Part 5
Depth: (m)	1.50	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	19.0	
	Final	%	20.3	
Dry Density		kg/m³	1473	
Void Ratio		-	0.892	
Degree of Saturation		%	59.3	
Relative Density (SG)		-	2.787	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	12	12	12	12	12	12	12	12	12	3	3	3	3
Height after increment	mm	25.45	25.29	24.84	24.06	23.19	22.27	21.41	20.52	19.69	20.03	20.36	20.60	20.86
Total Strain	%	-0.18	0.44	2.22	5.28	8.70	12.32	15.71	19.21	22.48	21.14	19.84	18.90	17.89
Void Ratio	-	0.895	0.884	0.850	0.792	0.727	0.659	0.595	0.528	0.467	0.492	0.516	0.534	0.553
Mv (1/Mpa)	-	-	1.033	1.380	1.251	0.721	0.397	0.194	0.104	0.051	0.014	0.055	0.157	0.652



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

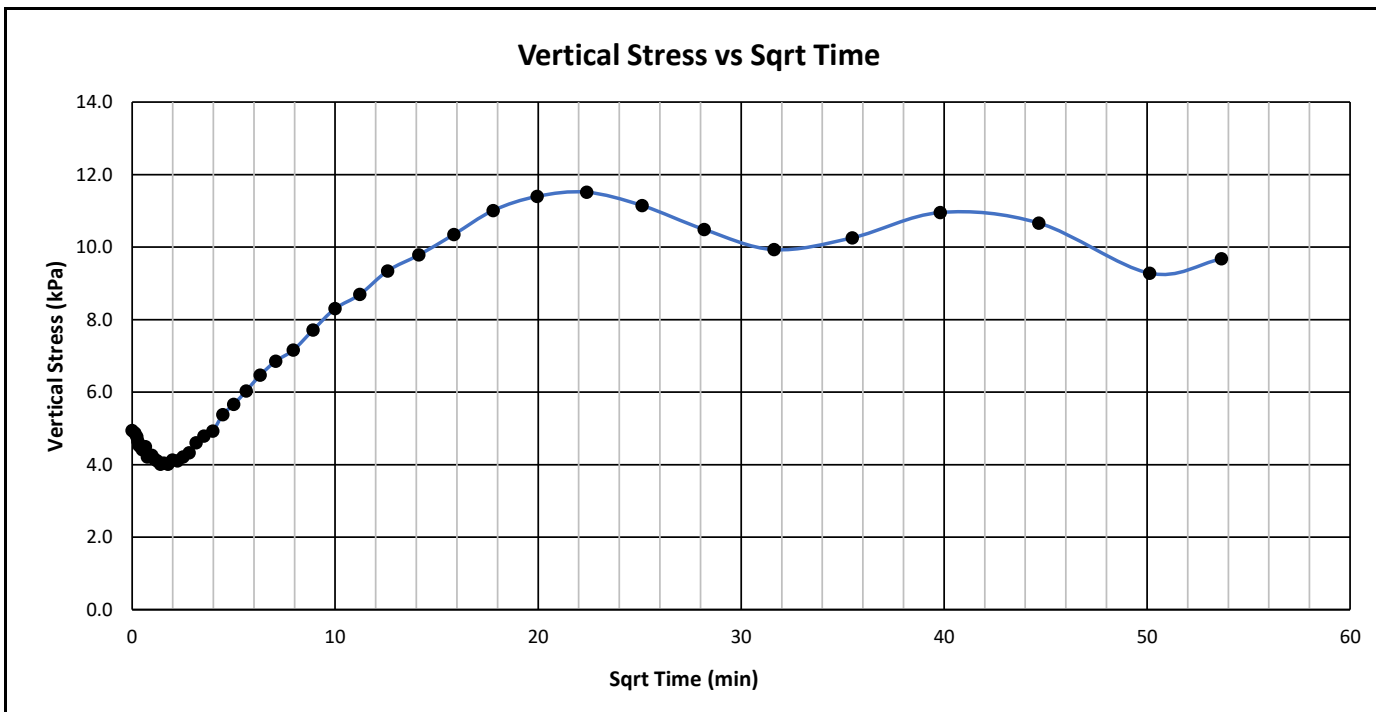
Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-95
Sample:	TP4	**Method:**	BS 1377 Part 5
Depth: (m)	1.50	**Date:**	14-Feb-23

SWELL PRESSURE TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	19.2	
	Final	%	27.4	
Dry Density		kg/m³	1615	
Void Ratio		-	0.726	
Degree of Saturation		%	73.6	
Relative Density (SG)		-	2.787	Determined

Swell Pressure	kPa	11.5

Vertical Stress	kPa	4.94	4.87	4.78	4.64	4.53	4.48	4.41	4.46	4.49	4.21	4.26	4.26	4.16
		4.11	4.01	4.04	4.01	4.12	4.10	4.21	4.33	4.60	4.79	4.92	5.37	5.66
		6.03	6.47	6.86	7.16	7.71	8.30	8.69	9.34	9.78	10.3	11.0	11.4	11.5
		11.1	10.5	9.9	10.3	11.0	10.7	9.3	9.7					
Time	Sqrt min	0.00	0.13	0.22	0.29	0.34	0.43	0.50	0.58	0.66	0.75	0.85	0.97	1.09
		1.23	1.39	1.57	1.76	1.98	2.22	2.50	2.81	3.15	3.54	3.97	4.46	5.01
		5.62	6.30	7.08	7.94	8.91	10.00	11.22	12.59	14.12	15.85	17.78	19.95	22.39
		25.12	28.18	31.62	35.48	39.81	44.67	50.12	53.67					



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

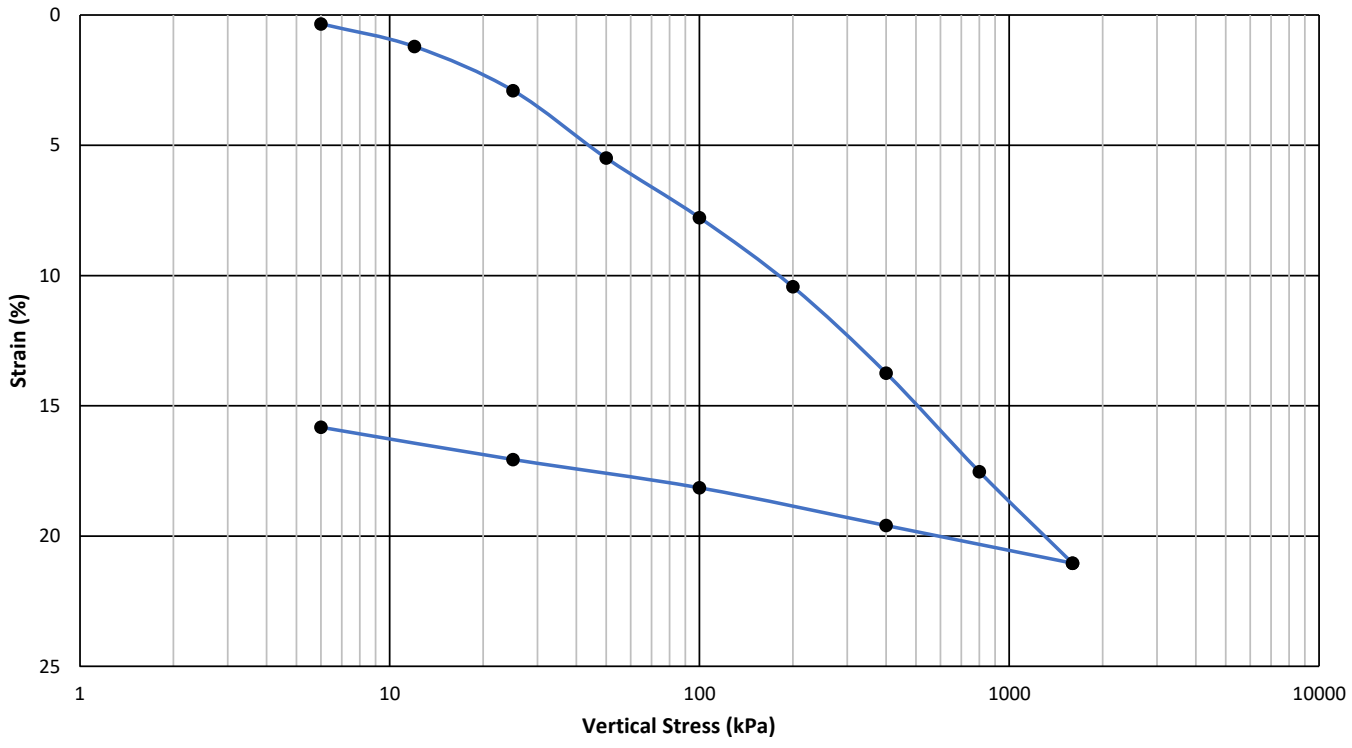
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-96
Sample:	TP5	**Method:**	BS 1377 Part 5
Depth: (m)	2.00	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	19.1	
	Final	%	20.6	
Dry Density		kg/m³	1513	
Void Ratio		-	0.825	
Degree of Saturation		%	63.8	
Relative Density (SG)		-	2.761	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.31	25.09	24.66	24.01	23.42	22.75	21.91	20.95	20.06	20.42	20.79	21.07	21.38
Total Strain	%	0.34	1.21	2.90	5.49	7.78	10.43	13.74	17.53	21.04	19.60	18.15	17.06	15.83
Void Ratio	-	0.819	0.803	0.772	0.725	0.683	0.635	0.574	0.505	0.441	0.467	0.494	0.514	0.536
Mv (1/Mpa)	-	-	1.453	1.317	1.068	0.484	0.287	0.185	0.110	0.053	0.015	0.060	0.177	0.784



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

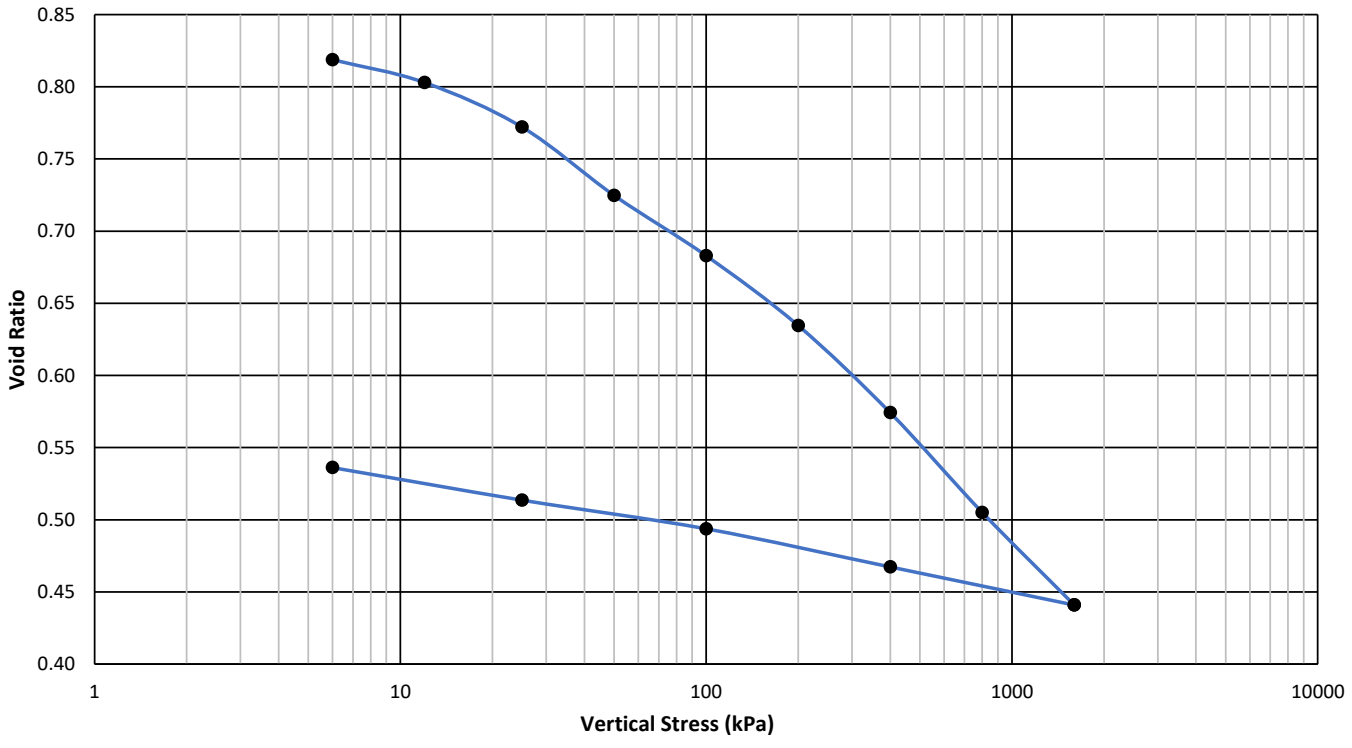
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-96
Sample:	TP5	**Method:**	BS 1377 Part 5
Depth: (m)	2.00	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	19.1	
	Final	%	20.6	
Dry Density		kg/m³	1513	
Void Ratio		-	0.825	
Degree of Saturation		%	63.8	
Relative Density (SG)		-	2.761	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.31	25.09	24.66	24.01	23.42	22.75	21.91	20.95	20.06	20.42	20.79	21.07	21.38
Total Strain	%	0.34	1.21	2.90	5.49	7.78	10.43	13.74	17.53	21.04	19.60	18.15	17.06	15.83
Void Ratio	-	0.819	0.803	0.772	0.725	0.683	0.635	0.574	0.505	0.441	0.467	0.494	0.514	0.536
Mv (1/Mpa)	-	-	1.453	1.317	1.068	0.484	0.287	0.185	0.110	0.053	0.015	0.060	0.177	0.784



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

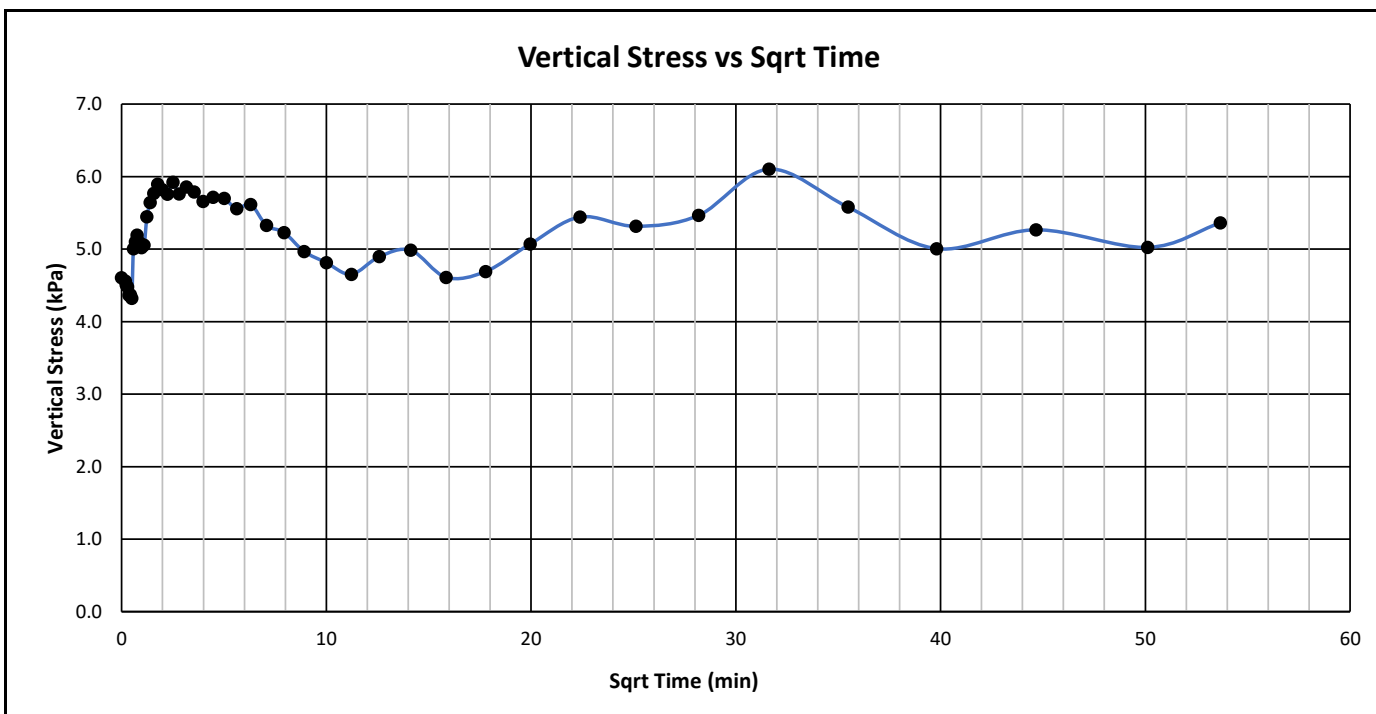
Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-96
Sample:	TP5	**Method:**	BS 1377 Part 5
Depth: (m)	2.00	**Date:**	14-Feb-23

SWELL PRESSURE TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	19.4	
	Final	%	25.3	
Dry Density		kg/m³	1564	
Void Ratio		-	0.765	
Degree of Saturation		%	70.0	
Relative Density (SG)		-	2.761	Determined

Swell Pressure	kPa	6.1

Vertical Stress	kPa	4.61	4.56	4.50	4.48	4.36	4.37	4.32	5.01	5.10	5.19	5.09	5.02	5.05
		5.45	5.64	5.77	5.90	5.82	5.76	5.92	5.76	5.86	5.79	5.66	5.71	5.70
		5.56	5.62	5.33	5.23	4.97	4.81	4.65	4.90	4.98	4.6	4.7	5.1	5.4
		5.3	5.5	6.1	5.6	5.0	5.3	5.0	5.4					
Time	Sqrt min	0.00	0.18	0.22	0.29	0.37	0.43	0.50	0.58	0.67	0.75	0.87	0.97	1.10
		1.24	1.40	1.57	1.77	1.99	2.23	2.51	2.81	3.16	3.54	3.98	4.46	5.01
		5.62	6.31	7.08	7.94	8.91	10.00	11.22	12.59	14.13	15.85	17.78	19.95	22.39
		25.12	28.18	31.62	35.48	39.81	44.67	50.12	53.67					



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

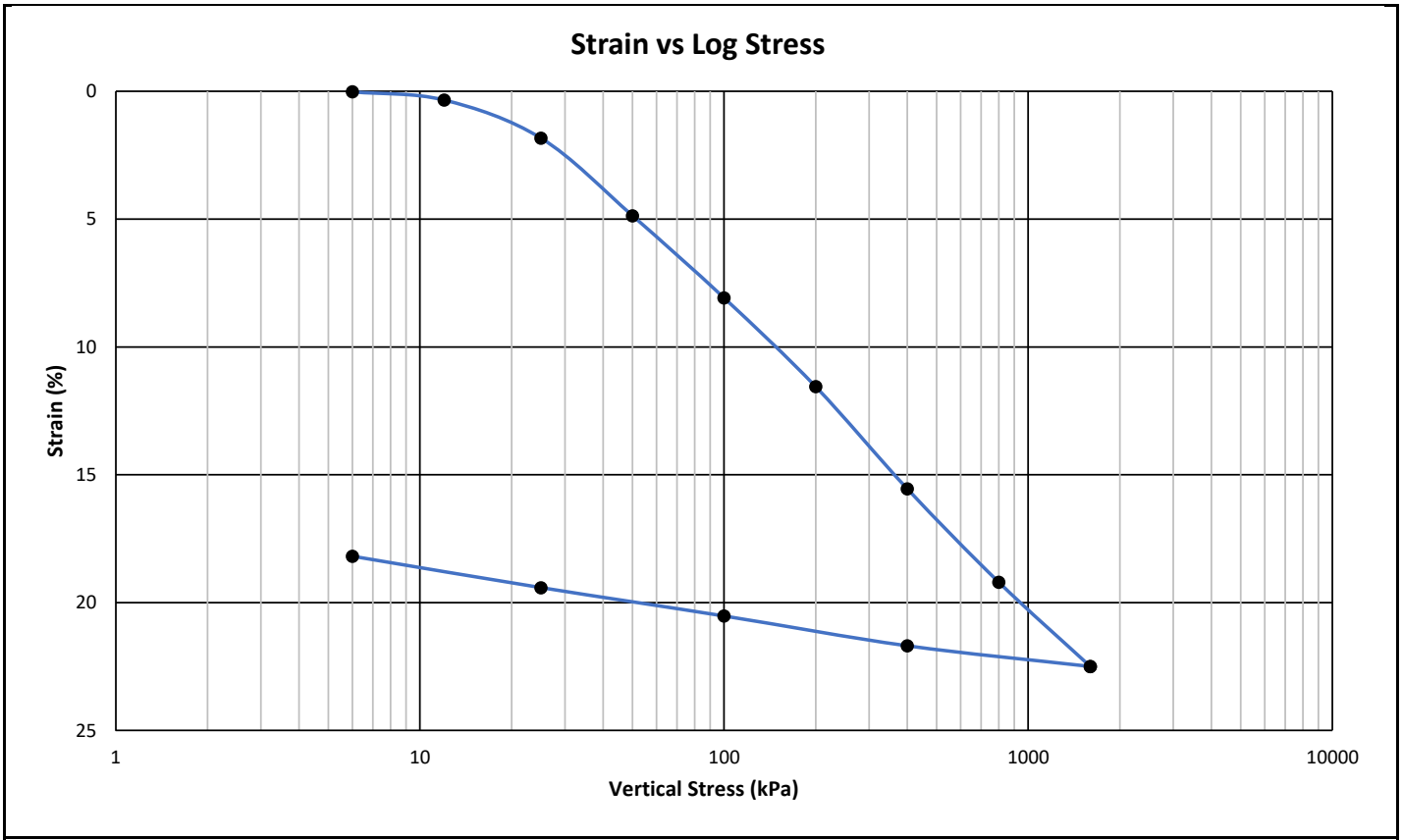
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-97
Sample:	TP7	**Method:**	BS 1377 Part 5
Depth: (m)	1.50	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	17.3	
	Final	%	15.4	
Dry Density		kg/m³	1558	
Void Ratio		-	0.658	
Degree of Saturation		%	68.0	
Relative Density (SG)		-	2.582	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.39	25.31	24.93	24.16	23.35	22.47	21.45	20.52	19.69	19.89	20.19	20.47	20.78
Total Strain	%	0.02	0.34	1.83	4.87	8.08	11.55	15.55	19.20	22.50	21.69	20.52	19.41	18.19
Void Ratio	-	0.657	0.652	0.627	0.577	0.524	0.466	0.400	0.339	0.285	0.298	0.317	0.336	0.356
Mv (1/Mpa)	-	-	0.537	1.151	1.237	0.676	0.377	0.226	0.108	0.051	0.009	0.050	0.186	0.801



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

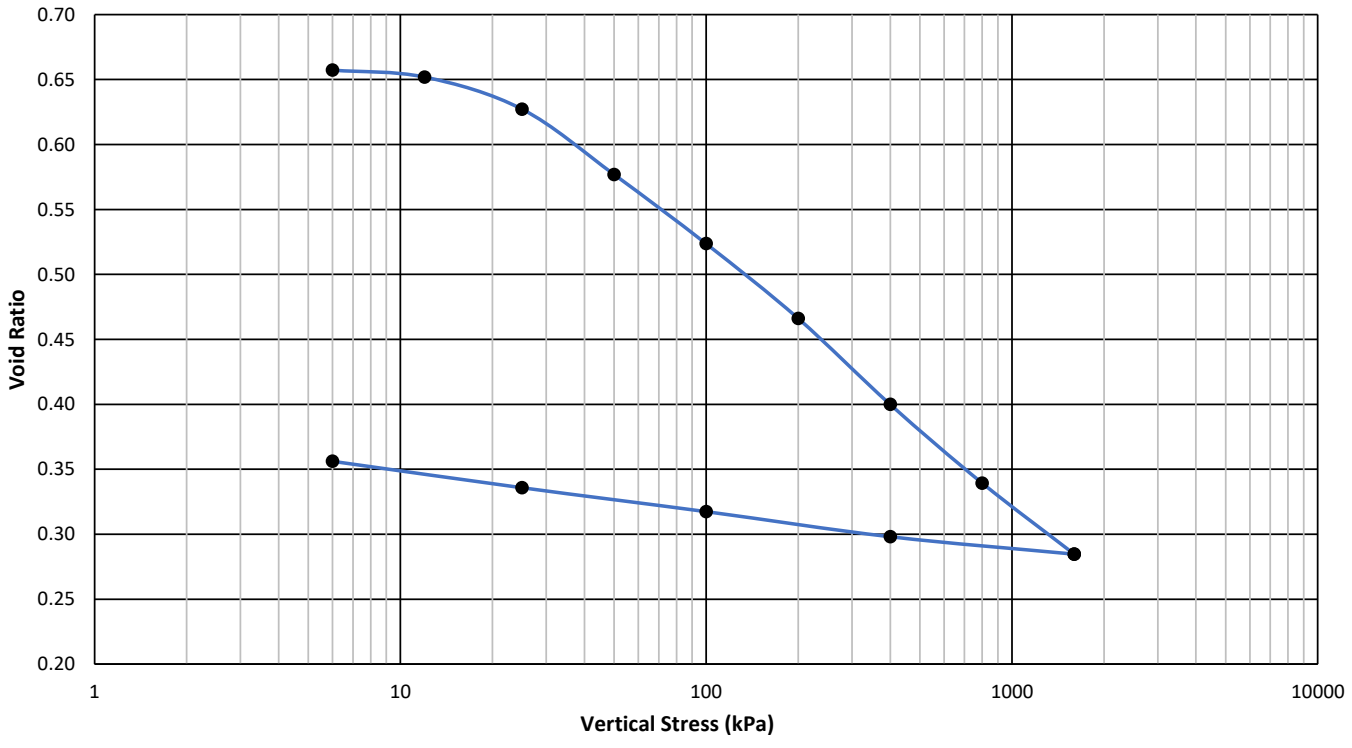
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Sample: TP7
Depth: (m) 1.50

Job Number: SGE-20
Lab Number: SGE-20-97
Method: BS 1377 Part 5
Date: 14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	17.3	
	Final	%	15.4	
Dry Density		kg/m³	1558	
Void Ratio		-	0.658	
Degree of Saturation		%	68.0	
Relative Density (SG)		-	2.582	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.39	25.31	24.93	24.16	23.35	22.47	21.45	20.52	19.69	19.89	20.19	20.47	20.78
Total Strain	%	0.02	0.34	1.83	4.87	8.08	11.55	15.55	19.20	22.50	21.69	20.52	19.41	18.19
Void Ratio	-	0.657	0.652	0.627	0.577	0.524	0.466	0.400	0.339	0.285	0.298	0.317	0.336	0.356
Mv (1/Mpa)	-	-	0.537	1.151	1.237	0.676	0.377	0.226	0.108	0.051	0.009	0.050	0.186	0.801



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

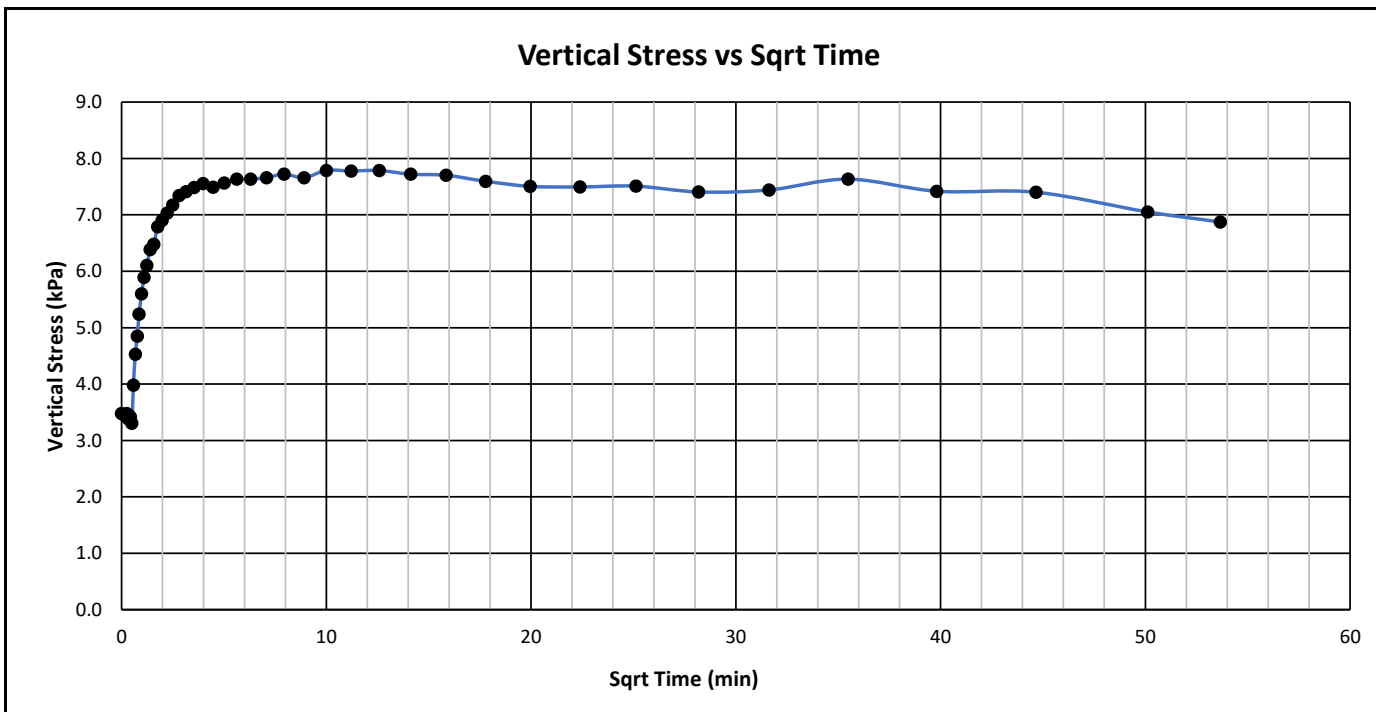
Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-97
Sample:	TP7	**Method:**	BS 1377 Part 5
Depth: (m)	1.50	**Date:**	14-Feb-23

SWELL PRESSURE TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	18.5	
	Final	%	25.9	
Dry Density		kg/m³	1553	
Void Ratio		-	0.663	
Degree of Saturation		%	72.0	
Relative Density (SG)		-	2.582	Determined

Swell Pressure	kPa	7.8

Vertical Stress	kPa	3.48	3.43	3.48	3.38	3.44	3.42	3.30	3.98	4.53	4.85	5.24	5.60	5.89
		6.10	6.39	6.48	6.79	6.91	7.03	7.18	7.34	7.41	7.48	7.56	7.49	7.57
		7.63	7.63	7.66	7.72	7.66	7.79	7.78	7.79	7.72	7.7	7.6	7.5	7.5
		7.5	7.4	7.4	7.6	7.4	7.4	7.1	6.9					
Time	Sqrt min	0.00	0.18	0.26	0.32	0.37	0.43	0.50	0.58	0.67	0.76	0.86	0.97	1.10
		1.24	1.40	1.57	1.77	1.98	2.23	2.50	2.81	3.15	3.54	3.97	4.46	5.01
		5.62	6.31	7.08	7.94	8.91	10.00	11.22	12.59	14.12	15.85	17.78	19.95	22.39
		25.12	28.18	31.62	35.48	39.81	44.67	50.12	53.67					



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

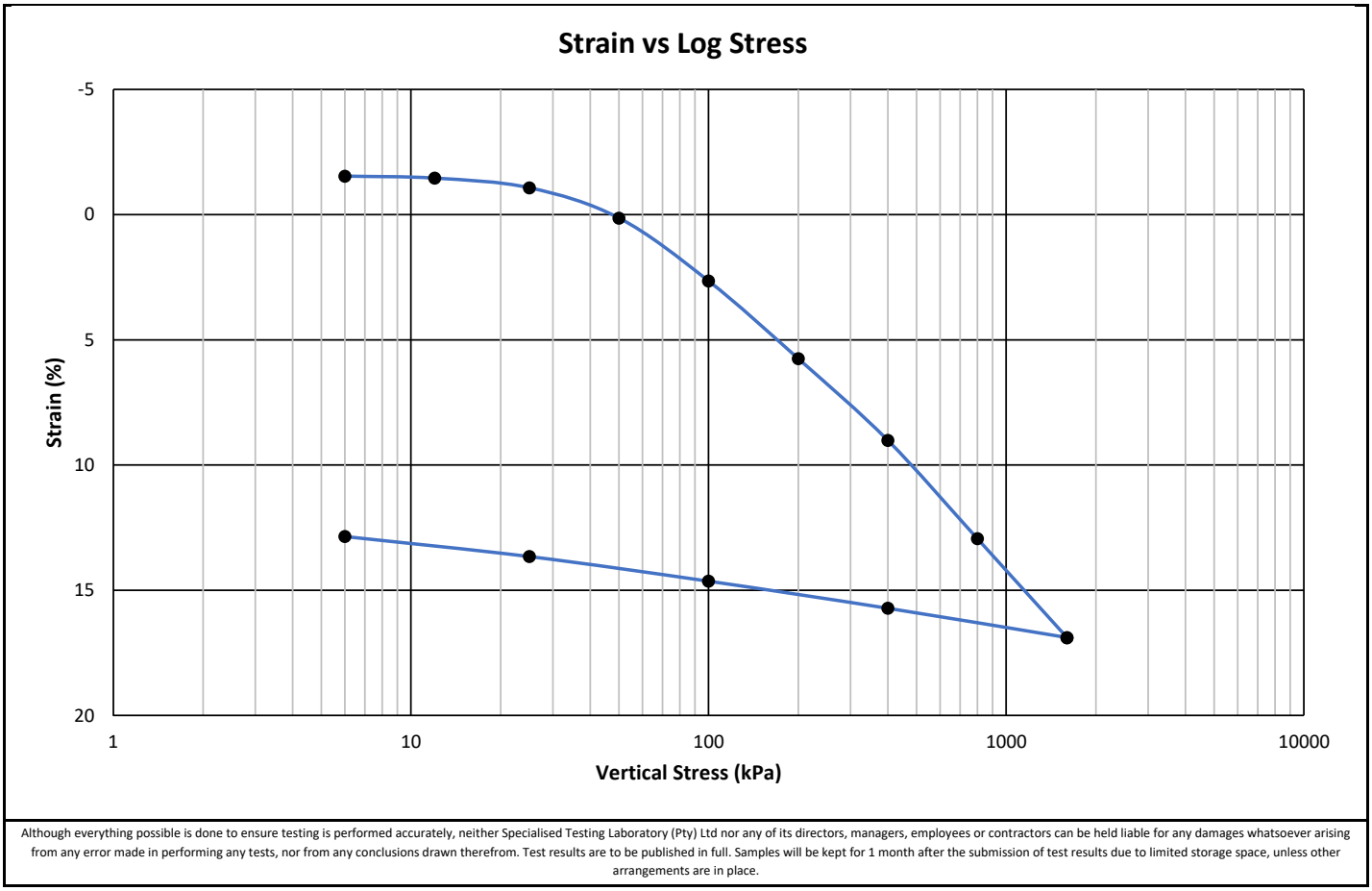
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-98
Sample:	TP8	**Method:**	BS 1377 Part 5
Depth: (m)	1.90	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	17.3	
	Final	%	14.1	
Dry Density		kg/m³	1789	
Void Ratio		-	0.493	
Degree of Saturation		%	93.8	
Relative Density (SG)		-	2.670	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.79	25.77	25.67	25.37	24.73	23.94	23.11	22.11	21.11	21.41	21.68	21.93	22.13
Total Strain	%	-1.54	-1.46	-1.07	0.14	2.65	5.75	9.01	12.94	16.89	15.72	14.64	13.66	12.86
Void Ratio	-	0.515	0.514	0.509	0.490	0.453	0.407	0.358	0.299	0.240	0.258	0.274	0.289	0.301
Mv (1/Mpa)	-	-	0.131	0.292	0.478	0.504	0.318	0.173	0.108	0.057	0.012	0.043	0.154	0.488



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

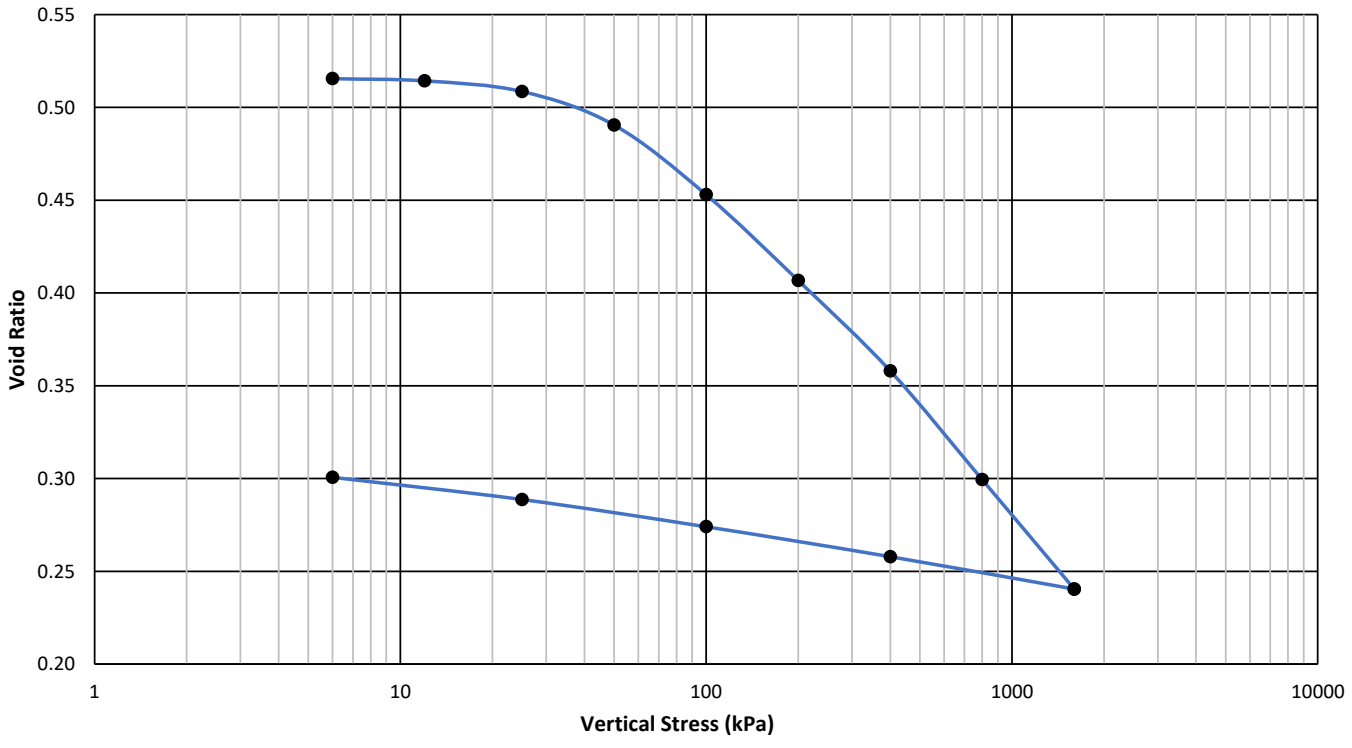
Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Sample: TP8
Depth: (m) 1.90

Job Number: SGE-20
Lab Number: SGE-20-98
Method: BS 1377 Part 5
Date: 14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	17.3	
	Final	%	14.1	
Dry Density		kg/m³	1789	
Void Ratio		-	0.493	
Degree of Saturation		%	93.8	
Relative Density (SG)		-	2.670	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.79	25.77	25.67	25.37	24.73	23.94	23.11	22.11	21.11	21.41	21.68	21.93	22.13
Total Strain	%	-1.54	-1.46	-1.07	0.14	2.65	5.75	9.01	12.94	16.89	15.72	14.64	13.66	12.86
Void Ratio	-	0.515	0.514	0.509	0.490	0.453	0.407	0.358	0.299	0.240	0.258	0.274	0.289	0.301
Mv (1/Mpa)	-	-	0.131	0.292	0.478	0.504	0.318	0.173	0.108	0.057	0.012	0.043	0.154	0.488



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

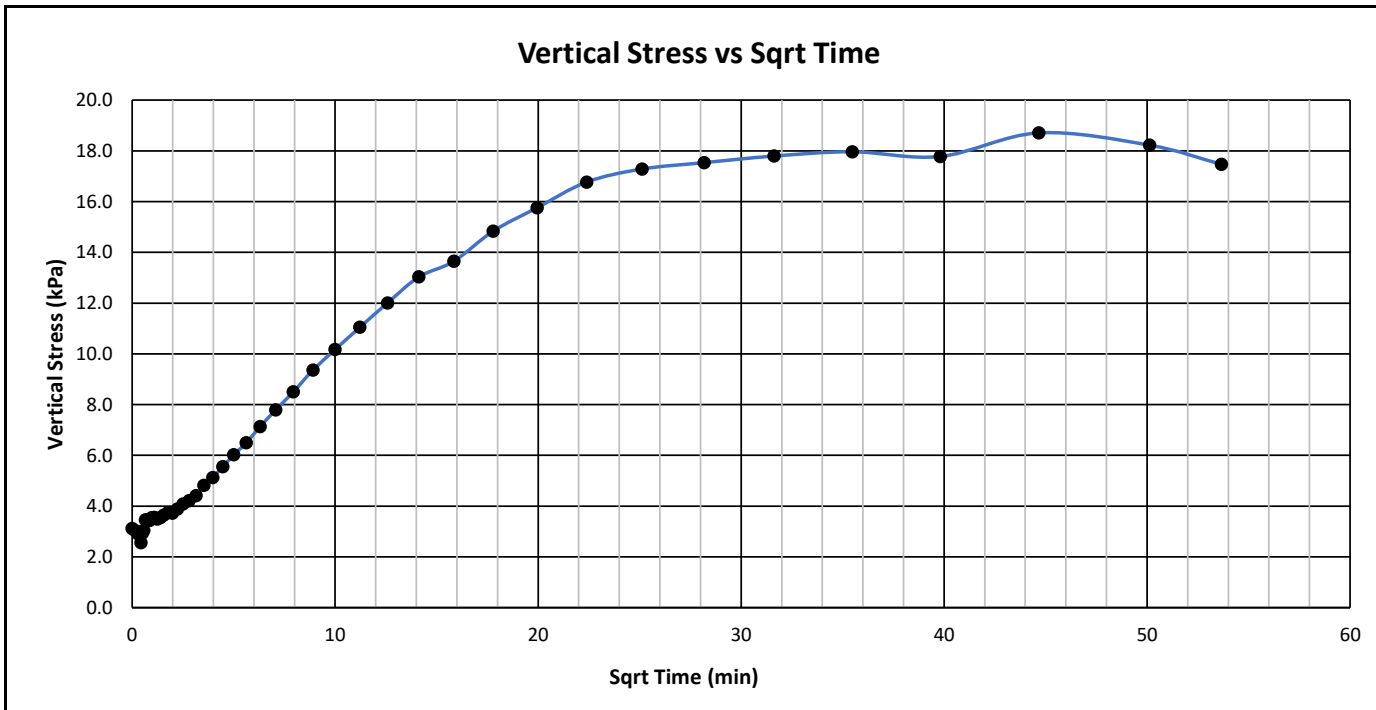
Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-98
Sample:	TP8	**Method:**	BS 1377 Part 5
Depth: (m)	1.90	**Date:**	14-Feb-23

SWELL PRESSURE TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	16.6	
	Final	%	19.8	
Dry Density		kg/m³	1783	
Void Ratio		-	0.498	
Degree of Saturation		%	89.0	
Relative Density (SG)		-	2.670	Determined

Swell Pressure	kPa	18.7

Vertical Stress	kPa	3.12	3.04	3.00	2.91	2.90	2.56	2.93	3.04	3.46	3.45	3.44	3.54	3.56
		3.49	3.54	3.64	3.75	3.72	3.89	4.08	4.22	4.41	4.82	5.13	5.55	6.02
		6.50	7.13	7.80	8.50	9.36	10.17	11.05	12.01	13.03	13.6	14.8	15.8	16.8
		17.3	17.5	17.8	18.0	17.8	18.7	18.2	17.5					
Time	Sqrt min	0.00	0.13	0.22	0.29	0.37	0.43	0.50	0.58	0.66	0.75	0.86	0.97	1.10
		1.23	1.39	1.57	1.76	1.98	2.23	2.50	2.81	3.15	3.54	3.97	4.46	5.01
		5.62	6.31	7.08	7.94	8.91	10.00	11.22	12.59	14.12	15.85	17.78	19.95	22.39
		25.12	28.18	31.62	35.48	39.81	44.67	50.12	53.67					



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

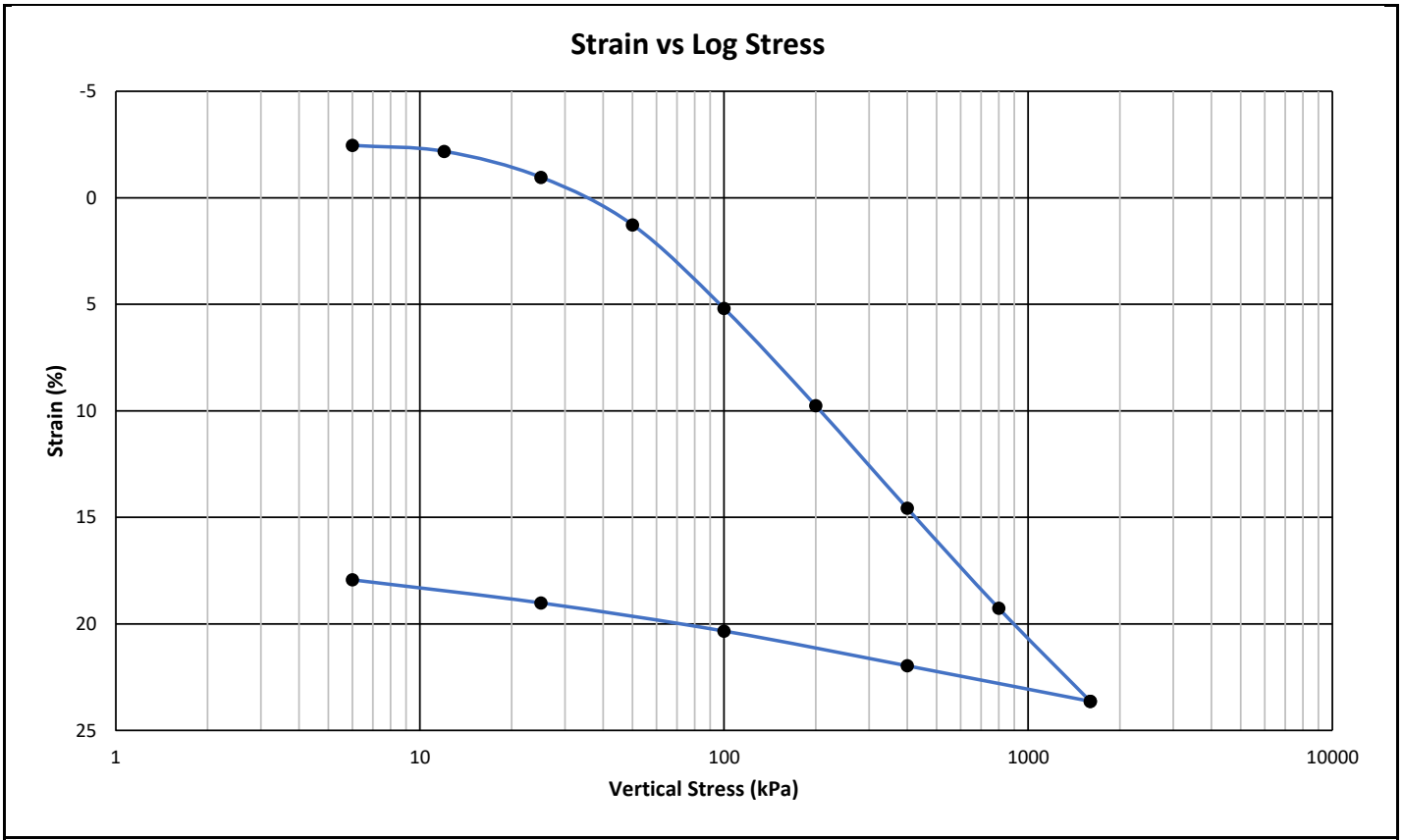
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-99
Sample:	TP9	**Method:**	BS 1377 Part 5
Depth: (m)	2.00	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	21.6	
	Final	%	21.1	
Dry Density		kg/m³	1456	
Void Ratio		-	0.825	
Degree of Saturation		%	69.6	
Relative Density (SG)		-	2.657	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	26.02	25.95	25.64	25.08	24.08	22.92	21.70	20.51	19.40	19.82	20.23	20.57	20.84
Total Strain	%	-2.46	-2.18	-0.96	1.27	5.19	9.76	14.57	19.27	23.64	21.97	20.34	19.02	17.93
Void Ratio	-	0.870	0.865	0.843	0.802	0.730	0.647	0.559	0.473	0.394	0.424	0.454	0.478	0.498
Mv (1/Mpa)	-	-	0.451	0.918	0.885	0.795	0.481	0.267	0.137	0.068	0.018	0.070	0.221	0.704



