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- Appendix D2 – Biodiversity: Terrestrial Ecology
- Appendix D3 – Wetlands
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APPENDIX D:

Specialist Studies

- ❖ **Appendix D1 – Screening Tool Report**

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

EIA Reference number: MR 184 MR

Project name: Valley Silts Expansion Project

Project title: Valley Silts Expansion Project

Date screening report generated: 16/08/2024 13:04:29

Applicant: Ergo Mining (Pty) Ltd

Compiler: Kongiwe Environmental (Pty) Ltd

Compiler signature: ... .

Application Category: Mining|Mining Right

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