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

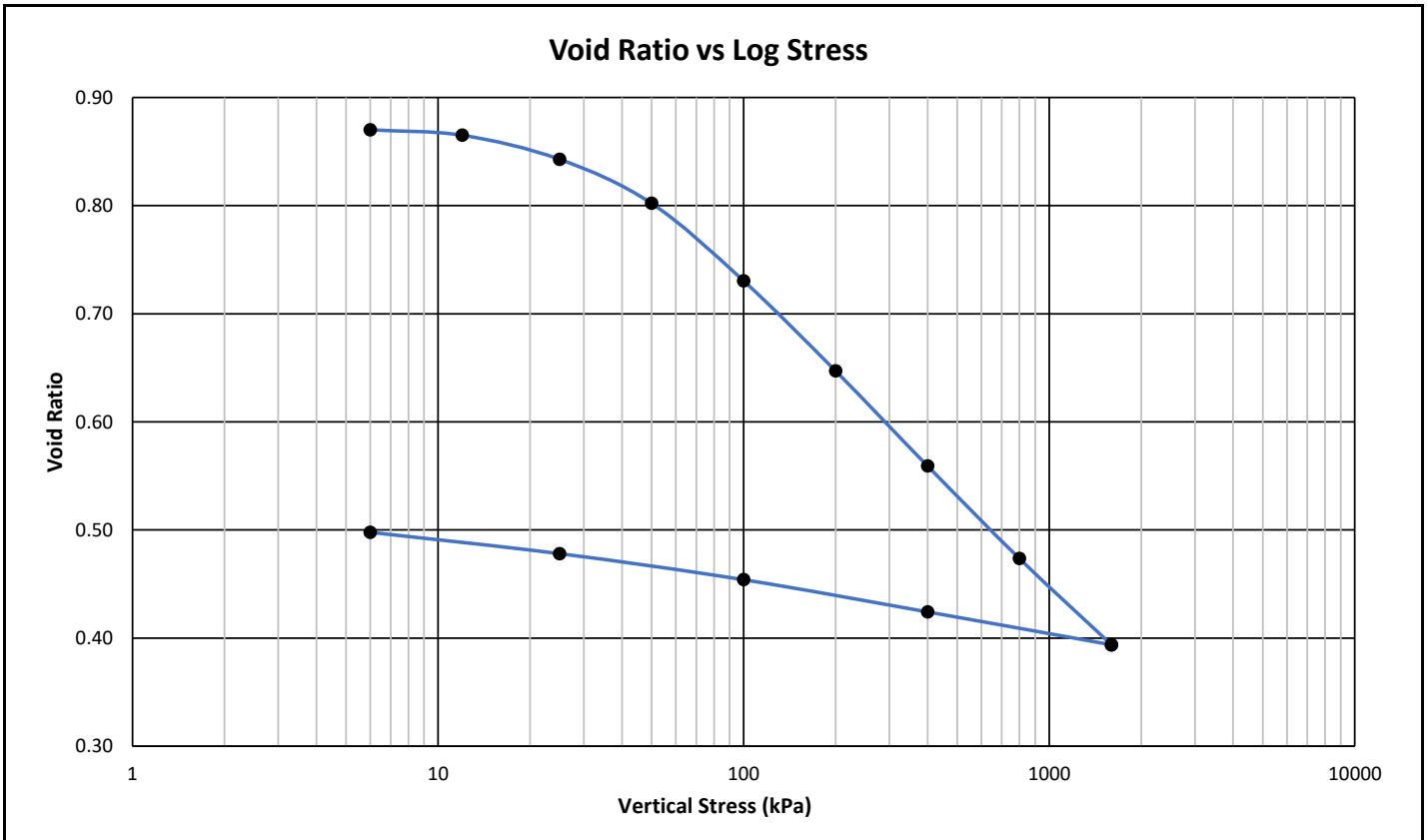
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-99
Sample:	TP9	**Method:**	BS 1377 Part 5
Depth: (m)	2.00	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	21.6	
	Final	%	21.1	
Dry Density		kg/m³	1456	
Void Ratio		-	0.825	
Degree of Saturation		%	69.6	
Relative Density (SG)		-	2.657	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	26.02	25.95	25.64	25.08	24.08	22.92	21.70	20.51	19.40	19.82	20.23	20.57	20.84
Total Strain	%	-2.46	-2.18	-0.96	1.27	5.19	9.76	14.57	19.27	23.64	21.97	20.34	19.02	17.93
Void Ratio	-	0.870	0.865	0.843	0.802	0.730	0.647	0.559	0.473	0.394	0.424	0.454	0.478	0.498
Mv (1/Mpa)	-	-	0.451	0.918	0.885	0.795	0.481	0.267	0.137	0.068	0.018	0.070	0.221	0.704



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

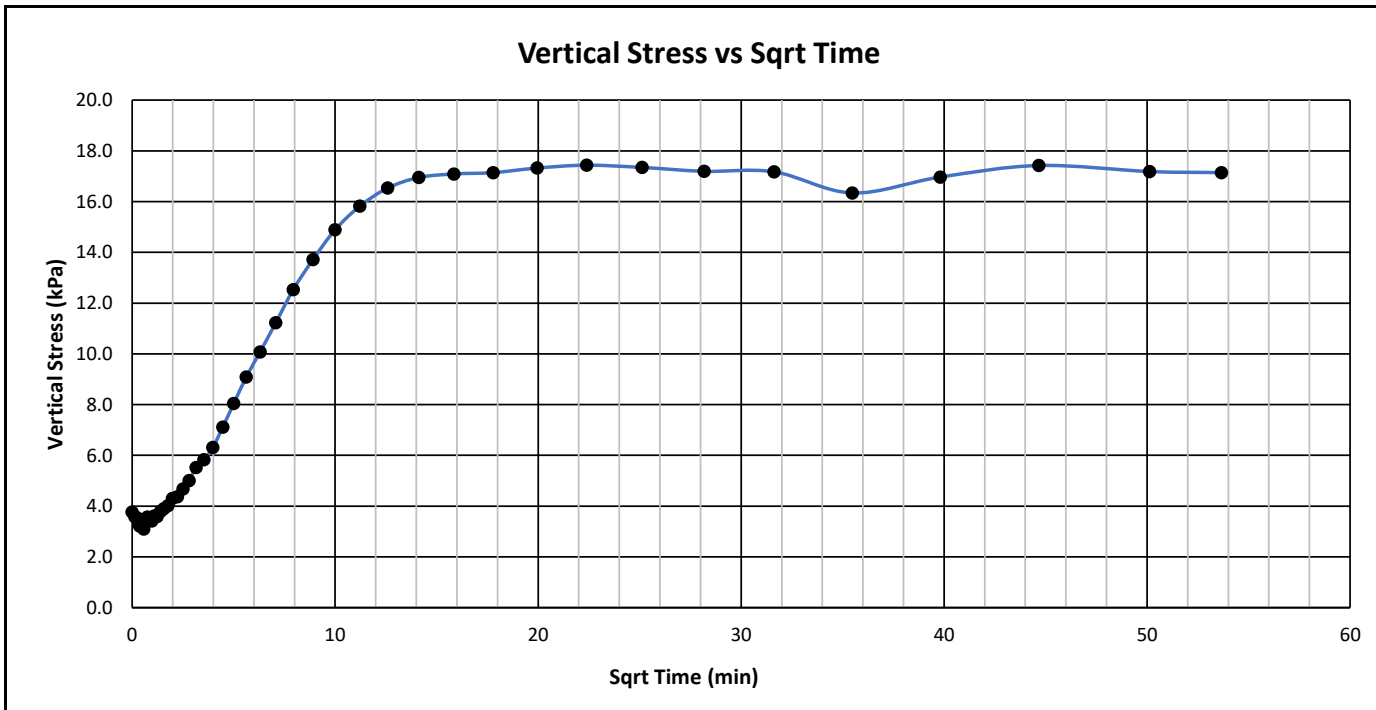
Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-99
Sample:	TP9	**Method:**	BS 1377 Part 5
Depth: (m)	2.00	**Date:**	14-Feb-23

SWELL PRESSURE TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	20.7	
	Final	%	25.1	
Dry Density		kg/m³	1642	
Void Ratio		-	0.618	
Degree of Saturation		%	88.9	
Relative Density (SG)		-	2.657	Determined

Swell Pressure	kPa	17.4

Vertical Stress	kPa	3.76	3.58	3.55	3.51	3.22	3.31	3.22	3.10	3.38	3.56	3.48	3.42	3.62
		3.60	3.79	3.89	4.02	4.30	4.37	4.68	5.01	5.53	5.83	6.31	7.11	8.04
		9.08	10.08	11.23	12.54	13.72	14.89	15.82	16.53	16.95	17.1	17.1	17.3	17.4
		17.3	17.2	17.2	16.3	17.0	17.4	17.2	17.1					
Time	Sqrt min	0.00	0.13	0.22	0.29	0.37	0.43	0.50	0.58	0.66	0.75	0.86	0.97	1.10
		1.23	1.39	1.57	1.76	1.98	2.22	2.50	2.81	3.15	3.54	3.97	4.46	5.01
		5.62	6.31	7.08	7.94	8.91	10.00	11.22	12.59	14.12	15.85	17.78	19.95	22.39
		25.12	28.18	31.62	35.48	39.81	44.67	50.12	53.67					



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

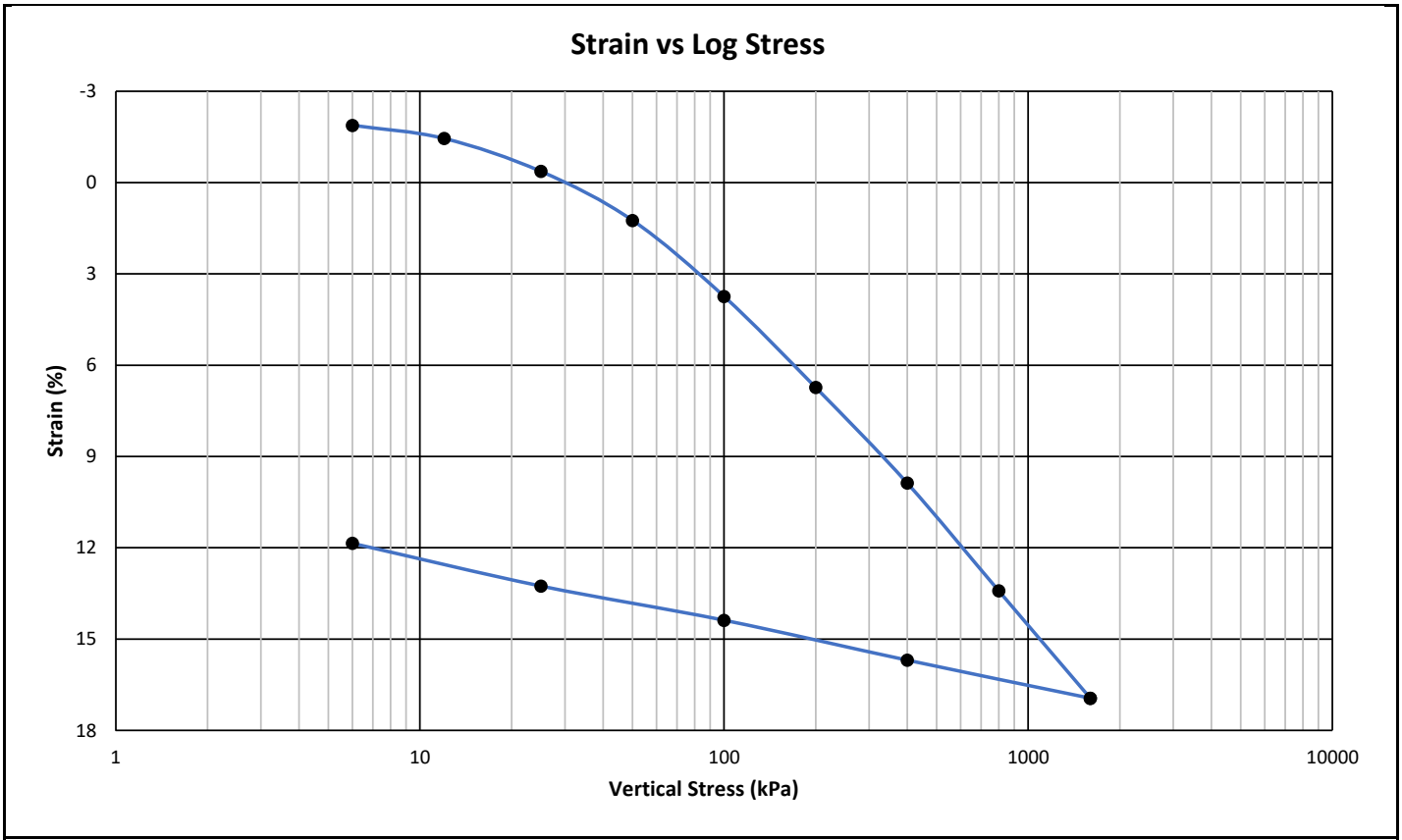
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-100
Sample:	TP10	**Method:**	BS 1377 Part 5
Depth: (m)	1.60	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	16.0	
	Final	%	14.1	
Dry Density		kg/m³	1760	
Void Ratio		-	0.528	
Degree of Saturation		%	81.3	
Relative Density (SG)		-	2.690	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.88	25.77	25.49	25.08	24.45	23.69	22.89	21.99	21.10	21.41	21.75	22.03	22.39
Total Strain	%	-1.88	-1.45	-0.37	1.24	3.74	6.73	9.87	13.42	16.94	15.69	14.38	13.26	11.85
Void Ratio	-	0.557	0.550	0.534	0.509	0.471	0.425	0.377	0.323	0.269	0.288	0.308	0.326	0.347
Mv (1/Mpa)	-	-	0.707	0.821	0.641	0.506	0.311	0.169	0.098	0.051	0.013	0.052	0.175	0.851



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

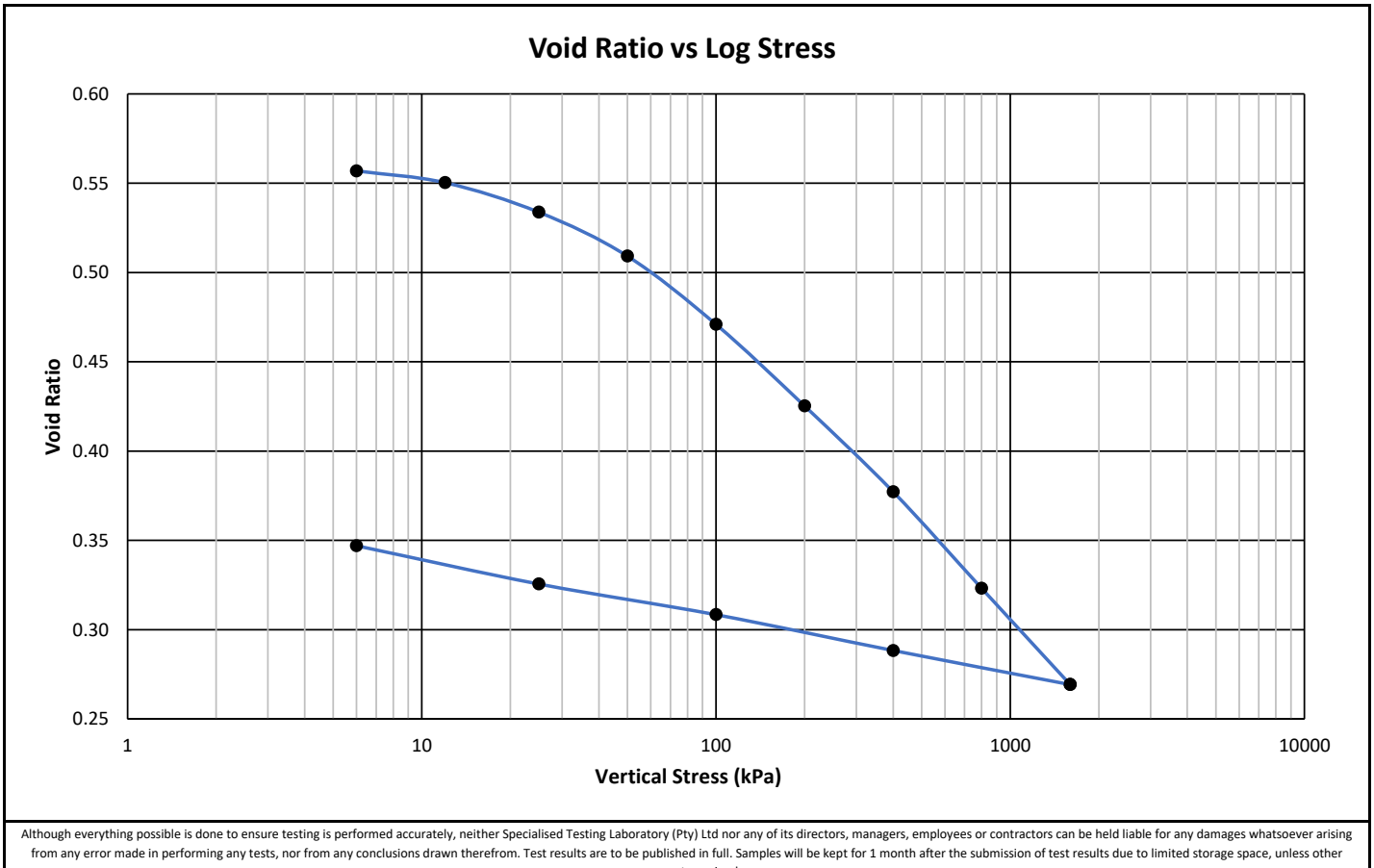
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-100
Sample:	TP10	**Method:**	BS 1377 Part 5
Depth: (m)	1.60	**Date:**	14/02/2023

ONE DIMENSIONAL CONSOLIDATION TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	16.0	
	Final	%	14.1	
Dry Density		kg/m³	1760	
Void Ratio		-	0.528	
Degree of Saturation		%	81.3	
Relative Density (SG)		-	2.690	Determined

Vertical Stress Applied:	kPa	6	12	25	50	100	200	400	800	1600	400	100	25	6
Load applied for:	Hrs	24	24	24	24	24	24	24	24	24	3	3	3	3
Height after increment	mm	25.88	25.77	25.49	25.08	24.45	23.69	22.89	21.99	21.10	21.41	21.75	22.03	22.39
Total Strain	%	-1.88	-1.45	-0.37	1.24	3.74	6.73	9.87	13.42	16.94	15.69	14.38	13.26	11.85
Void Ratio	-	0.557	0.550	0.534	0.509	0.471	0.425	0.377	0.323	0.269	0.288	0.308	0.326	0.347
Mv (1/Mpa)	-	-	0.707	0.821	0.641	0.506	0.311	0.169	0.098	0.051	0.013	0.052	0.175	0.851



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

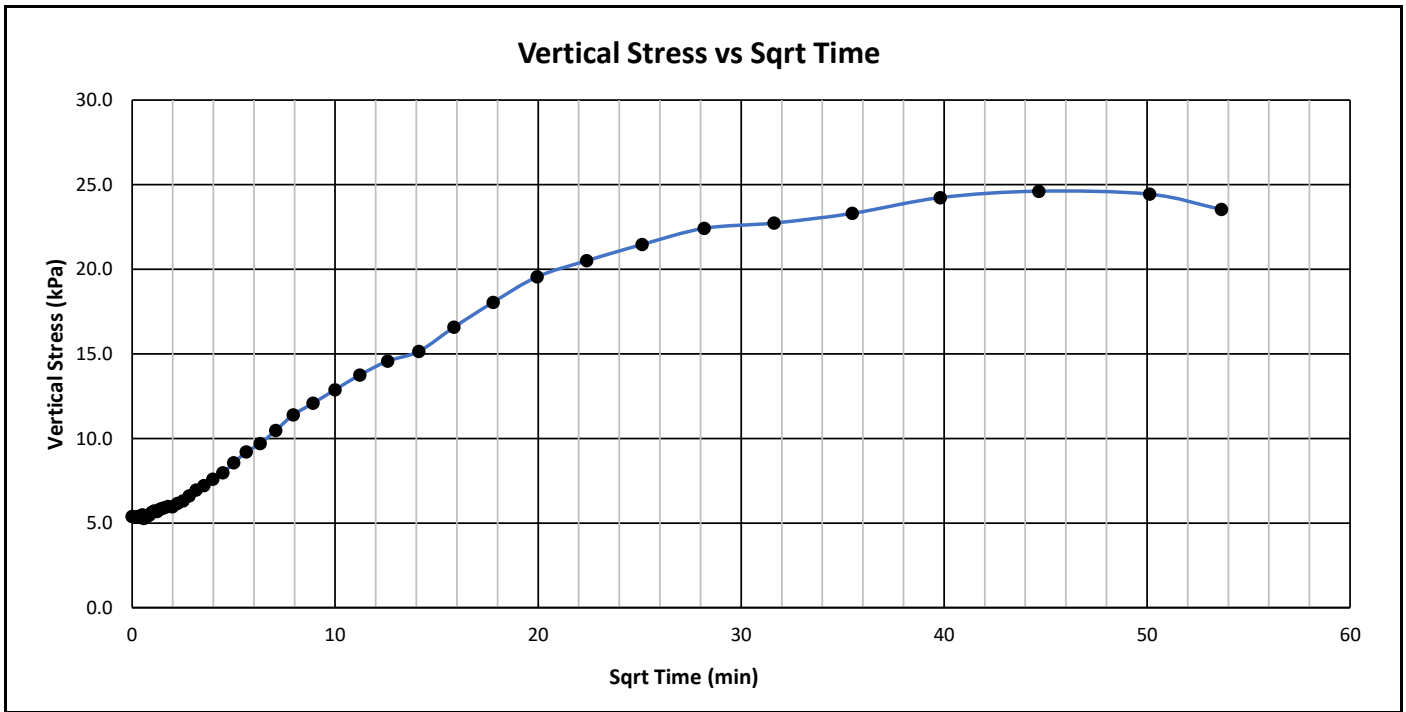
Client Name:	Southern Geotechnical Engineering	**Job Number:**	SGE-20
Project Name:	R30 Ventersdorp	**Lab Number:**	SGE-20-100
Sample:	TP10	**Method:**	BS 1377 Part 5
Depth: (m)	1.60	**Date:**	14-Feb-23

SWELL PRESSURE TEST

Sample Info		Unit	Initial	Test Remarks:
Test Specimen Height		mm	25.4	Undisturbed
Moisture Content	Initial	%	17.0	
	Final	%	20.4	
Dry Density		kg/m³	1745	
Void Ratio		-	0.541	
Degree of Saturation		%	84.3	
Relative Density (SG)		-	2.690	Determined

Swell Pressure	kPa	24.6

Vertical Stress	kPa	5.38	5.36	5.35	5.35	5.38	5.44	5.48	5.27	5.39	5.41	5.49	5.63	5.72
		5.68	5.83	5.90	5.98	5.96	6.17	6.31	6.61	6.96	7.21	7.60	7.96	8.56
		9.20	9.69	10.48	11.39	12.08	12.88	13.75	14.57	15.15	16.6	18.0	19.6	20.5
		21.5	22.4	22.7	23.3	24.2	24.6	24.4	23.5					
Time	Sqrt min	0.00	0.13	0.22	0.29	0.37	0.43	0.50	0.58	0.66	0.75	0.86	0.97	1.10
		1.23	1.39	1.57	1.76	1.98	2.22	2.50	2.81	3.15	3.54	3.97	4.46	5.01
		5.62	6.31	7.08	7.94	8.91	10.00	11.22	12.59	14.12	15.85	17.78	19.95	22.39
		25.12	28.18	31.62	35.48	39.81	44.67	50.12	53.67					



Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 14-Feb-23
Method: SANS 3001 GR1, GR3, GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Sheet Reference: R-STL-038 Rev01

Grading & Hydrometer Analysis (% Passing)

Sample	TP1	TP2	TP6	TP11	TP3	TP4	TP5	TP7
Depth (m)	0.5 - 1.5	1.5 - 2.5	0.7 - 1.1	1.5 - 2.2	2.0	1.5	2.0	1.5
Lab No	SGE-20-81	SGE-20-82	SGE-20-87	SGE-20-93	SGE-20-94	SGE-20-95	SGE-20-96	SGE-20-97
53.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
37.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
26.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
19.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
13.2	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
9.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
6.7	**100**	**100**	**100**	**100**	**100**	**99**	**99**	**99**
4.75	**100**	**100**	**100**	**100**	**99**	**98**	**99**	**97**
2.0	**100**	**99**	**100**	**97**	**93**	**94**	**94**	**91**
1.0	**99**	**96**	**94**	**89**	**71**	**88**	**88**	**85**
0.425	**96**	**89**	**77**	**74**	**50**	**79**	**80**	**76**
0.250	**90**	**75**	**66**	**62**	**44**	**73**	**75**	**69**
0.150	**85**	**66**	**58**	**55**	**39**	**67**	**71**	**65**
0.075	**75**	**51**	**40**	**47**	**34**	**57**	**61**	**54**
0.060	**65**	**45**	**29**	**40**	**32**	**52**	**54**	**48**
0.050	**62**	**42**	**26**	**38**	**31**	**49**	**51**	**46**
0.035	**56**	**36**	**22**	**35**	**29**	**45**	**46**	**41**
0.020	**52**	**31**	**19**	**31**	**27**	**42**	**42**	**39**
0.006	**48**	**28**	**15**	**27**	**25**	**39**	**36**	**36**
0.002	**46**	**26**	**11**	**25**	**24**	**36**	**33**	**34**
GM	**0.29**	**0.61**	**0.83**	**0.82**	**1.23**	**0.70**	**0.65**	**0.79**

Atterberg Limits

LL (%)	**49**	**35**	**17**	**37**	**45**	**34**	**38**	**33**
PI (%)	**37**	**18**	**6**	**22**	**26**	**19**	**22**	**19**
LS (%)	**26.0**	**9.0**	**3.0**	**11.5**	**13.5**	**10.0**	**11.5**	**9.5**

pH & Conductivity

pH								
EC (S/m)								

MDD / OMC

MDD (kg/m³)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 14-Feb-23
Method: SANS 3001 GR1, GR3, GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Sheet Reference: R-STL-038 Rev01

Grading & Hydrometer Analysis (% Passing)

Sample	TP8	TP9	TP10	TP7	BH2	BH2	BH4	BH5
Depth (m)	1.9	2.0	1.6	1.0 - 2.5	1.2 - 1.5	5.8 - 6.0	1.0 - 1.5	0.3 - 0.6
Lab No	SGE-20-98	SGE-20-99	SGE-20-100	SGE-20-101	SGE-20-102	SGE-20-103	SGE-20-104	SGE-20-105
53.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
37.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
26.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
19.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
13.2	**100**	**100**	**100**	**100**	**100**	**99**	**100**	**100**
9.5	**100**	**100**	**100**	**100**	**100**	**99**	**100**	**100**
6.7	**100**	**99**	**100**	**98**	**100**	**95**	**100**	**100**
4.75	**99**	**99**	**99**	**95**	**99**	**88**	**100**	**100**
2.0	**86**	**93**	**92**	**87**	**91**	**69**	**96**	**99**
1.0	**70**	**83**	**85**	**80**	**81**	**52**	**91**	**97**
0.425	**56**	**69**	**75**	**72**	**67**	**39**	**82**	**94**
0.250	**46**	**61**	**69**	**65**	**57**	**30**	**73**	**87**
0.150	**40**	**56**	**63**	**60**	**49**	**25**	**63**	**79**
0.075	**35**	**45**	**52**	**51**	**36**	**20**	**50**	**66**
0.060	**32**	**42**	**45**	**42**	**30**	**16**	**42**	**59**
0.050	**31**	**40**	**43**	**40**	**27**	**14**	**38**	**56**
0.035	**29**	**36**	**39**	**35**	**23**	**12**	**32**	**51**
0.020	**27**	**34**	**36**	**31**	**20**	**9**	**30**	**47**
0.006	**26**	**31**	**32**	**24**	**16**	**5**	**26**	**40**
0.002	**25**	**29**	**30**	**22**	**13**	**3**	**23**	**35**
GM	**1.23**	**0.93**	**0.81**	**0.90**	**1.06**	**1.72**	**0.72**	**0.41**

Atterberg Limits

LL (%)	**52**	**58**	**43**	**35**	**31**	**-**	**39**	**47**
PI (%)	**35**	**36**	**28**	**19**	**13**	**SP**	**23**	**32**
LS (%)	**23.0**	**23.5**	**13.0**	**10.0**	**7.0**	**0.5**	**11.5**	**22.5**

pH & Conductivity

pH								
EC (S/m)								

MDD / OMC

MDD (kg/m³)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 14-Feb-23
Method: SANS 3001 GR1, GR3, GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Sheet Reference: R-STL-038 Rev01

Grading & Hydrometer Analysis (% Passing)

Sample	BH5	BH6	BH7	BH16	BH15	BH17	BH12	BH13
Depth (m)	1.3 - 1.5	0.75 - 1.25	0.6 - 0.9	0.7 - 1.4	0.5 - 0.9	1.0 - 1.5	2.0 - 2.6	2.1 - 2.6
Lab No	SGE-20-106	SGE-20-107	SGE-20-108	SGE-20-109	SGE-20-110	SGE-20-111	SGE-20-112	SGE-20-113
53.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
37.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
26.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
19.0	**98**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
13.2	**98**	**100**	**100**	**99**	**100**	**100**	**100**	**100**
9.5	**97**	**100**	**99**	**99**	**100**	**100**	**100**	**100**
6.7	**96**	**100**	**96**	**97**	**99**	**100**	**100**	**99**
4.75	**95**	**100**	**94**	**95**	**97**	**100**	**100**	**98**
2.0	**83**	**99**	**88**	**88**	**92**	**99**	**96**	**94**
1.0	**68**	**98**	**82**	**78**	**86**	**96**	**91**	**88**
0.425	**55**	**94**	**72**	**64**	**74**	**91**	**82**	**80**
0.250	**45**	**85**	**56**	**50**	**66**	**85**	**73**	**73**
0.150	**40**	**79**	**48**	**45**	**61**	**80**	**66**	**68**
0.075	**34**	**67**	**38**	**40**	**54**	**72**	**50**	**60**
0.060	**28**	**58**	**31**	**35**	**49**	**65**	**37**	**55**
0.050	**26**	**55**	**29**	**33**	**47**	**62**	**34**	**53**
0.035	**23**	**48**	**26**	**30**	**43**	**57**	**28**	**50**
0.020	**21**	**42**	**23**	**27**	**40**	**51**	**23**	**47**
0.006	**18**	**31**	**17**	**22**	**36**	**40**	**19**	**44**
0.002	**16**	**25**	**12**	**18**	**33**	**30**	**17**	**42**
GM	**1.28**	**0.40**	**1.02**	**1.08**	**0.80**	**0.38**	**0.72**	**0.66**

Atterberg Limits

LL (%)	**37**	**37**	**31**	**37**	**46**	**43**	**29**	**73**
PI (%)	**26**	**19**	**15**	**20**	**26**	**25**	**16**	**40**
LS (%)	**11.5**	**9.5**	**7.5**	**11.5**	**15.5**	**13.0**	**8.0**	**24.0**

pH & Conductivity

pH								
EC (S/m)								

MDD / OMC

MDD (kg/m³)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name: Southern Geotechnical Engineering
Project Name: R30 Ventersdorp
Job Number: SGE-20
Date: 14-Feb-23
Method: SANS 3001 GR1, GR3, GR10, GR12 GR20, GR30, GR31, GR40, GR50, GR53, GR54 & BS 1377 (where applicable)

SUMMARY OF TEST DATA

Sheet Reference: R-STL-038 Rev01

Grading & Hydrometer Analysis (% Passing)

Sample	BH01	BH12	BH10	BH03	BH08	BH14	BH11	
Depth (m)	2.5 - 3.0	3.45 - 4.45	1.2 -1.5	4.0 - 4.5	2.7 - 2.95	2.0 - 2.3	3.5- 4.0	
Lab No	SGE-20-114	SGE-20-115	SGE-20-116	SGE-20-117	SGE-20-118	SGE-20-119	SGE-20-120	
53.0	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
37.5	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
26.5	**98**	**100**	**100**	**100**	**100**	**100**	**100**	
19.0	**93**	**100**	**100**	**100**	**100**	**100**	**94**	
13.2	**91**	**100**	**100**	**100**	**100**	**97**	**94**	
9.5	**90**	**100**	**100**	**100**	**100**	**96**	**94**	
6.7	**88**	**100**	**100**	**99**	**100**	**93**	**94**	
4.75	**87**	**98**	**99**	**92**	**100**	**91**	**93**	
2.0	**84**	**85**	**95**	**57**	**100**	**85**	**88**	
1.0	**76**	**72**	**92**	**35**	**98**	**76**	**77**	
0.425	**53**	**58**	**85**	**21**	**93**	**67**	**61**	
0.250	**39**	**49**	**78**	**15**	**85**	**61**	**51**	
0.150	**33**	**42**	**71**	**12**	**75**	**56**	**47**	
0.075	**26**	**34**	**57**	**9**	**58**	**51**	**40**	
0.060	**22**	**30**	**46**	**7**	**49**	**48**	**35**	
0.050	**20**	**28**	**43**	**6**	**46**	**47**	**33**	
0.035	**17**	**24**	**39**	**5**	**40**	**44**	**29**	
0.020	**16**	**21**	**35**	**4**	**36**	**41**	**27**	
0.006	**14**	**17**	**29**	**3**	**32**	**35**	**25**	
0.002	**13**	**14**	**27**	**2**	**28**	**32**	**23**	
GM	**1.37**	**1.23**	**0.63**	**2.13**	**0.49**	**0.97**	**1.11**	

Atterberg Limits

LL (%)	**32**	**35**	**47**	**26**	**41**	**56**	**49**	
PI (%)	**18**	**21**	**31**	**9**	**27**	**36**	**31**	
LS (%)	**9.0**	**10.0**	**21.5**	**4.5**	**13.5**	**26.5**	**21.5**	

pH & Conductivity

pH								
EC (S/m)								

MDD / OMC

MDD (kg/m³)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

Although everything possible is done to ensure testing is performed accurately, neither Specialised Testing Laboratory (Pty) Ltd nor any of its directors, managers, employees or contractors can be held liable for any damages whatsoever arising from any error made in performing any tests, nor from any conclusions drawn therefrom. Test results are to be published in full. Samples will be kept for 1 month after the submission of test results due to limited storage space, unless other arrangements are in place. Confidentiality statement: Unless the release of information is required by law or covered by confidentiality agreements all information obtained or created during the performance of laboratory activities will be kept confidential.

APPENDIX G

LABORATORY TEST RESULTS - ROCK

ROCKLAB REPORT **CONFIDENTIAL**
2022-SOUTHERN-GEOTECHNICAL-ENG-02

Issued by:

ROCKLAB
(ROCK MECHANICS & EXCAVATION LABORATORIES)
P O BOX 72928
LYNNWOOD RIDGE 0040
TEL: 012 8134910
E-MAIL: CHENJ@ROCKLAB.CO.ZA

RESULTS OF ROCK PROPERTIES TESTS

Sampling Site:

BY

DR J. F. CHEN

Submitted to:

Southern Geotechnical Engineering (PTY) LTD

24 NOVEMBER 2022

C O N T E N T S

TABLE 1 - RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH TESTS

APPENDIX 1 FAILURE CODES OF ROCK COMPRESSION TESTS

TABLE 1 RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH TESTS

ROCKLAB
Tel: 0027 12 813 4910
E-mail: Chenj@rocklab.co.za

Client: Southern Geotechnical Engineering Sampling Site: 25-11-2022

SPECIMEN PARTICULARS				SPECIMEN DIMENSIONS					SPECIMEN TEST RESULTS			
Rocklab Specimen No. 9109-	BH No	Depth m	Rock Type	Diameter mm	Height mm	Ratio of Height to Diameter	Mass g	Density g/cm³	Failure Load kN	Strength (UCS) MPa	Failure Code	Note
UCS-01	BH2	9.42		51.93	124.3	2.4	675.15	2.56	52.5	24.8	XA	
UCS-02	BH2	11.7		52.17	125.5	2.4	705.60	2.63	259.1	121.2	XA	
UCS-03	BH4	5.75		51.72	125.2	2.4	697.74	2.65	34.6	16.5	4B	
UCS-04	BH5	5.5		51.76	92.5	1.8	511.73	2.63	393.3	186.9	1B	
UCS-05	BH5	9.55		51.91	125.3	2.4	705.78	2.66	426.8	201.7	YA	
UCS-06	BH6	4.45		51.92	123.1	2.4	684.13	2.63	314.5	148.5	2B	
UCS-07	BH7	7.62		51.56	122.8	2.4	674.53	2.63	362.5	173.6	YA	
UCS-08	BH7	11.5		51.39	122.8	2.4	711.96	2.79	53.3	25.7	0B	

Note: All tests were conducted according to the ISRM's (International Society for Rock Mechanics) specification.
Failure codes refer to Appendix 1

APPENDIX 1

CLASSIFICATION OF ROCK SPECIMEN FAILURE MODE INFLUENCED / NOT INFLUENCED BY DISCONTINUITIES DURING COMPRESSION TESTING

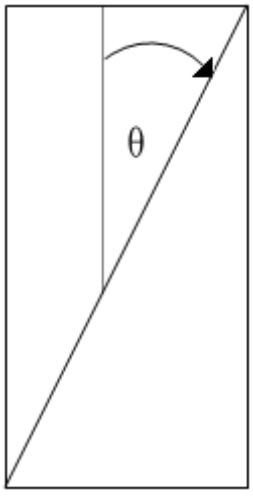
FAILURE NOT INFLUENCED BY DISCONTINUITIES (INTACT)

TYPE CODE	DESCRIPTION OF SUB CODES	
	A	B
X	SLIDING SHEAR FAILURE	COMPLETE CONE DEVELOPMENT
Y	SPLITTING	BREAKING INTO A LOT OF PIECES

FAILURE INFLUENCED BY DISCONTINUITIES

TYPE CODE	DESCRIPTION OF SUB CODES	
	A	B
	PARTIAL FAILURE ON DISCONTINUITY	FAILURE COMPLETELY ON DISCONTINUITY
1	AT 0-10° TO AXIS	AT 0-10° TO AXIS
2	AT 11-20° TO AXIS	AT 11-20° TO AXIS
3	AT 21-30° TO AXIS	AT 21-30° TO AXIS
4	AT 31-40° TO AXIS	AT 31-40° TO AXIS
5	AT 41-50° TO AXIS	AT 41-50° TO AXIS
6	AT 51-70° TO AXIS	AT 51-70° TO AXIS
7	AT 71-90° TO AXIS	AT 71-90° TO AXIS
0	Multiple Discontinuities	Multiple Discontinuities

Example: Failure Type3B: Failure completely on a discontinuity with an orientation of between 21°and 30° to the specimen axis.



ROCKLAB REPORT **CONFIDENTIAL**
2022-SOUTHERN-GEOTECHNICAL-ENG-03

Issued by:

ROCKLAB
(ROCK MECHANICS & EXCAVATION LABORATORIES)
P O BOX 72928
LYNNWOOD RIDGE 0040
TEL: 012 8134910
E-MAIL: CHENJ@ROCKLAB.CO.ZA

RESULTS OF ROCK PROPERTIES TESTS

Sampling Site: R30 Ventersdrop

BY

DR J. F. CHEN

Submitted to:

Southern Geotechnical Engineering (PTY) LTD

14 DECEMBER 2022

C O N T E N T S

TABLE 1 - RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH TESTS

APPENDIX 1 FAILURE CODES OF ROCK COMPRESSION TESTS

TABLE 1 RESULTS OF UNIAXIAL COMPRESSIVE STRENGTH TESTS

ROCKLAB
Tel: 0027 12 813 4910
E-mail: Chenj@rocklab.co.za

Client: Southern Geotechnical Engineering Sampling Site: R30 Ventersdorp 14-12-2022

SPECIMEN PARTICULARS				SPECIMEN DIMENSIONS					SPECIMEN TEST RESULTS			
Rocklab Specimen No. 9132-	BH No	Depth m	Rock Type	Diameter mm	Height mm	Ratio of Height to Diameter	Mass g	Density g/cm³	Failure Load kN	Strength (UCS) MPa	Failure Code	Note
UCS-01	BH12	6.3		52.22	119.2	2.3	664.55	2.60	125.4	58.6	0B	
UCS-02	BH10	7.4		51.99	125.6	2.4	704.26	2.64	356.0	167.7	1B	
UCS-03	BH17	19.0		51.85	123.0	2.4	650.78	2.51	1.4	0.7	XA	
UCS-04	BH15	7.25		51.70	125.6	2.4	733.15	2.78	213.8	101.8	3B	
UCS-05	BH09	6.55		52.00	106.6	2.0	600.46	2.65	155.0	73.0	3B	
UCS-06	BH14	8.8		51.79	127.9	2.5	810.93	3.01	534.3	253.6	YA	
UCS-07	BH08	6.45		51.88	126.6	2.4	704.33	2.63	284.9	134.8	1B	
UCS-08	BH13	6.75		51.88	112.8	2.2	681.77	2.86	51.9	24.5	0B	
UCS-09	BH16	2.45		51.93	130.5	2.5	789.95	2.86	314.7	148.6	YA	
UCS-10	BH11	4.4		52.33	88.7	1.7	472.03	2.47	44.8	20.8	0B	
UCS-11	BH03	13.9		51.32	128.9	2.5	742.17	2.78	40.9	19.7	0B	

Note: All tests were conducted according to the ISRM's (International Society for Rock Mechanics) specification.
Failure codes refer to Appendix 1

APPENDIX 1

CLASSIFICATION OF ROCK SPECIMEN FAILURE MODE INFLUENCED / NOT INFLUENCED BY DISCONTINUITIES DURING COMPRESSION TESTING

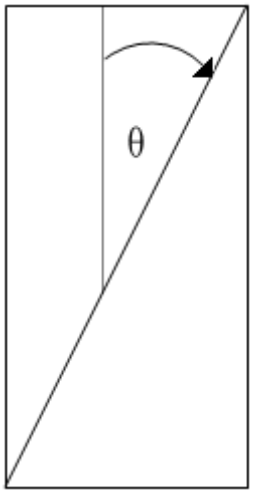
FAILURE NOT INFLUENCED BY DISCONTINUITIES (INTACT)

TYPE CODE	DESCRIPTION OF SUB CODES	
	A	B
X	SLIDING SHEAR FAILURE	COMPLETE CONE DEVELOPMENT
Y	SPLITTING	BREAKING INTO A LOT OF PIECES

FAILURE INFLUENCED BY DISCONTINUITIES

TYPE CODE	DESCRIPTION OF SUB CODES	
	A	B
	PARTIAL FAILURE ON DISCONTINUITY	FAILURE COMPLETELY ON DISCONTINUITY
1	AT 0-10° TO AXIS	AT 0-10° TO AXIS
2	AT 11-20° TO AXIS	AT 11-20° TO AXIS
3	AT 21-30° TO AXIS	AT 21-30° TO AXIS
4	AT 31-40° TO AXIS	AT 31-40° TO AXIS
5	AT 41-50° TO AXIS	AT 41-50° TO AXIS
6	AT 51-70° TO AXIS	AT 51-70° TO AXIS
7	AT 71-90° TO AXIS	AT 71-90° TO AXIS
0	Multiple Discontinuities	Multiple Discontinuities

Example: Failure Type3B: Failure completely on a discontinuity with an orientation of between 21°and 30° to the specimen axis.



APPENDIX 5.7: Traffic Engineering Assessment

MERCHELLES
COLLECTIVE

YOUR ENGINEERING NEEDS,
OUR PASSION

Traffic Engineering Assessment

The Improvement of National Road R30 Section 8 from km 36.8 to Ventersdorp km 68.646

REPORT

Submitted to :

Ndodana Consulting Engineers (Pty) Ltd
River Falls Office Park
262 Rose Ave,
Tamboti Building,
Doringkloof
Centurion,0157

18 May 2023

GP099

Merchelles Collective (Pty) Ltd Reg No 2016/481395/07
Building 1 Maxwell Office Park Magwa Crescent West cnr Allandale Road and Maxwell Drive
Waterfall City Midrand Johannesburg South Africa
TEL +27 (0)11 207 2060 EMAIL info@merchelles.co.za WEB merchellescollective.co.za
Directors L. Pike (CEO & COO) | L. Kgoa | K. Mafuta | R. Nel **Associate** L. Mposi **Financial Administrator** K. Modisane

CESA Consulting Engineers South Africa

PROUDLY LEVEL 1 B-BBEE

DOCUMENT CONTROL SHEET

Project Title: R.030-080-2016/1: TRAFFIC ENGINEERING ASSESSMENT

Project No: GP099

DOCUMENT APPROVAL

ACTION	DESIGNATION	NAME	DATE	SIGNATURE
Prepared	Transport Engineer Junior Engineer	Lerato Kgoa, BSc Eng (Civil) Khanyisile Rooi, BEng Civil	11 May 2023	
Reviewed	Transport Engineer	Lerato Kgoa	16 May 2023	
Approved	Senior Engineer	Llewellyn Pike, Pr Eng, Pr CPM	18 May 2023	

ISSUED BY: Project Leader:

Name: Webster Ndodana

SIGNATURE DATE 22 May 2023

APPROVED BY: SANRAL Regional Specialist

Name: _____

SIGNATURE DATE

ACCEPTED BY: SANRAL Project Manager:

Name: _____

SIGNATURE DATE

RECORD OF REVISIONS

DATE	REVISION	AUTHOR	COMMENTS
08-02-2022	01	Lerato Kgoa Khanyisile Rooi	Initial draft submitted to Ndodana Consulting for progress.
22-02-2022	02	Lerato Kgoa Khanyisile Rooi	Second draft submitted to Ndodana Consulting for comment.
26-04-2022	03	Lerato Kgoa Khanyisile Rooi	Third draft submitted to Ndodana Consulting for approval
18-05-2023	04	As above.	Final report updated according to SANRAL Preliminary Design review feedback.

1 EXECUTIVE SUMMARY

1.1 Introduction

Merchelles Collective (Pty) Ltd is appointed by Ndodana Consulting Engineers (Pty) Ltd to render Professional Traffic Engineering services for the improvement of National Road R30 Section 8 from KM 36.8 to Ventersdorp KM 68.65. The objective of the traffic assessment is to investigate prevailing traffic conditions and identify feasible road infrastructure capacity improvements.

The aim of undertaking a traffic assessment for the improvement of R30 Section 8 (R30-8) is to investigate prevailing traffic conditions and identify feasible infrastructure capacity improvements where warranted.

1.2 Route Overview

The R30 Section 8 is a Class 2 Rural Major Arterial that provides inter-regional connectivity between the towns of Derby, Ventersdorp, and Klerksdorp and is part of the R30 toll route that is an alternative route to the N1 between the Free State and the North West Province. The route is in disrepair with faded road markings and pavement damage. The road provides access to Ventersdorp town which spreads across both sides of the R30 supporting town activity. There is high pedestrian and on-street parking activity in the town section of the route. The lack of paved shoulders presents road safety, capacity, and maintenance challenges.

This section of the R30 is non-homogenous due to varying land use developments and traffic volumes, particularly, heavy vehicle traffic along the route. The route, is, therefore, divided into the following two sections:

- Section 1: Rural highway section from km 36.8 to km 64.4 with several intersections facilitating access to farming or agricultural land on either side.
- Section 2: Town section from km 64.4 up to 68.8 km , where the land-use changes from rural to peri-urban and finally to a CBD environment in Ventersdorp. The section is characterized by a significant number of at-grade, stop-controlled access intersections, on-street parking, and pedestrian activity.

1.3 Land Use Development and Transport Planning

There is a proposed Tshing Extension 10 township development at the intersection of the R30 and N14. The development is a mixed-use township development and trips generated by this development have been considered in the road network capacity analysis to determine the necessary intersection capacity improvements for the R30-8.

The R30 Section 8 intersects the N14 in the vicinity of this development and the existing road reserve allows for a diamond interchange at this intersection. In terms of access management, it is important that the road reserve is protected and the option of an interchange is considered.

1.4 Traffic Information and Analysis

Historic traffic data was made available from the SANRAL Comprehensive Traffic Observations (CTO) count stations, and the North West Provincial (NWP) PMS Database. New data was obtained from 12-hour Classified Manual Vehicle and Pedestrian surveys undertaken along the route. See Figure 5-5 and Figure 5-6 under Section 5.1.3.

The identified CTO stations within the project study area were temporary stations with the latest available data ranging from 2013 to 2019. The lack of permanent stations along the route implies that there is no consistent historic Average Daily Traffic (ADT) and Average Daily Truck Traffic (ADTT) volumes, however, data from the temporary stations was relied on establishing the current traffic composition and peak traffic

volumes. Data from the NWP database was used to supplement the CTO data and determine historic traffic growth trends.

Manual classified traffic counts were commissioned at 19 intersections along the route to establish the existing traffic volumes at intersections and along the sections between CTO count stations. Pedestrian counts were conducted at 10 of the 19 intersections located in the peri-urban to urban sections of the road as the surrounding land use would generate significant pedestrian movement.

1.4.1 Traffic Growth Rates

A trendline analysis of the historic traffic volumes along the road was used to determine traffic growth rates for the projection of future traffic demand along the R30-8.

From Figure 1-1 below, it is observed that post 2005, the traffic volumes and composition from the different stations indicate consistent patterns. Historic data on the rural section provides a stronger linear correlation with an R^2 value of 62% and was therefore used as a basis for projecting traffic volumes.

In the urban section, the ADT has grown by 4.7% p.a. and ADTT by 3.1% p.a. over 13 years. The rural section experienced less ADT growth at 2.8% p.a. and significantly greater ADTT growth of 13.3%.

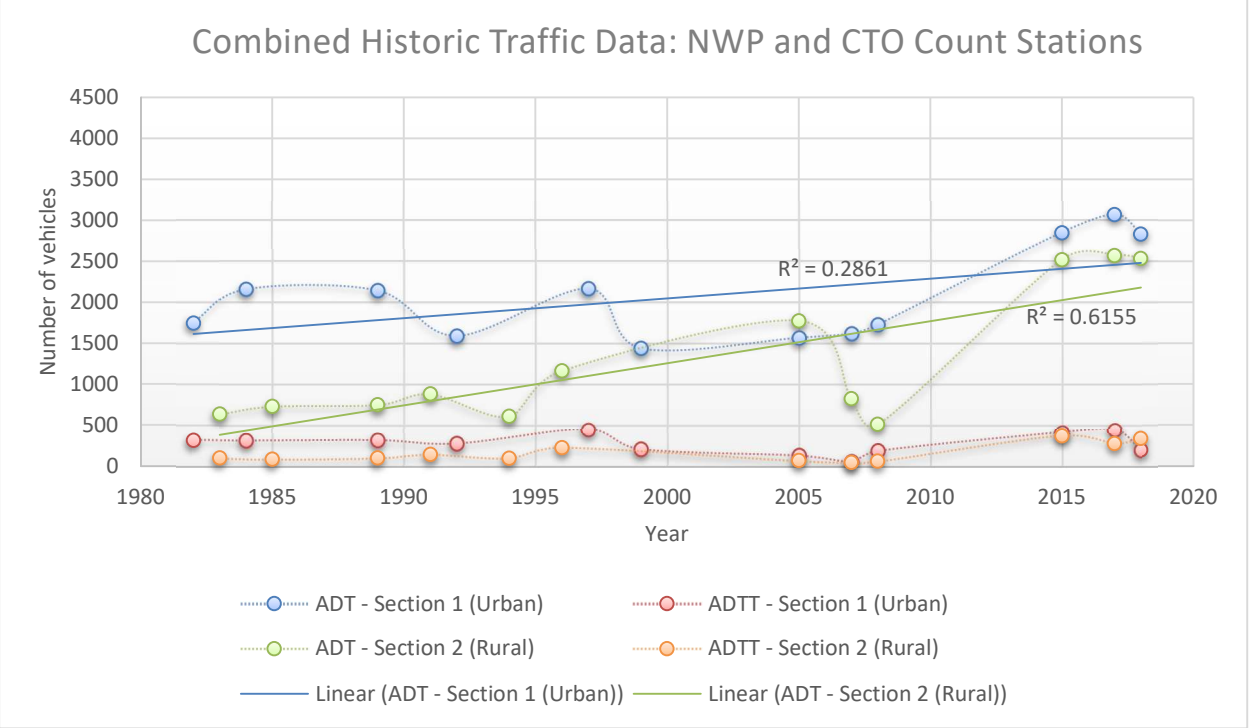


Figure 1-1: Combined historic traffic data

The factors considered in developing the growth rate scenarios include land use development potential, economic growth, and freight activity. The South African Gross Domestic Product (GDP) has been in decline since 2010 and a slow economic recovery is envisaged. The future growth rate scenarios are proposed in Table 1-1 below, with the expected growth in the order of 3.0% for both ADT and ADTT.

Growth rates were applied to the urban and rural sections to project future traffic.

Table 1-1: Proposed Growth Rates

No.	Growth Scenario	Growth Rate ADT	ADTT
1	Low	1.5	2.0
2	Medium (Expected)	2.8	3.0

No.	Growth Scenario	Growth Rate ADT	ADTT
3	High	4.0	4.5

1.5 Future Traffic Volumes

Traffic volumes were forecast over the 20-year design life of the road for the two homogeneous sections. Table 1-1 and Table 1-2 provide a summary of the projected traffic demand for Section 1 and Section 2 respectively.

The forecast assumes that the improved road will open in the Year 2025.

Table 1-2: Estimated Future Traffic Volumes – Section 1 (Rural)

Year	Low Growth		Medium Growth		High Growth	
	ADT	ADTT	ADT	ADTT	ADT	ADTT
Base Year 2018	2547	314	2547	314	2547	314
Opening Year 2025	2827	361	3090	386	3352	427
Design Year 2030	3045	398	3548	448	4078	533
Design Year 2035	3281	440	4073	519	4961	664
Design Year 2040	3534	485	4676	602	6036	827
Design Year 2045	3807	536	5368	697	7344	1031

Table 1-3: Estimated Traffic Volumes - Section 2 (Urban)

Year	Low Growth		Medium Growth		High Growth	
	ADT	ADTT	ADT	ADTT	ADT	ADTT
Base Year 2018	3023	423	3023	423	3023	423
Opening Year 2025	3355	486	3668	531	3978	587
Design Year 2030	3614	536	4211	615	4840	732
Design Year 2035	3894	592	4834	713	5889	912
Design Year 2040	4195	654	5550	827	7164	1136
Design Year 2045	4519	722	6372	958	8716	1416

The projected Design Year 2045 ADT volumes (medium growth) of the section of the R30 under consideration do not exceed the specified limiting volumes of 8700 AADT for a two-lane carriageway. This implies that a two-lane single carriageway should have adequate capacity to accommodate projected future traffic volumes on the R30 Section 8.

1.6 Link Capacity Analysis

SANRAL's HTM model was used to evaluate the current and future operating performance of the roadway for Base Year, Opening Year, and Design Year conditions. The two homogeneous sections were distinguished in the analysis.

The HTM analysis was conducted for the normal day peak hour and the 30th Highest Hourly Flow (HHF) utilizing the latest data from CTO stations. Two scenarios were considered for analysis as follows:

- No improvements to the existing cross-section (Do Nothing)
- Improved cross-section with 3 m wide shoulders and an additional lane in the urban section.

A summary of the HTM level of service results is provided in Table 1-4 and Table 1-5 for the two scenarios.

The existing cross-section is adequate to process current and future traffic volumes for all growth scenarios when considering the 30th HHF traffic conditions, where the road performs at LOS C and better by the end of design life.

The improved cross-section performs satisfactorily at predominantly LOS B and better for the low and medium growth scenario considering both the normal day peak and 30th HHF traffic conditions.

Table 1-4: Existing Cross Section HTM results

Peak Hour	Year	Percentage of road length operating at a level of service: NRA Criteria																	
		Low Growth						Medium Growth						High Growth					
		LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Normal Day	2018	0.9%	98.3%	0.8%	0.0%	0.0%	0.0%	1.0%	98.2%	0.7%	0.0%	0.0%	0.0%	1.0%	98.2%	0.7%	0.0%	0.0%	0.0%
	2025	0.0%	97.2%	2.3%	0.4%	0.0%	0.0%	0.0%	79.6%	19.9%	0.5%	0.0%	0.0%	0.0%	19.3%	80.1%	0.6%	0.0%	0.0%
	2035	0.0%	12.7%	86.6%	0.4%	0.3%	0.0%	0.0%	1.7%	93.9%	3.9%	0.4%	0.0%	0.0%	0.0%	7.5%	90.9%	1.2%	0.4%
	2045	0.0%	0.9%	85.8%	12.8%	0.5%	0.0%	0.0%	0.0%	3.1%	89.1%	7.3%	0.4%	0.0%	0.0%	0.0%	1.7%	25.4%	72.9%
30th HHF	2018	97.4%	2.5%	0.0%	0.0%	0.0%	0.0%	97.6%	2.4%	0.0%	0.0%	0.0%	0.0%	97.6%	2.4%	0.0%	0.0%	0.0%	0.0%
	2025	82.5%	17.1%	0.4%	0.0%	0.0%	0.0%	50.6%	49.1%	0.3%	0.0%	0.0%	0.0%	8.4%	91.0%	0.6%	0.0%	0.0%	0.0%
	2035	3.0%	96.3%	0.6%	0.0%	0.0%	0.0%	0.6%	98.3%	0.8%	0.3%	0.0%	0.0%	0.0%	24.2%	75.0%	0.4%	0.3%	0.0%
	2045	0.0%	97.7%	1.9%	0.4%	0.0%	0.0%	0.0%	10.8%	88.3%	0.5%	0.3%	0.0%	0.0%	0.0%	6.8%	91.3%	1.4%	0.4%

Table 1-5: Proposed Cross Section HTM Results

Peak Hour	Year	Percentage of road length operating at a level of service: NRA Criteria																	
		Low Growth						Medium Growth						High Growth					
		LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Normal Day	2018	84.3%	15.5%	0.2%	0.0%	0.0%	0.0%	84.3%	15.5%	0.2%	0.0%	0.0%	0.0%	84.3%	15.5%	0.2%	0.0%	0.0%	0.0%
	2025	10.4%	89.3%	0.2%	0.1%	0.0%	0.0%	9.3%	89.5%	1.2%	0.1%	0.0%	0.0%	8.1%	89.6%	2.1%	0.2%	0.0%	0.0%
	2035	8.1%	89.5%	2.3%	0.2%	0.0%	0.0%	8.1%	80.5%	11.1%	0.2%	0.1%	0.0%	7.9%	1.3%	87.6%	3.1%	0.1%	0.1%
	2045	8.1%	73.0%	18.2%	0.7%	0.0%	0.0%	7.9%	0.5%	86.8%	4.5%	0.2%	0.1%	7.4%	0.5%	0.2%	74.0%	16.2%	1.8%
30th HHF	2018	99.7%	0.3%	0.0%	0.0%	0.0%	0.0%	99.7%	0.3%	0.0%	0.0%	0.0%	0.0%	99.7%	0.3%	0.0%	0.0%	0.0%	0.0%
	2025	98.1%	1.8%	0.1%	0.0%	0.0%	0.0%	97.0%	2.9%	0.1%	0.0%	0.0%	0.0%	95.4%	4.5%	0.2%	0.0%	0.0%	0.0%
	2035	94.8%	5.1%	0.2%	0.0%	0.0%	0.0%	53.4%	46.4%	0.2%	0.1%	0.0%	0.0%	8.4%	88.6%	2.9%	0.1%	0.1%	0.0%
	2045	15.1%	84.6%	0.2%	0.1%	0.0%	0.0%	8.1%	88.0%	3.7%	0.1%	0.1%	0.0%	7.9%	1.8%	85.7%	4.3%	0.2%	0.1%

1.7 Intersection Capacity Analysis

Using the peak hour turning movement volumes, the existing intersection geometry was analysed using the SIDRA traffic analysis software to evaluate the capacity and operational performance of the intersections. A total of 19 intersections along the route were evaluated. The operational performance of each intersection was evaluated in terms of delay experienced on each approach as well as capacity of the intersection to process the current traffic flows.

All the existing intersections operate satisfactorily between LOS A and B for all scenarios except the three critical intersections, namely, **N14/R30, R30/Loccatie St,** and **R30/Voortrekker St** intersections. The three intersections operate at LOS C or D for the base and future year scenarios.

1.7.1 Intersection Improvements

The project entails the improvement of the national road by widening the existing cross-section and the addition of paved shoulders. Several intersections are also affected by the proposed Tshing Ext 10 development. A TIA report was available, and trips generated by the development were considered.

There are two new access intersections proposed for the development located at km 64.7 and km 66.0. The following intersections along the project route are affected by the development:

- R30/ De beer I/S
- R30/Loccatie St. I/S
- R30/Road Y I/S
- N14/R30 I/S
- R30/Road X I/S

The upgraded intersections and new development access intersections were analysed for the above-mentioned scenarios. The results for the performance assessment resulted in overall acceptable performance for the improved intersections except for the **R30/N14 and R30/Loccatie St** intersections. Without the development, the two intersections have satisfactory operational performance. These intersections are significantly affected by the planned Tshing Ext 10 development over the 20-year design life and it is recommended that these intersections be upgraded as follows:

- **R30/N14:** Although a signalised intersection was analysed, a diamond interchange is a preferred option and is recommended. As discussed with SANRAL, the analysis and design of the new interchange shall be undertaken under the SMEC contract for the N14.
- **R30/Loccatie Street:** A dual-lane traffic circle

A technical note on the traffic data and analysis of intersections about the Tshing Ext. 10 development has been prepared outlining inconsistencies in the data received for the development. The data used in analysing the intersections and the resultant recommendations may not be accurate and it is recommended that the developers provide correct trip data for the development or confirm in writing that the volumes used in this report are correct. This will ensure that the recommended intersection improvements allow for adequate capacity.

1.8 Conclusions and recommendations

The following conclusions are drawn from the traffic engineering study:

The section of R30 road can be classified as a Class 2 Rural major arterial that provides inter-regional connectivity between the towns of Derby, Ventersdorp, and Klerksdorp

This section of the R30 comprises two homogeneous sections with variable land use characteristics and heavy vehicle composition.

- The Tshing development will have a substantial impact on the upgrade/improvements along the section of the R30 under consideration.

The roadway under consideration performs at acceptable levels of service for existing and proposed conditions.

The western approach of the **R30/Loccatie St.** intersection operates at poor LOS F for the PM Peak Hour throughout the design life.

The Tshing Extension 10 development-generated trips have a significant impact on the operational performance of the **N14/R30** and **R30/Loccatie** intersections.

The following recommendations are made:

- Intersection improvements are recommended at the following intersections:
    - **N14/R30 I/S**: A new diamond interchange.
    - **Loccatie St./R30 I/S**: A dual-lane traffic circle.
- Non- Motorised transport recommendations:
    - Universal Access Design: The following design considerations should be implemented along the entire urban section of the R30 Section 8:
        - Tactile paving for people with sight impairments
        - Kerb ramp for trolley users, wheelchair users (etc)
        - Reduction in kerb radius for shorter crossing distance
        - All surfaces should be level, non-slip, and free from gravel or stones.
    - Pedestrian sidewalk and walkways: Sidewalks should be provided at a minimum width of 2h and along both sides of the road. Buffer strips of a 0.6m width should be considered where on-street is not provided.
    - Pedestrian crossings: Provision of full pedestrians crossing on the R30 at the following identified (5) priority intersections. In addition to the priority intersections, a raised pedestrian crossing is recommended at km 66.84 in the vicinity of Toevlug Primary School.
    - Public transport lay-byes: Public transport lay-bys are proposed in the vicinity of the following intersections:
        - R30/Loccatie St
        - R30/Steen St

On-street parking: The improvement of parking signage and speed control measures should be introduced limiting speeds to a maximum of 50km/hr on the route at priority sections.

TABLE OF CONTENTS

SECTION **PAGE**

1 EXECUTIVE SUMMARY III
1.1 Introduction iii
1.2 Route Overview iii
1.3 Land Use Development and Transport Planning iii
1.4 Traffic Information and Analysis iii
1.4.1 Traffic Growth Rates iv
1.5 Future Traffic Volumes v
1.6 Link Capacity Analysis v
1.7 Intersection Capacity Analysis i
1.7.1 Intersection Improvements i
1.8 Conclusions and recommendations i
LIST OF ACRONYMS VI
2 INTRODUCTION 1
2.1 Appointment 1
2.2 Project Background & Objectives 1
2.3 Project Locality 1
3 OVERVIEW OF THE ROUTE 2
3.1 Route Characteristics 2
3.2 Homogenous Traffic Sections 2
3.3 Existing Cross Section 3
4 INTEGRATED LAND USE & TRANSPORT PLANNING 4
4.1 Dr. Kenneth Kaunda District Development Model 2021 4
4.2 JB Marks Local Municipality Integrated Development Plan 2019-2020 4
5 TRAFFIC INFORMATION AND ANALYSIS 6
5.1 Summary of Traffic Information 6
5.1.1 CTO Traffic Data 6
5.1.2 North West Provincial PMS Database 7
5.1.3 12 – Hour Classified Count Data 9
5.1.4 Accident Data 13
5.2 Traffic Growth Rates 13
5.2.1 Historic Growth Rates 13
5.2.2 GDP Growth 14
5.2.3 Future Growth Rates 15
5.3 Estimated Future Traffic Volumes 17
5.4 Link Capacity Analysis 18
5.4.1 HTM Analysis for Existing Cross Section 19
5.4.2 HTM Analysis for Proposed Cross Section 20
5.5 Intersection Capacity Analysis 21
5.5.1 Intersection Overview 21
5.5.2 Intersections Analysis 22
5.5.3 Capacity Analysis Results (Existing) 22
5.5.4 Future Capacity Analysis (Road Upgrade & New Developments) 27
5.5.5 Recommended Intersection Improvement Analysis 31
5.6 Non – Motorized Transport & Public Transport 35
5.6.1 Non- Motorised Transport Analysis 35
5.6.2 Non- Motorised Transport Recommendations 37
6 CONCLUSIONS & RECOMMENDATIONS 39

LIST OF FIGURES

Figure 1-1: Combined historic traffic data iv
Figure 2-1: Locality Map 1
Figure 3-1: Homogenous Sections of R30 Section 8 3
Figure 3-2: Existing cross-section R30-8 (Assessment Report, 2021) 3
Figure 4-1: Tshing Extension 10 Development Land Use Layout (Assessment Report, 2021) 5
Figure -1: Location of CTO Stations 7
Figure -2: Historic Traffic Data - North West Province PMS Database 8
Figure -3: Traffic Count Locations (All-Sites) 10
Figure -4: Traffic Count Locations (Sites 10 to 19) 10
Figure -5: 2022 AM and PM Peak Hour Traffic Profile (Sites 1 to 9) 11
Figure -6: 2022 AM and PM Peak Hour Traffic Profile (Sites 10 to 19) 12
Figure -7: Combined historic traffic data 13
Figure -8: 10-year GDP Growth Trendline - RSA 14
Figure 5-9: Future Traffic Volumes on the Urban Section 16
Figure 5-10: Future Traffic Volumes on the Rural Section 16
Figure 5-11: Extract from SANRAL's Design Guideline for Single Carriageway National Roads, 2009 18
Figure 5-12: Tshing New Development and New Intersections 27
Figure 5-13: N14/R30: Opening Year - Without Development 29
Figure 5-14: N14/R30: Opening Year – With Development 29
Figure 5-15: R30/Loccatie: Opening Year - Without Development 31
Figure 5-16: R30/Loccatie: Opening Year - With Development 31
Figure 5-17: N14/R30 I/S Proposed Layout 32
Figure 5-18: R30/Loccatie St I/S - Proposed Layout Traffic Circle 33
Figure 5-19: R30/Loccatie St I/S - Proposed Layout Signalised Control 33
Figure 5-20: 2022 AM and PM Peak Hour Pedestrian Profile 35
Figure 5-21: 12-Hour AM and PM Peak Period Pedestrian Count 36
Figure 5-22: Priority NMT intersections 37
Figure 5-23: Typical lay – by (DoT, Pedestrians and Cyclists 2022) 38

LIST OF TABLES

Table 1-1: Proposed Growth Rates iv
Table 1-2: Estimated Future Traffic Volumes – Section 1 (Rural) v
Table 1-3: Estimated Traffic Volumes - Section 2 (Urban) v
Table 1-4: Existing Cross Section HTM results i

Table 1-5: Proposed Cross Section HTM Results i
Table 4-1: Summary of land use development for Tshing Ext 10 5
Table 5-1: CTO Stations 6
Table 5-2: Summary of CTO Data 7
Table 5-3: NWP Counting Stations 7
Table 5-4: Historic Traffic Data from NWP Count Stations 8
Table 5-5: Intersection Survey Locations 9
Table 5-6: Combined historic growth rates 14
Table 5-7: Proposed Growth Rates 15
Table 5-8: Estimated Future Traffic Volumes – Section 1 (Rural) 17
Table 5-9: Estimated Traffic Volumes - Section 2 (Urban) 17
Table 5-10: Normal Day Peak Hour Flow Data 18
Table 5-11: 30th HHF Data 18
Table 5-12: Existing Cross Section HTM results 19
Table 5-13: Proposed Cross Section HTM Results 20
Table 5-14: Identified Critical Intersections 21
Table 5-15: LOS Summary Results 23
Table 5-16:Loccatie Approach LOS 25
Table 5-17: Voortrekker Approach LOS Summary 26
Table 5-18: LOS Summary Results (Road Upgrade & New Development) 30
Table 5-19 : Recommended improvements LoS Results 34
Table 5-20: Priority Intersections 37

LIST OF ANNEXURES

ANNEXURE A: TRIP GENERATED (MSN CIVIL EXTRACT)
ANNEXURE B: MODELLED TRAFFIC VOLUMES
ANNEXURE C: LOS SUMMARY RESULTS FOR PROPOSED ROAD UPGRADE INTERSECTION DESIGN

LIST OF ACRONYMS

ADT	Average Daily Traffic
ADTT	Average Daily Truck Traffic
AWSC	All-Way Stop Control
CTO	Comprehensive Traffic Observations
DDM	District Development Model
DoT	Department of Transport
GDP	Gross Domestic Product
HHF	Highest Hourly Flow
HTM	Highway Traffic Model
HV	Heavy Vehicle
IDP	Integrated Development Plan
I/S	Intersection
LOS	Level of Service
LV	Light Vehicle
MBT	Minibus Taxi
MoE	Measure of Effectiveness
NMT	Non-motorized Transport
PT	Public Transport
TIA	Traffic Impact Assessment
TWSC	Two-Way Stop Control
SANRAL	South African Roads Agency SOC Ltd
V/C	Volume/ Capacity ratio
VPH	Vehicles per hour

2 INTRODUCTION

2.1 Appointment

Merchelles Collective (Pty) Ltd is appointed by Ndodana Consulting Engineers (Pty) Ltd to render Professional Traffic Engineering services as a Sub-Service Provider under contract NRA R.030-080-2016/1 for the improvement of National Road R30 Section 8 from KM 36.8 to Ventersdorp KM 68.65 under contract NRA R.030-080-2016/1.

2.2 Project Background & Objectives

The South African National Roads Agency SOC Limited (SANRAL) has appointed Ndodana Consulting Engineers (Pty) Ltd to provide Consulting Engineering Services for the Assessment, Detailed Design, Contract Documentation, and Monitoring of the improvement of National Road R30 Section 8 from km 36.8 to Ventersdorp km 68.646. The total length of the subject road is 31.3 km.

The project entails the improvement of the national road by widening the existing cross-section and the addition of paved shoulders.

The aim of undertaking a traffic assessment for the improvement of R30 Section 8 is to investigate prevailing traffic conditions and identify feasible infrastructure capacity improvements where warranted.

This report presents traffic information and analysis for the subject road and covers route characteristics, data collection, growth forecasting, road capacity evaluation, non-motorized transport (NMT) and makes recommendations on possible cross-section configurations and intersection improvements.

2.3 Project Locality

The project spans two local municipalities, namely, City of Matlosana and JB Marks which fall under the Dr Kenneth Kaunda District Municipality in the North West Province. The locality map is provided in Figure 2-1

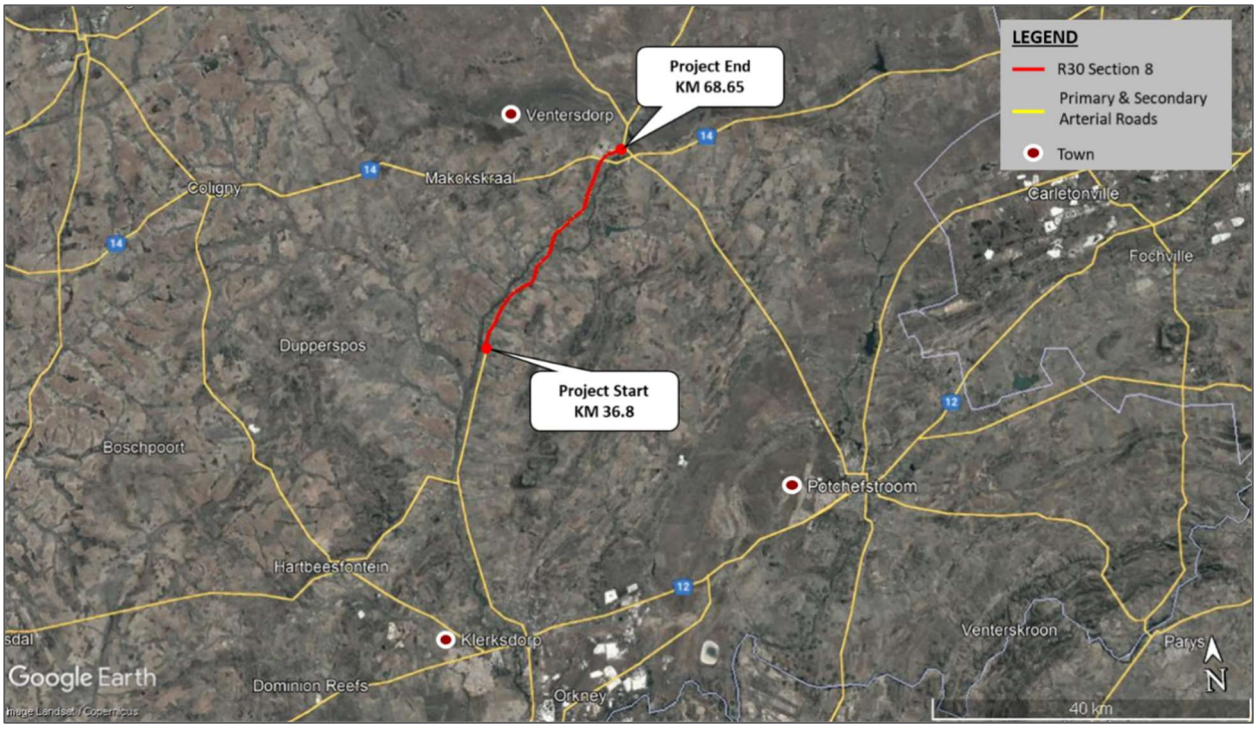


Figure 2-1: Locality Map

3 OVERVIEW OF THE ROUTE

This section provides an overview of the R30 Section 8 in terms of transport-related characteristics.

3.1 Route Characteristics

The existing R30 Section 8 is a two-lane single carriageway rural highway with bi-directional traffic movement. The R30 is a provincial route connects Bloemfontein with Rustenburg and is part of the R30 toll route that is an alternative route to the N1 between the Free State and the North West Province. The road can be classified as a Class 2 Rural Major Arterial.

The route has the following characteristics:

- The existing road is in significant disrepair with faded road markings and pavement damage.
- The section under investigation facilitates access to agricultural land between Klerksdorp and Ventersdorp, and the Ventersdorp town spreads across both sides of the R30 supporting most town activity and providing several accesses to residential settlements and social amenities. Significantly high pedestrian and on-street parking activity exist in the town section of the route.
- Four (4) schools, namely, Toevlug Primary School, Kgololosego Intermediate School, Springfield TVET College and Marcelyn Private College are located in the vicinity of the R30 Section 8 in the urban section, which implies that there will be significant pedestrian activity along this section.
- The only major road that intersects with the R30 along this section is the N14 near Ventersdorp at km 65.34.
- The roadway comprises five (5) bridges which accommodate a single traffic lane in each direction with no shoulders.
- The speed limit posted on the road is 100 km/h, reducing to 80 km/h and 60 km/h when approaching access intersections and in the town area.

3.2 Homogenous Traffic Sections

Homogenous sections of route may be described as those having similar traffic characteristics in terms of traffic volumes, travel speeds and adjacent land use types.

This section of the R30 is non-homogenous due to varying land use developments and traffic volumes, particularly, heavy vehicle traffic along the route. The route, is therefore, divided into the following two sections:

- **Section 1**: Rural highway section from km 36.8 to km 64.4 with several intersections facilitating access to farming or agricultural land on either side.
- **Section 2**: Town section from km 64.4 up to the end, where the land-use changes from rural to peri-urban and finally to a CBD environment in Ventersdorp. The section is characterized by a significant number of at-grade, stop-controlled access intersections, on-street parking and pedestrian activity.

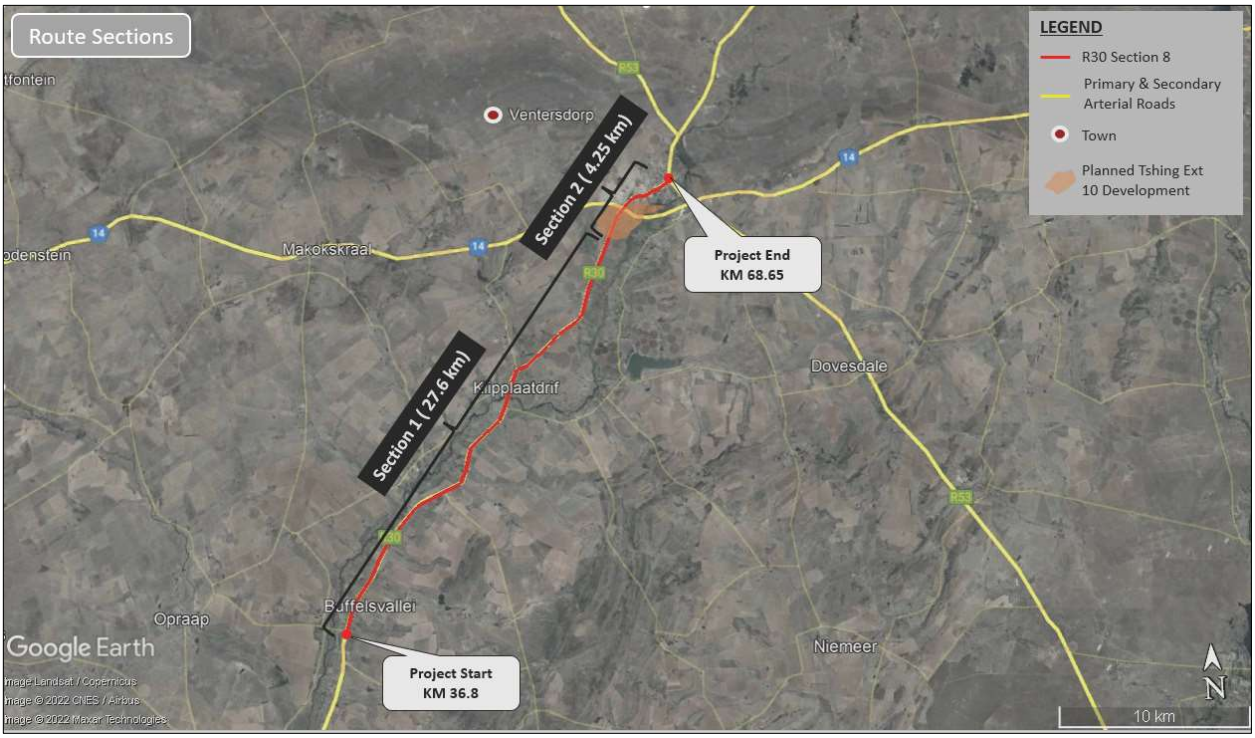


Figure 3-1: Homogenous Sections of R30 Section 8

3.3 Existing Cross Section

The existing road cross-section is a two-lane single carriageway with 3.5 m lanes and varying gravel shoulder widths. The lack of paved shoulders presents road safety, capacity, and maintenance challenges.

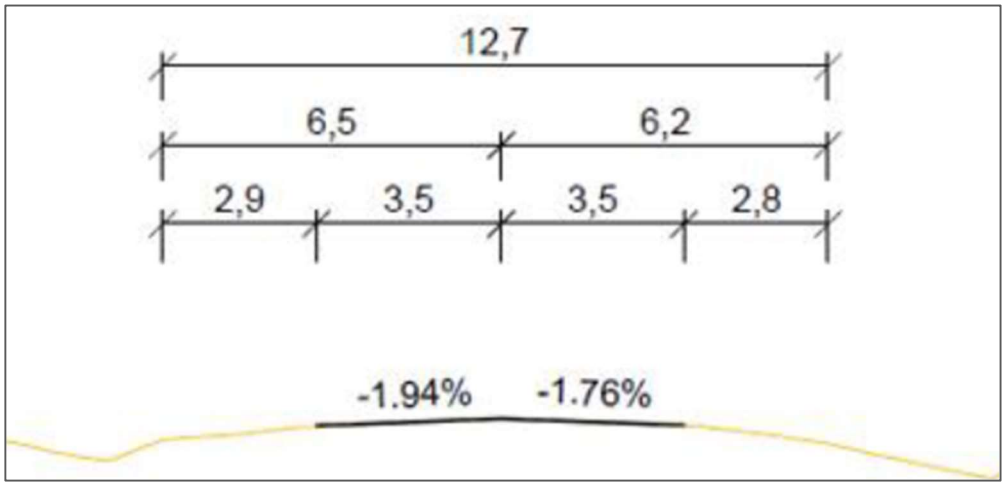


Figure 3-2: Existing cross-section R30-8 (Assessment Report, 2021)

The provision of surfaced shoulders would allow for additional space to make evasive manoeuvres, accommodate driver errors, reduce passing conflicts, structural support to pavement and ease of maintenance.

4 INTEGRATED LAND USE & TRANSPORT PLANNING

In efforts to understand future land use planning and its impact on transport infrastructure demand, a review of the municipal development planning documents was undertaken and is discussed below.

4.1 Dr. Kenneth Kaunda District Development Model 2021

Draft One Plan: District Development Model 2021 of the Dr. Kenneth Kaunda District Municipality which aims to address integrated planning and service delivery in the district was reviewed hereunder to establish if the development plans could affect the R30.

The document highlights the following spatial development projects which may be of significance in terms of future traffic demand forecasting within the study area:

- N14 route providing the link between Gauteng and the Northern Cape.
- The route includes the nodes of Ventersdorp, Delareyville and Vryburg, and it is supported by the Johannesburg Vryburg railway line.

4.2 JB Marks Local Municipality Integrated Development Plan 2019-2020

The draft JB Marks Local Municipality Integrated Development Plan (IDP) 2019/20 has been taken into consideration in the traffic assessment of R30 Section 8. The IDP seeks to link, integrate and coordinate various infrastructure development projects within the municipality and is intended to be implemented over five years between 2017 and 2022.

JB Marks Local Municipality is a Category B municipality situated within the Dr Kenneth Kaunda District and it is the largest municipality in the district taking up approximately half of the geographical area.

The nearest town to the subject road is Ventersdorp which consists of vast rural and commercial farming areas as well as some urban areas such as Ventersdorp CBD, Tshing and Toevlug. Primary economic sectors in Ventersdorp include agriculture, community services, manufacturing and trade. These economic activities attract heavy vehicle traffic and ought to be considered in determining future traffic loading on the surrounding road network.

The JB Marks IDP comprises various bulk infrastructure service projects, none of which have a direct impact on the R30 Section 8, except for the proposed Tshing Extension 10 township development.

The Tshing Extension 10 development is a mixed-use township development located at the intersection of R30 and N14. The proposed layout of the development is shown in Figure 4-1 below.

Table 4-1 provides a summary of the proposed land use development for Tshing Ext 10. The development comprises 2549 erven and spans across the R30 and the N14.

Trips generated by the development will be obtained from the Traffic Impact Assessment (TIA) Report, 2017, and distributed to the road network to account for the impact the development may have on the proposed intersection capacity improvements along the R30.

The R30 Section 8 intersects the N14 in the vicinity of this development and the existing road reserve allows for a diamond interchange at this intersection. In terms of access management, it is important that the road reserve is protected, and the option of an interchange is considered.

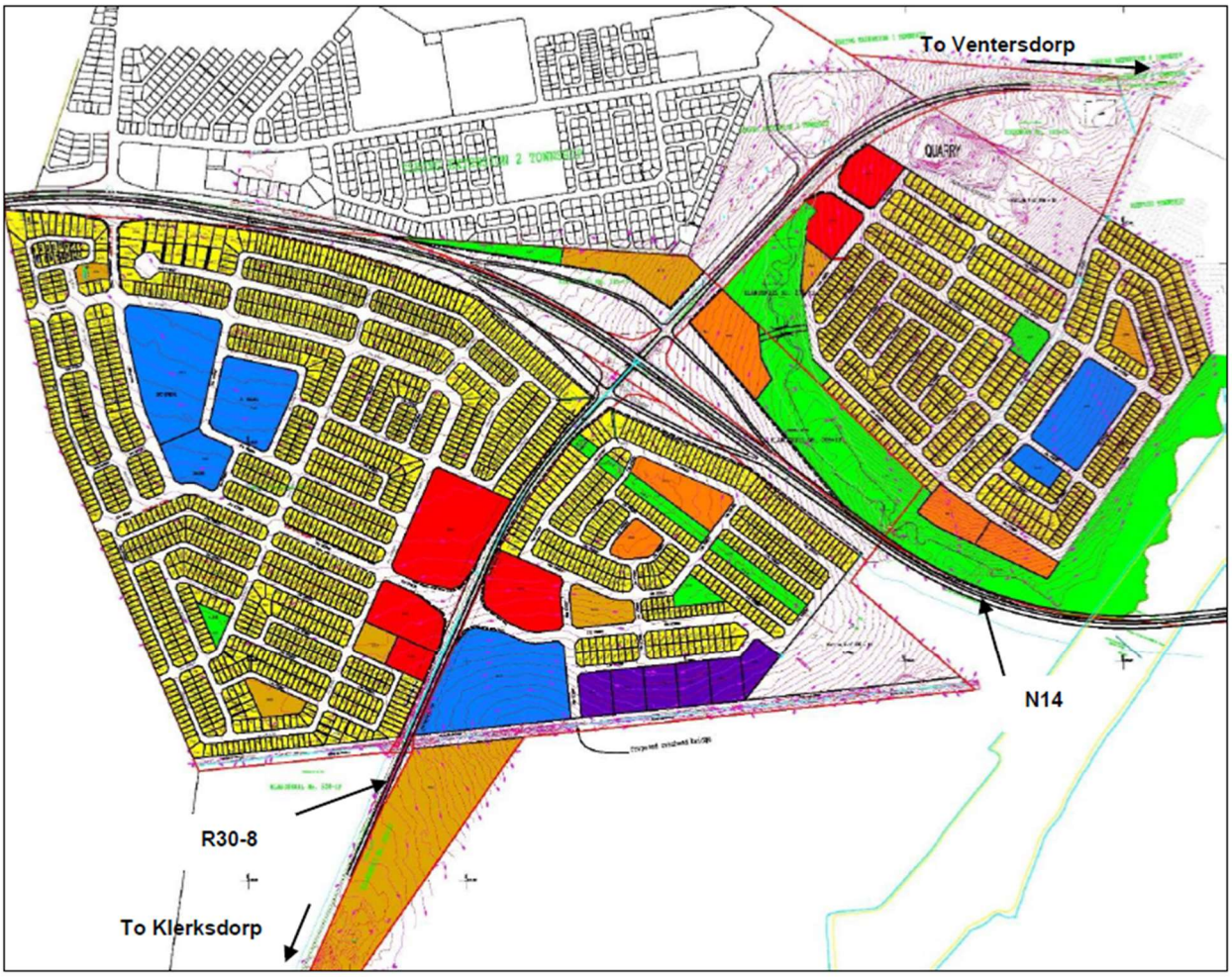


Figure 4-1: Tshing Extension 10 Development Land Use Layout (Assessment Report, 2021)

Table 4-1: Summary of land use development for Tshing Ext 10

Zoning	Colour Code	Erf Numbers	No. of Erven	Area (Ha)	% of Area
Residential 1		6432-8939	2507	80.21	31.18
Residential 2		8940-8944	5	6.68	2.59
Institutional		8945-8950	6	27.43	10.65
Business		8951-8956	6	11.62	4.51
Industrial		8957-8962	6	4.42	1.72
Municipal		8963-8970	8	17.92	6.96
Public Open Space		8971-8981	11	27.65	10.72
Streets	-	-	-	82.07	31.87

5 TRAFFIC INFORMATION AND ANALYSIS

This section of the report evaluates the traffic and transportation engineering requirements for the project and addresses the following:

- Review and assessment of traffic data.
- Link capacity evaluation of geometric design options.
- Intersection capacity evaluation of major crossroads and access roads.
- Non-motorised transport.
- Parking provision; and
- Recommendations.

5.1 Summary of Traffic Information

Traffic data was available from the SANRAL Comprehensive Traffic Observations (CTO) count stations, the North West Provincial PMS Database, and 12-hour Classified Manual Vehicle and Pedestrian surveys undertaken along the route.

5.1.1 CTO Traffic Data

Three temporary CTO count stations exist along this section of the R30 as described in Table 5-1 and discussed below.

Table 5-1: CTO Stations

Station Number	Station Name	Station Type	Position WRT to Project Limit (km 36.80 – 68.64)	Available Data
19220	Lapfontein	Secondary (Temp)	Outside Project Limits	May 2015 – Sept 2019
19221	Tebogo	Secondary (Temp)	Outside Project Limits	May 2015 – Aug 2018
19222	Tshing	Secondary (Temp)	km 66.71 (Within Project Limits)	May 2015 – Aug 2018

- CTO Station 19220 Lapfontein and 19221 Tebogo are secondary stations located outside project limits. The latest available data ranges from 2013 – 2019. Although the stations are located outside the bounds of the project, the stations are along the route and near Klerksdorp. CTO 19221, located north of the R507 turn-off, will represent the rural section of the highway.
- CTO Station 19222 Tshing Located at km 66.71 within project limits is a Secondary station with data available ranging from 2015-2018. The station data will be used for the prediction of growth rates in conjunction with other CTO data. This station will represent the urban section of the highway.

The lack of permanent stations along the route implies that there is no consistent historic Average Daily Traffic (ADT) and Average Daily Truck Traffic (ADTT) volumes to determine the historic growth trend. The latest data from the temporary CTO count stations will therefore be utilized to establish current traffic composition and peak flows for highway capacity modelling and analysis.

A summary of the CTO traffic data is provided in Table 5-2 below.

Table 5-2: Summary of CTO Data

No.	CTO Station	Year	ADT	ADTT	Heavy Vehicles	Night Traffic	Directional Split
1	19220	2019	2815	329	11.7 %	11.0 %	49.9 : 50.1
2	19221	2018	2547	314	12.3 %	11.6 %	49.8 : 50.2
3	19222	2018	3023	423	14.0 %	10.9 %	49.5 : 50.5

The data indicates that stations 19220 and 19221 have similar ADT and ADTT, whilst station 19222 has slightly higher ADT and ADTT volumes. The percentage of heavy vehicles varies across all three stations, being the lowest at station 19220 in the rural section. The higher ADTT volumes at station 19222 are not surprising given that station 19222 is located within the Ventersdorp town where there is a higher concentration of businesses and commercial activities.

Data from stations 19221 and 19222 will therefore be used for the analysis the Section 1 and Section 2 of the identified homogenous sections respectively.

The relative location of the CTO stations to the project route is shown in Figure 5-1 below.



Figure 5-1: Location of CTO Stations

5.1.2 North West Provincial PMS Database

Two manual counting stations from the North West Department of Transport exist along this section of the R30 and are described in Table 5-3 below.

Table 5-3: NWP Counting Stations

Station Number	Road Link	Station Type	Position WRT to NW Links	Correlation to SANRL CTO	Available Data
1502_1509	P32/1_020	Cyclical	km 0.78	19222	1982 - 2008
1342_1348	P32/1_160	Cyclical	km 1.68	19221	1983 – 2008

- Station 1502_1509 correlates to CTO station 19222 which is located within the project limits, along the urban section, and data from this station will thus be useful for establishing historic traffic trends along the project route.
- Station 1342_1348 correlates to CTO station 19221 which is located outside the limits of the project and shall represent the rural section.

The historic data from both stations were plotted graphically to assess the reliability of the data and establish growth trends in ADT and ADTT as depicted in Figure 5-2.

ADT and ADTT data from both NWP stations appear to be erratic with a poor linear correlation over the 25 years. Station 1502_1509 shows a sharp decline in ADT and ADTT volumes in the late 1990s whilst the ADT on NWP station 1342_1348 was on a steady increase during the same period. Between 1999 and 2005, traffic volumes from both stations have ADT and ADTT volumes and growth patterns.

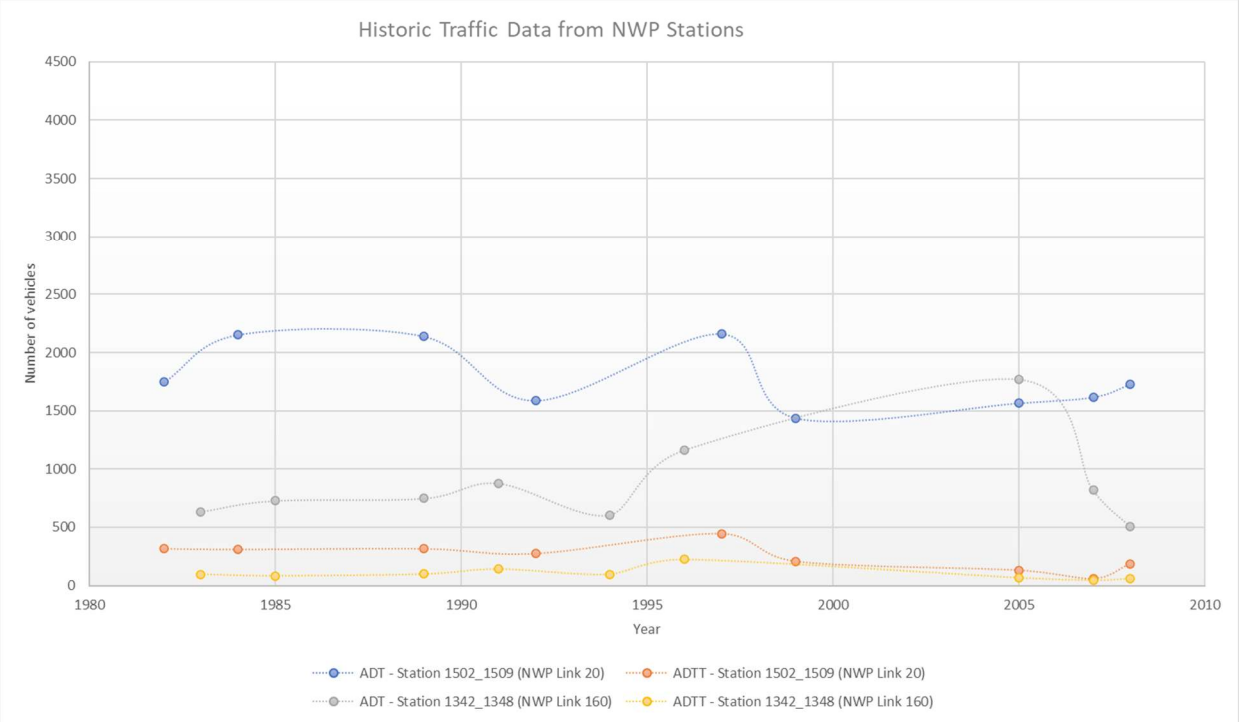


Figure 5-2: Historic Traffic Data - North West Province PMS Database

A summary of recent traffic volumes and composition from the NWP count stations is provided in Table 5-4 for the two highway sections. Between 2005 and 2008, traffic volumes in the urban section grew steadily by 3.3 % and declined on the rural section by -34.0 %. The reason for the drastic decline of traffic volumes on the rural section between this period is not known.

Table 5-4: Historic Traffic Data from NWP Count Stations

Year	Urban Section (NWP 1502_1509)			Rural Section (NWP 1342_1348)		
	ADT	ADTT	% Heavy Vehicle	ADT	ADTT	% Heavy Vehicle
2005	1566	133	8.5 %	1772	67	3.8 %
2007	1616	61	3.8 %	821	45	5.5%
2008	1726	188	10.9%	509	60	11.8 %

5.1.3 12 – Hour Classified Count Data

CTO data was provided for by SANRAL, however, to establish the current traffic conditions at intersections, manual classified traffic counts were commissioned at 19 intersections along the R30 Section 8. The Traffic intersection counts were undertaken on Thursday, 20th January 2022. The count was conducted in accordance with the COTO TIA guidelines.

Pedestrian counts were conducted at 10 of the 19 intersections located in the peri-urban to urban sections of the road as the surrounding land use would generate significant pedestrian movement.

Vehicle movements were classified as Light, Minibus Taxi, Bus and Heavy Vehicles. The intersections are listed in Table 5-5 below and shown spatially in Figure 5-3 and Figure 5-4.

Table 5-5: Intersection Survey Locations

No.	Intersecting Road	Chainage (km)	Intersection Type	Type of Count Undertaken
1	Opraap Access Road	36.994	T – Junction (Left)	Vehicle
2	Sterkstroom Access Road	45.187	T – Junction (Left)	Vehicle
3	Doornfontein Access Road	46.168	T – Junction (Right)	Vehicle
4	Rietspruitdam Access Road	51.977	T – Junction (Right)	Vehicle
5	Sterkstroom Access Road	53.232	T – Junction (Left)	Vehicle
6	Ratzegaaiskraal Access Road	54.212	T – Junction (Left)	Vehicle
7	Klipplaatdrift Access Road	54.896	T – Junction (Left)	Vehicle
8	Klipplaatdrift Access Road	58.757	T – Junction (Right)	Vehicle
9	Rietspruitdam Access Road	60.537	T – Junction (Right)	Vehicle
10	N14 (Krugersdorp/Coligny)	65.432	4-legged Junction, All-Way Stop Control (AWSC)	Vehicle, NMT
11	Loccatie Street	67.123	4-legged Junction, AWSC	Vehicle, NMT
12	De Beer Street	67.306	4-legged Junction, Two-Way Stop Control (TWSC)	Vehicle, NMT
13	Gouws Street	67.589	T - Junction (Right)	Vehicle, NMT
14	Steen Street	67.636	T – Junction (Left), AWSC	Vehicle, NMT
15	Berg Street	67.891	4-legged Junction, AWSC	Vehicle, NMT
16	Mark Street	68.085	4-legged Junction, TWSC	Vehicle, NMT
17	Voortrekker Street	68.286	4-legged Junction, AWSC	Vehicle, NMT
18	Koekemoer Street	68.470	4-legged Junction, TWSC	Vehicle, NMT
19	Visser Street	68.559	4-legged Junction, TWSC	Vehicle, NMT

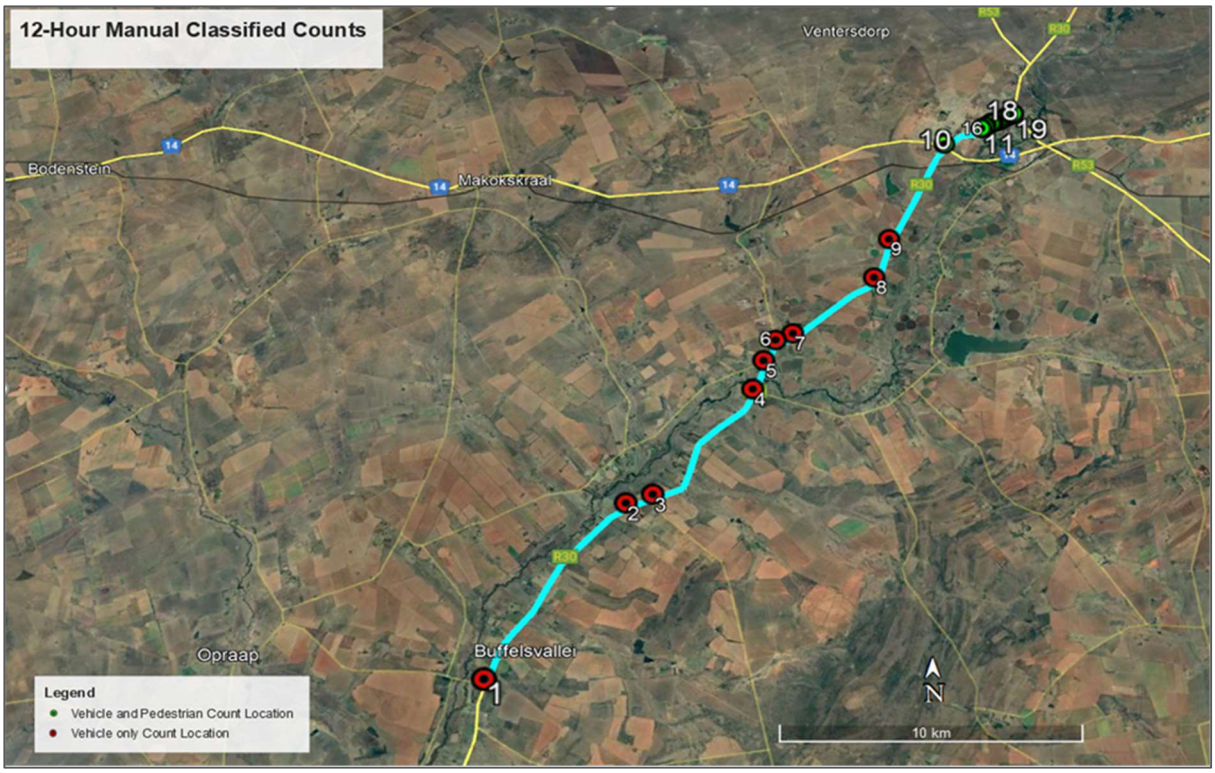


Figure 5-3: Traffic Count Locations (All-Sites)



Figure 5-4: Traffic Count Locations (Sites 10 to 19)

A review of the 12-hour counts indicates that the AM and PM hour periods on the road are as follows:

- AM Peak Hour: 7:00 – 8:00
- PM Peak Hour: 14:15 – 15:15

Figure 5-5 and Figure 5-6 provides a summary of the AM and PM peak traffic profile along the road.

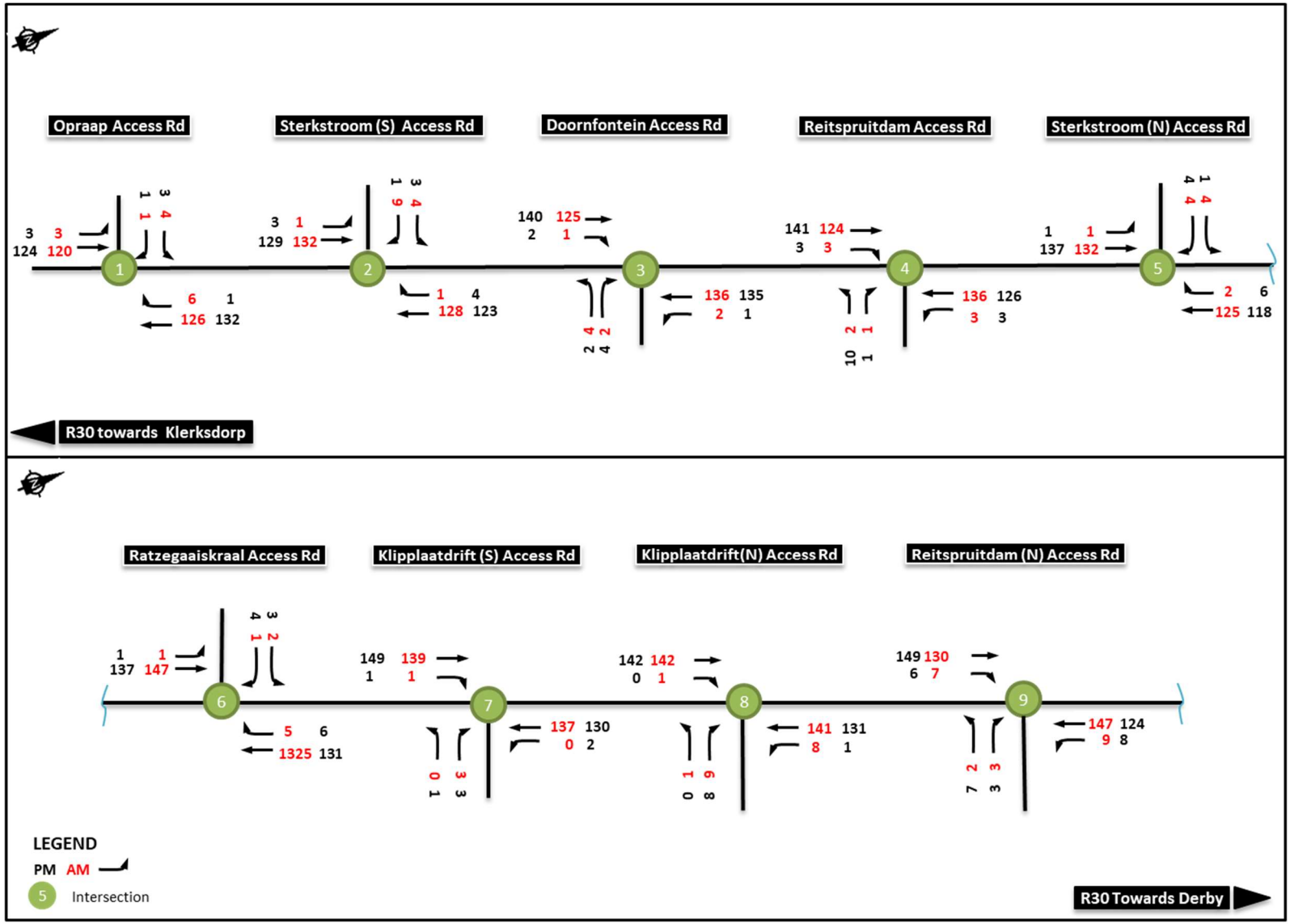


Figure 5-5: 2022 AM and PM Peak Hour Traffic Profile (Sites 1 to 9)

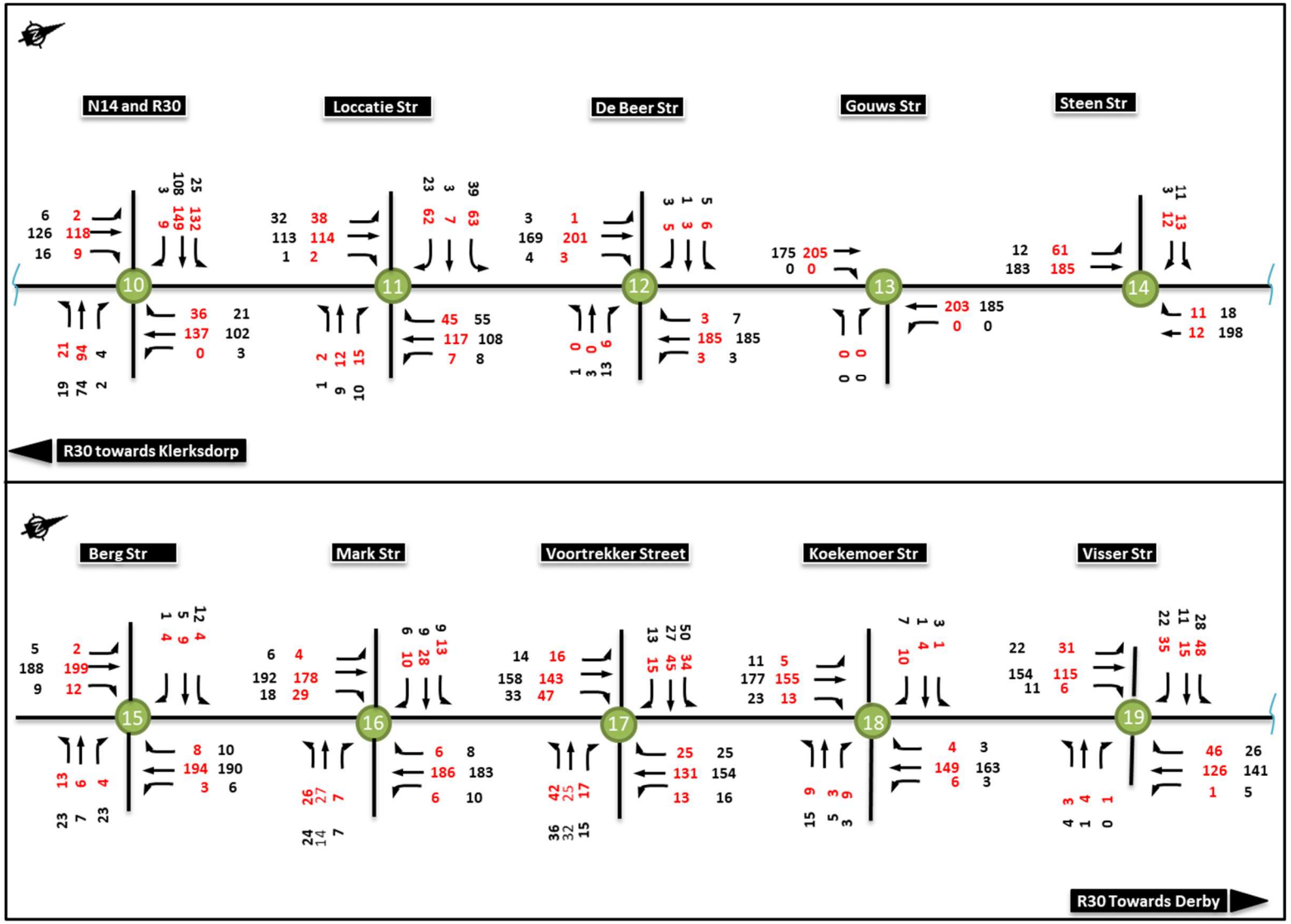


Figure 5-6: 2022 AM and PM Peak Hour Traffic Profile (Sites 10 to 19)

5.1.4 Accident Data

Accident reports recorded for the period 2020 to 2021 were provided by SANRAL. The data indicates a total of seventeen (17) incidents along the subject section of the R30 of which five (5) occurred at night, three at sunrise/sunset and ten (10) during daylight.

The data does not provide information on the exact location of the incidents and whether there were resultant fatalities.

A significant number of the accidents were crashes with animals. This is consistent with the surround farming land along this road.

A summary report of incidents from 2016 was also provided and indicates three accidents which occurred during daylight. Two of these accidents resulted in fatalities and one was caused by loss of vehicle control.

5.2 Traffic Growth Rates

To determine traffic growth rates for the projection of future traffic demand along this section of the R30, trendline analysis of historic traffic from the SANRAL CTO stations and from North West counting stations was utilised.

5.2.1 Historic Growth Rates

Figure 5-7 below plots the combined historic traffic data from the SANRAL CTO stations and the NWP stations representative of ADT and ADTT on the different sections of the highway. Post 2005, the traffic volumes and composition from the different stations indicate consistent patterns. In addition, data from station 1342_1348 (NWP Link 160) and CTO station 19221 representing the rural section of the highway provides a stronger linear correlation with an R^2 value of 62% and will therefore be used as a basis for projection of traffic volumes.

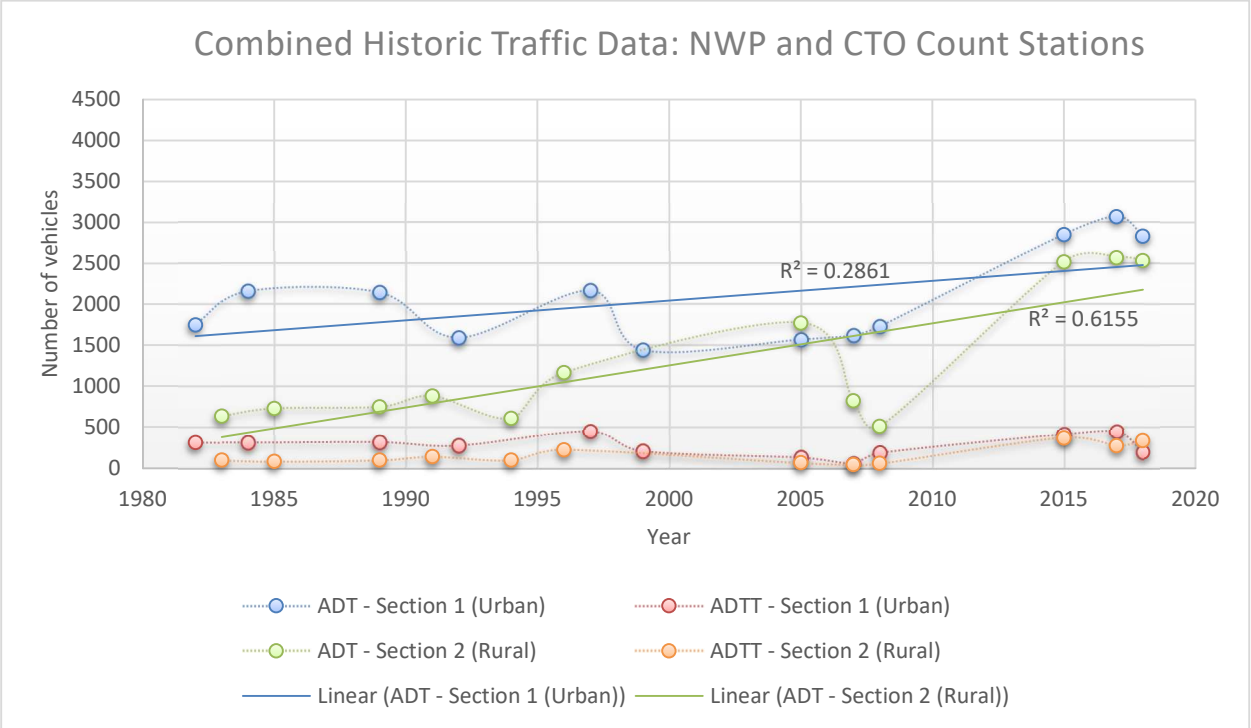


Figure 5-7: Combined historic traffic data

Table 5-6 provides the combined historic traffic data and the associated growth rates for ADT and ADTT on the different sections. The growth rates were calculated using the compound growth formula.

Table 5-6: Combined historic growth rates

Year	Urban Section (NWP 1502_1509 & CTO 19222)		Rural Section (NWP 1342_1348 & CTO 19221)	
	ADT	ADTT	ADT	ADTT
2005	1566	133	1772	67
2007	1616	61	821	45
2008	1726	188	509	60
2015	2848	411	2518	370
2017	3067	441	2570	275
2018	2829	198	2535	338
Growth from 2005 to 2018 (13 years)	**4.7 %**	**3.1 %**	**2.8 %**	**13.3 %**

On the urban section, the ADT has grown at 4.7% p.a. and ADTT by 3.1% p.a. over a 13-year period. The rural section experienced less ADT growth at 2.8% p.a. and significantly greater ADTT growth of 13.3%.

5.2.2 GDP Growth

Traffic growth patterns tend to mimic economic growth, and for this reason, the historic Gross Domestic Product (GDP) growth rate was considered to contrast with and inform future growth.

Figure 5-8 below shows the 10-year performance of the country's GDP growth. GDP growth has been on a continuous decline since 2010 and averages at 1.0 %.



Figure 5-8: 10-year GDP Growth Trendline - RSA

5.2.3 Future Growth Rates

The future growth rate scenarios are proposed in Table 5-7 below, with the expected growth in the order of 3.0% for both ADT and ADTT

Several factors have been considered in the development of the growth scenarios as follows:

- **Land Use Development:** It is considered unlikely that the intensity of land use along the route will change significantly throughout the design life.
- **Economic Activity/ GDP:** For the past number of years the GDP for South Africa has been reducing from approximately 4% in 2010 to under 1% currently. It is further anticipated that the COVID-19 Pandemic will affect the country's economy quite significantly, resulting in slower economic growth for the foreseeable future. In terms of the local growth in the urban area, it is expected that the new mixed-use Tshing Ext 10 development will stimulate jobs and economic activity and the proposed growth rate of 2.8% to accommodate this can be regarded as realistic, considering the overall national economic outlook. The area would require significant socio-economic upliftment before any growth (including local area traffic growth) can be expected.
- **Freight Movement:** Historically, the heavy movement vehicle movement along the route has been erratic, ranging between 3.8 – 14.5 % of ADT on both sections. A conservative 3.0% ADTT growth is considered acceptable to ensure that any unexpected future growth in freight movement is allowed for in the pavement design.

The growth rates are to be applied on the urban and rural sections to project future traffic.

Table 5-7: Proposed Growth Rates

No.	Growth Scenario	Growth Rate ADT	ADTT
1	Low	1.5	2.0
2	Medium (Expected)	2.8	3.0
3	High	4.0	4.5

Growth rates were applied to the 2018 ADT and ADTT traffic volumes using the compound growth formula.

Figure 5-9 and Figure 5-10 below plot historic traffic volumes as wells as future traffic volumes based on the abovementioned scenarios for the two homogenous sections of the highway. It can be observed that the ADT trendline provides a higher coefficient of determination than the heavy vehicle (ADTT) trendline, making the historic ADT data more reliable for forecasting than the latter.

The projection of traffic data based on the historic trendline yields volumes that are similar to the low growth scenario confirming that a 1.5% growth is practicable. The low, medium and high scenarios will be evaluated and carried forward to the link capacity analysis using SANRAL's Highway Traffic Model (HTM) to evaluate the performance of the existing and proposed cross sections.

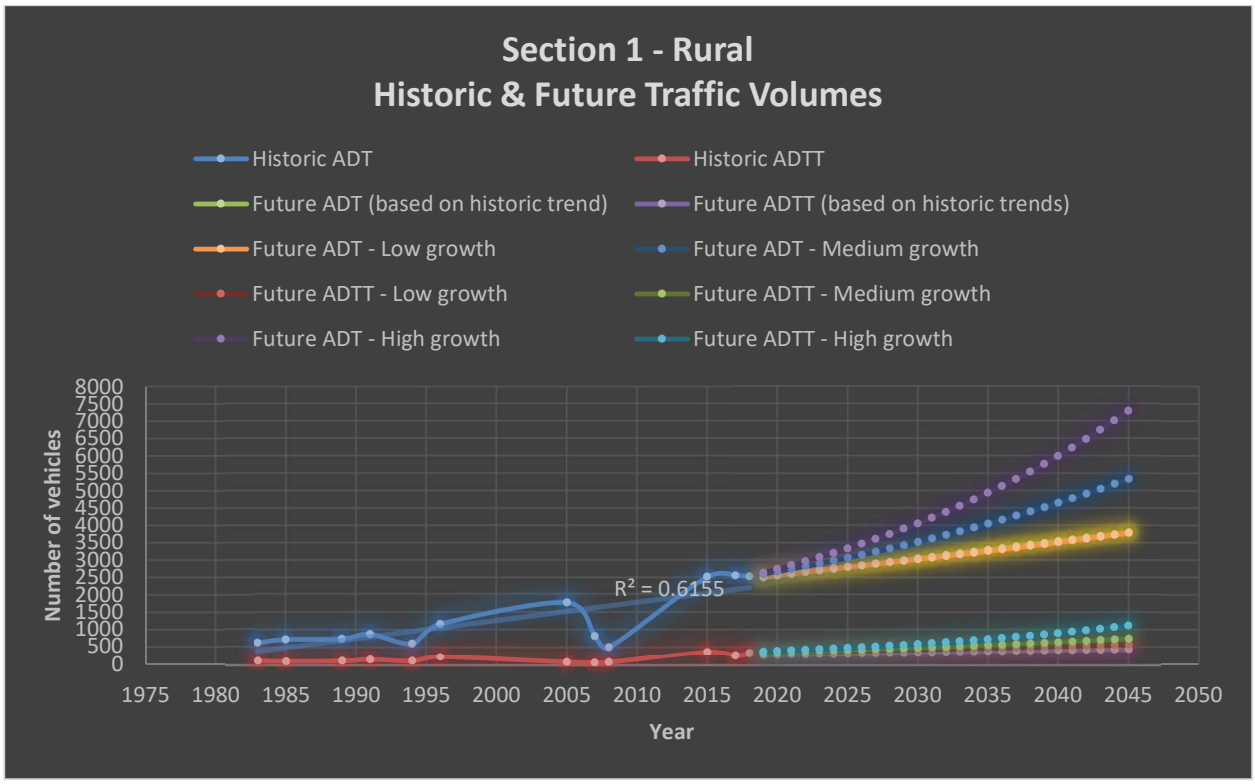


Figure 5-9: Future Traffic Volumes on the Urban Section

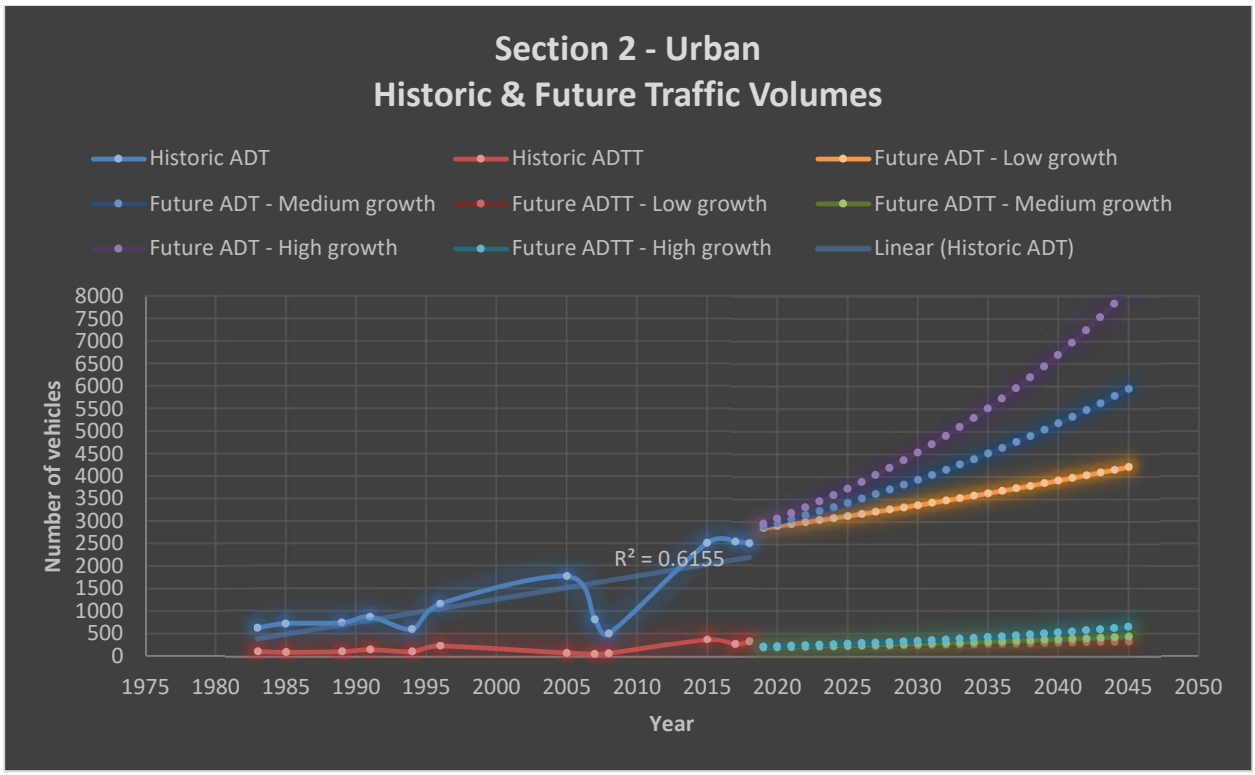


Figure 5-10: Future Traffic Volumes on the Rural Section

5.3 Estimated Future Traffic Volumes

Traffic volumes were subsequently forecast over the 20-year design life of the road for the two homogeneous sections. Table 5-8 and Table 5-9 provide a summary of the projected traffic demand for Section 1 and Section 2 respectively.

The forecast assumes that the improved road will open in Year 2025.

Table 5-8: Estimated Future Traffic Volumes – Section 1 (Rural)

Year	Low Growth		Medium Growth		High Growth	
	ADT	ADTT	ADT	ADTT	ADT	ADTT
Base Year 2018	2547	314	2547	314	2547	314
Opening Year 2025	2827	361	3090	386	3352	427
Design Year 2030	3045	398	3548	448	4078	533
Design Year 2035	3281	440	4073	519	4961	664
Design Year 2040	3534	485	4676	602	6036	827
Design Year 2045	3807	536	5368	697	7344	1031

Table 5-9: Estimated Traffic Volumes - Section 2 (Urban)

Year	Low Growth		Medium Growth		High Growth	
	ADT	ADTT	ADT	ADTT	ADT	ADTT
Base Year 2018	3023	423	3023	423	3023	423
Opening Year 2025	3355	486	3668	531	3978	587
Design Year 2030	3614	536	4211	615	4840	732
Design Year 2035	3894	592	4834	713	5889	912
Design Year 2040	4195	654	5550	827	7164	1136
Design Year 2045	4519	722	6372	958	8716	1416

According to *SANRAL's Design Guideline for Single Carriageway National Roads – 2009* (see Figure 5-11), the limiting volumes for a two-lane single carriageway highway link without climbing lanes is 8700 AADT for flat terrain with less than 14% heavy vehicles.

The calculated project Design Year 2023 ADT volumes of the section of the R30 under consideration do not exceed the specified limiting volumes for a two-lane carriageway. For the high growth scenario, the projected volumes reachthis limiting capacity at the end of the design life. This implies that a two-lane single carriageway should have adequate capacity to accommodate projected future traffic volumes on the R30 Section 8.

A more accurate evaluation of the current and future capacity is undertaken in the subsequent section of the report using SANRAL's HTM software program to confirm.

TABLE 1: LIMITING VOLUMES FOR TWO LANE SINGLE CARRIAGEWAY HIGHWAY LINKS OR SEGMENTS WITHOUT CLIMBING LANES; 12,4m WIDTH

LOS	Terrain Classification	AVERAGE ANNUAL DAILY TRAFFIC (AADT) – VEHICLES PER DAY											
		Peak Factor	15,00%								Split	39%	61%
		Proportion Heavy Vehicles of Traffic Stream											
		8%	10%	12%	14%	16%	18%	20%	22%	24%	26%	28%	30%
A	Flat	2,930	2,830	2,740	2,650	2,570	2,500	2,430	2,360	2,290	2,230	2,180	2,120
B		7,030	6,790	6,570	6,370	6,170	5,990	5,820	5,660	5,510	5,360	5,220	5,090
C		9,370	9,060	8,760	8,490	8,230	7,990	7,760	7,550	7,340	7,150	6,970	6,790
D		9,600	9,280	8,980	8,700	8,440	8,190	7,960	7,740	7,530	7,330	7,140	6,960
A	Rolling	1,760	1,700	1,640	1,590	1,540	1,500	1,460	1,420	1,370	1,340	1,310	1,270
B		4,220	4,070	3,940	3,820	3,700	3,590	3,490	3,400	3,310	3,220	3,130	3,050
C		5,620	5,440	5,260	5,090	4,940	4,790	4,660	4,530	4,400	4,290	4,180	4,070
D		5,760	5,570	5,390	5,220	5,060	4,910	4,780	4,640	4,520	4,400	4,280	4,180
A	Mountainous	1,170	1,130	1,100	1,060	1,030	1,000	970	940	920	890	870	850
B		2,810	2,720	2,630	2,550	2,470	2,400	2,330	2,260	2,200	2,140	2,090	2,040
C		3,750	3,620	3,500	3,400	3,290	3,200	3,100	3,020	2,940	2,860	2,790	2,720
D		3,840	3,710	3,590	3,480	3,380	3,280	3,180	3,100	3,010	2,930	2,860	2,780

Figure 5-11: Extract from SANRAL's Design Guideline for Single Carriageway National Roads, 2009

5.4 Link Capacity Analysis

This section of the R30 comprises of two homogeneous sections with variable land use characteristics and heavy vehicle composition. The two sections will thus be distinguished in the traffic analysis.

SANRAL's HTM model was used to evaluate current and future operating performance of the roadway for Base Year, Opening Year and Design Year conditions

The HTM model is an Excel spreadsheet software which requires three primary components of data input as follows:

- Geometric details: number of lanes, road widths, shoulder lanes, gradient, vertical and horizontal alignment, and no passing zones,
- Traffic characteristics: light and heavy vehicle classification, Peak Hour Factor, ADT, % directional distribution (K), speed limit etc.,
- Intersection and interchange information to determine spacing and resulting weaving sections.

The HTM analysis was conducted for the normal day peak hour and the 30th Highest Hourly Flow (HHF) utilising the latest data from CTO stations. The traffic parameters used in the model are summarised in Table 5-10 and Table 5-11 below.

Table 5-10: Normal Day Peak Hour Flow Data

Section	Start Chainage	End Chainage	Q /ADT	PHF	% Directional Split	% HV
1	KM 0.0	KM 64.4	0.160	0.900	50.0 %	12.3 %
2	KM 64.4	KM 68.65	0.135	0.900	50.0 %	14.0 %

Table 5-11: 30th HHF Data

Section	Start Chainage	End Chainage	Q /ADT	PHF	% Directional Split	% HV
1	KM 0.0	KM 64.4	0.100	0.900	50.0 %	12.3 %
2	KM 64.4	KM 68.65	0.093	0.900	50.0 %	14.0 %

5.4.1 HTM Analysis for Existing Cross Section

The existing cross-section of the R30 from start to end were thus analysed in HTM to evaluate the highway performance over the next 20-years if no improvements were conducted on the road. A summary of the HTM level of service results is provided in Table 5-12.

The results indicate that the cross section is adequate to process current and future traffic volumes for all growth scenarios when considering the 30th HHF traffic conditions, where the road performs at LOS C and better by the end of design life.

For normal peak hour traffic conditions, the roadway performance declines to LOS D on the medium growth scenario and LOS F on the high growth scenario at the end of design life. No capacity upgrades are warranted on this section of the R30, however, the addition of paved shoulders as per the SANRAL standard may be warranted to improve road safety.

Table 5-12: Existing Cross Section HTM results

Peak Hour	Year	Percentage of road length operating at a level of service: NRA Criteria																	
		Low Growth						Medium Growth						High Growth					
		LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Normal Day	2018	0.9%	98.3%	0.8%	0.0%	0.0%	0.0%	1.0%	98.2%	0.7%	0.0%	0.0%	0.0%	1.0%	98.2%	0.7%	0.0%	0.0%	0.0%
	2025	0.0%	97.2%	2.3%	0.4%	0.0%	0.0%	0.0%	79.6%	19.9%	0.5%	0.0%	0.0%	0.0%	19.3%	80.1%	0.6%	0.0%	0.0%
	2035	0.0%	12.7%	86.6%	0.4%	0.3%	0.0%	0.0%	1.7%	93.9%	3.9%	0.4%	0.0%	0.0%	0.0%	7.5%	90.9%	1.2%	0.4%
	2045	0.0%	0.9%	85.8%	12.8%	0.5%	0.0%	0.0%	0.0%	3.1%	89.1%	7.3%	0.4%	0.0%	0.0%	0.0%	1.7%	25.4%	72.9%
30th HHF	2018	97.4%	2.5%	0.0%	0.0%	0.0%	0.0%	97.6%	2.4%	0.0%	0.0%	0.0%	0.0%	97.6%	2.4%	0.0%	0.0%	0.0%	0.0%
	2025	82.5%	17.1%	0.4%	0.0%	0.0%	0.0%	50.6%	49.1%	0.3%	0.0%	0.0%	0.0%	8.4%	91.0%	0.6%	0.0%	0.0%	0.0%
	2035	3.0%	96.3%	0.6%	0.0%	0.0%	0.0%	0.6%	98.3%	0.8%	0.3%	0.0%	0.0%	0.0%	24.2%	75.0%	0.4%	0.3%	0.0%
	2045	0.0%	97.7%	1.9%	0.4%	0.0%	0.0%	0.0%	10.8%	88.3%	0.5%	0.3%	0.0%	0.0%	0.0%	6.8%	91.3%	1.4%	0.4%

5.4.2 HTM Analysis for Proposed Cross Section

A new cross-section comprising of 3m wide shoulders on the rural section of the highway and additional lanes and NMT infrastructure on the urban section of the highway is proposed and was analysed in HTM. The rural highway section comprises of 3.7m single lanes and the urban section, 3.5m dual lanes in each direction. A summary of the HTM level of service results is provided in Table 5-13.

The results indicate that the proposed cross-section performs satisfactorily at predominantly LOS B and better for the low and medium growth scenario considering both the normal day peak and 30th HHF traffic conditions. For the high growth scenario, the cross-section maintains adequate performance at LOS C and better by the end of the design life.

Table 5-13: Proposed Cross Section HTM Results

Peak Hour	Year	Percentage of road length operating at a level of service: NRA Criteria																	
		Low Growth						Medium Growth						High Growth					
		LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Normal Day	2018	84.3%	15.5%	0.2%	0.0%	0.0%	0.0%	84.3%	15.5%	0.2%	0.0%	0.0%	0.0%	84.3%	15.5%	0.2%	0.0%	0.0%	0.0%
	2025	10.4%	89.3%	0.2%	0.1%	0.0%	0.0%	9.3%	89.5%	1.2%	0.1%	0.0%	0.0%	8.1%	89.6%	2.1%	0.2%	0.0%	0.0%
	2035	8.1%	89.5%	2.3%	0.2%	0.0%	0.0%	8.1%	80.5%	11.1%	0.2%	0.1%	0.0%	7.9%	1.3%	87.6%	3.1%	0.1%	0.1%
	2045	8.1%	73.0%	18.2%	0.7%	0.0%	0.0%	7.9%	0.5%	86.8%	4.5%	0.2%	0.1%	7.4%	0.5%	0.2%	74.0%	16.2%	1.8%
30th HHF	2018	99.7%	0.3%	0.0%	0.0%	0.0%	0.0%	99.7%	0.3%	0.0%	0.0%	0.0%	0.0%	99.7%	0.3%	0.0%	0.0%	0.0%	0.0%
	2025	98.1%	1.8%	0.1%	0.0%	0.0%	0.0%	97.0%	2.9%	0.1%	0.0%	0.0%	0.0%	95.4%	4.5%	0.2%	0.0%	0.0%	0.0%
	2035	94.8%	5.1%	0.2%	0.0%	0.0%	0.0%	53.4%	46.4%	0.2%	0.1%	0.0%	0.0%	8.4%	88.6%	2.9%	0.1%	0.1%	0.0%
	2045	15.1%	84.6%	0.2%	0.1%	0.0%	0.0%	8.1%	88.0%	3.7%	0.1%	0.1%	0.0%	7.9%	1.8%	85.7%	4.3%	0.2%	0.1%

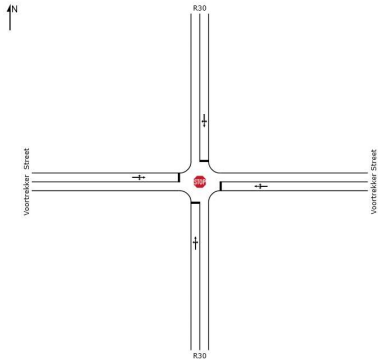
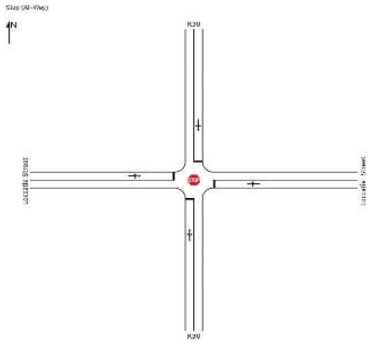
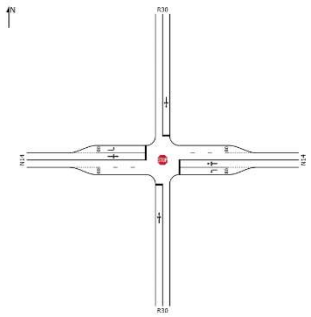
5.5 Intersection Capacity Analysis

5.5.1 Intersection Overview

The section of the R30 under assessment comprises of rural and urban road sections. The turning movement surveys were commissioned at 19 intersections. Of the commissioned survey intersections, 9 intersections are located in the rural section and 10 along the urban section of the R30. The description and location of the intersections is discussed in Section 5.1.3.

Three (3) intersections were identified as critical intersections based on site observations and turning movement volumes. The three intersections attract high traffic volumes due to their close proximity to key economic and social activities. Table 5-14 provides detailed descriptions of the intersections.

Table 5-14: Identified Critical Intersections

Intersection	Intersection Layout	Site Photo
R30 / Voortrekker St I/S • All way stop-controlled junction • Major road – R30 • Located in town epicentre • Surrounded by social and economic land use activities • Significant pedestrian activity • Minibus Taxi and HV activity • Lack of NMT and public transport facilities		
R30 / Loccatie St. I/S • All way stop-controlled junction • Major road – R30 • Provides primary access to major residential settlement (Tshing). • Lack of NMT and public transport facilities		
N14 / R30 I/S • All way stop-controlled junction • Major road - N14 • Provides primary access to Ventersdorp town from Mafikeng, Derby, Klerksdorp and Johannesburg. • Lack of NMT and public transport facilities		

5.5.2 Intersections Analysis

The 19 intersections were modelled, and the operational performance was investigated in the SIDRA traffic analysis software. The operational performance of each intersection was evaluated in terms of delay experienced on each approach as well as capacity of the intersection to process the current traffic flows. The performance measurement is the Level of Service (LOS) defined by the Highway Capacity Manual in which letters A through F are used. LOS A depicts free flow conditions while LOS F denotes a breakdown in traffic flow. These definitions are based on Measures of Effectiveness (MoE) for the type of facility, which in this case is an intersection. Typical MoE's include speed, travel-time, density and delay for the associated volume of vehicles that use the facility.

The Volume Demand to Capacity Ratio (v/c) is a measure that compares roadway demand (vehicle volumes) with roadway supply (carrying capacity). For example, V/C = 1.00 indicates that the roadway facility is operating at its capacity.

SANRAL typically accepts LOS C on rural sections and LOS D on urban sections, similarly, the COTO TIA Manual indicates that a LOS D is acceptable for urban roads.

The intersections were modelled and analysed as follows:

- Modelling of the existing geometric configuration
- A growth rate of 2.8% was applied to the background traffic for future year capacity evaluation of intersections for the following scenarios:
    - Base Year 2022
    - Opening Year 2025
    - Design Year 2045
- Analysis of AM and PM Peak hour traffic conditions for all scenarios
- A Peak Hour Factor (PHF) was determined for each intersection from the 12-hour count data as follows:
- $PHF = \frac{v}{4 \times v_{15}}$

  Where:

  V = Maximum Vehicle Volume at the intersection at the Peak hour

  V_{15} = Max Vehicle volume within the peak hour

The SIDRA capacity evaluation of all the intersections resulted in adequate performance of LOS D and better for the different scenarios. A summary of the analysis results is provided in Table 5-15

5.5.3 Capacity Analysis Results (Existing)

All the evaluated intersections operate satisfactorily between LOS A and B for all scenarios except the three critical intersections, namely, **N14/R30**, **R30/Loccatie St** and **R30/Voortrekker St** intersections (See below). The three intersections operate at LOS C or D for the base and future year scenarios.

An intersection LOS summary diagram is shown in Table 5-15 and the LOS diagram for **R30/Loccatie St** and **R30/Voortrekker St** intersections is seen in Table 5-16 and Table 5-17.

Table 5-15: LOS Summary Results

SITE ID	INTERSECTION R30	CONTROL TYPE	PEAK PERIOD	OPERATIONAL CONDITIONS								
				Base Year			Opening Year			Design Life		
				INTERSECTION			INTERSECTION			INTERSECTION		
				V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
1	Opraap Access Road	T Junction (Left)	AM	0.078	0.40	A	0.087	0.40	A	0.131	0.50	A
			PM	0.076	0.20	A	0.089	0.20	A	0.134	0.20	A
2	Sterkstroom Access Road (South)	T Junction (Left)	AM	0.077	0.60	A	0.085	0.60	A	0.125	0.60	A
			PM	0.075	0.30	A	0.083	0.30	A	0.125	0.30	A
3	Doornfontein Access Road	T Junction (Right)	AM	0.109	0.30	B	0.121	0.30	B	0.182	0.40	B
			PM	0.114	0.30	A	0.127	0.30	A	0.191	0.40	A
4	Rietspruitsdam (North) Access Road	T Junction (Right)	AM	0.087	0.50	A	0.086	0.20	A	0.130	0.20	A
			PM	0.083	0.50	A	0.097	0.50	A	0.146	0.60	A
5	Sterkstroom Access Road (South)	T Junction (Left)	AM	0.078	0.50	A	0.087	0.50	A	0.130	0.50	A
			PM	0.085	0.40	A	0.094	0.40	A	0.142	0.50	A
6	Ratzegaaiskraal Access Road	T Junction (Left)	AM	0.108	0.30	A	0.120	0.30	A	0.180	0.30	A
			PM	0.091	0.30	A	0.101	0.30	A	0.151	0.40	A
7	Klippaatdrift (South) Access Road	T Junction (Left)	AM	0.090	0.20	A	0.100	0.20	A	0.151	0.20	A
			PM	0.096	0.20	A	0.107	0.20	A	0.161	0.20	A
8	Klippaatdrift (North) Access Road	T Junction (Right)	AM	0.086	0.50	A	0.100	0.50	A	0.150	0.50	A
			PM	0.145	3.60	A	0.164	3.70	A	0.273	3.90	A
9	Rietspruitsdam (North) Access Road	T Junction (Right)	AM	0.092	0.50	A	0.103	0.50	A	0.137	0.60	A
			PM	0.097	0.60	A	0.108	0.70	A	0.163	0.70	B
10	N14	STOP (FOUR-WAY)	AM	0.722	26.90	D	0.803	31.20	D	0.840	38.80	E
			PM	0.505	18.90	C	0.562	20.10	C	0.844	31.70	D

11	Manaka Loccatie Road	STOP (FOUR-WAY)	AM	0.539	18.40	C	0.600	19.60	C	0.902	34.00	D
			PM	0.558	20.30	C	0.620	21.80	C	0.933	36.30	E
12	De Beer Road	STOP (TWO-WAY)	AM	0.140	0.80	A	0.156	0.80	A	0.236	1.10	A
			PM	0.110	1.00	A	0.123	1.00	A	0.186	1.20	A
13	Gouws Road	T Junction (Right)	AM	0.121	0.10	A	0.134	0.10	A	0.202	0.10	A
			PM	0.111	0.10	A	0.124	0.10	A	0.186	0.10	A
14	Steen Road	T Junction (Left, 3 way stop)	AM	0.146	1.10	A	0.163	1.20	A	0.251	1.40	A
			PM	0.124	0.80	A	0.138	0.80	A	0.210	0.90	A
15	Berg Road	STOP (FOUR-WAY)	AM	0.126	1.30	A	0.141	1.40	B	0.382	14.40	B
			PM	0.120	1.50	A	0.134	1.60	B	0.325	12.40	B
16	Mark Road	STOP (TWO-WAY)	AM	0.133	2.80	A	0.149	2.90	A	0.229	3.70	A
			PM	0.133	2.00	A	0.149	2.10	A	0.227	2.60	A
17	Voortrekker Road	STOP (FOUR-WAY)	AM	0.427	18.40	C	0.474	19.20	C	0.713	25.50	D
			PM	0.386	17.10	C	0.429	17.80	C	0.645	22.60	C
18	Koekemoer	STOP (TWO-WAY)	AM	0.106	1.20	A	0.118	1.30	A	0.180	1.50	A
			PM	0.126	1.30	A	0.140	1.30	A	0.214	1.50	A
19	Visser	STOP (TWO-WAY)	AM	0.119	3.50	A	0.137	3.60	A	0.255	4.10	A
			PM	0.136	2.60	A	0.151	2.70	A	0.258	3.30	A

Table 5-16:Loccatie Approach LOS

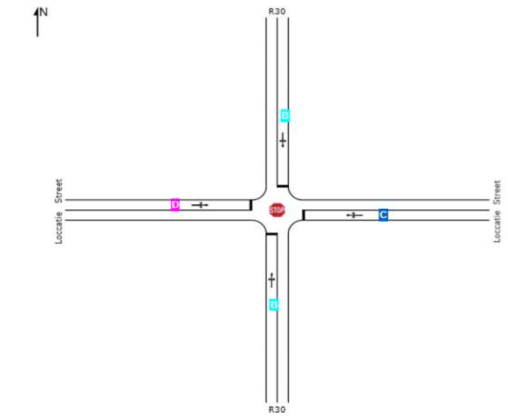
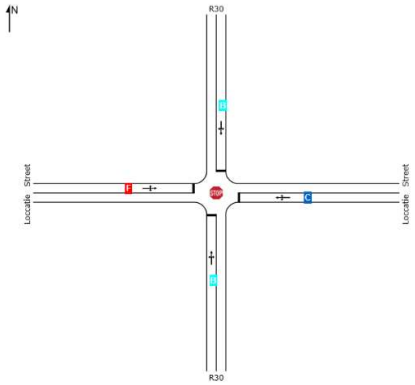
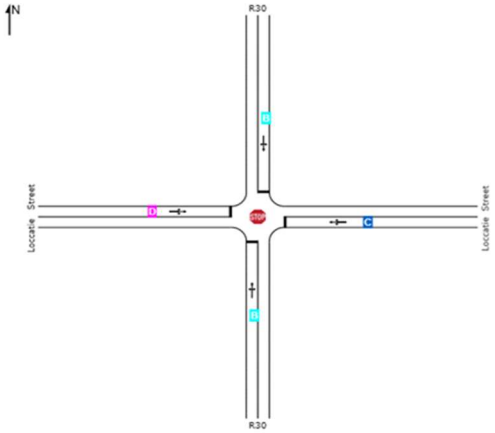
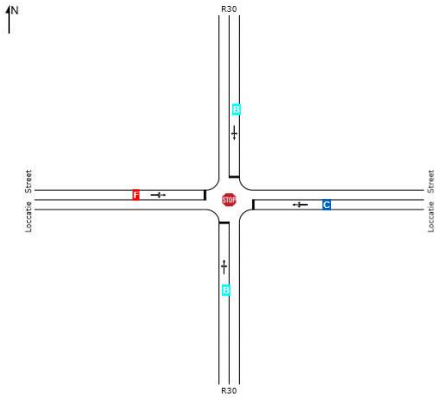
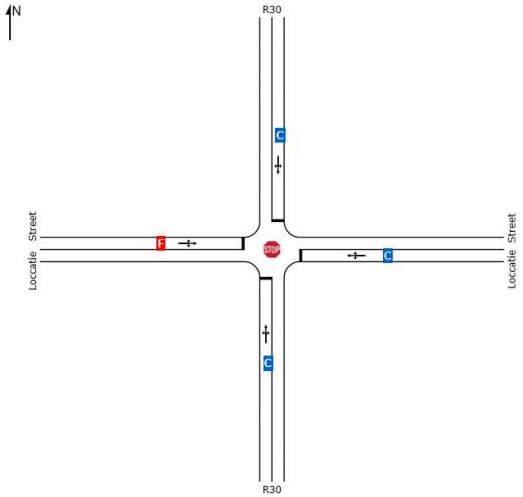
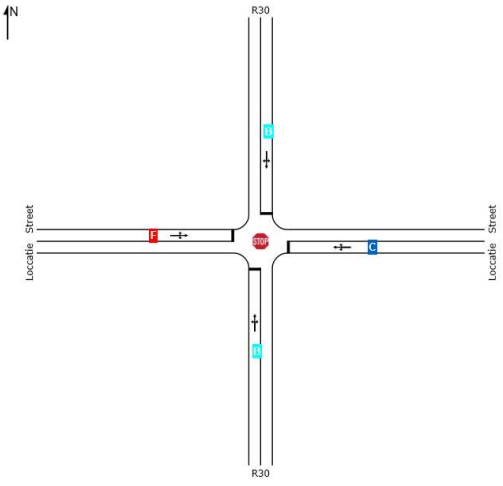
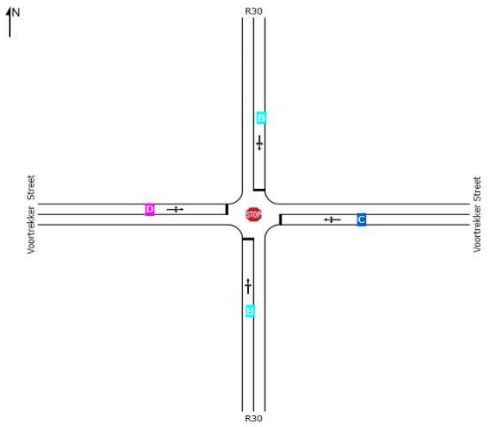
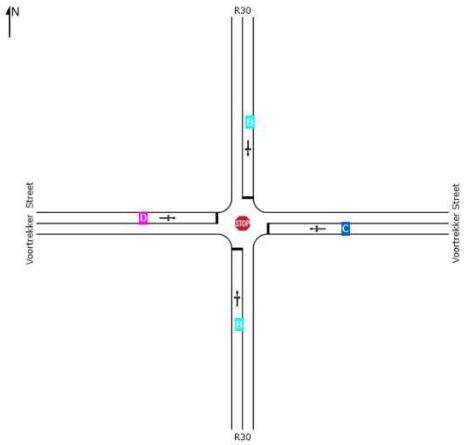
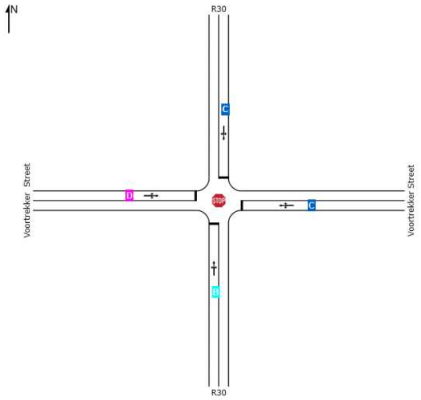
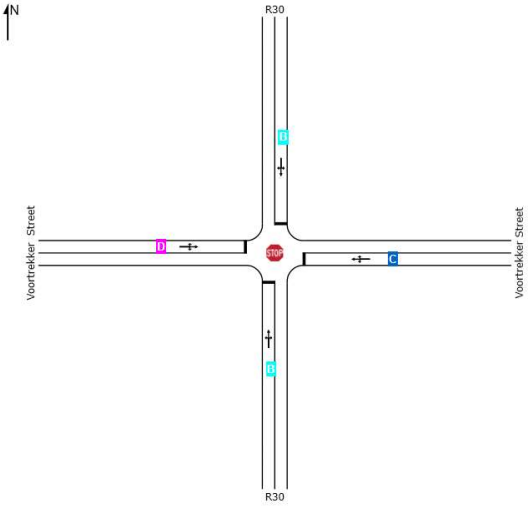
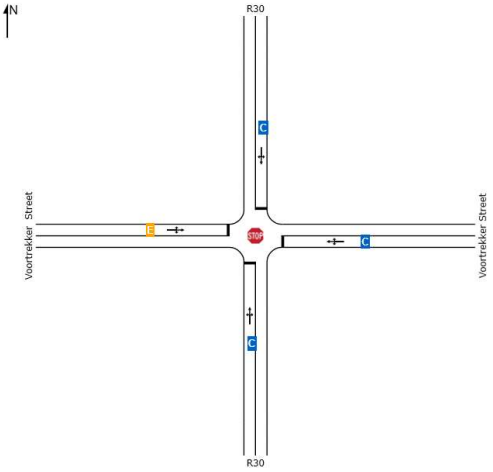
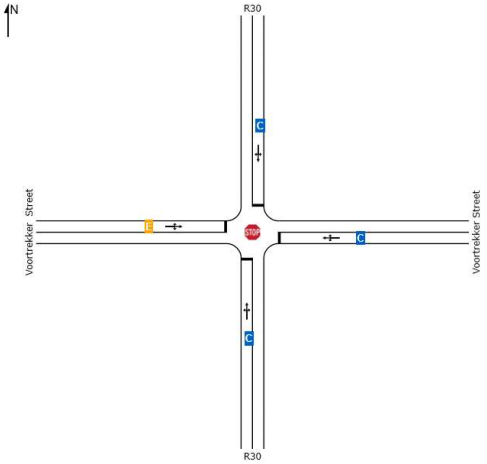
Scenario	AM	PM
Base Year 2022		
Opening Year 2025		
Design Year 2045		

Table 5-17: Voortrekker Approach LOS Summary

Scenario	AM	PM
Base Year 2022		
Opening Year 2025		
Design Year 2045		

The results show that the western approach of **R30/Loccatie St I/S** operates at LOS F for the PM Peak for all the scenarios. The intersection serves as primary access intersection to town and to the N14 highway for the existing Tshing residential settlement. To improve traffic flow at this junction and relieve pressure on the western approach, the introduction of auxiliary turning lanes or a traffic circle will be considered further.

The intersection of **R30/Voortrekker St.** is located at the epicentre of the town and is surrounded by land use activity that attracts high trips such as municipal offices, the local licensing department, and a major grocery store. The western approach of this intersection experiences significant deterioration in level of service at the end of Design Life. Intersection upgrades may not be critical at this intersection as strain is experienced at the end of life, however, if planned land use development in Ventersdorp area materialises, capacity within the 20-year design life, capacity improvements may be warranted.

5.5.4 Future Capacity Analysis (Road Upgrade & New Developments)

The project entails the improvement of national road by widening the existing cross-section and the addition of paved shoulders. Furthermore, there are proposed infrastructure developments in Tshing area discussed in Chapter 4.2. A traffic study was conducted to estimate the possible impact the development would have in terms of traffic volumes in the area and trip generation from the study was incorporated in this assessment.

Two new intersections proposed for the development are located at km 64.7 (intersection site ID X) and km 66.0 (Intersection site ID Road Y). Figure 5-12 below illustrates the location of the proposed intersection locations in relation to the Tshing Extension 10 development.



Figure 5-12: Tshing New Development and New Intersections

The proposed new layout and the trips generated by the development were utilised to model and determine the performance of the intersections. The intersections were evaluated considering the following parameters and conditions:

- Update intersection layouts according to the proposed new geometric configuration and include new intersections.
- Apply a background traffic growth rate of 2.8% to base year volumes for future year capacity evaluation of intersections for the following scenarios:
  - Opening Year without development 2025

- Opening Year with development 2025
- Design Year with development 2045

- Analysis of AM and PM Peak hour traffic conditions for all scenarios

The Trips generated by the development from the site development study were distributed to the road network to account for the effect the development would have on applicable intersections. The trips generated can be found in Annexure A and the traffic volumes used for modelling purposes can be found in Annexure B.

The upgraded intersections and new development access intersections existing intersections were analysed for the above-mentioned scenarios. The results presented from this analysis will focus on the following intersections that are mostly affected by the new trips generated by the new development.

- Site ID 12 – R30/ De beer
- Site ID 11 – R30/Loccatie St. I/S
- Site ID Y – R30/Rd Y I/S
- Site ID 10 - N14/R30 I/S
- Site ID X – R30/Rd X I/S

The results for the performance assessment resulted in an overall acceptable performance of the new intersections and poor operational performance for the **R30/N14** and **R30/Loccatie St** intersections. Without the development, the proposed geometric layouts result in satisfactory operational performance. The analysis shows that the intersections are significantly affected by the planned Tshing Ext 10 development throughout the 20-year design life.

The LOS summary results for the intersections are provided in Table 5-18. The LOS summary results for all upgraded road intersections can be found under Annexure C.

The proposed **N14/R30** intersection configuration and AM LOS summaries are presented in Figure 5-13 and Figure 5-14. The intersection performs adequately without the Tshing Ext 10 development and fails when development-generated traffic is distributed to the intersection.

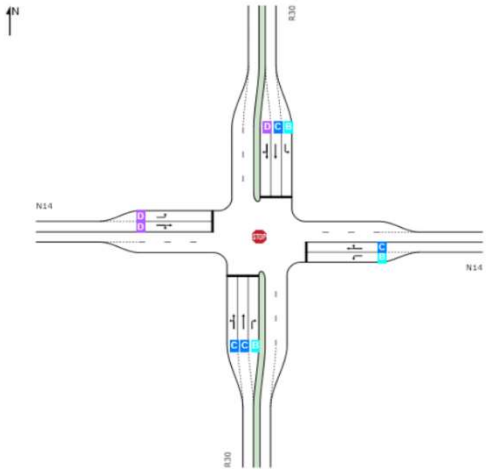


Figure 5-13: N14/R30: Opening Year - Without Development

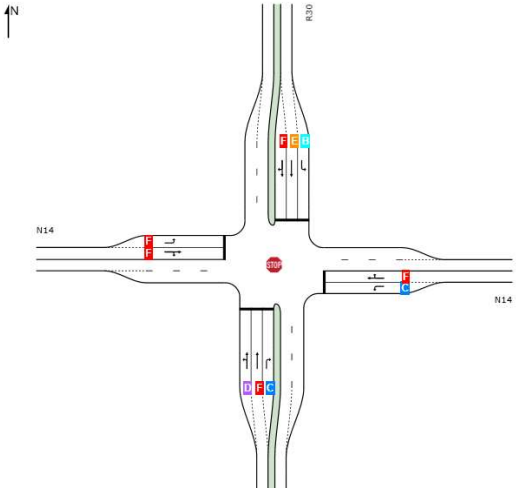


Figure 5-14: N14/R30: Opening Year – With Development

Similarly, the proposed **R30/Loccatie St**. intersection underperforms when development traffic is taken into consideration. The majority of the approaches to this intersection experience delays due to high traffic turning movements and through movement on the R30. A summary of the upgraded intersection LOS is presented in Figure 5-16and Figure 5-19 below.

Table 5-18: LOS Summary Results (Road Upgrade & New Development)

INTERSECTION R30	CONTROL TYPE	PEAK PERIOD	OPERATIONAL CONDITIONS								
			Opening Year Without Development			Opening Year with development			Design Life with development		
			INTERSECTION			INTERSECTION			INTERSECTION		
			V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
De Beer Road	STOP (TWO-WAY)	AM	0.140	0.80	A	0.156	0.80	A	0.236	1.10	A
		PM	0.110	1.00	A	0.123	1.00	A	0.186	1.20	A
Manaka/Loccatie Road	STOP (FOUR-WAY)	AM	0.459	17.60	C	1.289	73.1	F	1.600	116.40	F
		PM	0.563	21.70	C	1.428	73.3	F	1.609	86.00	F
New (km 66.0)	STOP (FOUR-WAY)	AM				0.343	8.2	A	0.462	10.00	B
		PM				0.370	9.8	A	0.455	10.50	B
N14	STOP (FOUR-WAY)	AM	0.570	23.90	C	0.937	41.7	E	1.402	123.40	F
		PM	0.495	21.70	C	0.607	22.8	C	1.119	65.50	F
New (km 64.7)	STOP (FOUR-WAY)	AM				0.23	3.6	A	0.449	4.10	A
		PM				0.133	2.5	A	0.798	11.80	B

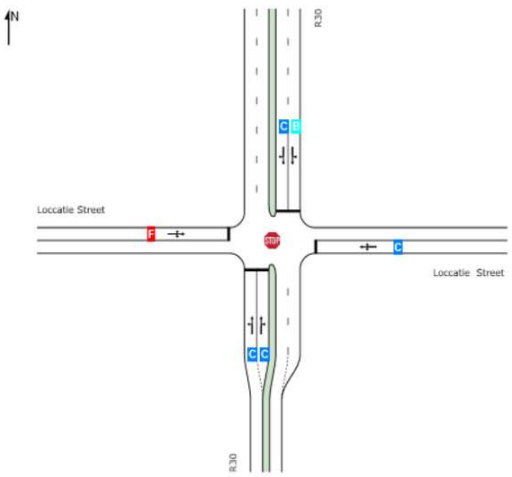


Figure 5-15: R30/Loccatie: Opening Year - Without Development

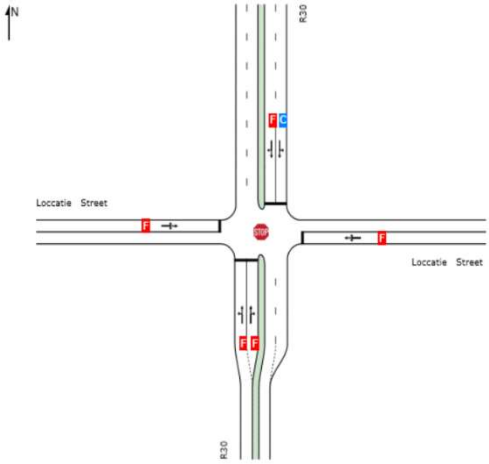


Figure 5-16: R30/Loccatie: Opening Year - With Development

5.5.5 Recommended Intersection Improvement Analysis

The analysis for the intersection improvements considered the option of improving the geometric configuration of the intersections to improve traffic flow, as well as the option of introducing signal control to the applicable intersections to allow for desired traffic flow conditions.

The following intersection improvements are proposed to ensure adequate performance levels from the opening year and throughout the design life:

- **N14/R30 I/S**: The currently proposed intersection layout comprises of auxiliary lanes in the northern and southern approaches 100m in length. The capacity analysis conducted in SIDRA indicates that the provision of auxiliary lanes of 500m on the northern and southern approaches results and converting the intersection from Stop control to Signalised control results in improved traffic flow and satisfactory intersection performance. Upon further engagement with SANRAL, it was decided that it will be better to construction an interchange at this junction to maintain high service levels on the N14 as a Class 1 road. The analysis and design of the interchange is to be undertaken as part of the SMEC appointment on the N14.

The proposed intersection configuration for this intersection is in Figure 5-17 below

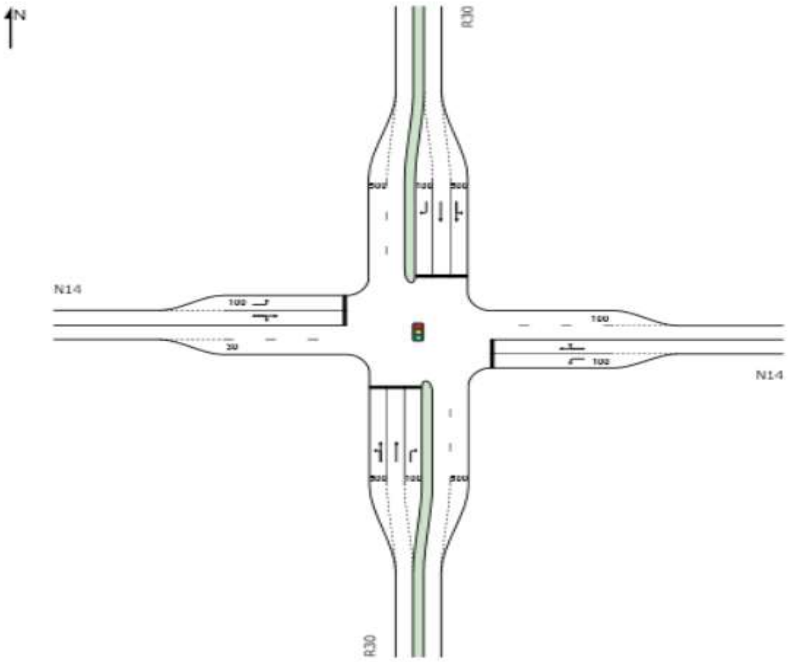


Figure 5-17: N14/R30 I/S Proposed Layout

- **R30/Loccatie St. I/S**: This intersection fails due to high traffic volumes on the majority of the approaches. The option of signal control, as well as a traffic circle, were considered to optimise intersection performance.

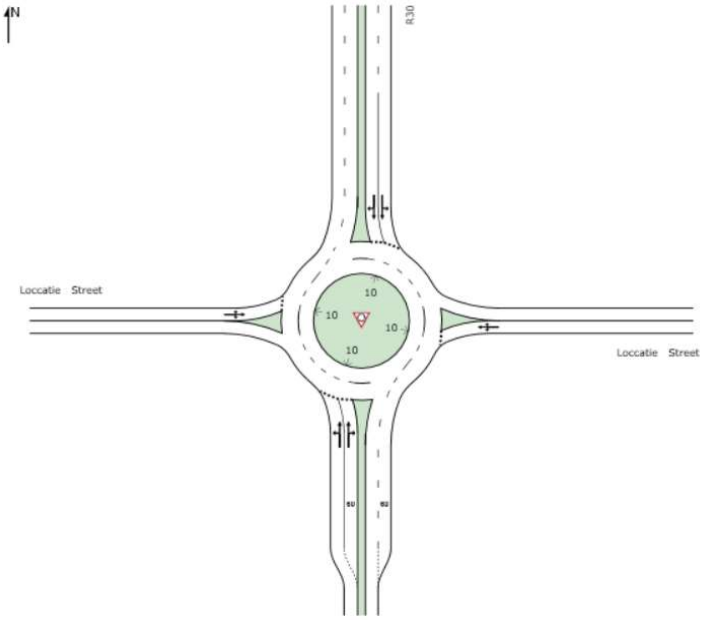


Figure 5-18: R30/Loccatie St I/S - Proposed Layout Traffic Circle

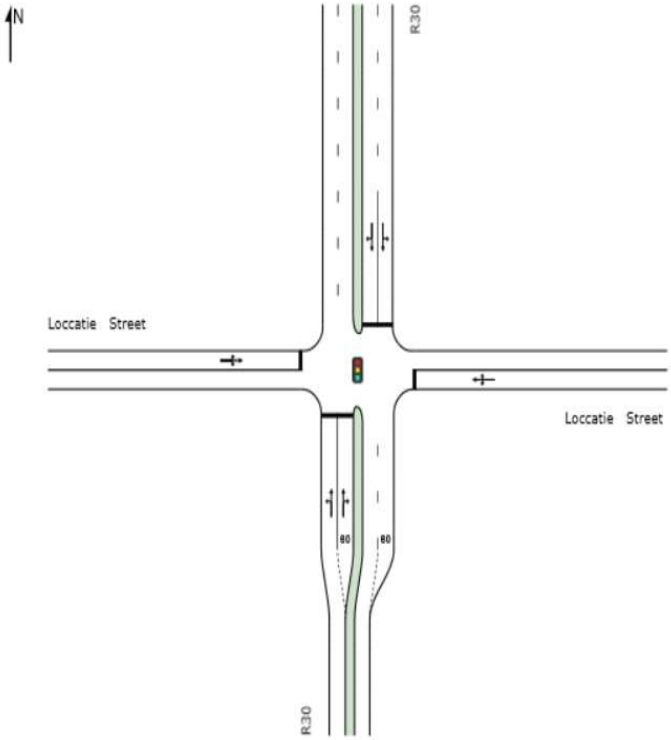


Figure 5-19: R30/Loccatie St I/S - Proposed Layout Signalised Control

The results of the analysis seen in Table 5-19 below indicate that a signalised control for the **N14/R30 I/S** improves the LoS at the intersection. The options for R30/Loccatie St I/S both improve the intersection

throughout the road design life. However, a signalised control for **R30/Loccatie St I/S** may need further analysis as it may result in congestion upstream of route.

Table 5-19 : Recommended improvements LoS Results

INTERSECTION R30	CONTROL TYPE	PEAK PERIOD	Opening Year with development			Design Life with development		
			INTERSECTION			INTERSECTION		
			V/C	Delay	LOS	V/C	Delay	LOS
Manaka/Loccatie	Signalised Traffic Control	AM	0.665	14.1	B	0.821	18.10	B
		PM	0.418	10.9	B	0.679	13.40	B
	Traffic Circle	AM	0.421	7.9	A	0.474	7.4	A
		PM	0.284	7.6	A	0.38	7.9	A
N14	Signalised Traffic Control	AM	0.672	13.4	B	0.927	16.70	B
		PM	0.576	12.1	B	0.718	13.50	B

The following recommendations are thus made for upgrading the intersections:

R30/N14: A new diamond interchange. The land required for the grade separated intersection has already been reserved. It was discussexd with SANRAL that this will be undertaken under the SMEC contract for the N14.

R30/Loccatie Street: A new 30 m two-lane traffic circle intersection.

5.6 Non – Motorized Transport & Public Transport

5.6.1 Non- Motorised Transport Analysis

Non – Motorised Transport plays a significant role in the mobility of people in the Ventersdorp town. The surrounding transport infrastructure in the urban area of Ventersdorp is characterised by poor mobility and accessibility, limited and debilitating non-motorised transport (NMT) infrastructure which poses safety risks to all road users, especially vulnerable road users such as pedestrians, cyclists, the blind and wheelchair users.

The proposed upgrades on the urban section of the R30 ought to ensure adequate NMT and public transport (PT) facilities are provided. 12-Hour pedestrian movement count was conducted at 9 intersections in the urban section of the route for the purpose of identifying safety hazards and obstructions to NMT movements.

The AM and PM pedestrian profile from the survey is shown in Figure 5-20 below.

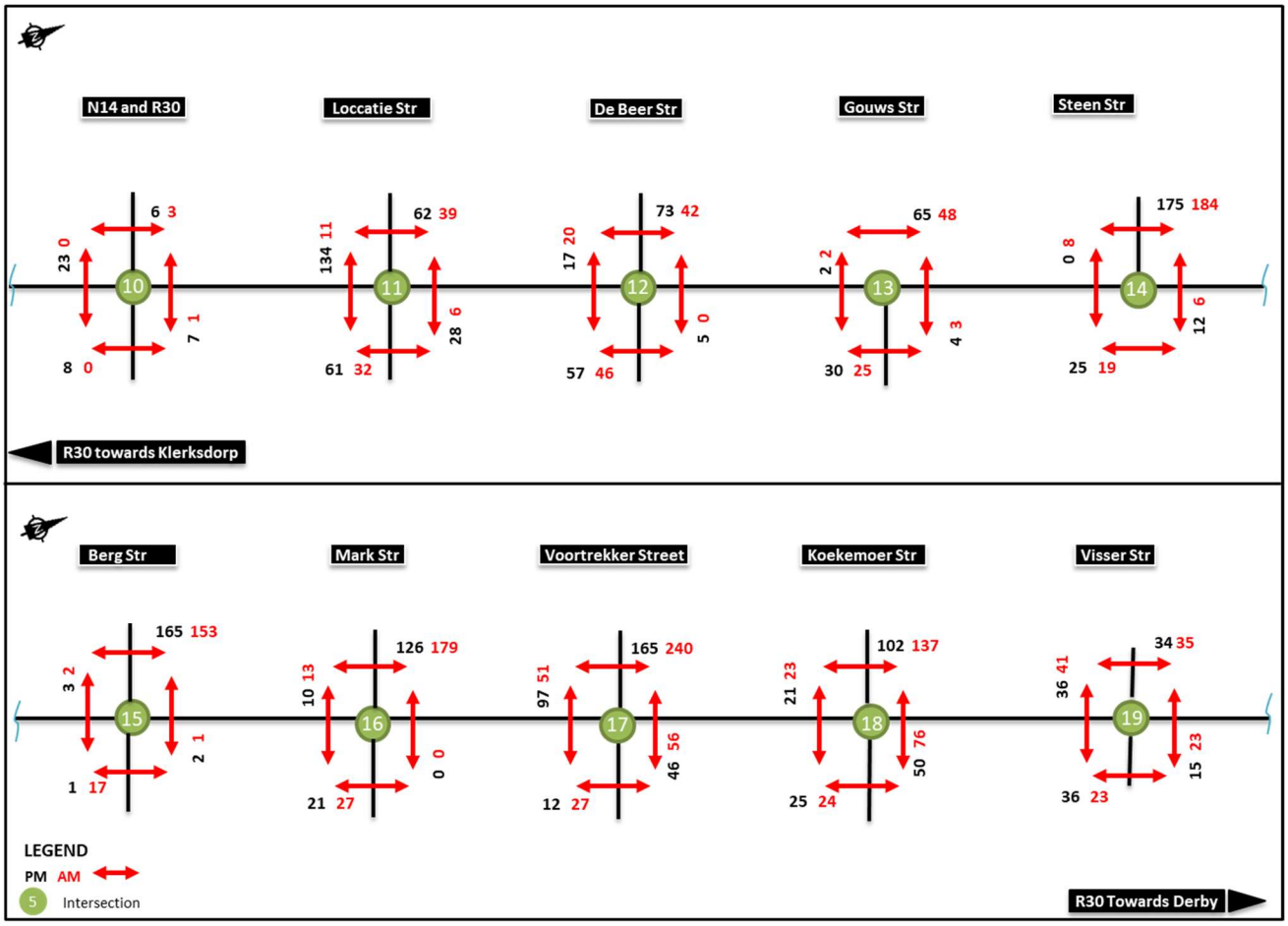


Figure 5-20: 2022 AM and PM Peak Hour Pedestrian Profile

Relatively low pedestrian movements are observed at the N14/R30 I/S in all directions, however, from the R30/Loccatie St. I/S up to the R30/Visser St. I/S, significant east-west pedestrian movement is observed during the peak hours in excess of 50 ped/per hour on either side of the road, however, an increase in the east-west pedestrian movement to over 100 ped/hour is observed from the R30/Steen St to R30/Koekemoer St I/S (in the town epicentre). The contrast in volumes may further imply that pedestrians are dropped off by mini-bus taxi or park their vehicles within proximity of the intersections with high volumes.

The volumes of pedestrian crossing the R30 in the urban area is more pronounced at the intersections with Loccatie St, Voortrekker St, Koekemoer St and Visser St.

The total AM and PM peak hour pedestrian volumes at each intersection are shown graphically in Figure 5-21.

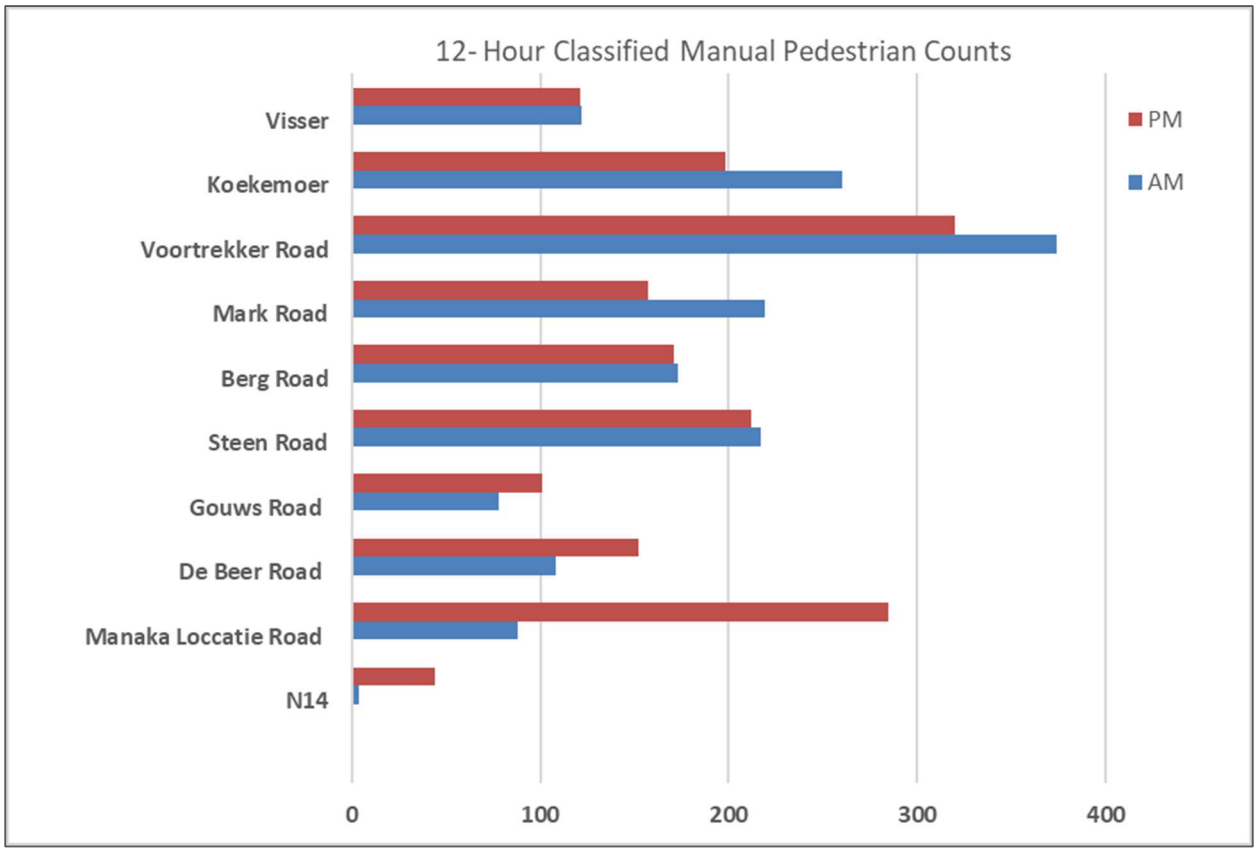


Figure 5-21: 12-Hour AM and PM Peak Period Pedestrian Count

It is observed that the R30/Loccatie I/S process higher volumes of pedestrians during the PM peak hour suggesting that pedestrians may utilise other NMT routes or transport modes when travelling to work/school and then walking back home to established Tshing residential settlement.

NMT and PT infrastructure are warranted over the entire urban section of the R30 Section 8, however, the need to provide pedestrian crossings on the R30 was assessed based on the following criteria:

- **Demand for NMT**: The existing pedestrian volumes, land use changes and facilities that would generate trips.
- **Policy:** Improvements supported by government policy, regional strategic plans or the area's local master planning.
- **Degree of Barrier**: The challenges of mobility such as usage of longer routes, safety hazards (high speed roads). Site investigation noted the lack of pedestrian signs and faded road marking.

  (2009 Todd Litman, Robin Blair, et al.)

Table 5-20 below summaries priority intersections where pedestrian crossing should be considered on the R30. These intersections are considered to serve current NMT desire lines based on pedestrian counts.

Table 5-20: Priority Intersections

Site ID	Intersection	Location (km)	Intersection Type	Average Pedestrian count (ped/hr)
11	Loccatie Street	67.123	All Way Stop Control	150
14	Steen Street	67.636	T – Junction (All Way Stop Control)	190
17	Voortrekker Street	68.286	All Way Stop Control	227
18	Koekemoer Street	68.470	Two Way Stop Control	230
19	Visser Street	68.559	Two Way Stop Control	51

Figure 5-22 below shows the surrounding land use at the priority intersections which support NMT desire lines. The identified NMT priority intersections support existing commercial, education, residential and public transport land use activities in the town. In addition to priority intersections, informal NMT walkways were observed at approximately 66.84 km.

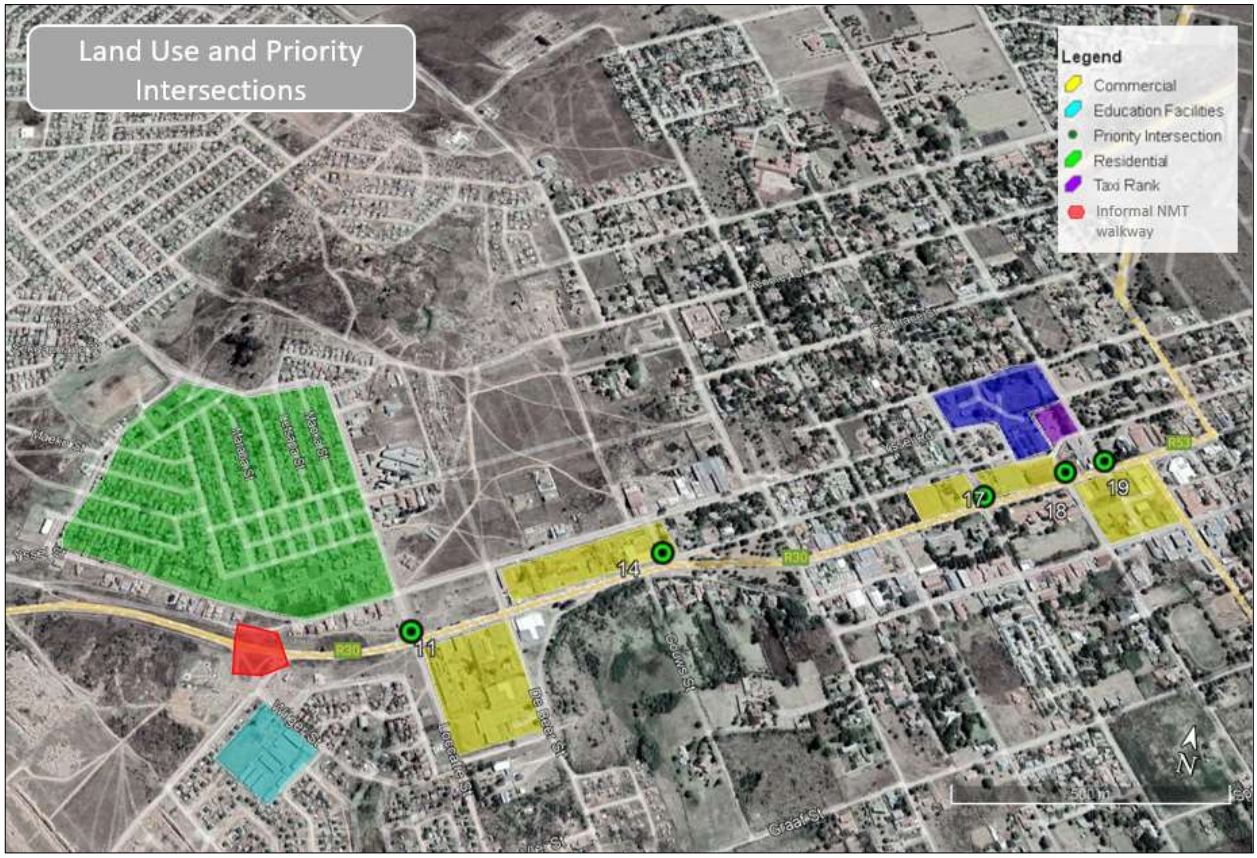


Figure 5-22: Priority NMT intersections

5.6.2 Non- Motorised Transport Recommendations

The following NMT and PT facilities are recommended to accommodate pedestrian and public transport demand along this section of the R30.

- **Universal Access Design:** Universal Design is fundamental in ensuring accessibility and integrating pedestrian movement within the South African transport systems. In accordance with the UN Charter on the Rights of People with Disabilities and Promotion of Equality and Prevention of Unfair Discrimination (Act 4 of 2000), ensuring safety for all pedestrians the following considerations should be made at all the pedestrian crossings along the route:
    - Tactile paving for people with sight impairments

- Kerb ramp for trolley users, wheelchair users (etc)
- Reduction in kerb radius for shorter crossing distance
- All surfaces should be level, non-slip and free from gravel or stones**.**

It is therefore recommended that Universal Access Design be implemented along the entire urban section of the R30 Section 8.

- **Pedestrian sidewalk and walkways:** Pedestrian mobility is prevalent in the Ventersdorp CBD. According to (DoT,2004), sidewalks should be provided at minimum width of 2m and along both sides of the road.
- **Pedestrian crossings:** Pedestrian crossings should be provided where there are relatively high pedestrian flows. Raised pedestrian crossings should also be considered at locations identified as hazardous for pedestrians as they provide ahead visibility for motorist which in turn reducing speed and providing safe crossing of pedestrians. Full pedestrian crossings on the R30 are recommended for consideration at the identified five (5) priority intersections in Section 5.6.1.
  In addition, a mid-block pedestrian raised crosswalk with associated road signs are recommended at km 66.86 to accommodate the anticipated high pedestrian crossings by learners attending at Toevlug Primary School and residing in Tshing.
- **Public transport lay-bys:** Lay-bys are for the improvement of pedestrian safety when getting off public transport and furthermore improve the free flow of traffic along routes. Taxi lay-bys are proposed in the vicinity of the following intersections:
  - **R30/Loccatie St**
  - **R30/Steen St**

  Figure 5-23 below provides an illustration of typical public transport lay-by**.**

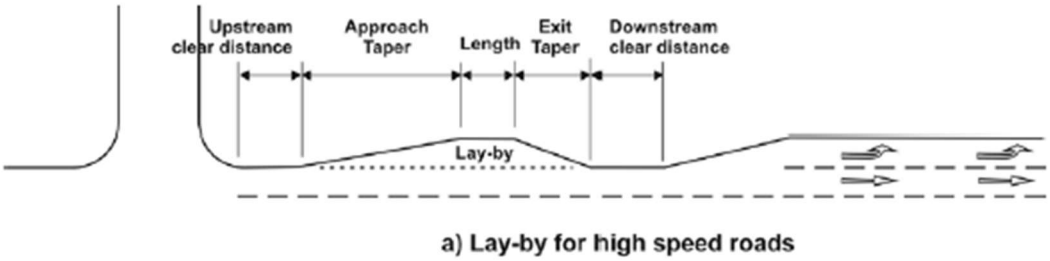


Figure 5-23: Typical lay – by (DoT, Pedestrians and Cyclists 2022)

- **On-street parking:** Parking is available at priority sections along the route and is supported due to the road being a destination for vehicular traffic. It is recommended that existing parking provision be improved. Parking Bay widths are related to adjacent traffic lane widths, and global best practice recommends that traffic lanes wider than 3.3 m have 2.1 m wide parking bays.
- **Speed Limits:** Limiting the speeds as far as possible is an important part of ensuring that the road environment is safe for individuals outside of vehicles. Proposed amendments to the Road Traffic Act (Act No.93 of 1996) reflect the importance of lowering speed limits. It is proposed that speed limits be reduced from 60 km/h to 50 km/h in urban areas. The reduced speed limit would also improve road safety in sections where on-street parking is provided.

6 CONCLUSIONS & RECOMMENDATIONS

The following conclusions are drawn from the traffic engineering study:

The section of R30 road can be classified as a Class 2 Rural major arterial that provides inter-regional connectivity between the towns of Derby, Ventersdorp and Klerksdorp

This section of the R30 comprises of two homogeneous sections with variable land use characteristics and heavy vehicle composition.

- The Tshing development will have a substantial impact on the upgrade/improvements along the section of the R30 under consideration.
- The roadway under consideration performs at acceptable levels of service for existing and proposed conditions.
- The Tshing Extension 10 development-generated trips have a significant impact on the operational performance of the N14/R30 and R30/Loccatie intersections.
- The western approach of the R30/Loccatie St. intersection operates at poor LOS F for the PM Peak Hour throughout the design life.
- The N14/R30 intersection fails for peak hour traffic conditions due to high additional turning volumes.

The following recommendations are made:

- Intersection improvements are recommended at the following intersections:
    - **N14/R30 I/S**: A new diamond interchange.
    - **Loccatie St./R30 I/S**: A dual lane traffic circle.
- Non- Motorised transport recommendations:
    - Universal Access Design: The following design considerations should be implemented along the entire urban section of the R30 Section 8:
        - Tactile paving for people with sight impairments
        - Kerb ramp for trolley users, wheelchair users (etc)
        - Reduction in kerb radius for shorter crossing distance
        - All surfaces should be level, non-slip and free from gravel or stones.
    - Pedestrian sidewalk and walkways: Sidewalks should be provided at minimum width of 2m although and along both sides of the road. Buffer strips of a 0.6m width should be considered where on street parking is not provided.
    - Pedestrian crossings: Provision of full pedestrians crossing on the R30 at the following identified (5) priority intersections. In addition to the priority intersections, a raised pedestrian crossing is recommended at km 66.84 in the vicinity of Toevlug Primary School.
    - Public transport lay-byes: Public transport lay-bys are proposed in the vicinity of the following intersections:
        - R30/Loccatie St
        - R30/Steen St
- On- street parking: The improvement of parking signage and speed control measures should be introduced limiting speeds to a maximum of 50km/hr on the route at priority sections.

Annexures

MERCHELLES
COLLECTIVE

YOUR ENGINEERING NEEDS,
OUR PASSION

Our Ref: GP099
14 June 2022

Project:	**Contract NRA R.030-080-2016/1: Consulting Engineering Services for the improvement of National Road R30 Section 8 from KM 36.8 to Ventersdorp KM 68.65** Provision of Traffic Engineering Sub-Consulting Services
Technical Note No.	001 (Draft)
Date:	14 June 2022
Description:	Update on traffic data and analysis related to the proposed Tshing Extension 10 development in Ventersdorp and impact on the R30 improvement project.
Prepared by:	Lerato Kgoa, BSc (Eng) Civil Merchelles Collective – Sub-Consultant to Ndodana Consulting
Circulation:	J. Kabaale Pr Eng (Ndodana) – Review G. Broekman Pr Eng (Ndodana) - Review A. Robinson Pr Eng (SANRAL NR) – Comment

1 Introduction

Merchelles Collective (Pty) Ltd is appointed by Ndodana Consulting Engineers (Pty) Ltd to render Traffic Engineering services as a Sub-Service Provider for the improvement of National Road R30 Section 8 from KM 36.8 to Ventersdorp KM 68.65 under contract NRA R.030-080-2016/1.

The traffic engineering assessment comprises of intersection capacity analysis for several intersections along the project route. The proposed Tshing Extension 10 township development has an impact on three existing intersections, namely:

1. N14/R30 Intersection ("A")
2. R30/Loccatie St Intersection ("B")
3. R30/De Beer St Intersection ("C")

A traffic impact assessment (TIA) report was undertaken in 2017 for the development and was made available to the consultants. Merchelles undertook capacity analysis of these intersections and made capacity upgrade recommendations for the N14/R30 and R30/Loccatie St intersections. The analysis was based on overall development trips as indicated in Figure 4AO of the TIA Report.

2 Development Traffic Volumes

An initial draft report was submitted to Ndodana for review and feedback proposed changes to the traffic growth rate scenarios to suit realistic pavement design options and the proposed growth were changed from 2.0% p.a. applied all to all traffic to 2.8% applied to light vehicles and 3.0% p.a. applied to heavy vehicles.

The new growth rate warranted updating the intersection analysis and upon doing this, Merchelles found that the recommended geometric upgrades at the R30/Loccatie intersection do not hold due to errors in the turning movement volumes. It further found that the analysis results and recommendations provided in the Tshing Ext. 10 TIA Report were not consistent and some annexures relating to results were omitted. Merchelles thus contacted MSN Civils who prepared the TIA report to request the missing Annexure D. Annexure D indicated significantly higher development related trips for the N14/R30 and R30/Loccatie St. intersections than those presented in Figure 4AO. The differences are highlighted in Table 2-1 below.

Table 2-1: Differences in Development Trips – AM Peak

Intersection	Trips from Figure 4AO (veh/hr)					Trips from Annexure D (veh/hr)					% Difference
Approach	**N**	**E**	**S**	**W**	**Total**	**N**	**E**	**S**	**W**	**Total**	
N14/R30	177	12	99	21	**309**	462	136	370	229	**1197**	**74.0%**
R30/Loccatie	95	113	11	307	**526**	160	200	60	490	**910**	**42.0%**

It should be noted that there are further inconsistencies in trip volumes within Annexure D, where the calculated trips do not match trips applied for analysis in Annexure E. Telephonic communication with MSN Civils concluded that the correct volumes are as per Annexure E for the R30/Loccatie St I/S, however it is recommended that MSN Civils provides written confirmation on which volumes are correct for all intersections to ensure the proposed geometric configuration of intersections allows adequate capacity and efficient traffic flow.

3 Intersection Analsyis

3.1 Development Impact

The trips generated by the development were distributed to the three impacted intersections to evaluate their impact on traffic operations. The existing intersections were analysed for the following scenarios:

- Opening Year without development 2025
- Opening Year with development 2025

Table 3-1: Level of Service Results for Existing Intersections

INTERSECTION	CONTROL TYPE	PEAK PERIOD	LEVEL OF SERVICE (LOS)	
			OPENING YEAR (WITHOUT DEVELOPMENT)	OPENING YEAR (WITH DEVELOPMENT)
N14/R30	Stop (Four-Way)	AM	**LOS C**	**LOS E**
		PM	**LOS C**	**LOS C**
R30/Loccatie	Stop (Four-Way)	AM	**LOS C**	**LOS F**
		PM	**LOS C**	**LOS F**
R30/De Beer	Stop (Two-Way)	AM	**LOS A**	**LOS A**
		PM	**LOS A**	**LOS A**

The results indicate that, with development traffic, the existing N14/R30 and R30 Loccatie intersections fail at opening year and require upgrades.

3.2 Intersection Upgrades

The following intersection improvements are proposed to ensure adequate performance levels from the opening year and throughout the design life:

- **N14/R30 I/S:** Provision of 500 m auxiliary lanes on the northern and southern approaches and converting the intersection control from All-Way-Stop control to a signalised control results in improved traffic flow and satisfactory intersection performance.
- **R30/Loccatie St. I/S:** Upgrading existing Two-Way-Stop control with a 10 m traffic circle or signalised control results in improved traffic flow conditions.

The upgraded intersections were analysed for the following scenarios:

- Opening Year with development 2025
- Design Year with development 2045

INTERSECTION	CONTROL TYPE	PEAK PERIOD	LEVEL OF SERVICE (LOS)	
			OPENING YEAR (WITH DEVELOPMENT)	DESIGN YEAR (WITH DEVELOPMENT)
N14/R30	Signal	AM	**LOS B**	**LOS B**
		PM	**LOS B**	**LOS B**
R30/Loccatie	Traffic Circle	AM	**LOS A**	**LOS A**
		PM	**LOS A**	**LOS A**
	Signal	AM	**LOS B**	**LOS B**
		PM	**LOS B**	**LOS B**

All upgrade options result in desirable operational conditions throughout the design life. The traffic circle option for the R30/Loccatie St. I/S is the most efficient for traffic flow with minimum delays in all directions. Figure 3-1 to Figure 3-3 below indicate the warranted geometric upgrades at the N14/R30 and R30/Loccatie St. intersections due to traffic generated by the Tshing Ext. 10development.

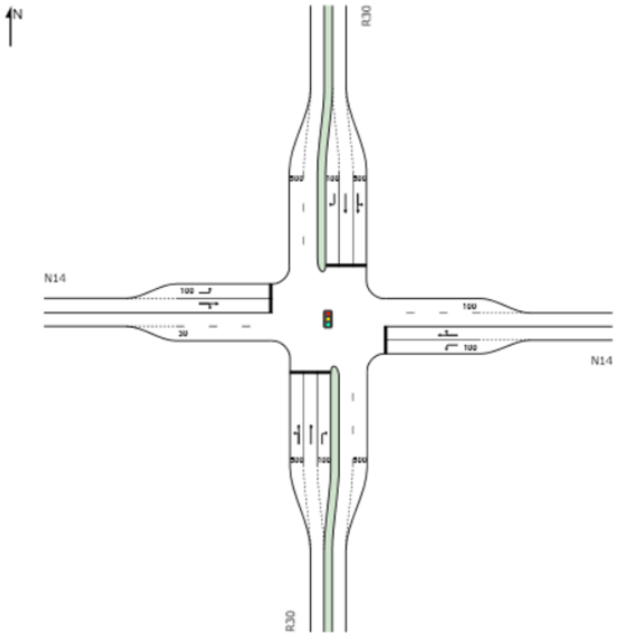


Figure 3-1: N14/R30 I/S Layout

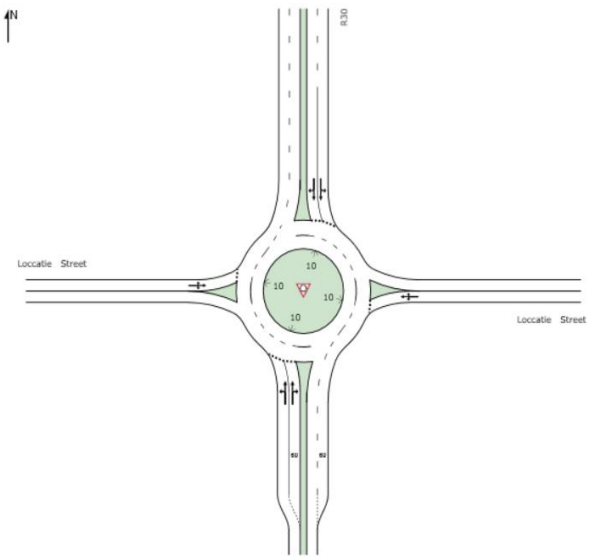


Figure 3-2: R30.Loccatie St. I/S Layout (Option 1)

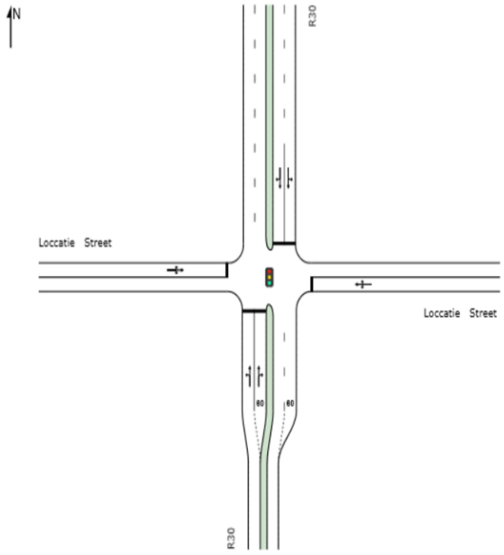


Figure 3-3: R30.Loccatie St. I/S Layout (Option 2)

The following document is attached for reference:

- Loccatie Extracts – Ndodana (Extracts of Annexure D and E of MSN Civils TIA Report, 2017)

Annexure D

Traffic Counts

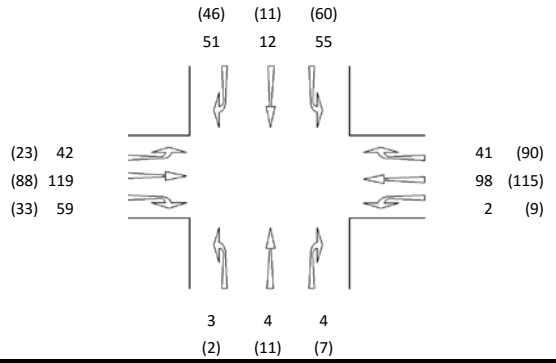
Peak hour trips & Projections

Intersection B : Loccatie Str & R30

Development : Ventersdorp N14 Development

Date : 22-Feb-18 (Thursday)

Name of Capturer : Johannes & Dolly



	Northern Approach												Southern Approach												Western Approach												Eastern Approach											
	NL				NS				NR				SL				SS				SR				WL				WS				WR				EL				ES				ER			
Time	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B
6:00 - 6:15	2	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	6	1	1	0	3	0	0	0	0	0	0	0	10	0	1	0	5	1	0	0
6:15 - 6:30	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	15	3	2	1	1	1	0	0	0	1	0	0	8	1	1	0	3	2	0	1
6:30 - 6:45	8	1	1	0	0	1	0	0	4	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	6	0	0	0	8	0	2	1	2	1	1	0	2	0	0	0	7	3	0	1	4	3	0	0
6:45 - 7:00	11	1	1	0	2	0	0	0	6	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0	1	1	1	2	17	1	4	1	7	0	0	0	1	0	0	0	14	1	0	0	5	1	0	0
7:00 - 7:15	11	2	0	0	4	0	0	0	13	1	1	1	0	0	0	0	0	0	0	0	1	1	0	0	7	5	0	0	35	5	0	2	7	7	1	1	0	0	0	0	13	2	3	0	8	2	2	0
7:15 - 7:30	10	1	1	0	4	0	1	0	7	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	3	0	0	19	2	1	0	11	6	1	3	1	0	0	0	28	6	4	1	9	2	0	0
7:30 - 7:45	14	1	1	1	1	0	0	0	14	3	0	0	3	0	0	0	1	0	0	0	0	0	0	0	12	6	0	0	28	3	0	1	12	2	1	0	0	0	0	0	18	4	4	0	8	4	0	0
7:45 - 8:00	15	1	2	0	1	0	0	0	3	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0	10	3	0	0	25	2	0	0	12	5	0	0	0	0	0	0	20	2	3	0	1	1	2	0
8:00 - 8:15	10	1	2	0	1	0	0	0	11	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	9	1	0	0	28	2	0	0	6	3	1	0	2	0	0	0	17	0	5	0	6	2	2	0
8:15 - 8:30	10	1	0	0	0	0	0	0	8	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	9	4	0	0	20	2	0	0	4	0	1	0	0	0	0	0	24	1	2	0	13	0	7	0
15:00 - 15:15	4	0	2	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	22	2	2	0	5	0	1	0	1	0	0	0	12	0	1	0	8	1	2	0
15:15 - 15:30	6	2	0	0	1	0	0	0	6	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	12	2	2	0	9	0	0	0	2	0	0	0	31	2	3	0	6	1	1	0
15:30 - 15:45	11	0	0	0	3	0	0	0	8	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	4	1	0	0	24	3	1	1	4	0	0	0	1	1	0	0	27	0	5	0	7	1	0	1
15:45 - 16:00	7	1	0	0	1	0	0	0	8	0	0	0	0	0	0	0	2	0	0	0	3	1	0	0	4	0	0	0	8	0	2	0	2	0	0	0	1	0	0	0	24	0	2	0	8	3	1	0
16:00 - 16:15	10	0	0	0	0	0	0	0	7	1	0	0	1	0	0	0	3	0	0	0	2	0	0	0	17	0	0	0	24	0	1	0	1	1	2	0	0	0	0	0	22	1	5	0	12	0	0	0
16:15 - 16:30	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	21	2	1	0	4	1	0	0	1	0	0	0	19	0	2	0	21	0	1	0
16:30 - 16:45	11	1	0	0	1	0	0	0	4	0	0	0	0	0	0	0	1	0	1	0	3	0	0	0	2	1	1	0	17	3	2	0	9	1	0	0	1	0	0	0	26	1	2	1	19	1	0	1
16:45 - 17:00	23	0	0	1	1	1	0	0	19	3	0	0	2	0	0	0	1	0	0	0	0	2	0	0	5	1	0	0	20	0	2	1	8	0	0	0	1	0	0	0	24	2	4	0	19	0	0	0
17:00 - 17:15	16	1	0	0	2	0	0	0	10	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2	1	0	0	26	0	0	0	8	1	0	0	5	0	0	0	21	2	6	0	27	0	1	0
17:15 - 17:30	7	0	0	0	6	0	0	0	9	0	0	0	0	0	0	0	7	0	0	0	1	0	0	0	9	1	0	0	16	1	0	0	6	0	0	0	2	0	0	0	23	1	2	0	22	0	0	0
17:30 - 17:45	7	1	0	0	0	0	0	0	3	0	1	0	2	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	11	0	1	0	2	1	0	0	3	0	0	0	20	0	3	0	15	2	0	0
17:45 - 18:00	8	0	0	0	1	0	0	0	8	0	0	4	1	0	0	0	1	0	0	0	0	0	0	0	6	0	0	1	19	2	0	3	1	0	0	0	0	0	0	0	26	0	1	0	15	1	0	0

	NL				NS				NR				SL				SS				SR				WL				WS				WR				EL				ES				ER			
Peak Period	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B	L	Tx	Tr	B
6:45 - 7:45	46	5	3	1	11	0	1	0	40	9	1	1	3	0	0	0	2	1	1	0	1	3	0	0	24	15	1	2	99	11	5	4	37	15	3	4	2	0	0	0	73	13	11	1	30	9	2	0
16:30 - 17:30	57	2	0	1	10	1	0	0	42	4	0	0	2	0	0	0	10	0	1	0	5	2	0	0	18	4	1	0	79	4	4	1	31	2	0	0	9	0	0	0	94	6	14	1	87	1	1	1

Base and Horizon, Background and Projected Traffic Volumes

% Growth = 3,5

No of yrs = 5

PHF = 0,92

Projected Traffic = $V (1 + 0.01 \times P)^{n}$

V = Traffic Volume

P = Percentage Growth

n = number of years for projection

Intersection: A R30 & N14

	North			South			West			East		
AM Peak	**NL**	**NT**	**NR**	**SL**	**ST**	**SR**	**WL**	**WT**	**WR**	**EL**	**ES**	**ER**
2018 Background	26	107	9	21	113	4	4	65	15	6	57	32
2018 with PHF	28	116	10	23	123	4	4	71	16	7	62	35
2023 Background	34	138	12	27	146	5	5	84	19	8	74	41
Total Sub - Dev	58	231	173	68	221	81	127	17	85	82	17	37
2018 + Development	28	116	10	23	123	4	4	71	16	7	62	35
2023 + Development	92	219	97	27	210	5	63	84	19	8	74	78
PM Peak												
2018 Background	28	135	5	22	100	8	10	54	30	3	86	22
2018 with PHF	30	147	5	24	109	9	11	59	33	3	93	24
2023 Background	36	174	6	28	129	10	13	70	39	4	111	28
Total Sub - Dev	34	179	138	88	246	84	140	17	69	80	17	50
2018 + Development	30	147	5	24	109	9	11	59	33	3	93	24
2023 + Development	36	174	6	28	129	10	13	70	39	4	111	28

Intersection: B Loccatie Str & R30

	North			South			West			East		
AM Peak	**NL**	**NT**	**NR**	**SL**	**ST**	**SR**	**WL**	**WT**	**WR**	**EL**	**ES**	**ER**
2018 Background	55	12	51	3	4	4	42	119	59	2	98	41
2018 with PHF	60	13	55	3	4	4	46	129	64	2	107	45
2023 Background	71	15	66	4	5	5	54	154	76	3	127	53
Total Sub - Dev	0	0	160	60	0	0	170	251	69	0	200	0
2018 + Development	60	13	55	3	4	4	46	129	64	2	107	45
2023 + Development	71	15	178	36	5	5	178	305	114	3	249	53
PM Peak												
2018 Background	60	11	46	2	11	7	23	88	33	9	115	90
2018 with PHF	65	12	50	2	12	8	25	96	36	10	125	98
2023 Background	77	14	59	3	14	9	30	114	43	12	148	116
Total Sub - Dev	0	0	127	52	0	0	129	208	55	0	191	0
2018 + Development	65	12	50	2	12	8	25	96	36	10	125	98
2023 + Development	77	14	59	3	14	9	30	114	43	12	148	116

Annexure E

Micro-analysis results

AutoJ

Loccatie Str & R30
Ventersdorp N14 Development

Scenario 1: 2018 Background

XX | **Stop street on all approaches**

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**		**total**
AM		28	116	10	**154**		23	147	4	**174**		4	71	16	**91**		7	62	35	**104**		**523**
off																						
PM		30	147	5	**182**		24	127	9	**160**		11	59	33	**103**		3	93	24	**120**		**565**

Lanes

(if lanes shared L:S or S:R = 0.5:0.5; L:S:R = 0.3:0.4:0.3)

	from North				from South				from West				from East			
	L~	L	S	R	L~	L	S	R	L~	L	S	R	L~	L	S	R
# lanes		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3

Control

	from North				from South				from West				from East			
	peds	left	str	right	*peds*	left	str	right	*peds*	left	str	right	*peds*	left	str	right
		stop	stop	stop		stop	stop	stop		stop	stop	stop		stop	stop	stop

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**overall**
AM		0,51	0,51	0,51	**0,51**		0,61	0,61	0,61	**0,61**		0,36	0,36	0,36	**0,36**		0,41	0,41	0,41	**0,41**	0,61	0,50
off																						
PM		0,61	0,61	0,61	**0,61**		0,55	0,55	0,55	**0,55**		0,38	0,38	0,38	**0,38**		0,49	0,49	0,49	**0,49**	0,61	0,53

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<15, C<25, D<35, E<50

Ped LOS A<10, B<15, C<25, D<35, E<50, F=50+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**overall**
AM		10	11	12	11		12	13	13	13		9	10	10	10		9	10	11	10	13	11
off																						
PM		12	13	13	13		11	12	12	12		9	10	10	10		10	11	12	11	13	12

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**total**
AM		0,1	0,4	0,0	**0,5**		0,1	0,5	0,0	**0,6**		0,0	0,2	0,0	**0,3**		0,0	0,2	0,1	**0,3**	0,5	**1,7**
off																						
PM		0,1	0,5	0,0	**0,6**		0,1	0,4	0,0	**0,5**		0,0	0,2	0,1	**0,3**		0,0	0,3	0,1	**0,4**	0,5	**1,8**

copyright:
Dr John Sampson

AutoJ

Loccatie Str & R30
Ventersdorp N14 Development

Scenario 2: 2018 + Dev

XX | **Stop street on all approaches**

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**		**total**
AM		28	116	170	**314**		83	147	4	**234**		175	322	86	**583**		7	262	35	**304**		**1 435**
off																						
PM		30	147	76	**253**		58	127	9	**194**		99	203	76	**378**		3	178	24	**205**		**1 030**

Lanes

(if lanes shared L:S or S:R = 0.5:0.5; L:S:R = 0.3:0.4:0.3)

	from North				from South				from West				from East			
	L~	L	S	R	L~	L	S	R	L~	L	S	R	L~	L	S	R
# lanes		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3

Control

	from North				from South				from West				from East			
	peds	left	str	right	*peds*	left	str	right	*peds*	left	str	right	*peds*	left	str	right
		stop	stop	stop		stop	stop	stop		stop	stop	stop		stop	stop	stop

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**overall**
AM		1,21	1,21	1,21	**1,21**		0,66	0,66	0,66	**0,66**		1,76	1,76	1,76	**1,76**		1,25	1,25	1,25	**1,25**	1,76	1,35
off																						
PM		0,93	0,93	0,93	**0,93**		0,57	0,57	0,57	**0,57**		1,19	1,19	1,19	**1,19**		0,85	0,85	0,85	**0,85**	1,19	0,94

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<15, C<25, D<35, E<50

Ped LOS A<10, B<15, C<25, D<35, E<50, F=50+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**overall**
AM		389	396	398	397		13	14	15	14		854	862	864	860		435	443	445	443	864	532
off																						
PM		35	40	42	40		11	12	13	12		363	371	373	370		22	26	27	26	373	153

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**total**
AM		3,0	12,8	18,8	**34,6**		0,3	0,6	0,0	**0,9**		41,5	77,1	20,6	**139,3**		0,8	32,2	4,3	**37,4**	77,1	**212,2**
off																						
PM		0,3	1,6	0,9	**2,8**		0,2	0,4	0,0	**0,6**		10,0	20,9	7,9	**38,8**		0,0	1,3	0,2	**1,5**	20,9	**43,7**

copyright:
Dr John Sampson

AutoJ

Loccatie Str & R30
Ventersdorp N14 Development

Scenario 2a: 2018 + Dev (Alt 1)

RR | **Roundabout or mini-circle, yield on all approaches**

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R		total
AM		60	13	216	**289**		63	4	4	**71**		216	380	133	**729**		2	307	45	**354**		**1 443**
off																						
PM		65	12	177	**254**		54	12	8	**74**		154	303	91	**548**		10	316	98	**424**		**1 300**

Lanes

	from North		from South		from West		from East	
	L~	LSR	L~	LSR	L~	LSR	L~	LSR
# lanes		1		1		1		1

Control

from North				from South				from West				from East			
peds	left	str	right	*peds*	left	str	right	*peds*	left	str	right	*peds*	left	str	right
	yield	yield	yield		yield	yield	yield		yield	yield	yield		yield	yield	yield

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		0,32	0,32	0,32	**0,32**		0,08	0,08	0,08	**0,08**		0,48	0,48	0,48	**0,48**		0,33	0,33	0,33	**0,33**	0,48	0,39
off																						
PM		0,25	0,25	0,25	**0,25**		0,09	0,09	0,09	**0,09**		0,39	0,39	0,39	**0,39**		0,36	0,36	0,36	**0,36**	0,39	0,34

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<15, C<25, D<35, E<50

Ped LOS A<10, B<15, C<25, D<35, E<50, F=50+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		6	6	6	6		5	5	5	5		7	7	7	7		6	6	6	6	7	6
off																						
PM		5	5	5	5		5	5	5	5		6	6	6	6		6	6	6	6	6	6

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	total
AM		0,1	0,0	0,3	**0,4**		0,1	0,0	0,0	**0,1**		0,4	0,7	0,2	**1,3**		0,0	0,5	0,1	**0,6**	0,7	**2,4**
off																						
PM		0,1	0,0	0,3	**0,4**		0,1	0,0	0,0	**0,1**		0,3	0,5	0,2	**0,9**		0,0	0,5	0,2	**0,7**	0,5	**2,1**

copyright:
Dr John Sampson

print:
2018/10/16

AutoJ

Loccatie Str & R30
Ventersdorp N14 Development

Scenario 2a: 2018 + Dev (Alt 2)

2 | **2 stage signal**

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R		total
AM		60	13	216	**289**		63	4	4	**71**		216	380	133	**729**		2	307	45	**354**		**1 443**
off																						
PM		65	12	177	**254**		54	12	8	**74**		154	303	91	**548**		10	316	98	**424**		**1 300**

Lanes

(if lanes shared L:S or S:R = 0.5:0.5; L:S:R = 0.3:0.4:0.3)

	from North				from South				from West				from East			
	L~	L	S	R	L~	L	S	R	L~	L	S	R	L~	L	S	R
# lanes		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3

Green / Cycle ratio

	g/c from North					g/c from South					g/c from West					g/c from East				
	peds	left	thru	rt gaps		*peds*	left	thru	rt gaps		*peds*	left	thru	rt gaps		*peds*	left	thru	rt gaps	
AM	*0,15*	0,22	0,22	0,22		*0,15*	0,22	0,22	0,22		*0,56*	0,63	0,63	0,63		*0,56*	0,63	0,63	0,63	
off	*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34	
PM	*0,17*	0,25	0,25	0,25		*0,17*	0,25	0,25	0,25		*0,53*	0,61	0,61	0,61		*0,53*	0,61	0,61	0,61	

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		0,77	0,77	0,77	**0,77**		0,18	0,18	0,18	**0,18**		0,77	0,77	0,77	**0,77**		0,46	0,46	0,46	**0,46**	0,77	0,66
off																						
PM		0,60	0,60	0,60	**0,60**		0,17	0,17	0,17	**0,17**		0,60	0,60	0,60	**0,60**		0,60	0,60	0,60	**0,60**	0,60	0,58

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<20, C<35, D<55, E<80, F=80+

Ped LOS A<10, B<20, C<35, D<55, E<80, F=80+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		32	32	32	**32**		22	22	22	**22**		15	15	15	**15**		8	8	8	**8**	32	**17**
off																						
PM		26	26	26	**26**		21	21	21	**21**		11	11	11	**11**		11	11	11	**11**	26	**15**

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	total
AM		0,5	0,1	1,9	**2,5**		0,4	0,0	0,0	**0,4**		0,9	1,6	0,6	**3,1**		0,0	0,7	0,1	**0,8**	1,9	**6,8**
off																						
PM		0,5	0,1	1,3	**1,8**		0,3	0,1	0,0	**0,4**		0,5	0,9	0,3	**1,7**		0,0	1,0	0,3	**1,3**	1,3	**5,3**

copyright:
Dr John Sampson

AutoJ

Loccatie Str & R30
Ventersdorp N14 Development

Scenario 3a: 2023 Background (Alt 1)

RR | **Roundabout or mini-circle, yield on all approaches**

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**		**total**
AM		71	15	66	**152**		4	5	5	**14**		54	154	76	**284**		3	127	53	**183**		**633**
off																						
PM		77	14	59	**150**		3	14	9	**26**		30	114	43	**187**		12	148	116	**276**		**639**

Lanes

	from North		from South		from West		from East	
	L~	LSR	L~	LSR	L~	LSR	L~	LSR
# lanes		1		1		1		1

Control

	from North			from South			from West			from East		
	peds	left	str	right	*peds*	left	str	right	*peds*	left	str	right	*peds*	left	str	right
		yield	yield	yield		yield	yield	yield		yield	yield	yield		yield	yield	yield

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**overall**
AM		0,12	0,12	0,12	**0,12**		0,01	0,01	0,01	**0,01**		0,19	0,19	0,19	**0,19**		0,14	0,14	0,14	**0,14**	0,19	0,15
off																						
PM		0,11	0,11	0,11	**0,11**		0,02	0,02	0,02	**0,02**		0,14	0,14	0,14	**0,14**		0,20	0,20	0,20	**0,20**	0,20	0,15

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<15, C<25, D<35, E<50

Ped LOS A<10, B<15, C<25, D<35, E<50, F=50+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**overall**
AM		5	5	5	5		5	5	5	5		5	5	5	5		5	5	5	5	5	5
off																						
PM		5	5	5	5		5	5	5	5		5	5	5	5		5	5	5	5	5	5

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	*peds*	left	str	right	**L+S+R**	max	**total**
AM		0,1	0,0	0,1	**0,2**		0,0	0,0	0,0	**0,0**		0,1	0,2	0,1	**0,4**		0,0	0,2	0,1	**0,2**	0,2	**0,9**
off																						
PM		0,1	0,0	0,1	**0,2**		0,0	0,0	0,0	**0,0**		0,0	0,2	0,1	**0,3**		0,0	0,2	0,2	**0,4**	0,2	**0,9**

copyright:
Dr John Sampson

print:
2018/10/16

AutoJ

Loccatie Str & R30
Ventersdorp N14 Development

Scenario 3a: 2023 Background (Alt 2)

2 | **2 stage signal**

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R		total
AM		71	15	66	**152**		4	5	5	**14**		54	154	76	**284**		3	127	53	**183**		**633**
off																						
PM		77	14	59	**150**		3	14	9	**26**		30	114	43	**187**		12	148	116	**276**		**639**

Lanes

(if lanes shared L:S or S:R = 0.5:0.5; L:S:R = 0.3:0.4:0.3)

	from North				from South				from West				from East			
	L~	L	S	R	L~	L	S	R	L~	L	S	R	L~	L	S	R
# lanes		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3

Green / Cycle ratio

	g/c from North					g/c from South					g/c from West					g/c from East				
	peds	left	thru	rt gaps		*peds*	left	thru	rt gaps		*peds*	left	thru	rt gaps		*peds*	left	thru	rt gaps	
AM	*0,20*	0,28	0,28	0,28		*0,20*	0,28	0,28	0,28		*0,50*	0,58	0,58	0,58		*0,50*	0,58	0,58	0,58	
off	*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34	
PM	*0,20*	0,27	0,27	0,27		*0,20*	0,27	0,27	0,27		*0,51*	0,58	0,58	0,58		*0,51*	0,58	0,58	0,58	

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		0,29	0,29	0,29	**0,29**		0,03	0,03	0,03	**0,03**		0,29	0,29	0,29	**0,29**		0,21	0,21	0,21	**0,21**	0,29	0,26
off																						
PM		0,30	0,30	0,30	**0,30**		0,06	0,06	0,06	**0,06**		0,19	0,19	0,19	**0,19**		0,30	0,30	0,30	**0,30**	0,30	0,26

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<20, C<35, D<55, E<80, F=80+

Ped LOS A<10, B<20, C<35, D<55, E<80, F=80+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		21	21	21	**21**		18	18	18	**18**		8	8	8	**8**		8	8	8	**8**	21	**11**
off																						
PM		21	21	21	**21**		19	19	19	**19**		7	7	7	**7**		8	8	8	**8**	21	**11**

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	total
AM		0,4	0,1	0,4	**0,9**		0,0	0,0	0,0	**0,1**		0,1	0,4	0,2	**0,7**		0,0	0,3	0,1	**0,4**	0,4	**2,0**
off																						
PM		0,4	0,1	0,3	**0,9**		0,0	0,1	0,0	**0,1**		0,1	0,2	0,1	**0,4**		0,0	0,3	0,3	**0,6**	0,4	**2,0**

copyright:
Dr John Sampson

AutoJ

Loccatie Str & R30
Ventersdorp N14 Development

Scenario 4a: 2023 + Dev (Alt 1)

RR | **Roundabout or mini-circle, yield on all approaches**

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R		total
AM		71	15	226	**312**		64	5	5	**74**		225	405	145	**775**		3	327	53	**383**		**1 544**
off																						
PM		77	14	186	**277**		54	14	9	**77**		158	321	98	**577**		12	339	116	**467**		**1 398**

Lanes

	from North		from South		from West		from East	
	L~	LSR	L~	LSR	L~	LSR	L~	LSR
# lanes		1		1		1		1

Control

	from North			from South			from West			from East		
	peds	left	str	right	*peds*	left	str	right	*peds*	left	str	right	*peds*	left	str	right
		yield	yield	yield		yield	yield	yield		yield	yield	yield		yield	yield	yield

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		0,36	0,36	0,36	**0,36**		0,09	0,09	0,09	**0,09**		0,52	0,52	0,52	**0,52**		0,37	0,37	0,37	**0,37**	0,52	0,43
off																						
PM		0,28	0,28	0,28	**0,28**		0,10	0,10	0,10	**0,10**		0,42	0,42	0,42	**0,42**		0,41	0,41	0,41	**0,41**	0,42	0,37

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<15, C<25, D<35, E<50

Ped LOS A<10, B<15, C<25, D<35, E<50, F=50+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		6	6	6	6		5	5	5	5		7	7	7	7		6	6	6	6	7	6
off																						
PM		5	5	5	5		5	5	5	5		6	6	6	6		6	6	6	6	6	6

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	total
AM		0,1	0,0	0,4	**0,5**		0,1	0,0	0,0	**0,1**		0,4	0,8	0,3	**1,5**		0,0	0,5	0,1	**0,6**	0,8	**2,7**
off																						
PM		0,1	0,0	0,3	**0,4**		0,1	0,0	0,0	**0,1**		0,3	0,5	0,2	**1,0**		0,0	0,6	0,2	**0,8**	0,6	**2,3**

copyright:
Dr John Sampson

print:
2018/10/16

AutoJ

Loccatie Str & R30
Ventersdorp N14 Development

Scenario 4a: 2023 + Dev (Alt 2)

2 | **2 stage signal**

Volume (evu/hr)

	from North					from South					from West					from East					intersection	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R		total
AM		71	15	226	**312**		64	5	5	**74**		225	405	145	**775**		3	327	53	**383**		**1 544**
off																						
PM		77	14	186	**277**		54	14	9	**77**		158	321	98	**577**		12	339	116	**467**		**1 398**

Lanes

(if lanes shared L:S or S:R = 0.5:0.5; L:S:R = 0.3:0.4:0.3)

	from North				from South				from West				from East			
	L~	L	S	R	L~	L	S	R	L~	L	S	R	L~	L	S	R
# lanes		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3		0,3	0,4	0,3

Green / Cycle ratio

	g/c from North					g/c from South					g/c from West					g/c from East				
	peds	left	thru	rt gaps		*peds*	left	thru	rt gaps		*peds*	left	thru	rt gaps		*peds*	left	thru	rt gaps	
AM	*0,15*	0,22	0,22	0,22		*0,15*	0,22	0,22	0,22		*0,56*	0,64	0,64	0,64		*0,56*	0,64	0,64	0,64	
off	*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34		*0,18*	0,34	0,34	0,34	
PM	*0,17*	0,24	0,24	0,24		*0,17*	0,24	0,24	0,24		*0,54*	0,62	0,62	0,62		*0,54*	0,62	0,62	0,62	

VOLUME to CAPACITY (V/C)

A-B | C-D | E | F

LOS A<0.5, B<0.8, C<0.9, D<0.95, E<0.99

Ped LOS A<0.1, B<0.3, C<0.4, D<0.6, E<0.97, F=0.97+

	V/C from North					V/C from South					V/C from West					V/C from East					V/C	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		0,83	0,83	0,83	**0,83**		0,19	0,19	0,19	**0,19**		0,83	0,83	0,83	**0,83**		0,52	0,52	0,52	**0,52**	0,83	0,73
off																						
PM		0,68	0,68	0,68	**0,68**		0,18	0,18	0,18	**0,18**		0,64	0,64	0,64	**0,64**		0,68	0,68	0,68	**0,68**	0,68	0,64

Average DELAY per vehicle (secs)

A-B | C-D | E | F

LOS A<10, B<20, C<35, D<55, E<80, F=80+

Ped LOS A<10, B<20, C<35, D<55, E<80, F=80+

	delay from North					delay from South					delay from West					delay from East					delay / veh	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	overall
AM		35	35	35	**35**		23	23	23	**23**		19	19	19	**19**		9	9	9	**9**	35	**20**
off																						
PM		28	28	28	**28**		22	22	22	**22**		12	12	12	**12**		13	13	13	**13**	28	**16**

Average QUEUE length (veh)

(= total delay veh-hrs / hr)

OK | WARN | POOR

Q <4 = OK, <10 = WARN, 10+ = POOR

	Q from North					Q from South					Q from West					Q from East					Queue	
	peds	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	*peds*	left	str	right	L+S+R	max	total
AM		0,7	0,1	2,2	**3,0**		0,4	0,0	0,0	**0,5**		1,2	2,1	0,8	**4,1**		0,0	0,8	0,1	**1,0**	2,2	**8,5**
off																						
PM		0,6	0,1	1,4	**2,2**		0,3	0,1	0,1	**0,5**		0,5	1,0	0,3	**1,9**		0,0	1,2	0,4	**1,6**	1,4	**6,1**

copyright:
Dr John Sampson

TRAFFIC VOLUMES 2045

3% 24

R30 /N14 AM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	2	4	50%	68	**72**	**36**
		T1	114	221	6%	221	**442**	**26**
		R2	9	17	22%	81	**98**	**22**
	E	L2	21	41	5%	37	**78**	**4**
		T1	94	182	32%	17	**199**	**64**
		R2	4	8	25%	82	**90**	**22**
	N	L2	0	0	0%	58	**58**	**0**
		T1	137	266	7%	231	**497**	**33**
		R2	36	70	6%	173	**243**	**14**
	W	L2	132	256	12%	127	**383**	**46**
		T1	149	289	33%	17	**306**	**101**
		R2	9	17	0%	85	**102**	**0**

R30 /N14 PM			Base Year Volumes	Growth Rate	% HV	Generated Trips	New Volumes	New HV
	S	L2	6	12	17%	88	**100**	**17**
		T1	126	244	17%	246	**490**	**84**
		R2	16	31	17%	84	**115**	**19**
	E	L2	19	37	11%	50	**87**	**9**
		T1	74	144	41%	17	**161**	**65**
		R2	2	4	50%	80	**84**	**42**
	N	L2	3	6	0%	34	**40**	**0**
		T1	102	198	5%	179	**377**	**18**
		R2	21	41	10%	138	**179**	**17**
	W	L2	25	49	12%	140	**189**	**23**
		T1	105	204	33%	17	**221**	**73**
		R2	9	17	67%	69	**86**	**58**

R30/ Loccattie AM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	38	74	3%	170	**244**	**6**
		T1	114	221	6%	251	**472**	**29**
		R2	2	4	50%	69	**73**	**36**
	E	L2	2	4	0%	60	**64**	**0**
		T1	12	23	8%	0	**23**	**2**
		R2	15	29	0%	0	**29**	**0**
	N	L2	7	14	2%	0	**14**	**0**
		T1	117	227	14%	200	**427**	**58**
		R2	45	87	29%	0	**87**	**25**
	W	L2	63	122	3%	0	**122**	**4**
		T1	7	14	14%	0	**14**	**2**
		R2	62	120	2%	160	**280**	**4**

R30/ Loccattie PM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	32	62	3%	69	**131**	**4**
		T1	113	219	1%	251	**470**	**4**
		R2	1	2	100%	170	**172**	**2**
	E	L2	1	2	0%	0	**2**	**0**
		T1	9	17	50%	0	**17**	**9**
		R2	15	29	0%	52	**81**	**0**
	N	L2	8	16	0%	0	**16**	**0**
		T1	108	210	12%	191	**401**	**48**
		R2	55	107	0%	0	**107**	**0**
	W	L2	39	76	5%	0	**76**	**4**
		T1	3	6	0%	0	**6**	**0**
		R2	23	45	0%	127	**172**	**0**

de beer

R30/DE BEER			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	1	2	0%	18	**20**	**0**
		T1	201	390	8%	130	**520**	**39**
		R2	3	6	33%	8	**14**	**5**
	E	L2	0	0	0%	0	**0**	**0**
		T1	0	0	0%	0	**0**	**0**
		R2	6	12	0%	11	**23**	**0**
	N	L2	3	6	0%	0	**6**	**0**
		T1	185	359	12%	90	**449**	**53**
		R2	7	14	0%	0	**14**	**0**
	W	L2	6	12	0%		**12**	**0**
		T1	3	6	0%	0	**6**	**0**
		R2	5	10	0%	0	**10**	**0**

R30/DE BEER			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	lew Volume	New HV
	S	L2	3	6	0%	12	**18**	**0**
		T1	169	328	10%	73	**401**	**40**
		R2	4	8	25%	12	**20**	**5**
	E	L2	1	2	0%	0	**2**	**0**
		T1	3	6	50%	0	**6**	**3**
		R2	13	25	0%	17	**42**	**0**
	N	L2	3	6	0%	0	**6**	**0**
		T1	185	359	8%	103	**462**	**38**
		R2	7	14	0%	0	**14**	**0**
	W	L2	5	10	0%	0	**10**	**0**
		T1	1	2	0%	0	**2**	**0**
		R2	3	6	0%	0	**6**	**0**

TRAFFIC VOLUMES 2025

3% 4

R30 /N14 AM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	2	2	50%	68	**70**	**35**
		T1	114	127	6%	221	**348**	**20**
		R2	9	10	22%	81	**91**	**20**
	E	L2	21	23	5%	37	**60**	**3**
		T1	94	105	32%	17	**122**	**39**
		R2	4	4	25%	82	**86**	**22**
	N	L2	0	0	0%	58	**58**	**0**
		T1	137	153	7%	231	**384**	**25**
		R2	36	40	6%	173	**213**	**12**
	W	L2	132	147	12%	127	**274**	**33**
		T1	149	166	33%	17	**183**	**60**
		R2	9	10	0%	85	**95**	**0**

R30 /N14 PM			Base Year Volumes	Growth Rate	% HV	Generated Trips	New Volumes	New HV
	S	L2	6	7	17%	88	**95**	**16**
		T1	126	141	17%	246	**387**	**66**
		R2	16	18	17%	84	**102**	**17**
	E	L2	19	21	11%	50	**71**	**7**
		T1	74	83	41%	17	**100**	**40**
		R2	2	2	50%	80	**82**	**41**
	N	L2	3	3	0%	34	**37**	**0**
		T1	102	114	5%	179	**293**	**14**
		R2	21	23	10%	138	**161**	**15**
	W	L2	25	28	12%	140	**168**	**20**
		T1	105	117	33%	17	**134**	**45**
		R2	9	10	67%	69	**79**	**53**

R30/ Loccattie AM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	38	42	3%	170	**212**	**6**
		T1	114	127	6%	251	**378**	**23**
		R2	2	2	50%	69	**71**	**36**
	E	L2	2	2	0%	60	**62**	**0**
		T1	12	13	8%	0	**13**	**1**
		R2	15	17	0%	0	**17**	**0**
	N	L2	7	8	2%	0	**8**	**0**
		T1	117	131	14%	200	**331**	**45**
		R2	45	50	29%	0	**50**	**14**
	W	L2	63	70	3%	0	**70**	**2**
		T1	7	8	14%	0	**8**	**1**
		R2	62	69	2%	160	**229**	**4**

R30/ Loccattie PM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	32	36	3%	69	**105**	**3**
		T1	113	126	1%	251	**377**	**3**
		R2	1	1	100%	170	**171**	**2**
	E	L2	1	1	0%	0	**1**	**0**
		T1	9	10	50%	0	**10**	**5**
		R2	15	17	0%	52	**69**	**0**
	N	L2	8	9	0%	0	**9**	**0**
		T1	108	121	12%	191	**312**	**37**
		R2	55	61	0%	0	**61**	**0**
	W	L2	39	44	5%	0	**44**	**2**
		T1	3	3	0%	0	**3**	**0**
		R2	23	26	0%	127	**153**	**0**

de beer

R30/DE BEER			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	1	1	0%	18	**19**	**0**
		T1	201	224	8%	130	**354**	**27**
		R2	3	3	33%	8	**11**	**4**
	E	L2	0	0	0%	0	**0**	**0**
		T1	0	0	0%	0	**0**	**0**
		R2	6	7	0%	11	**18**	**0**
	N	L2	3	3	0%	0	**3**	**0**
		T1	185	207	12%	90	**297**	**35**
		R2	7	8	0%	0	**8**	**0**
	W	L2	6	7	0%		**7**	**0**
		T1	3	3	0%	0	**3**	**0**
		R2	5	6	0%	0	**6**	**0**

R30/DE BEER			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	lew Volume	New HV
	S	L2	3	3	0%	12	**15**	**0**
		T1	169	189	10%	73	**262**	**26**
		R2	4	4	25%	12	**16**	**4**
	E	L2	1	1	0%	0	**1**	**0**
		T1	3	3	50%	0	**3**	**2**
		R2	13	15	0%	17	**32**	**0**
	N	L2	3	3	0%	0	**3**	**0**
		T1	185	207	8%	103	**310**	**25**
		R2	7	8	0%	0	**8**	**0**
	W	L2	5	6	0%	0	**6**	**0**
		T1	1	1	0%	0	**1**	**0**
		R2	3	3	0%	0	**3**	**0**

TRAFFIC VOLUMES 2024

3% 4

R30 /N14 AM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	2	2	50%	68	**70**	**35**
		T1	114	127	6%	221	**348**	**20**
		R2	9	10	22%	81	**91**	**20**
	E	L2	21	23	5%	37	**60**	**3**
		T1	94	105	32%	17	**122**	**39**
		R2	4	4	25%	82	**86**	**22**
	N	L2	0	0	0%	58	**58**	**0**
		T1	137	153	7%	231	**384**	**25**
		R2	36	40	6%	173	**213**	**12**
	W	L2	132	147	12%	127	**274**	**33**
		T1	149	166	33%	17	**183**	**60**
		R2	9	10	0%	85	**95**	**0**

R30 /N14 PM			Base Year Volumes	Growth Rate	% HV	Generated Trips	New Volumes	New HV
	S	L2	6	7	17%	88	**95**	**16**
		T1	126	141	17%	246	**387**	**66**
		R2	16	18	17%	84	**102**	**17**
	E	L2	19	21	11%	50	**71**	**7**
		T1	74	83	41%	17	**100**	**40**
		R2	2	2	50%	80	**82**	**41**
	N	L2	3	3	0%	34	**37**	**0**
		T1	102	114	5%	179	**293**	**14**
		R2	21	23	10%	138	**161**	**15**
	W	L2	25	28	12%	140	**168**	**20**
		T1	105	117	33%	17	**134**	**45**
		R2	9	10	67%	69	**79**	**53**

R30/ Loccattie AM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	38	42	3%	170	**212**	**6**
		T1	114	127	6%	251	**378**	**23**
		R2	2	2	50%	69	**71**	**36**
	E	L2	2	2	0%	60	**62**	**0**
		T1	12	13	8%	0	**13**	**1**
		R2	15	17	0%	0	**17**	**0**
	N	L2	7	8	2%	0	**8**	**0**
		T1	117	131	14%	200	**331**	**45**
		R2	45	50	29%	0	**50**	**14**
	W	L2	63	70	3%	0	**70**	**2**
		T1	7	8	14%	0	**8**	**1**
		R2	62	69	2%	160	**229**	**4**

R30/ Loccattie PM			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	32	36	3%	69	**105**	**3**
		T1	113	126	1%	251	**377**	**3**
		R2	1	1	100%	170	**171**	**2**
	E	L2	1	1	0%	0	**1**	**0**
		T1	9	10	50%	0	**10**	**5**
		R2	15	17	0%	52	**69**	**0**
	N	L2	8	9	0%	0	**9**	**0**
		T1	108	121	12%	191	**312**	**37**
		R2	55	61	0%	0	**61**	**0**
	W	L2	39	44	5%	0	**44**	**2**
		T1	3	3	0%	0	**3**	**0**
		R2	23	26	0%	127	**153**	**0**

de beer

R30/DE BEER			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	New Volumes	New HV
	S	L2	1	1	0%	18	**19**	**0**
		T1	201	224	8%	130	**354**	**27**
		R2	3	3	33%	8	**11**	**4**
	E	L2	0	0	0%	0	**0**	**0**
		T1	0	0	0%	0	**0**	**0**
		R2	6	7	0%	11	**18**	**0**
	N	L2	3	3	0%	0	**3**	**0**
		T1	185	207	12%	90	**297**	**35**
		R2	7	8	0%	0	**8**	**0**
	W	L2	6	7	0%		**7**	**0**
		T1	3	3	0%	0	**3**	**0**
		R2	5	6	0%	0	**6**	**0**

R30/DE BEER			Base Year Volumes	Growth Rate Applied	% HV	Generated Trips	lew Volume	New HV
	S	L2	3	3	0%	12	**15**	**0**
		T1	169	189	10%	73	**262**	**26**
		R2	4	4	25%	12	**16**	**4**
	E	L2	1	1	0%	0	**1**	**0**
		T1	3	3	50%	0	**3**	**2**
		R2	13	15	0%	17	**32**	**0**
	N	L2	3	3	0%	0	**3**	**0**
		T1	185	207	8%	103	**310**	**25**
		R2	7	8	0%	0	**8**	**0**
	W	L2	5	6	0%	0	**6**	**0**
		T1	1	1	0%	0	**1**	**0**
		R2	3	3	0%	0	**3**	**0**

SITE ID	TERSECTION F	CONTROL TYP	PEAK PERIOD	OPERATIONAL CONDITIONS					
				Opening Year			Design Life		
				INTERSECTION			INTERSECTION		
				V/C	Delay	LOS	V/C	Delay	LOS
1	Opraap Access Road	T Junction (Left)	AM	0.084	0.4	A	0.116	0.4	A
			PM	0.086	0.2	A	0.118	0.2	A
2	Sterkstroom Acess Road (South)	T Junction (Left)	AM	0.081	0.3	A	0.113	0.6	A
			PM	0.075	0.3	A	0.111	0.3	A
3	Doornfontein Access Road	T Junction (Right)	AM	0.118	0.3	B	0.161	0.3	B
			PM	0.123	0.3	A	0.169	0.4	A
4	Rietspruitsdam (North) Access Road	T Junction (Right)	AM	0.084	0.2	A	0.115	0.2	A
			PM	0.094	0.5	A	0.129	0.6	A
5	Sterkstroom Acess Road (South)	T Junction (Left)	AM	0.084	0.5	A	0.115	0.5	A
			PM	0.091	0.4	A	0.125	0.4	A
6	Ratzegaaiskraal Access Road	T Junction (Left)	AM	0.116	0.3	A	0.159	0.3	A
			PM	0.098	0.3	A	0.134	0.3	A
7	ift (South) Ac	T Junction (Left)	AM	0.098	0.2	A	0.134	0.2	A
			PM	0.104	0.2	A	0.142	0.2	A
8	rift (North) Ac	T Junction (Right)	AM	0.097	0.5	A	0.133	0.5	A
			PM	0.159	3.6	A	0.233	3.8	A
9	Rietspruitsdam (North) Access Road	T Junction (Right)	AM	0.1	0.5	A	0.317	0.6	A
			PM	0.104	0.7	A	0.144	0.7	B
Y	New (km 66.0)	STOP (FOUR-WAY)	AM	0.178	4.9	A	0.284	5.5	A
			PM	0.119	4	A	0.187	4.4	A

10	N14	STOP (FOUR-WAY)	AM	0.656	29.1	D	0.986	62.6	F
			PM	0.491	20.3	C	0.739	29.2	D
X	New (km 64.7)	STOP (FOUR-WAY)	AM	0.441	8.8	A	0.775	11.6	B
			PM	0.434	8.8	A	0.798	11.8	B
11	Manaka/Loc catie Road	STOP (FOUR-WAY)	AM	0.776	28.7	D	1.167	60.6	F
			PM	0.656	24.1	C	0.991	38	E
12	De Beer Road	STOP (TWO-WAY)	AM	0.152	0.8	A	0.208	1	B
			PM	0.119	0.13	A	0.164	1.1	A
13	Gouws Road	T Junction (Right)	AM	0.13	0.1	A	0.179	0.1	A
			PM	0.12	0.1	A	0.164	0.2	A
14	Steen Road	T Junction (Left, 3 way stop)	AM	0.159	1.1	A	0.22	1.3	A
			PM	0.134	0.8	A	0.185	0.8	A
15	Berg Road	STOP (FOUR-WAY)	AM	0.279	13.4	B	0.382	14.4	B
			PM	0.237	11.8	B	0.325	12.4	B
16	Mark Road	STOP (TWO-WAY)	AM	0.144	2.9	B	0.201	3.4	A
			PM	0.144	2.1	B	0.2	2.4	B
17	Voortrekker Road	STOP (FOUR-WAY)	AM	0.461	19	C	0.631	22.7	C
			PM	0.417	17.6	C	0.571	20.5	C
18	Koekemoer	STOP (TWO-WAY)	AM	0.115	1.3	A	0.159	1.4	A
			PM	0.136	1.3	A	0.188	1.4	A
19	Visser	STOP (TWO-WAY)	AM	0.132	3.6	A	0.209	3.9	A
			PM	0.147	2.7	A	0.203	3.1	A

APPENDIX 6: SITE SENSITIVITY VERIFICATION REPORT

Earthlink Environmental Services

SITE SENSITIVITY VERIFICATION REPORT

PROPOSED IMPROVEMENT OF NATIONAL ROAD R30 SECTION 8 FROM KM 36.8 TO VENTERSDORP KM 68.646, IN THE PROVINCE OF NORTH WEST AND IN THE DISTRICT MUNICIPALITIES OF CITY MATLOSANA AND JB MARKS.

Prepared by:

Earthlink Environmental Services

Applicant:

South African National Roads Agency SOC Limited

Competent Authority:

Department of Forestry, Fisheries, and the Environment

FEBRUARY 2026

PURPOSE OF THE DOCUMENT

The main aim of the **Site Sensitivity Verification Report** (SSVR) is to confirm the current use of the land and the environmental sensitivity of the site under consideration (I.e., a proposed development site where an Environmental Authorisation (EA) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated 2014 Environmental Impact Assessment (EIA) regulations, as amended is required as identified by the national web-based environmental screening tool. This should be undertaken prior to commencing with any specialist assessment/s. The site sensitivity verification must be undertaken using:

- A desktop analysis using satellite imagery.
- A preliminary onsite inspection; and
- Any other available and relevant information

The outcome of the site sensitivity verification must be recorded in the form of a report that:

- Confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.
- contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and
- Is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations1 (EIA Regulations).

TABLE OF CONTENTS

1 INTRODUCTION 4
2 PROJECT LOCATION 5
3 SCREENING TOOL RESULTS 7
4 ON-SITE ASESSMENT 8
5 SPECIALIST STUDIES 10
5.1 Specialist studies to be undertake 10
5.2 Specialist Studies that may be undertaken 10
6 CONLCUSION 11

List of Tables

TABLE 1: DFFE SCREENING TOOL RESULTS 7
TABLE 2: THE STARTING POSITION IS AT KM 36.800 (**26°31'56.56"S; 26°38'9.19"E**), SOUTH OF THE OPRAAP ROAD-SIDE JUNCTION. 8

List of Figures

FIGURE 1: LOCALITY MAP OF THE PROPOSED R30 SECTION 8 ROAD TO BE UPGRADED. 6

1 INTRODUCTION

South African National Road Agency SOC Limited (SANRAL) proposes to upgrade Road R30 section 8, a 31.846-kilometer stretch located from (km 36.8) to Ventersdorp (km 68.646). The project starts at km 36.800, south of the Opraap road-side junction, and continues up to km 68.646 west of the 3-way stop control intersection with the R 53 to Potchefstroom. This project falls within the City Matlosana and JB Marks Local Municipalities and is situated within the Dr Kenneth Kaunda District Municipality in the North West province, with Ventersdorp the closest town. The R 30 Section 8 is a two-lane single carriageway rural road with bi-directional traffic movement and can be classified as an AASHTO Class IIIA secondary rural arterial. The road cross-section varies considerably, with gravel shoulders provided up to km 67.00. The new proposed carriageway width will be 13.4m under normal conditions and 12.4m on high fills.

The project is aimed at improving the road geometry by adding surfaced shoulders and rehabilitating the existing pavement structure to enable it to carry a 20-year design traffic load.

The major aspects of this project include the following:

- Improvement of the existing pavement structure,
- general widening of the existing road cross section to 3.7m lanes and 2.5m (high fill) – 3.0m(normal conditions) surfaced shoulders,
- Isolated vertical and horizontal geometric improvements,
- widening of river bridges and some major and minor culverts,
- Demolishing and construction of new river bridges
- horizontal re-alignment of the road at curves:
    - from KM 46.9 to KM 47.7
    - from KM 53.9 to KM 55
    - from KM60.2 to KM60.7
- Possible 6.5m wide temporary deviation to accommodate two-way traffic during construction.
- Possible Opening of one hard-rock quarry and re-entry into 5 potential borrow pits
- Stockpile areas and vegetation clearance outside road reserve in excess of one hectare.
- Possible utilisation of four detours/bypasses during construction, these are provincial/municipal roads, both gravel and/or surfaced. The contractor will be responsible for maintaining these roads
- Stockpile areas and vegetation clearance outside road reserve more than 1 Hectare.

2 PROJECT LOCATION

This project falls within the City Matlosana and JB Marks Local Municipalities and is situated within the Dr Kenneth Kaunda District Municipality in the North West province, with Ventersdorp the closest town. The project starts at km 36.800 (**26°31'56.56"S; 26°38'9.19"E**), south of the Opraap road-side junction, and continues up to km 68.646 (**26°18'54.98"S, 26°49'38.86"E**) west of the 3-way stop control intersection with the R 53 to Potchefstroom (figure 1).

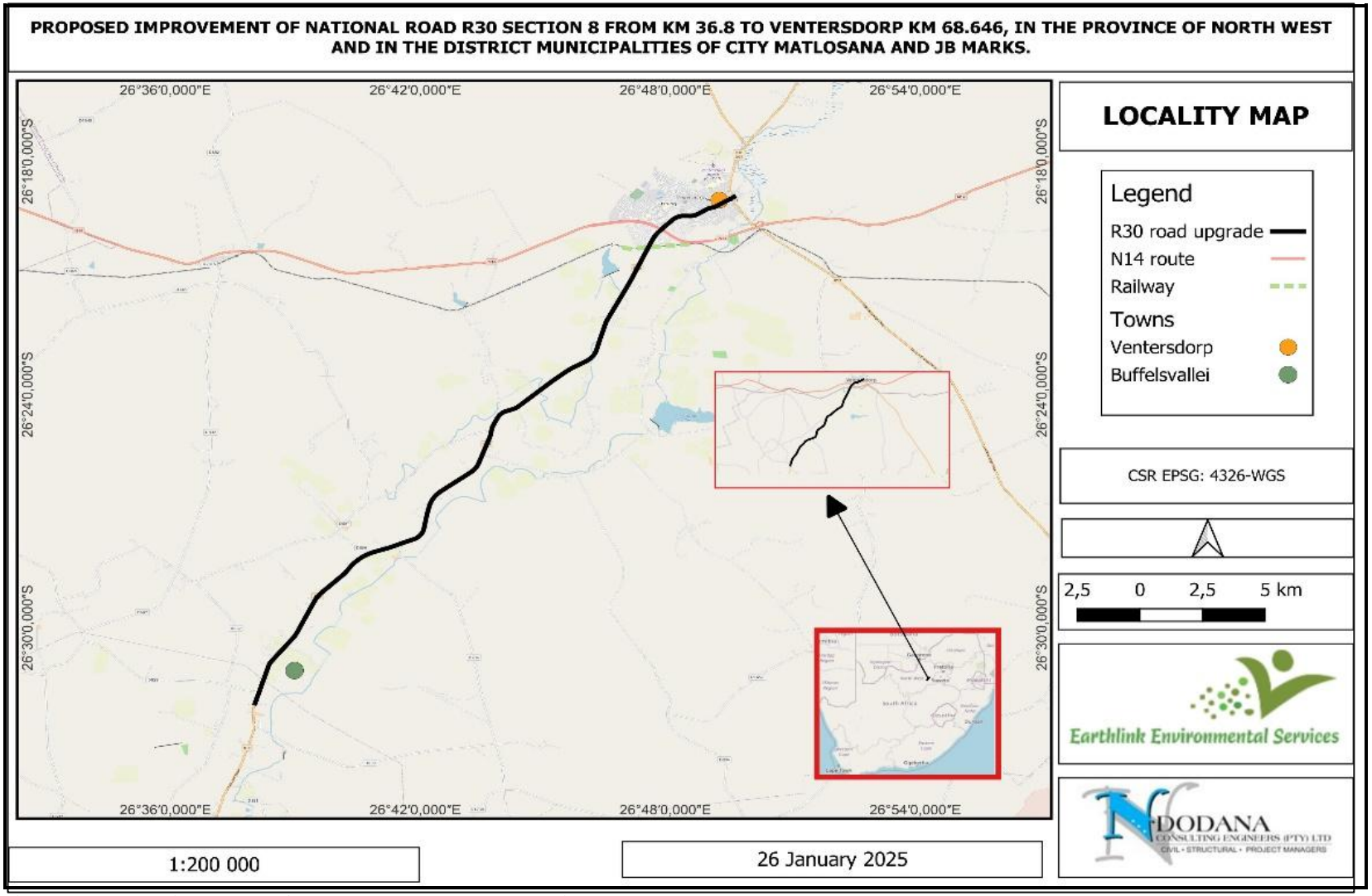


Figure 1: Locality Map of the proposed R30 section 8 road to be upgraded.

3 SCREENING TOOL RESULTS

The following environmental themes and their associated sensitivities were identified in the Screening Tool Report generated from the Department of Forestry, Fisheries, and the Environment (DFFE) national web. The screening tool is attached in this report as the Appendix 1.

According to the screening tool report, various specialist studies were identified and recommended to be undertaken as part of the environmental process.

Table 1: DFFE Screening tool Results

Theme	Very high sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme	X			
Animal Species Theme		X		
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme	X			
Civil Aviation Theme		X		
Defence Theme				X
Palaeontology Theme			X	
Plant Species Theme			X	
Terrestrial Biodiversity Theme	X			

4 ON-SITE ASESSMENT

On 31st July 2024, a site visit was carried out, during which the Environmental Assessment Practitioner (EAP) conducted a personal inspection of the area. Several photographs were taken to capture a general overview of the site's sensitivities.

Table 2: The starting position is at km 36.800 (**26°31'56.56"S; 26°38'9.19"E**), south of the Opraap road-side junction.



Table 5: End point of the R30 road to be upgraded (**26°18'54.98"S, 26°49'38.86"E**).

Photo Plate: The end position is near the intersection of the R30 and Road R53 in Ventersdrop (**26°18'54.98"S, 26°49'38.86"E**).


5 SPECIALIST STUDIES

5.1 Specialist studies to be undertake

Based onsite sensitivity variation the following studies are required as part of this project:

- **Agricultural Compliance Statement**: The proposed road upgrade crosses agricultural land, making it essential to evaluate the potential impacts on soil quality and land capability.

- **Terrestrial Biodiversity Compliance Statement (Plant and Animal Themes)**: The terrestrial theme is rated very high by the screening tool. Since the road passes through areas of natural and riparian vegetation, a specialist must assess the potential impacts on plant and animal species. Given the affected area, it is the EAP's view that compliance statement will be sufficient as the site is dominated by the agricultural fields.

- **Aquatic Impact Assessment**: The upgrade involves construction within watercourses and the improvement of existing bridges, which may affect riparian vegetation. Therefore, an Aquatic Assessment is required.

- **Heritage Compliance Statement**: Given the high heritage sensitivity rating, a heritage assessment must be conducted to ensure that archaeological and cultural resources are not adversely impacted by the project.

5.2 Specialist Studies that may be undertaken

The below assessments have been identified by the screening tool and can also be undertaken if required by the Department/SANRAL

- Visual Assessment: The proposed road upgrade is anticipated to have minimal visual impacts, which will be addressed by the Environmental Assessment Practitioner (EAP) in the Impact Assessment and Environmental Management Programme (EMPr). The EAP considers that a specialist visual assessment is not necessary.
- Socio-Economic Assessment: The project is expected to have negligible socio-economic impacts on surrounding communities, with no significant displacement of people or businesses. Since the project does

not require extensive land acquisition or relocation, the risk of socio-economic disruption is low. These impacts can be effectively managed and will be covered in the Environmental Management Plan. Therefore, a specialist socio-economic assessment will not be required.

6 CONLCUSION

SANRAL SOC LTD intends to upgrade R30 road section 8, a 31.846-kilometer stretch located from (km 36.8) to Ventersdorp (km 68.646). Earthlink has been appointed by Ndodana Consulting Engineers (Pty) Ltd to manage the necessary EA Application process in accordance with the EIA Regulations, 2014 (as amended) issued under NEMA.

A Screening Tool Report has been produced for the proposed project. As per the Screening Tool Report, the following specialist studies and compliance statements have been identified and suggested to be conducted as part of the environmental process:

- **Agricultural Impact Assessment (Compliant Statement)**
- **Heritage Compliance Statement (Including Archaeology and Paleontology)**
- **Terrestrial Biodiversity Compliance Statement**
- **Aquatic Biodiversity Compliance Statement**

We trust you find this in order.

Kind Regards,

Terrence Sepuru (Registered EAP: 2021/3938)
Environmental Assessment Practitioner.

Appendix 1: Screening Report

APPENDIX 7: ENVIRONEMNTAL MANAGEMENT PROGRAMME REPORT (EMPR)

IMPROVEMENT OF NATIONAL ROAD R30 SECTION 8 FROM KM 36.8 TO VENTERSDORP KM 68.646, WITHIN DR KENNETH KAUNDA DISTRICT MUNICIPALITY IN THE NORTH WEST PROVINCE

ENVIRONMENTAL ASSESSMENT PRACTIONERS:	**APPLICANT:**	**CONSULTING ENGINEER:**
Earthlink Environmental Services (Pty) Ltd. 572 24th Withok Estates, Brakpan, 1451.	South African National. Roads Agency SOC Ltd. Northern Region, 38 Ida Street, Menlo Park, Pretoria, 0081.	Ndodana Consulting Engineers (Pty) Ltd River Falls Office Park 262 Rose Avenue, Tamboti Building Doringkloof 0157

August 2025

CONTACT DETAILS

CONSULTANT: EARTHLINK ENVIRONMENTAL SERVICES

Project Team	**Ms. – Lehlogonolo Chuene EAP** **Ms. Kgakile Mapoulo- Project Manager**
Email Address	lehlogonolo@earthlinkenvironmental.co.za kgakile@earthlinkenvironmental.co.za
Physical Address	572 24th Rd, Withok Estates, Brakpan, 1541
Contact Details	067 212 4095 071 878 8295

APPLICANT: SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD (SANRAL)

Contact Person	**Naailah Mia**
Email	mian@nra.co.za
Physical Address	38 Ida Street, Menlo Park, Pretoria, Gauteng, 0081, South Africa
Contact Details	062 292 0965

TABLE OF CONTENTS

SECTION 1: INTRODUCTION 8
1.1 Background Information 8
1.2 Details of the Applicant 12
1.3 Details of the Eap 12
1.4 PURPOSE AND OBJECTIVES OF THE EMPR 12
1.4.1 Purpose of the Environmental Management Programme 12
1.4.2 Objectives of the Environmental Management Programme 13
1.5 SCOPE of the EMPr 14
1.5.1 Structure of an EMPr 14
1.5.2 Legal Requirements 17
1.6 SPECIFICATION STRUCTURE AND APPLICATION 24
1.6.1 Method statements 24
1.6.2 Site documentation 25
1.6.3 Pro forma documentation 26
1.7 Summary of impacts associated with the proposed road improvement 26
SECTION 2: ON-SITE IMPLEMENTATION 28
2.1 Environmental Roles and Responsibilities 28
2.1.1 South African National Roads Agency Soc Ltd (SANRAL) 28
2.1.2 Consulting Engineers (To be appointed by SANRAL) 28
2.1.3 Environmental Control Officer (To be appointed by SANRAL) 29
2.1.4 Contractor (To be appointed SANRAL) 29
2.1.5 The Authorities 29
2.1.6 Project Environmental Contact Details 30
2.2 Non-Compliance 34
2.2.1 Provisions for addressing non-conformance. 35
2.2.2 Emergency Preparedness 35
2.2.3 Administration 36
2.2.4 House Keeping 36
2.2.5 Record Keeping 36
2.2.6 Document Control 37
2.3 Awareness training 37
SECTION 3: ENVIRONMENTAL MANAGEMENT MEASURES 39
3.1 Pre-Construction Phase 40
3.2 Construction Phase 41

3.3 Operational Phase 61
SECTION 4: DETAILS OF THE PERSON/ COMPANY WHO PREPARED THE EMPR 64
SECTION 5: CONCLUSION 65

LIST OF FIGURES

Figure 1: Regional Locality Map 10
Figure 2: Sensitivity Map 11

LIST OF TABLES

Table 1: Coordinates of the Road 8
Table 2: The affected property coordinates 8
Table 3: Improvement Strategy for Major Structures 9
Table 4: Details of the applicant 12
Table 5: Details of the EAP 12
Table 6: Triggered activity listed under GNR.327 (Listing Notice 1) 19
Table 7: Triggered activity listed under GNR.324 (Listing Notice 3) 20
Table 8: Pre-Construction Phase 40
Table 9: Construction Phase 41
Table 10: Operational Phase 61

ABBREVIATIONS

BA	Basic Assessment
BAR	Basic Assessment Report
DEAT	Department of Environmental Affairs and Tourism
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
EO	Environmental Officer
GA	General Authorisation
GNR	Government Notice Regulation
IEM	Integrated Environmental Management
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
SANRAL	South Africa National Roads Agency SOC Limited

DEFINITIONS

Contractor	The main contractor as engaged by SANRAL for the construction of the subject infrastructure, including all Subcontractors and service provides appointed by the main contractor of his own volition for the execution of parts of the Works. "Contractor" also includes any other contractor engaged by SANRAL directly in connection with any part of the construction operations, which is not a nominated sub-contractor to the main contractor.
Environment	Our surroundings, including living and non-living elements, e.g. land, soil, plants, animals, air, water and humans. The environment also refers to our social and economic surroundings, and our effect on our surroundings.
Environmental Control Officer	A person who is responsible for the monitoring of the implementation of the requirements of Environmental Authorisation (EA) and Environmental Management Programme (EMPr).
Environmental Officer	A person who is responsible for the implementation of the requirements of EA and EMPr.
Environmental Impact	An environmental change caused by some human act.
Environmental Impact Assessment (EIA)	An EIA refers to the process of identifying, predicting, and assessing the potential positive and negative social, economic and biophysical impacts of a proposed development. The EIA includes an evaluation of alternatives; recommendations for appropriate management actions for minimising or avoiding negative impacts and for enhancing positive

	impacts; as well as proposed monitoring measures.
Impact	A description of the potential effect or consequence of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space.
Indigenous species	Plants and animals that are naturally found in an area.
Integrated Environmental Management (IEM)	A way of managing the environment by including environmental factors in all stages of development. This includes thinking about physical, social, cultural and economic factors and consulting with all the people affected by the proposed developments.
Method Statement	Setting out in detail how the management actions contained in an EMPr will be implemented, in order to ensure that the environmental objectives are achieved.
Mitigation	Measures designed to avoid, reduce or remedy adverse impacts.
Proponent.	Developer. Entity which applies for environmental approval and is ultimately accountable for compliance to conditions stipulated in the EA and requirements of the EMPr.

SECTION 1: INTRODUCTION

1.1 BACKGROUND INFORMATION

South African National Road Agency SOC Limited (SANRAL) proposes to improve Road R30 section 8, from KM 36.8 to Ventersdorp KM 68.646 within Dr Kenneth Kaunda District Municipality in the Northwest Province. The project is aimed at improving the road geometry by adding surfaced shoulders and rehabilitating the existing pavement structure to enable it to carry a 20-year design traffic load.

The major aspects of this project include the following:

- No increase of the road reserve width is anticipated,
- Improvement of the existing pavement structure,
- general widening of the existing road cross section to 3.7m lanes and 2.5m (high fill) – 3.0m(normal conditions) surfaced shoulders,
- Isolated vertical and horizontal geometric improvements,
- widening of river bridges and some major and minor culverts,
- Demolishing and construction of new river bridges
- horizontal re-alignment of the road at curves:
  - from KM 46.9 to KM 47.7
  - from KM 53.9 to KM 55
  - from KM60.2 to KM60.7
- possible 6.5m wide temporary deviation to accommodate two-way traffic during construction.
- Possible Opening of one hard-rock quarry and re-entry into 5 potential borrow pits
- Stockpile areas and vegetation clearance outside road reserve in excess of one hectare.
- Possible utilisation of four detours/bypasses during construction, these are provincial/municipal roads, both gravel and/or surfaced.

Table 1: Coordinates of the Road

Table 2: The affected property coordinates	
Affected Property	Elandskuil 208
Road coordinates:	**Start Point:** 26°31'56.56″S 26°38'9.19″E **Middle point:** 26°25'55.21″S 26°43'36.24″E **End point:** 26°18'54.98″S 26°49'38.86″E
SGID Code:	T0IP00000000020800191

Table 3: Improvement Strategy for Major Structures

Culvert & Bridge No.	**PROPOSED STRUCTURE** **NO / WIDTH X HEIGHT X LENGTH**	**Coordinates**
C0403	1.8m X1.2m	26°30'16.74"S 26°38'59.37"E
C4411	1.8m X 1.45m	26°29'21.11"S 26°39'34.71"E
C0411	1.7m X 0.975m	26°28'11.85"S 26°40'39.97"E
C0414	1.8m x 1.23m	26°27'39.01"S 26°41'59.43"E
C0418	3.525m X 3.5m	26°19'27.92"S 26°48'08.96"E
B1018	26.58m	26°27'24.88"S 26°42'13.29"E
B1845	40.75m	26°25'14.88"S 26°43'44.07"E
B4039	53.21m	26°24'26.13"S 26°44'12.83"E
B1167	20.09m	26°21'16.11"S 26°47'04.05"E
B2181	18.45m	26°20'12.44"S 26°47'35.69"E

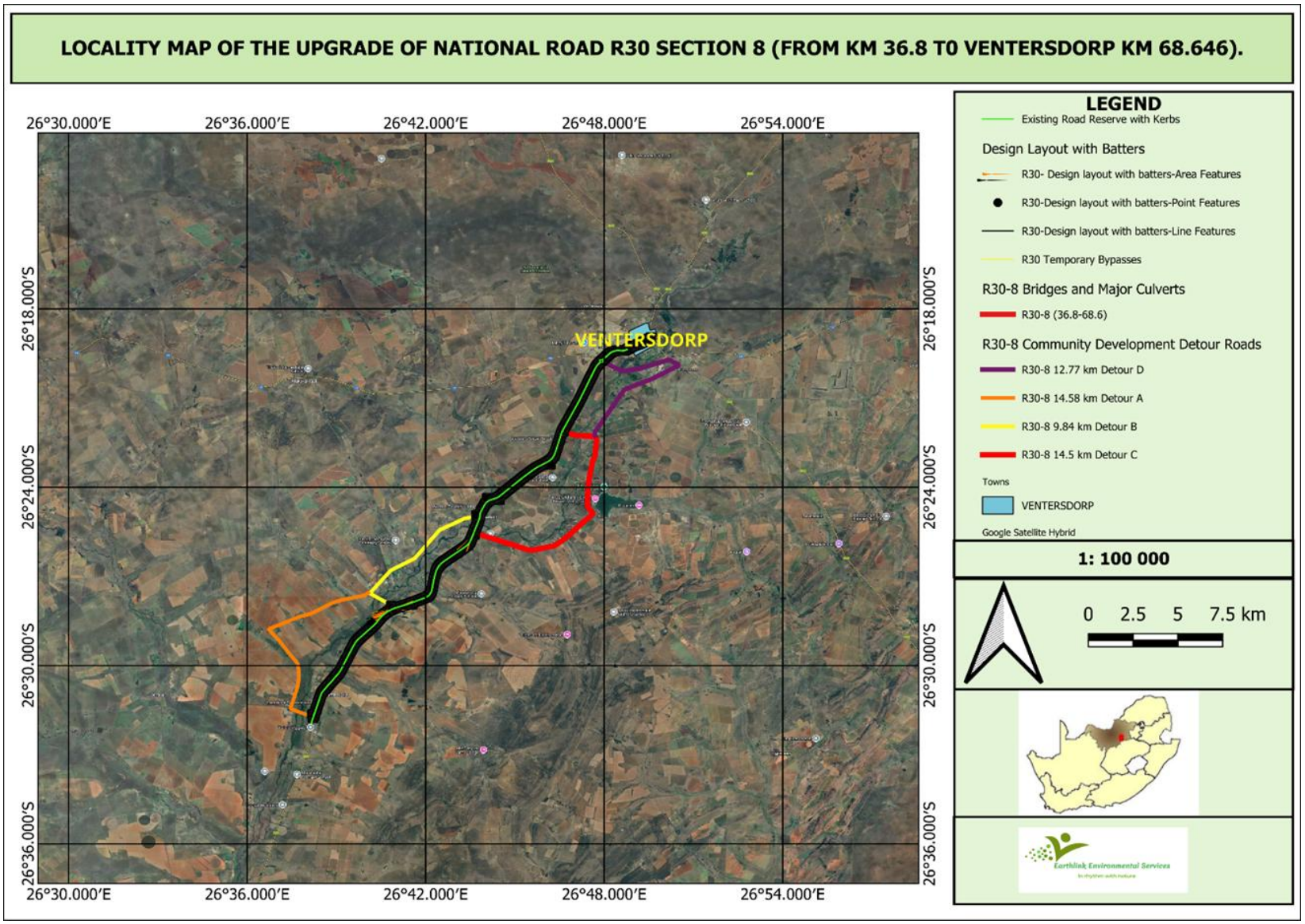


Figure 1: Regional Locality Map

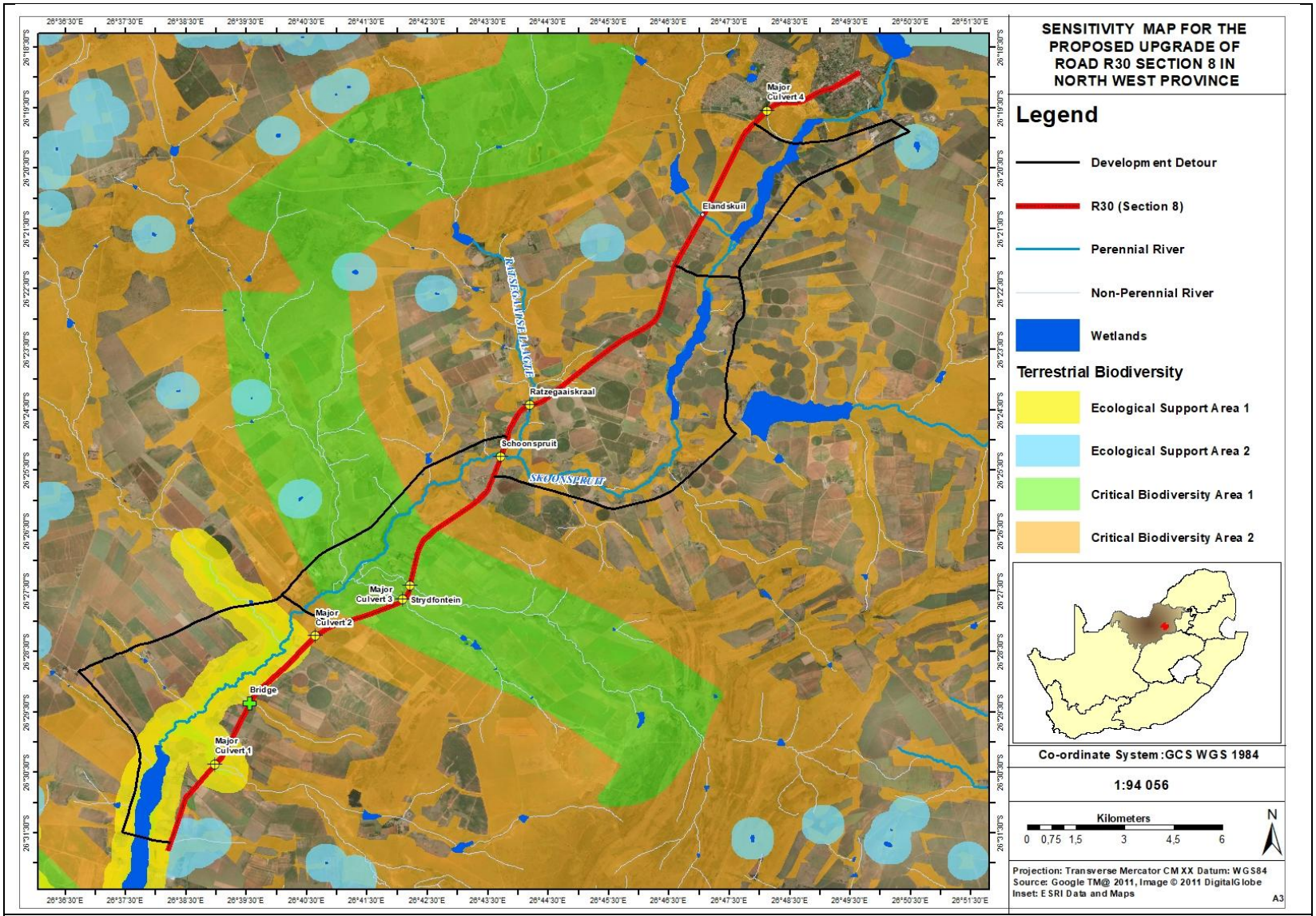


Figure 2: Sensitivity Map

1.2 DETAILS OF THE APPLICANT

Table 4: Details of the applicant

Project applicant:	South African National Roads Agency (SANRAL)		
Contact person:	Naailah Mia		
Physical address:	38 Ida Street, Menlo Park, Pretoria, Gauteng, 0081, South Africa		
Postal code:	0081	Cell:	062 292 0965
Telephone:		Fax:	
E-mail	mian@nra.co.za		

1.3 DETAILS OF THE EAP

Table 5: Details of the EAP

Aspect	Details
Name	Earthlink Environmental Services (Pty) Ltd
Contact Person	Mrs. Lehlogonolo Chuene
Physical Address	572 24th Rd, Withok Estates, Brakpan, 1541
Other contact details	067 212 4095/ 071 878 8295
Expertise/experience	EAP Experience: 10 years' experience Affiliation: EAPASA Registered Qualifications: • MSc of Geography- University of Limpopo Current • BSc Honours in Geography- University of Limpopo: 2014 • BSc Environmental and Resource Studies
Registration	EAPASA 2019/1567

1.4 PURPOSE AND OBJECTIVES OF THE EMPR

This Environmental Management Programme (EMPr) has been compiled in terms of generally acceptable environmental practices and policies.

1.4.1 Purpose of the Environmental Management Programme

The EMPr has been compiled to provide recommendations and guidelines in order to minimise the environmental impacts during the construction phase and should be used for compliance monitoring during the construction phase of the proposed R30 road improvements. This EMPr informs all relevant parties of the legal requirements for the construction and operation of the R30 road which would have been improved, with particular reference to the prevention and mitigation of anticipated potential environmental impacts.

This EMPr has been compiled in accordance with Appendix 4 of GNR.326.

EMPr is defined as "*an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the project phases are prevented and that the positive benefits of the projects are enhanced*". *Impacts range from those incurred during start up (e.g. site clearing) and through to those incurred during the construction activities themselves (erosion, pollution of watercourses, noise, dust etc.)*".

The purpose of this EMPr is therefore to ensure that undue or reasonably avoidable adverse impacts of the proposed road improvements are prevented and that the positive impacts are enhanced during the road.

1.4.2 Objectives of the Environmental Management Programme

This EMPr has been compiled to provide recommendations and guidelines in order to minimise the environmental impacts during the construction phase and should be used for compliance monitoring during the construction phase of the proposed R30 road improvements.

This EMPr informs all relevant parties, the Project Co-ordinator, the Contractor (s) and all other staff employed by SANRAL at the site as to their duties in the fulfilment of the legal requirements for the R30 road improvements with particular reference to the prevention and mitigation of anticipated potential environmental impacts.

Specifically, the objectives of this EMPr can be articulated as follows:

- To give effect to the construction related requirements.
- To give effect to the environmental commitments to the various role players.
- To ensure that these requirements/ commitments are expressed in a manner that is accessible to all parties and is binding upon those responsible for project implementation.
- To ensure that sufficient resources are allocated to the project budget in order to give effect to the environmental requirements / commitments, and to ensure that the scale of EMPr-related interventions is consistent with the significance of identified impacts.
- To provide a coherent and pragmatic framework for the implementation of the requirements, ranging from the roles and responsibilities of the key project participants to the auditing and reporting of compliance;
- To facilitate appropriate and proactive response to unforeseen events or changes in project implementation; and
- To ensure that the construction phase of the project does not result in undue or reasonably unavoidable adverse environmental impacts, and that any

potential environmental benefits are enhanced.

The EMPr is compiled in accordance with the Integrated Environmental Management (IEM) philosophy which aims to achieve a desirable balance between conservation and development (Department of Environmental Affairs and Tourism (DEAT, 2004)). IEM is a key instrument of the NEMA. NEMA promotes the IEM of activities that may have a significant effect on the environment, while IEM prescribes a methodology for ensuring that environmental management principles are fully integrated into all stages of the development process. It advocates the use of several environmental management tools that are appropriate for the various levels of decision-making. One such tool under the NEMA Chapter 5 is an EMPr.

The IEM guidelines encourage a pro-active approach to sourcing, collating and presenting information in a manner that can be interpreted at all levels.

1.5 SCOPE OF THE EMPR

The scope of the EMPr must ensure that the objectives outlined above will be addressed. In order to achieve the above objectives, the scope of an EMPr should include the following:

- Definition of the environmental management objectives to be realised during the construction phase in order to enhance benefits and minimise adverse environmental impacts.
- Description of the detailed actions needed to achieve these objectives, including how they will be achieved, by whom, by when, with what resources, with what monitoring/verification, and to what target or performance level. Mechanisms must also be provided to address changes in the project implementation, emergencies or unexpected events, and the associated approval processes.
- Clarification of institutional structures, roles, communication and reporting processes required as part of the implementation of the EMPr.
- Description of the link between the EMPr and associated legislated requirements.
- Description of requirements for record keeping, reporting, review, auditing and updating of the EMPr.

The scope of the EMPr is principally determined by the key documentation related to the EIA process, notably the Draft Basic Assessment Report (BAR).

1.5.1 Structure of an EMPr

An EMPr focuses on sound environmental management practices, which should be undertaken to minimise adverse impacts on the environment through the lifetime of a development. In addition, an EMPr identifies which measures will be in place or will be actioned to manage any incidents and emergencies that may occur during all

phases of the R30 road improvements. However, this EMPr has been developed particularly for the R30 road improvements. This EMPr provides specifications that should be adhered to, in order to minimise adverse environmental impacts associated with the R30 road improvements.

According to Appendix 4 of GNR.326, as amended, an EMPr must include:

1. An EMPr must comply with section 24N of the Act and include—	**Section in the Report**
(a). details of– (i) the EAP who prepared the EMPr; and (ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae.	**Section 4**
(b). a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description.	**Section 1**
(c). a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	**Section 1**
(d). description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including— (i) planning and design; (ii) preconstruction activities; (iii) construction activities; (iv) rehabilitation of the environment after construction and where	**Section 3**

applicable post closure; and (v) where relevant, operation activities	
(f) a description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraph (d) will be achieved, and must, where applicable, include actions to — (i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) comply with any prescribed environmental management standards or practices; (iii) comply with any applicable provisions of the Act regarding closure, where applicable; and (iv) comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable;	**Section 3**
(g) the method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	**Section 2**
(h) the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	**Section 2**
(i) an indication of the persons who will be responsible for the implementation of the impact management actions;	**Section 2**

(j) the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	**Section 2**
(k) the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);	**Section 2**
(l) a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	**Section 2**
(m) an environmental awareness plan describing the manner in which— (i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and	**Section 2**
(n) any specific information that may be required by the competent authority.	**Section 3**

1.5.2 Legal Requirements

The Contractor must identify and comply with all South African national and provincial environmental legislation, including associated regulations and all local by-laws relevant to the project. Key legislation currently applicable to the construction phase of the project must be complied with, even during design and implementation phases.

1.5.2.1 The Constitution of South Africa (Act No. 108 of 1996)

Section 24 of the Constitution of South Africa No. 108 of 1996 states that "…*everyone has the right (a) to an environment that is not harmful to their health or well-being;*

and (b) to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that (c) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development.

1.5.2.2 National Environmental Management Act (Act 107 of 1998)

The NEMA provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by State Departments and to provide for matters connected therewith.

On 5 September 1997, the Minister of Environmental Affairs and Tourism had, under sections 26 and 28 of the Environment Conservation Act, 1989 (Act No. 73 of 1989) (ECA), and with the concurrence of the Minister of Finance, promulgated Regulations in terms of Section 21 of the Act, GNR. 1182 GG No.18261, GNR. 1183 GG No. 8261, 1184 GG 18261 (as amended).

On 21 April 2006, the Minister of the Department of Water and Environmental Affairs [DWEA, now called the DFFE and the Department of Water and Sanitation (DWS) separately] promulgated Regulations in terms of Chapter 5 of the NEMA. When these Regulations came into effect on 3 July 2006, they replaced the EIA Regulations that were promulgated in terms of the ECA in 1997 and introduced new provisions for EIAs. Subsequently, the National Environmental Management Amendment Act, 2008 (Act No. 62 of 2008) (NEMAA) was promulgated on 9 January 2009 and came into effect on 1 May 2009. The NEMAA made a number of significant amendments to the general provisions applicable to EIAs. On 18 June 2010, the Minister promulgated amended EIA Regulations in terms of Chapter 5 of NEMA. From the date of effect of these amended EIA Regulations, 2 August 2010, these amended EIA Regulations replaced the previous EIA Regulations that were promulgated on 21 April 2006.

In 2014 on 8 December, new EIA Regulations came into effect and replaced the previous EIA Regulations of 18 June 2010. The Regulations are as follows:

- GNR. 982 provides with the methodology and format which needs to be considered when conducting a Basic Assessment (BA) and S&EIR processes.
- GNR. 983 (Listing Notice 1) provides for activities which require a BA process to be followed.
- GNR. 984 (Listing Notice 2) provides for activities which require a S&EIR to be followed; and
- GNR. 985 (Listing Notice 3) also provides for activities which require a BA process to be followed.

The Minister of Environmental Affairs has again made amendments to the EIA Regulations, 2014, published under GNR. 982, GNR. 983, GNR. 984 and GNR. 985 of 4 December 2014, in terms of sections 24(5) and 44 of the NEMA through the promulgation of GNR. 324, GNR. 325, GNR. 326 and GNR. 327 of 07 April 2017.

The NEMA EIA Regulations define two broad processes for an EIA, namely: BA and S&EIR.

S&EIR is applicable to all projects likely to have significant environmental impacts due to their nature or extent, activities associated with potentially high levels of environmental degradation, or activities for which the impacts cannot be easily predicted.

BA is required for projects with less significant impacts or impacts that can easily be mitigated.

The project will entail the undertaking of the BA in terms of the EIA Regulations 2014, as amended; promulgated in terms of the NEMA as listed in GNR. 327 and GNR. 324. These activities are identified as actions that may not commence without an EA from the relevant competent authorities, in this case, the DFFE.

Listed and specified activities for the R30 Road improvement project
The listed activities associated with the project in respect of NWA are also provided. Based on the nature and extent of the listed activities, Earthlink on behalf of SANRAL will conduct separate EA and GA applications.

Table 6: Triggered activity listed under GNR.327 (Listing Notice 1)

Activity No(s):	**Provide the relevant Basic Assessment Activity(ies) as set out in Listing Notice 1 of the EIA Regulations, 2014 as amended**	**Describe the portion of the proposed project to which the applicable listed activity relates. Ensure to include thresholds/area/footprint applicable.**
19	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from- (i) a watercourse;	The proposed road improvement involves the widening of river bridges and some major and minor culverts, demolishing and construction of new river bridges within watercourses and it is estimated that about 30m3 or more of material will be excavated and deposited within the water course.

27	The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for— (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The road improvement will require stockpile areas and vegetation clearance outside road reserve and about 1 hectare or more for stockpiling.
56	The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre— (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres; Excluding where widening or lengthening occur inside urban areas.	The road improvement will require about 6.5m widening of the road to accommodate two-way traffic during construction.

Table 7: Triggered activity listed under GNR.324 (Listing Notice 3)

Activity No(s):	Provide the relevant Basic Assessment Activity(ies) as set out in Listing Notice 3 of the EIA Regulations, 2014 as amended	Describe the portion of the proposed project to which the applicable listed activity relates. Ensure to include thresholds/area/footprint applicable.
12	The clearance of an area of 300square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan h. North West ii. A protected area including municipal or provincial nature reserves as contemplated by NEMPAA or other legislation;	Clearing of more than 300m^2 of indigenous vegetation will be required in some areas identified as endangered and/or important ecosystems and biodiversity areas, especially at the bridge site.

	iv. Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority; vi. Areas within a watercourse or wetland, or within 100 metres from the edge of a watercourse or wetland.	
14	The development of— (i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or **(ii) infrastructure or structures with a physical footprint of 10 square metres or more;** where such development occurs— (a) within a watercourse; h. North West iv. Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority;	The project includes structure of more than 10 square meters (bridges and culverts) within the critical biodiversity (CBA 1).

1.5.2.3 National Water Act (1998)

Water uses listed under Section 21 of the NWA will be triggered by the proposed project. The GA Application is therefore being lodged with the relevant Regional DWS. Water uses identified in terms of Section 21 of the NWA are as follows:

(c)impending or diverting the flow of water in a watercourse.

(i) altering the bed, banks, course, or characteristics of a watercourse.

Due to water resources identified on the proposed site, the proposed development triggers Section (c) and (i) water uses listed in Section 21 of the NWA.

The NWA recognizes that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorized by DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorization is obtained from the DWS in terms of Section 21 (c) and (i) of the NWA.

However, according to General Notice (GN) 509 as published in the Government Gazette No. 48187 of 10 March 2023, it must be noted that as defined by the Replacement General Authorization (GA) in terms of Section 39 of the NWA, on

account of the extremely sensitive nature of wetlands and estuaries, the section 21(c) and (i) water use GA does not apply to:

- To the use of water in terms of section 21(c) or (i) of the Act for the rehabilitation of a wetland as contemplated in General Authorization 1198 published in Government Gazette 32805 dated 18 December 2009.
- To the use of water in terms of section 21(c) or (i) of the Act within the regulated area of a watercourse where the Risk Class is Medium or High as determined by the Risk Matrix. The Risk Matrix must be completed by a suitably qualified SACNASP professional member.
- In instances where an application must be made for a Water Use License (WUL) for the authorization of any other water use as defined in section 21 of the Act that may be associated with a new activity.
- Where storage of water results from the impeding or diversion of flow or altering the bed, banks, course, or characteristics of a watercourse; and
- To any water use in terms of section 21 (c) or (i) of the Act associated with construction/ installation or maintenance of main or bulk sewage sewerage pipelines, pipelines carrying hazardous materials.
- To any section 21 (c) or (i) water use associated with construction of water- and wastewater treatment works.
- To any section 21 (c) or (i) water use associated with hazardous material within the regulated area of a watercourse; and
- To any section 21 (c) or (i) water use associated with mining activities and associated infrastructure unless it falls within appendix D2

A GA Application is therefore imperative for the proposed development as the proposed use of water in terms of section 21(c) or (i) of the Act is within the regulated area of a watercourse and the Risk Class is Low.

The following definitions have been provided to give clarity on the imperativeness of the GA Application for the proposed development:

"Watercourse" means - (a) a river or spring;(b) a natural channel in which water flows regularly or intermittently;(c) a wetland, pan, lake or dam into which, or from which, water flows; and any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse as defined in the NWA; and a reference to a watercourse includes, where relevant, its bed and banks.

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

For the purpose of S21 (c) and (i) water uses, the water course encompasses the extent (i) of the riparian habitat, as delineated according to the Department of Water Affairs and Forestry (DWAF) (2005a) or the 1:100-year flood line, whichever is greatest, or (ii) within 500m radius from the boundary of any wetland.

1.5.2.4 National Heritage Resources Act (NHRA) (Act 25 of 1999)

The National Heritage Resources Act's mission is to inspire communities to protect and preserve their heritage for the benefit of present and future generations. A Heritage Impact Assessment (HIA) is the process to be followed in order to determine whether any heritage resources are located within the area of interest, in particular as per S38 (1).

1.5.2.5 National Environmental Management: Biodiversity Act (Act No 10 of 2004)

NEMBA was signed into law in mid-2004 and entered into effect on 1 September 2004. NEM: BA provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities. Certain activities, known as Restricted Activities, are regulated on listed species using permits by a special set of regulations published under the Act. Restricted activities regulated under the act are keeping, moving, having in possession, importing and exporting, and selling.

1.5.2.6 The National Biodiversity Framework (2017-2022)

The National Biodiversity Framework (NBF) is a requirement under Section 38 of the National Environmental Management: Biodiversity Act (Act 10 of 2004, hereafter referred to as the 'Biodiversity Act'). The NBF is a short to medium-term coordination tool that shows the alignment between the strategic objectives and outcomes identified in the National Biodiversity Strategy and Action Plan (NBSAP v.2, 2015) and other key national strategies, frameworks and systems that currently guide the work of the biodiversity sector and identifies mechanisms through which this work is coordinated. It also identifies a set of interventions or "acceleration measures" that can unlock or fast-track implementation of the NBSAP and indicates the relative roles of the many agencies involved in implementing these activities. The purpose of the NBF is not to provide a comprehensive review of all work currently being undertaken in the biodiversity sector, nor to list all of the actions required to conserve and manage South Africa's biodiversity in support of sustainable development.

1.5.2.7 The North West Biodiversity Management Act, 2016 (Act No. 4 of 2016) (NWBMA)

The objective of this act is to provide for the management and conservation of the North West Province's biophysical environment and protected areas within the framework of the National Environmental Management Act, 1998 (Act No 107 of 1998); to provide for the protection of species and ecological systems that warrant provincial protection; to provide for the sustainable use of indigenous biological resources; and to provide for matters connected therewith.

1.5.2.8 Conservation of Agricultural Resource Act (Act no 43 of 1983)

This act regulates the utilization and protection of wetlands, soil conservation and all matters relating thereto; control and prevention of veld fires, control of weeds and invader plants, the prevention of water pollution resulting from farming practices and losses in biodiversity.

1.6 SPECIFICATION STRUCTURE AND APPLICATION

These specifications are not exclusive and could, within reason, be expanded on or amended at any time during the contract by the Environmental Control Officer (ECO).

1.6.1 Method statements

Environmental practitioners are not specialists with regard to construction techniques. Therefore, so as not to hinder construction activities by stipulating elaborate, costly and/ or ineffective mitigation measures, the environmental specification is underpinned by a series of Method Statements, within which the Contractor is required to outline how they propose to mitigate any identified environmental risks. For example, if the specification states that "cement contaminated water shall not be allowed to contaminate the soil or adjacent watercourse", the Method Statement compiled by the Contractor would be required to outline how he or she intends to achieve this requirement.

In terms of the environmental specifications for the proposed project, the Contractors must submit various written Method Statements to the Engineer and ECO as requested in the Specification. For the purposes of the environmental specifications, a Method Statement is defined as "a written submission by the Contractor to the Engineer in response to the Specification or a request by the Engineer, setting out the materials, labour and method the Contractor proposes using to carry out an activity, identified by the relevant specification or the Engineer when requesting the Method Statement, in such detail that the Engineer is enabled to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications".

The Method Statement must cover applicable details with regard to:

- Construction procedures;
- Materials and equipment to be used;
- Getting the equipment to and from site;
- How the equipment/ material will be moved while on site;
- How and where material will be stored;
- The containment (or action to be taken if containment is not possible) of leaks

or spills of any liquid or material that may occur;
- Timing and location of activities;
- Compliance/ non-compliance with the Specifications; and
- Any other information deemed necessary by the Engineer.

The environmental specifications set very stringent requirements in terms of the provision of Method Statements and the commencement of the activities they cover:

- Any Method Statement required by the Engineer or the specification must be produced within the timeframes specified by the Engineer or the specification (typically two weeks);
- The Contractor may not commence the activity covered by the Method Statement until it has been approved, except in the case of emergency activities and then only with the consent of the Engineer;
- The Engineer may require changes to a Method Statement if the proposal does not comply with the specification or if the proposed methodology carries an unreasonable risk of excessive damage to the environment;
- Approved Method Statements must be readily available on the site and must be communicated to all relevant personnel;
- The Contractor is required to carry out the activities covered by the Method Statement in accordance with the proposed approach; and
- Approval of the Method Statement does not absolve the Contractor from their obligations or responsibilities in terms of the Contract.

The following specific method statements must be drawn up before construction on commence site

- Emergency spills, accidental leaks and fire procedures;
- Cement and concrete batching;
- Management of hazardous materials (including oils and chemicals);
- Solid waste management;
- Dust control management;
- Crew camps and construction lay down areas;
- Handling of stockpiles;
- Clearance of vegetation during construction

1.6.2 Site documentation

The following is a list of documentation that must be held on site and must be made available to the ECO on request:

- This EMPr;
- Site daily diary / instruction book / incident reports with incident registers;
- Copies of Environmental Officer (EO) and ECO reports (management and monitoring);
- Complaints register; and

- Method statements.

1.6.3 Pro forma documentation

1.6.3.1 Prior to the commencement of improving activities

The following pro forma documentation are to be filled out and is binding to the EMPr and project contract and includes *inter alia*:

- Declaration of understanding by the Proponent;
- Declaration of understanding by the Engineer;
- Declaration of understanding by the Contractor;
- Method statements; and
- ECO / Engineer approval for method statements.

1.6.3.2 During construction activities

The following attached pro forma documentation are to be filled out and maintained. These are binding to the EMPr and project contract.

They include *inter alia*:

- Amended Method Statements;
- ECO / Engineer approval for amended method statements;
- Environmental incidents; and

1.7 SUMMARY OF IMPACTS ASSOCIATED WITH THE PROPOSED ROAD IMPROVEMENT

Environmental impacts associated with proposed road construction/ improvement have been identified. Consequently, mitigation measures to be implemented during construction/ improvement have been prescribed in order to reduce, or if possible, avoid the impacts that may be caused by the proposed project activities.

The following is a summary of impacts associated with the road construction/ - activities:

Biophysical Impacts

Construction Phase

- Degradation and/or destruction of wetland habitats.
- Loss of indigenous fauna and flora diversity associated with wetlands.
- Alien Invasive Species
- Pollution of water resources and soils
- Sedimentation and soil erosion
- Loss of habitat associated with the road improvement
- Loss of Species of special concern (SCC)

Operational Phase

- Loss of habitat associated with the road improvement.

Cumulative Impacts

- Increased Employment and local economic development

SECTION 2: ON-SITE IMPLEMENTATION

The implementation of the impact management actions and an indication of the persons who will be responsible for the implementation of the impact management actions.

This EMPr is specifically compiled for the period of time prior to commencement of, and activities associated with road improvements of the above-mentioned activities.

2.1 ENVIRONMENTAL ROLES AND RESPONSIBILITIES

In order for the EMPr to be successfully implemented, all the role players involved in the project need to co-operate. Role players must clearly understand their roles and responsibilities in the project. They must also be professional, form respectful and transparent relationships, and maintain open lines of communication.

2.1.1 South African National Roads Agency Soc Ltd (SANRAL)

SANRAL will be responsible for making sure that the EMPr is being complied to and conditions contained in the EA. SANRAL will appoint an ECO for the period of R30 road improvement. The ECO will objectively monitor implementation of all relevant environmental legislation, conditions of an EA, and the EMPr for the project.

2.1.2 Consulting Engineers (To be appointed by SANRAL)

SANRAL will appoint Consulting Engineers who will fulfil the role of Project Co-Coordinator/ Project Managers on behalf of SANRAL.

Consulting Engineers will be responsible and accountable for ensuring that all parties involved in the implementation of the standing EMPr are compliant. The Consulting Engineers will therefore be responsible for overall management of project and EMPr implementation. The following tasks will fall within their responsibilities:

- Be familiar with the recommendations and mitigation measures of this EMPr and implement these measures.
- Monitor site activities on a regular basis for compliance.
- Conduct internal audits of the construction site against the EMPr.
- Confine the construction site to the demarcated area.
- Rectify transgressions through the implementation of corrective action.

The Consulting Engineers will also have ability to issue site instructions and in some instances, variation orders to the contractor.

They will also be responsible for the appointment of an Environmental Officer (EO) who will be responsible for monitoring all the contractors' activities on site for compliance with the EMPr.

The Consulting Engineers will ensure that there is always a representative on site (Engineer Representative) who will fulfil their duties in their absence.

2.1.3 Environmental Control Officer (To be appointed by SANRAL)

The ECO will be independently appointed by SANRAL. The ECO will be expected to be present on site prior to any site establishment.

The ECO will be responsible for the following:

- Conduct regular site visits to be able to report on compliance to relevant environmental legislation and respond to any environmental issues;
- Report compliance and non-compliance issues to SANRAL;
- Advise the Contractor on environmental issues within the defined work areas;
- Review access and incidents records that may pertain to the environment and reconcile the entries with the observations made during site inspection, monitoring and auditing;
- Recommend corrective action when required for aspects of noncompliance with the EMPr; and
- Take immediate action on site where clearly defined and agreed "no-go" areas are violated or in danger of being violated and to inform SANRAL of the occurrence immediately and to take action.

2.1.4 Contractor (To be appointed SANRAL)

The Contractor will be responsible for the overall execution of the activities during construction phase including the implementation and compliance with recommendations and conditions of the EMPr. The Contractor must therefore ensure compliance with the EMPr at all times and maintain an environmental register which keeps a record of all environmental incidents which occur on the site during construction. The Contractor is also responsible for the implementation of corrective actions issued by the ECO and SANRAL within a reasonable or agreed period of time.

2.1.5 The Authorities

The authorities that should be involved include the DFFE. The authorities may be required to perform the following roles:

- Review Monitoring and Audit reports, if required;
- Review whether there is compliance by the Applicant and Contractor with the terms of the EMPr and permit/license conditions. Whenever necessary, the authorities should assist the Applicant in understanding and meeting the specified requirements; and

- The authorities may perform random controls to check compliance. In case of persistent non-compliance, the Applicant will be required to provide an action plan with corrective measures, and have it approved by the authorities.

2.1.6 Project Environmental Contact Details

Proponent: SANRAL	
Naailah Mia Project Manager mian@nra.co.za 38 Ida Street, Menlo Park, Pretoria, Gauteng, 0081, South Africa 062 292 0965	
Consulting Engineers	
Ndodana Consulting Engineers (Pty) Ltd River Falls Office Park 262 Rose Avenue, Tamboti Building Doringkloof 0157	

Environmental Control Officer: Earthlink Environmental Services	
Ms. Kgakile Mapaulo Project Manager kgakile@earthlinkenvironmental.co.za 572 24th Rd, Withok Estates, Brakpan, 1541 071 878 8295	
Contractor	
Not Appointed yet.	
Post Construction: SANRAL	
Naailah Mia Project Manager mian@nra.co.za 38 Ida Street, Menlo Park, Pretoria, Gauteng, 0081, South Africa 062 292 0965	

The method of monitoring the implementation of the impact management actions

The frequency of monitoring the implementation of the impact management actions

The time periods within which the impact management actions must be implemented

The Contractor should ensure that his/ her employees and any third party who carries out all or part of the Contractor's obligations are adequately trained with regard to the implementation of the EMPr, as well as regarding environmental legal requirements and obligations.

Awareness training programmes should be targeted at all levels of employment.

The ECO must conduct regular audits. The audits are to verify the projects compliance with the EMPr and conditions of the EA. Monthly audits must be undertaken until the end of the construction phase and then every 2 months for the rehabilitation phase if so required.

Before any improvement and rehabilitation activities commence, the appointed independent ECO must first compile a checklist based on the contents of this EMPr and conditions of the EA and communicate it to SANRAL. The ECO must at the request of the DFFE forward audit reports to the Department at a frequency determined by the DFFE, which must be stipulated in the EA.

As per GNR. 326 of the EIA Regulations 2014, as amended, Regulation 34.

(1) The holder of an environmental authorisation must, for the period during which the environmental authorisation and EMPr, and where applicable the closure plan, remain valid—

(a) ensure that the compliance with the conditions of the environmental authorisation and the EMPr, and where applicable the closure plan, is audited; and

(b) submit an environmental audit report to the relevant competent authority.

(2) The environmental audit report contemplated in sub regulation (1) must—

(a) be prepared by an independent person with the relevant environmental auditing expertise.

(b) provide verifiable findings, in a structured and systematic manner, on (i) the level of performance against and compliance of an organisation or project with the provisions of the requisite environmental authorisation or EMPr and, where applicable, the closure plan; and (ii) the ability of the measures contained in the EMPr, and where applicable the closure plan, to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity;

(c) contain the information set out in Appendix 7; and

(d) be conducted and submitted to the competent authority at intervals as indicated in the environmental authorisation.

(3) The environmental audit report contemplated in sub regulation (1) must determine—

(a) the ability of the EMPr, and where applicable the closure plan, to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity on an ongoing basis and to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the closure of the facility; and

(b) the level of compliance with the provisions of environmental authorisation, EMPr and where applicable, the closure plan.

(4) Where the findings of the environmental audit report contemplated in sub regulation (1) indicate—

(a) insufficient mitigation of environmental impacts associated with the undertaking of the activity; or

(b) insufficient levels of compliance with the environmental authorisation or EMPr and, where applicable the closure plan; the holder must, when submitting the environmental audit report to the competent authority in terms of sub regulation (1), submit recommendations to amend the EMPr or closure plan in order to rectify the shortcomings identified in the environmental audit report.

(5) When submitting recommendations in terms of sub regulation (4), such recommendations must have been subjected to a public participation process, which process has been agreed to by the competent authority and was appropriate to bring the proposed amendment of the EMPr and, where applicable the closure plan, to the attention of potential and registered interested and affected parties, including organs of state which have jurisdiction in respect of any aspect of the relevant activity and the competent authority, for approval by the competent authority.

(6) Within 7 days of the date of submission of an environmental audit report to the competent authority, the holder of an environmental authorisation must notify all potential and registered interested and affected parties of the submission of that report, and make such report immediately available—

(a) to anyone on request; and

(b) on a publicly accessible website, where the holder has such a website.

(7) An environmental audit report must contain all information set out in Appendix 7 to these Regulations.

Appendix 7 of GNR 326 provides with the objectives of the environmental audit report, and are as follows:

(a) report on—(i) the level of compliance with the conditions of the environmental authorisation and the EMPr, and where applicable, the closure plan; and (ii) the extent to which the avoidance, management and mitigation measures provided for in the EMPr, and where applicable, the closure plan achieve the objectives and outcomes of the EMPr, and closure plan;

(b) identify and assess any new impacts and risks as a result of undertaking the activity;

(c) evaluate the effectiveness of the EMPr, and where applicable, the closure plan;

(d) identify shortcomings in the EMPr, and where applicable, the closure plan; and

(e) identify the need for any changes to the avoidance, management and mitigation measures provided for in the EMPr, and where applicable, the closure plan.

Content of environmental audit reports

(1) An environmental audit report prepared in terms of these Regulations must contain—

(a) details of the—(i) independent person who prepared the environmental audit report; and (ii) expertise of the independent person that compiled the environmental audit report;

(b) a declaration that the independent auditor is independent in a form as may be specified by the competent authority.

(c) an indication of the scope of, and the purpose for which, the environmental audit report was prepared;

(d) a description of the methodology adopted in preparing the environmental audit report;

(e) an indication of the ability of the EMPr, and where applicable, the closure plan to— (i) sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity on an ongoing basis; (ii) sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the closure of the facility; and (iii) ensure compliance with the provisions of environmental authorisation, EMPr, and where applicable, the closure plan;

(f) a description of any assumptions made, and any uncertainties or gaps in knowledge;

(g) a description of any consultation process that was undertaken during the course of carrying out the environmental audit report;

(h) a summary and copies of any comments that were received during any consultation process; and

(i) any other information requested by the competent authority.

2.2 NON-COMPLIANCE

The mechanism for monitoring compliance with the impact management actions

A copy of the EMPr must be kept on site at all times during the road improvement period. The EMPr will be binding on all contractors operating on the site and must be included within the Contractual Clauses.

In terms of the Section 28 of the NEMA, *"those responsible for environmental damage must pay the repair costs both to the environment and human health and the preventative measures to reduce or prevent further pollution and/or environmental damage (The 'polluter pays' principle)".*

The Contractors should act immediately when notice of non-compliance is received and correct whatever is the cause for the issuing of the notice. Complaints received regarding activities on the construction site pertaining to the environment should be recorded in a dedicated register and the response noted with the date and action taken.

It is recommended that the Contractor institute penalties for the following less serious violations and any others determined during the course of work as detailed below:

- Littering on site.
- Lighting of illegal fires on site.
- Persistent or un-repaired fuel and oil leaks.
- Any persons, vehicles or equipment related to the Contractor's operations found within the designated "no-go" areas.
- Excess dust or excess noise emanating from site.
- Possession or use of intoxicating substances on site.
- Any vehicles being driven in excess of designated speed limits.
- Removal and/or damage to fauna, flora or cultural or heritage objects on site.
- Urination and defecation anywhere except at designated facilities.

2.2.1 Provisions for addressing non-conformance.

Ultimately, the key to effective environmental management during the construction phase is ensuring that the requirements of the EMPr are adequately and appropriately implemented on site. Accordingly, monitoring performance and addressing non-compliance are key attributes of any environmental interventions.

The Contractor is deemed NOT to have complied with the EMPr if:

- Within the boundaries of the site there is evidence of contravention of the EMPr confirmed and verified by the ECO;
- Environmental damage ensues due to non-compliance of EMPr requirements;
- The Contractor fails to comply with corrective or other instructions issued by the Engineer within a specific time, and
- The Contractor fails to respond to complaints to the satisfaction of the complainant in line with requirements of this EMPr which could lead to a fine

The cost to be incurred to rectify non-compliances must be incurred by the Contractor ("The polluter's pays principle".

2.2.2 Emergency Preparedness

The Contractor should compile and maintain environmental emergency procedures to ensure that there will be an appropriate response to unexpected or accidental actions or incidents that will cause environmental impacts, throughout the construction period. Such activities may include, *inter alia*:

- Accidental discharges of polluting substances to water and land.
- Accidental exposure of employees to hazardous substances.
- Accidental fires.
- Accidental spillage of hazardous substances.
- Accidental toxic emissions into the air.
- Specific environmental and ecosystem effects from accidental releases or incidents.

These plans should include:

- Emergency organisation and responsibilities, accountability and liability.
- A list of key personnel and contact details.
- Details of emergency services available (e.g. the fire department, spill clean-up services, etc.).
- Internal and external communication plans, including prescribed reporting procedures where required by legislation.
- Actions to be taken in the event of different types of emergencies.
- Incident recording, progress reporting and remediation measures required to

be implemented.

- Information on hazardous materials, including the potential impact associated with each, and measures to be taken in the event of accidental release.
- Training plans, testing exercises and schedules for effectiveness.

A program for reporting on compliance, taking into account the requirements as prescribed by EIA Regulations 2014, as amended

2.2.3 Administration

Before the Contractor begins the improvement activities, the Contractor should give to the ECO a written method statement setting out the following:

- The type of construction activity.
- Locality where the activity will take place.
- Identification of impacts that might result from the activity.
- Identification of activities that may cause an impact.
- Methodology and/or specifications for impact prevention for each activity or aspect.
- Methodology and/or specifications for impact containment for each activity or aspect.
- Emergency/disaster incident and reaction procedures.
- Treatment and continued maintenance of impacted environment.

The Contractor may provide such information in advance of any or all improvement activities provided that new submissions are given to the ECO whenever there is a change or variation to the original.

The ECO may provide comment on the methodology and procedures proposed by the Contractor, but he will not be responsible for the Contractor's chosen measures of impact mitigation and emergency/disaster management systems.

2.2.4 House Keeping

The Contractor should undertake "good housekeeping" practices during the improvement . This will help avoid disputes on responsibility and allow for the smooth running of the contract as a whole. Good housekeeping extends beyond the wise practice of construction methods to include the care for and preservation of the environment within which the construction is situated.

2.2.5 Record Keeping

The ECO will continuously monitor the Contractor's adherence to the approved impact prevention procedures and the ECO should issue to the Contractor a notice of non-compliance whenever transgressions are observed. The ECO should

document the nature and magnitude of the non-compliance in a designated register, the action taken to discontinue the non-compliance, the action taken to mitigate its effects and the results of the actions. The non-compliance should be documented and reported to SANRAL in a monthly report.

2.2.6 Document Control

The Contractor will be responsible for establishing a procedure for electronic document control. The document control procedure should comply with the following requirements:

- Documents must be identifiable by organisation, division, function, activity and contact person.
- Every document should identify the personnel and their positions, who was responsible for drafting and compiling the document, who reviewed and recommended approval, and who finally approved the document for distribution.
- All documents should be dated, provided with a revision number and reference number, filed systematically, and retained for a five-year period.

The Contractor should ensure that documents are periodically reviewed and revised, where necessary, and that current versions are available at all locations where operations essential to the functioning of the EMPr are performed. All documents must be made available to the ECO and other independent external auditors.

An environmental awareness plan describing the manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work; and risks must be dealt with in order to avoid pollution or the degradation of the environment.

2.3 AWARENESS TRAINING

Contractors should ensure that its employees and any third party who carries out all or part of the Contractor's obligations are adequately trained with regard to the implementation of the EMPr, as well as regarding environmental legal requirements and obligations.

An ECO may be contracted to provide training and to ensure that records of all training interventions are kept in accordance with the record keeping and documentation control requirements as set out in this EMPr.

The environmental training should, as a minimum, include the following:

- Environmental legal requirements and obligations.
- The importance of conformance with all environmental policies.
- The environmental impacts, actual or potential, of their work activities.

- The environmental benefits of improved personal performance.
- Their roles and responsibilities in achieving conformance with the environmental policy and procedures, including emergency preparedness and response requirements.
- The potential consequences of departure from specified operating procedures.
- The mitigation measures required to be implemented when carrying out their work activities.
- Details regarding floral/faunal species of special concern and protected species, and the procedures to be followed should these be encountered during the construction of main access roads, approach roads or construction camps.
- The importance of not littering.
- The importance of using supplied toilet facilities.
- The need to use water sparingly.
- Details of and encouragement to minimise the production of waste and re-use, recover and recycle waste where possible.
- Details regarding archaeological and/or historical sites which may be unearthed during construction and the procedures to be followed should these be encountered.

The EO will be responsible for ensuring that everyone on site is given an environmental awareness induction which outlines the requirements of the EMPr as a management tool to protect the environment.

SECTION 3: ENVIRONMENTAL MANAGEMENT MEASURES

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

The sections below form the core mitigation measures appropriate to the **pre-construction, construction and operational phases.**

3.1 PRE-CONSTRUCTION PHASE

Table 8: Pre-Construction Phase

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
PHASE OF THE DEVELOPMENT: PRE-CONSTRUCTION PHASE				
Legal and policy compliance	All necessary authorisations, permits and licenses must be obtained for the implementation of the activity.	• The development must comply with relevant legislation (municipal by-laws etc.). • All applications for licences in respect of protected trees must be obtained from the DFFE. • GA must be obtained from the DWS. • Mining Permits must be obtained from DMRE	Proponent/ Developer	To be undertaken prior to the start of construction phase. Once-off
Preparation of Method Statements	To control methods of works on site	• Relevant method Statements must be submitted by the Contractor to the SHE Officer and must be adhered to by the Contractor and Project Engineer.	Contractor	Once-off
General	To prevent environmental degradation through educating the construction team	• An environmental incident management reporting procedure must be implemented. • Every effort should be made to avoid potential impacts on the environment. No contamination of wetland resources may occur.	Developer/ contractor	Once- off

3.2 CONSTRUCTION PHASE

Table 9: Construction Phase

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
PHASE OF THE DEVELOPMENT: CONSTRUCTION PHASE				
Dangerous and toxic materials	• Prevention of pollution of soil and ground water resources • Minimise chances of transgression of the acts controlling pollution and ensure safety of workers.	• Materials such as fuel, oil, paint, herbicide and insecticides must be sealed and stored in caged areas or under lock and key, as appropriate, in well-ventilated areas. • Sufficient care must be taken when handling these materials to prevent pollution. Training on the handling of dangerous and toxic materials must be conducted for all staff prior to the commencement of construction. • Storage areas must display the required safety signs depicting "no smoking", No naked lights" and "Danger" containers must be clearly marked to indicate contents as well as safety requirements. • The contractor must supply a method statement for the storage of hazardous materials at tender stage. • All pollutants on site, including waste materials and construction debris must be handled and disposed of in a manner that does not cause contamination of stormwater runoff by, e.g. bunding storage areas that contain hazardous substances, etc. • Good housekeeping practices must be employed to prevent contamination of stormwater runoff. • Clean up spills in bunded areas, remove and dispose of safely from the bunded area as soon as possible after detection.	Contractor and ECO to check if mitigation measures are being properly implemented	Mitigation measures to be monitored daily

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
Oils and Chemicals	• Prevention of pollution of soil and ground water resources • Minimise chances of transgression of the acts controlling pollution and ensure safety of workers	• The contractor must provide method statements for the "handling & storage of oils and chemicals", "fire", and "emergency spills procedures". • These substances must be confined to specific and secured areas, and in a way that does not pose a danger of pollution even during times of high rainfall. • These areas must be imperviously bunded with adequate containment (at least 1.5 times the volume of the fuel) for potential spills or leaks. • Drip trays (minimum of 10cm deep) must be placed under all vehicles that stand for more than 24 hours. Vehicles suspected of leaking must not be left unattended, drip trays must be utilised. • The surface area of the drip trays will be dependent on the vehicle and must be large enough to catch any hydrocarbons that may leak from the vehicle while standing. • The depth of the drip tray must be determined considering the total amount/ volume of oil in the vehicle. The drip tray must be able to contain the volume of oil in the vehicle. • Spill kits must be available on site and in all vehicles that transport hydrocarbons for dispensing to other vehicles on the construction site. Spill kits must be made up of material/product that is in line with environmental best practice (example for consideration SUNSORB is a recommended product that is environmentally friendly). • All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site, (this includes contaminated soils,	Contractor and ECO to check if mitigation measures are being properly implemented	Mitigation measures to be monitored daily

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		and drenched spill kit material). • Construction should preferably take place during the dry season. • All construction vehicles should be kept in good working conditions.		
Stockpiles	• Minimise scaring of the soil surface and land features • Minimise disturbance and loss of soil • Minimise construction footprint • Minimise sedimentation of nearby drainage lines • Maintain the integrity of topsoil for landscaping and rehabilitation • Containment of invasive plant growth • Minimise contamination of storm water run-off	• All stockpiles must be stored on flat developed or to be paved over areas where run-off will be minimised and be surrounded by berms. Stockpiles must also only be stored for the minimum amount of time necessary. • All stockpiled material must be easily accessible without any environmental damage. • All temporarily stockpiled material must be stockpiled in such a way that the spread of materials is minimised. • Stockpiles are to be stabilised prior to the loss of soils due to erosion. • Soils from different horizons must be stockpiled such that topsoil stockpiles do not get contaminated by sub-soil material. • No plant, workforce or any construction related activities may be allowed onto the topsoil stockpiles. • Topsoil stockpiles must be clearly demarcated as no-go areas. • Stockpiles must not be higher than 2m to avoid compaction thereby maintaining the soil integrity and chemical composition (for the topsoil stockpiles that will be used for re-vegetation).	Contractor and ECO to check if mitigation measures are being properly implemented	Mitigation measures to be monitored daily

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
Cement (if Applicable)	• Minimise the possibility of cement residue entering into the surrounding environment • Minimise pollution of soil and ground water resources	• The contractors must provide and maintain a method statement for "cement and concrete batching". The method statement must provide information on proposed storage, washing & disposal of cement, packaging, tools and plant. • The mixing of concrete must only be done at specifically selected sites on mortar boards or similar structures to contain run-off into soils, rocky outcrops, streams and natural vegetation. • Cleaning of cement mixing and handling equipment must be done using proper cleaning trays. • All empty containers must be stored in a dedicated area and later removed from the site for appropriate disposal at a licensed facility. • Any spillage that may occur must be investigated and immediate remedial action must be taken. • The visible remains of concrete, either solid, or from washings, must be physically removed immediately and disposed of as waste to a registered landfill site. • Cement batching areas must be located in consultation with the Engineer Representative, his/ her EO or ECO to ensure residues are contained.	Contractor and ECO to check if mitigation measures are being properly implemented	Mitigation measures to be monitored daily
Bulk Storage of Fuel	• Prevention of pollution of soil and ground water resources in the immediate and surrounding environments.	• Bulk fuel storage tanks on the site shall be on an impervious surface with an appropriate bunding and be able to contain at least 110% of the volume of the tanks. • Bulk fuel storage tanks shall be located such that they do not pose a high risk in terms of water pollution (i.e. they must be located away from water courses). • Bulk fuel storage tanks shall be placed so that they are out	Contractor and ECO to check if mitigation measures are being properly implemented	Mitigation measures to be monitored daily

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		of the way of traffic, so that the risk of the tanks being ruptured or damaged by vehicles is minimised. • The combined volume of Diesel and/or dangerous goods stored on site must not be greater than 80m3, at any one time.		
Eating areas and camp followers	• Control potential influx of vermin and flies • Neat workplace and hygienic environment • Minimise negative social impacts to local residents and businesses	• The contractors must provide and maintain a method statement for construction lay down areas". • The Contractor must, in conjunction with the EO, designate restricted eating areas for eating during normal working hours. Adequate closed refuse bins must be provided and cleaned on a daily basis. • No fires are to be lit outside of a facility designed to contain fires. The adequacy and positioning of these structures must be determined in consultation with the EO. • The feeding, or leaving of food, for stray or other animals in the area is strictly prohibited. • Camp followers/ informal traders must not be allowed to congregate outside the construction site. • Litter (even if originating outside the camp but within the site boundary) and concrete bags, etc. must be picked up daily and put into suitably closed bins.	contractor. The ECO to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored as and when required
Toilets and Ablution Facilities	• Minimise potential of diseases on site • Minimise potential to pollute soils, water resources and natural habitats	• The contractor is responsible for providing all sanitary arrangements for his and the sub-contractors team. A minimum of one chemical toilet must be provided per 15 persons. • Sanitary arrangements must be to the satisfaction of the ECO. Toilets must be of the chemical type. The contractor must keep the toilets in a clean, neat and hygienic condition. The contractor must supply toilet paper at all	contractor. The ECO to check if mitigation measures are being properly implemented	Mitigation measures to be monitored as daily

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		toilets at all times. Toilet paper dispensers must be provided in all toilets. • Toilets provided by the contractor must be easily accessible. All toilets will be located within the contractor's camp and not within sensitive areas. Should toilets be needed elsewhere, their location must first be approved by the EO or ECO. • The contractor (who must use reputable toilet-servicing company) must be responsible for the cleaning, maintenance and servicing of the toilets. The contractor (using reputable toilet-servicing company) must ensure that all toilets are cleaned and emptied weekly • Toilets out on site must be secured to the ground and have a sufficient locking mechanism operational at all times. • Ensure proper sanitation is achieved which will encourage the workforce to utilise toilets provided and not the surrounding habitat.		
Solid Waste Management	• To keep the site neat and tidy • Reduce visual impact • Control potential influx of vermin and flies thereby minimising the potential of diseases on site and the surrounding	• The contractors must provide and maintain a method statement for "solid waste management". The method statement must provide information on proposed licensed facility to be utilised and details of proposed record keeping for auditing purposes. • Waste must be separated into recyclable and non-recyclable waste. • Any illegal dumping of waste must not be tolerated, this action will result in a fine and if required further legal action will be taken. This aspect must be closely monitored and reported on; proof of legal dumping must be able to be produced on request.	Contractor. The ECO is to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored daily.

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
	environment • Minimise potential to pollute soils, water resources and natural habitats	• Bins must be clearly marked for ease of management. • All refuse bins must have a secured lid so that animals cannot gain access. • Sufficient closed containers must be strategically located around the construction site to handle the amount of litter, wastes, rubbish, debris, and builder's wastes generated on the site. • All solid wastes, including chemical wastes that are generated must be removed and disposed of at a licensed waste disposal site. The contractor is to provide proof of such to the EO and ECO. • Chemical containers and packaging brought onto the site must be removed for disposal at a suitable site. • A skip, with a cover, must be used to contain refuse from campsite bins, rubble and other construction material.		
Workshop equipment, maintenance and storage	• Prevent pollution of the environment • Minimise chance of transgression of the acts controlling pollution • Disposal of hazardous substances in an appropriate manner	• All maintenance and washing of vehicles and equipment must take place in an area that is equipped with a bund wall and grease trap oil separator. During servicing of vehicles/equipment, a suitable drip tray must be used, especially where emergency repairs are done outside the workshop/ camp laydown area. Leaking equipment must be repaired immediately/ be removed from site to facilitate repair. All wastes must be collected and removed to an appropriate registered waste site. • Workshop areas must be monitored for oil and fuel spills and such spills must be cleaned and remediated to the satisfaction of the EO or Engineer Representative. Cleaning and remediation must be done with products that are in line with best environmental practice i.e.	Contractor. The ECO to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored daily.

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		SUNSORB • A method statement is required from the Contractor, tendering for the project to show procedures for dealing with possible emergencies that can occur, such as fire, accidental leaks and spillage. • The Contractor must be in possession of an emergency spill kit that is complete and available at all times on site. The Contractor must ensure that senior and other relevant members of the workforce are trained in dealing with spills by using emergency spill kits. • The following must be applied: o All contaminated soil/yard stone shall be removed and disposed of as hazardous waste at a registered facility or placed in containers to be taken to one central point where bioremediation can be done. o A specialist Contractor shall be used for the bioremediation of contaminated soil where the required remediation material and expertise is not available on site. o All spills of hazardous substances must be reported to the EO, Engineer Representative or ECO. o The contractor must comply with the regulations of the OHSA.		
Crew Camps	• Minimise water pollution • Minimise dust fallout • Minimise unwarranted environmental	• The contractors must provide and maintain a method statement for "Crew camps and construction lay down areas". • Accommodation for members of the workforce is not permitted on site. • Dedicated wash areas must be situated 30m away from watercourses, areas of shallow groundwater.	Contractor. The ECO is to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored as and when required

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
	damage outside the footprint • Maintain a clean and healthy working environment • Minimise impact to surrounding environment	• The contractor's camp must be monitored for dust fallout and dust suppression applied as required. • The contractor must provide labourers plastic bags to clean up the contractor's camp and construction site on a daily basis. These areas must then be inspected by the contractor to ensure compliance with this requirement. • The contractor is responsible for cleaning the contractor's camp and construction site of all structures, equipment, residual litter and building materials at the end of the construction period and, the topsoil restored in areas where landscaping is to take place.		
Fires	• Minimise risk of fires • Minimise destruction of natural fauna and flora • Maintain safety on site • Conduct management review of fire preparedness and response before onset of fire season	• The contractors must provide and maintain a method statement for "fires", clearly indicating where and for what fires will be utilised plus details on the fuel to be utilised. • Absolutely no burning of waste is permitted. • Fires within the designated areas must be small in scale so as to prevent excessive smoke being released into the air. • No wood is to be collected, chopped or felled for fires from private or public property as well as from no-go or sensitive areas within the site and any surrounding natural vegetation.	Contractor. The ECO to check if mitigation measures are being properly implemented	Mitigation measures to be monitored as and when required
Graves	• Minimise risk of damaging identified graves	• The graveyard is situated 5m to 15m from the road. The road verge on the opposite side is also approximately the same width. It is recommended that the graveyard be properly fenced with a gate for family access, with a 5m buffer around the graves. Although a 30-50m buffer is	Contractor/ Applicant	Mitigation measures to be monitored frequently

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		preferred for graves, this is not practicable in this case. Should this not be feasible, 2 alternatives remain: 1. Reduce the width of the northbound verge to provide a small 5-10m buffer or 2. Relocate all graves to a formal graveyard of the families choosing. Cem_R30_1 (GPS: S26° 40' 40.1" E26° 35' 30.6")		
		The graveyard is situated 35m from the road. The cemetery is also fenced and maintained. It is recommended that the graves remain in situ and the 30m buffer be maintained. Road engineers will need to take this into consideration while planning the road expansion. Cem_R30_2 (GPS: S26° 36' 26.3" E26° 36' 45.1")		
		The graveyard is situated 15m from the road. The cemetery is also fenced and maintained. It is recommended that the graves remain in situ and the 15m buffer be maintained. Road engineers will need to take this into consideration while planning the road expansion. Cem_R30_3 (GPS: S26° 33' 58.9" E26° 37' 34.4")		
Crime, Safety and Security	• Reduce the risk of potential incidences • Minimise the potential impact on the environment	• Staff must regularly be informed of the necessary safety procedures and be competent in the work they are employed to do. • No site staff, other than security personnel will be housed on site. Security personnel must be supplied with adequate protective clothing, ablution facilities, water and refuse collection facilities, facilities for cooking and	Contractor. The ECO to check if mitigation measures are being properly implemented	Mitigation measures to be monitored as and when required

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		heating so that open fires are not necessary. • Ensure that staff is familiar with the Occupational Health and Safety Policy and the Health, Safety, Security and Environmental Policy of the relevant contractor. • All the necessary safety regulations must be abided by including building codes and the fire practice requirements; • The contractor must ensure that all emergency procedures are in place prior to commencing work. Emergency procedures must include (but not be limited to) fire, spills, contamination of the ground, accidents to employees, use of hazardous substances and materials, etc. • The contractor must ensure that lists of all emergency telephone numbers/ contact persons are kept up to date and that all numbers and names are posted at relevant locations throughout the construction site. • The nearest emergency service provider must be identified during all phases of the project as well as its capacity and the magnitude of accidents it will be able to handle. The contact details of this emergency centre, as well as the police and ambulance services must be available at prominent locations around the construction site and the construction crew camps.		
Visual Impact	• Minimise littering on site • Prevent adverse health effects on workers and the	• The site must be managed properly, and all rubbish and rubble removed to a registered waste disposal facility. • Excess soil and bedrock should be disposed of at an appropriate facility. A certificate of disposal must be obtained for any waste that is disposed of.	Contractor. The ECO is to check if mitigation measures are	Mitigation measures to be monitored daily

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
	surrounding community • Maintain a peaceful environment for the community during construction	• Refuse bins must be provided on site and these must be emptied regularly. Waste must not remain on site for more than 2 weeks. • The construction camp must be properly screened and located closer to the access road. • Indigenous plants or trees must be retained to provide screens to make the construction site less visually intrusive. • Construction activities must be limited to the daylight hours. • Should overtime/night work be authorised, the Contractor shall be responsible to ensure that lighting does not cause undue disturbance to neighbouring residents. In this situation low flux and frequency lighting shall be utilised.	being properly implemented.	
Noise Impact	• Minimise noise pollution from construction activities • Prevent adverse health effects on workers and the surrounding community • Ensure compliance with local noise regulations and standards • Mitigate impacts on nearby sensitive receptors, such as	• The Occupational Health and Safety Act's regulations must be followed during all operations during the building period (Act No 85 of 1993). • During certain times of construction, activities that produce noise levels exceeding 85 dBA must be forbidden. • To help mitigate the effects of noise levels, PPE should be made available to on-site individuals working in regions where the threshold exceeds the ambient 8-hour noise levels (75dBA). • Construction work must only be done during regular business hours (weekdays, 7 a.m. to 5 p.m., excluding holidays). • On-site signage should be created to alert the public to construction operations. • If construction must proceed after regular business hours,	Contractor. The Contractor and ECO is to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored daily.

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
	schools, hospitals, and residential areas • Maintain a peaceful environment for the community during construction	the neighbours and I&APs must be informed. • The CLO is required to notify the neighbourhoods of any anticipated noise disturbances outside of regular business hours. • Noise levels must be within reasonable bounds. South African National Standard (SANS) must be followed for all created noise and sounds. • Wherever possible, it is necessary to enclose stationary noisy equipment (such as compressors, generators, etc.) with acoustic coverings, screens, or sheds. The usage of portable acoustic shields is required when noisy equipment is not stationary (for example drills, angle grinders, and chipping hammers). • The Contractor is required to take action to prevent workers from lingering and making noise disturbances in the vicinity. When feasible, the Contractor or his subcontractors must transport workers to and from the site using their own vehicles. • In areas where construction will be taking place near residential and/or business property make use of noise reduction techniques such as sound barriers. • Avoid undertaking construction activities after daylight hours. In instances when this is not possible ensure that potentially affected parties are informed. • If blasting is required ensure that potentially affected parties are informed prior to any blasting taking place.		
Traffic Impact	• Minimise Traffic during construction • To ensure that	• Develop and implement a traffic management plan. The traffic management plan should be inclusive of traffic management measures for alternative routes.	Contractor. The ECO is to check if mitigation	Mitigation measures to be monitored

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
	public roads around the site are safe and the flow of traffic is not disrupted	• Ensure there is suitable road signage, including the use of the variable messaging • System informing road users of construction activities and potential delays. • Where possible, separate fast- and slow-moving traffic into specific lanes. • During peak periods (morning and evening) stack heavy duty vehicles and allow through during non-peak times. • Do not allow heavy duty vehicles onto alternative routes. • Encourage road users to avoid the affected section of road during peak hours (Particularly the communities who have alternatives routes to consider). • Make use of local radio stations, newspapers, and social media to inform the public well in advance of any road closures or extended delays. • Construction vehicles must not dispose of soil or other material on roads. Where this occurs, the material must immediately be removed before the end of the working day	measures are being properly implemented	daily
Air Quality Impact	• Minimise Air pollution during construction	• The liberation of dust into the surrounding environment shall be effectively controlled using inter alia, water spraying and/or other dust-allaying agents such as dust nets. • Regular and effective damping down of working areas must be carried out to avoid dust pollution. • Machinery or equipment used on site must not constitute a pollution hazard regarding air pollution via excessive exhaust fumes. This shall be inspected regularly by the contractor and rectified immediately.	Contractor. The ECO is to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored daily

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
Degradation and/ or Destruction of wetland Habitats	• Reduce the risk of potential degradation of wetland habitats Minimise the potential impact on the environment	• Any construction activities in or within a delineated buffer zone of a water resource may only take place after the necessary water use license has been obtained. • Where wetlands may be encroached upon by proposed activities, the edge of the wetland must be clearly demarcated in the field with pegs or poles that will last for the duration of the construction phase, color-coded as follows: o RED – Indicating the edge of the wetland (Note: This includes the permanent, seasonal and temporal zones of wetlands, or parts thereof; and no vehicles or building materials are allowed in this zone). These should be placed along the entire length of the site. o ORANGE – Indicating the edge of the buffer zone • Construction machinery and associated vehicles are not allowed to enter wetlands. Strictly no re- fuelling of vehicles or machinery will be allowed to take place in any area close to a wetland. • During and after construction areas of exposed soil can easily erode and subsequently end up in the wetlands. A well-designed storm water system must be put in place to avoid erosion into wetlands. Natural runoff from the natural terrestrial habitat surrounding the wetlands should however not be restricted unnecessarily. • The use of potential pollutants (paint, chemicals, etc.) during construction and operational phases must be strictly controlled and a high quality of management and supervision concerning such materials must be enforced, especially close to wetland buffer zone areas.	Contractor. The ECO is to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored on regular basis

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		• Sanitary facilities must be made available to construction workers to prevent urine and human waste entering the wetlands. If at any point construction activities encroach on wetlands, it is strongly advised that a wetland/aquatic specialist is appointed during all phases to monitor impacts and related mitigation measures regarding wetland habitats.		
Loss of Indigenous Fauna and Flora Diversity Associated with Wetlands	• Reduce the risk of potential loss of indigenous fauna and flora.	• Destruction of natural wetland vegetation must be avoided at all costs. • Development of an alien invasive management plan. Alien and invasive vegetation control must take place throughout all development phases to prevent loss of habitat of indigenous fauna and flora. • Movement of vehicles and construction workers in wetlands and buffer zones must be strictly prohibited. No harvesting of plants or animals is allowed. • Any specimens of protected plant species known to occur in the wetlands and the delineated buffer zone and may potentially be impacted by the construction activities, are to be fenced off for the duration of the activity. • Include environmental awareness aspects into the site induction program to ensure all staff are aware of the location and importance of wetland habitats. • Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills. • No stockpiling of materials may take place within wetland/ watercourse areas and temporary construction	Contractor. The ECO is to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored on regular basis

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		camps and infrastructure should be located outside the wetland footprint. • Regular cleaning up of the wetland areas should be undertaken to remove litter. • Design and implement a construction stormwater management plan that aims to minimise the concentration of flow and increase in flow velocity, as well as minimising sediment transport off site. • Where practically possible, the major earthworks should be undertaken during the dry seasons (roughly from April to August) to limit the erosion during rainfall. • Store and handle potentially polluting substance and waste in designated bunded facilities. • Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities. • Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge Keep sufficient quantities of spill clean-up material on site.		
Introduction of Alien Invasive Species	• Reduce the risk of potential loss of species.	• Implementation of an Alien Invasive Management Programme. • Ongoing alien plant control must be undertaken, particularly in the disturbed areas as these areas will quickly be colonised by invasive alien species, especially in the riparian zone, which is particularly sensitive to AIP infestation. • Herbicides must be carefully applied, in order to prevent any chemicals from entering the river. Spraying of	Contractor. The ECO is to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored on a regular basis

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		herbicides within or near to the wetland areas is strictly forbidden. • Re-instate indigenous vegetation (grasses and indigenous trees) in disturbed areas. • After rehabilitation, re-vegetate any exposed surfaces and mulch re-vegetated areas. Select appropriate species for wetland and terrestrial areas and ensure species diversity is enhanced, with species commonly found in the natural wetland area.		
Pollution of Water Resource and Soils	• Reduce the risk of potential loss of species.	• Demarcate wetland areas to avoid unauthorised access. • No washing of any equipment in close proximity to a watercourse is permitted. • No releases of any substances that could be toxic to fauna or faunal habitats within the channels or any watercourses is permitted. • Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil must be removed, and the affected area rehabilitated immediately. • Education of workers is key to establishing good pollution prevention practices. Training programs must provide information on material handling and spill prevention and response, to better prepare employees in case of an emergency. • Signs should also be placed at appropriate locations to remind workers of good housekeeping practices including	Contractor. The ECO is to check if mitigation measures are being properly implemented	Mitigation measures to be monitored on a regular basis

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		litter and pollution control. • The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be ensured. All employees handling fuels and other hazardous materials are to be properly trained. Storage containers must be regularly inspected so as to prevent leaks. All contractors and employees should undergo induction which is to include a component of environmental awareness.		
Sedimentation and Soil Erosion	• Reduce the risk of potential loss of species.	• Implement a stormwater management plan • Do not allow surface water or stormwater to be concentrated, or to flow down cut or fill slopes without erosion protection measures being in place. • Exposed soils must be rehabilitated as soon as practically possible to limit the risk of erosion. Erosion control measures must be employed where required. • Riparian vegetation bordering on drainage lines, wetlands and rivers will be considered environmentally sensitive and impacts on these habitats should be avoided. • If erosion has taken place, rehabilitation will commence as soon as possible.	Contractor. The ECO is to check if mitigation measures are being properly implemented	Mitigation measures to be monitored on a regular basis
Destruction, further loss of habitat and fragmentation of the vegetation Community	• Reduce the risk of potential loss of habitat.	• Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further. • All areas outside of the direct footprint that were disturbed by the geological sampling must be rehabilitated and restored to a natural state. • Rehabilitation of the disturbed areas must be made a	Contractor. The ECO is to check if mitigation measures are being properly implemented.	Mitigation measures to be monitored on regular basis

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		priority. Any disturbed area must be revegetated with plant and grass species which are endemic to this vegetation type. • All activities must be restricted too within the low/medium sensitivity areas. No unnecessary loss of high sensitivity areas should be permitted. • All construction/operational and access must make use of the existing roads. • All laydown, chemical toilets etc. should be restricted to low/medium sensitivity areas. Any materials may not be stored for extended periods of time and must be removed from the project area once the construction/closure phase has been concluded. • Construction impacts associated with the proposed project must be contained within the footprint of the demarcated areas as indicated on the final approved project layout plan. • Prior to construction, the final road alignment, road reserve and development footprint area must be demarcated on site to ensure that construction impacts are contained within this area. If necessary, these areas may be fenced or, alternatively, nearby sensitive areas are to be fenced to prevent access. • Minimise the impacted area and clear only what is required • Avoid erosion, manage alien invasive species establishment, ensure the re-establishment of natural vegetation • Employ stormwater management measures		

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
Loss of species of special concern (SSC)	• Reduce the risk of potential loss of species.	• Conduct a site walkdown to identify any SSC within the project area prior to site clearance • Minimise the impacted area and clear only what is required • Tag and avoid all Red Data plants • No removal or relocation of Plant SSC without prior approval from the competent authority • Restricting blasting and operation of machinery to daylight hours	Contractor. The ECO is to check if mitigation measures are being properly implemented	Mitigation measures to be monitored on regular basis

3.3 OPERATIONAL PHASE

Table 10: Operational Phase

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
PHASE OF THE DEVELOPMENT: PRE-CONSTRUCTION PHASE				
Impact of freshwater sources	• Manage water resources	• During routine road maintenance operations, clear all channels located upstream of the road crossings of any debris and sediment build-up, particularly at the culverts and bridge structures where flows maybe impeded; and • Remove any invasive alien plants occurring in the river channels at the river crossings and the road reserve on an ongoing basis.	Developer (SANRAL)	On going
Increased impervious area (Hardened surfaces)	• Manage stormwater flows and pollution to watercourses.	• During the operational phase, there is a medium-high risk due to the increased traffic that will occur on the road. This will increase the risk of toxic hydrocarbons being washed into the wetland areas. • The increased area of hardened surfaces will increase flow volumes/ flood-peaks leading to increased erosion	Developer (SANRAL)	On going

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		potential. • Attenuation of stormwater from the road improvement is important to control the velocity of runoff towards the stream. Attenuation structures must be placed between the road and the stream i.e. stormwater must not be directly deposited into the stream. • Address increased runoff volumes at source. • Disturbed area in the watercourse as a result of road maintenance must be rehabilitated as soon as maintenance in an area is complete or near complete and not left until the end to be rehabilitated (progressive rehabilitation). • Bank erosion must be monitored at regular intervals during the operational phase in order to assess whether further riverbank protection/stabilisation works are required. • Ensure the stream banks are well maintained and vegetated to prevent any scouring of the supporting structures. • The grass must be allowed to lengthen and thicken naturally to facilitate reduction in runoff velocity and volume, increase sediment deposition within the buffer zone and increase infiltration of stormwater. • Areas sensitive to erosion must be identified and monitored to ensure that erosion risks are minimised. • Watercourse crossings must be regularly checked to ensure they are not being degraded or causing degradation and that, openings (under or at a culvert opening) are kept clear to avoid impeding flows to downstream areas. This minimises erosion.		

ENVIRONMENTAL RISK OR ISSUE	MANAGEMENT OBJECTIVE	MITIGATION MEASURE	RESPONSIBILITY	FREQUENCY OF ACTION
		• Stockpiled topsoil must be replaced following construction activities and be shaped to match the natural topography of the site. All stripped topsoil MUST be appropriately replaced on the site.		
Road user safety and traffic accommodation	• improve overall road user safety and accommodate future anticipated traffic volumes	• Ensure the safety and traffic accommodation measures as indicated in the proposed project design are implemented as planned; and • Ensure that a Routine Road Maintenance Programme is implemented along the proposed project route.	Developer (SANRAL)	

SECTION 4: DETAILS OF THE PERSON/ COMPANY WHO PREPARED THE EMPR

Earthlink Environmental Services was appointed as the Independent Environmental Assessment Practitioner (EAP) and has adequate experience within the required Environmental Impact Assessment (EIA) field to facilitate the required Assessment Process. See Appendix G for a full CV. The persons involved in the project include.

ENVIRONMENTAL ASSESSMENT PRACTITIONER

Ms. Chuene is a registered Environmental Assessment Practitioner (EAPASA) with over 10 years of experience in environmental management, compliance, and waste management services. She holds a B.Sc. Environmental and Resource Studies and B.Sc. (Hons) from the University of Limpopo and currently pursuing an MSc in Geography specializing in Waste Management.

Ms. Chuene has experience in overseeing Environmental Impact Management, Biodiversity Management, Waste Management Planning, and Environmental Compliance. My expertise includes facilitating Environmental Authorizations, Water Use Licenses, and Waste Management Licenses for various projects, including renewable energy facilities, mining activities, waste management facilities, roads, bridges, dams, and agricultural developments.

She is the EAP for the proposed project.

SECTION 5: CONCLUSION

This EMP and associated Basic Assessment have been compiled to meet regulatory requirements under the National Environmental Management Act (Act No. 107 of 1998) [NEMA] and its associated 2010 EIA Regulations.

This EMPr comprehensively addresses the potential construction and operational phase's impacts of all relevant aspects related to road improvement activities on the site and has been informed inter alia through the undertaking of specialist assessments over the site. The EMP allows for continuous improvement through regular monitoring and reporting to IAPs and relevant spheres of Local, Provincial, and National Government.

APPENDIX 9 – EAP CV

APPENDIX 8 – SPECIALIST DECLARATION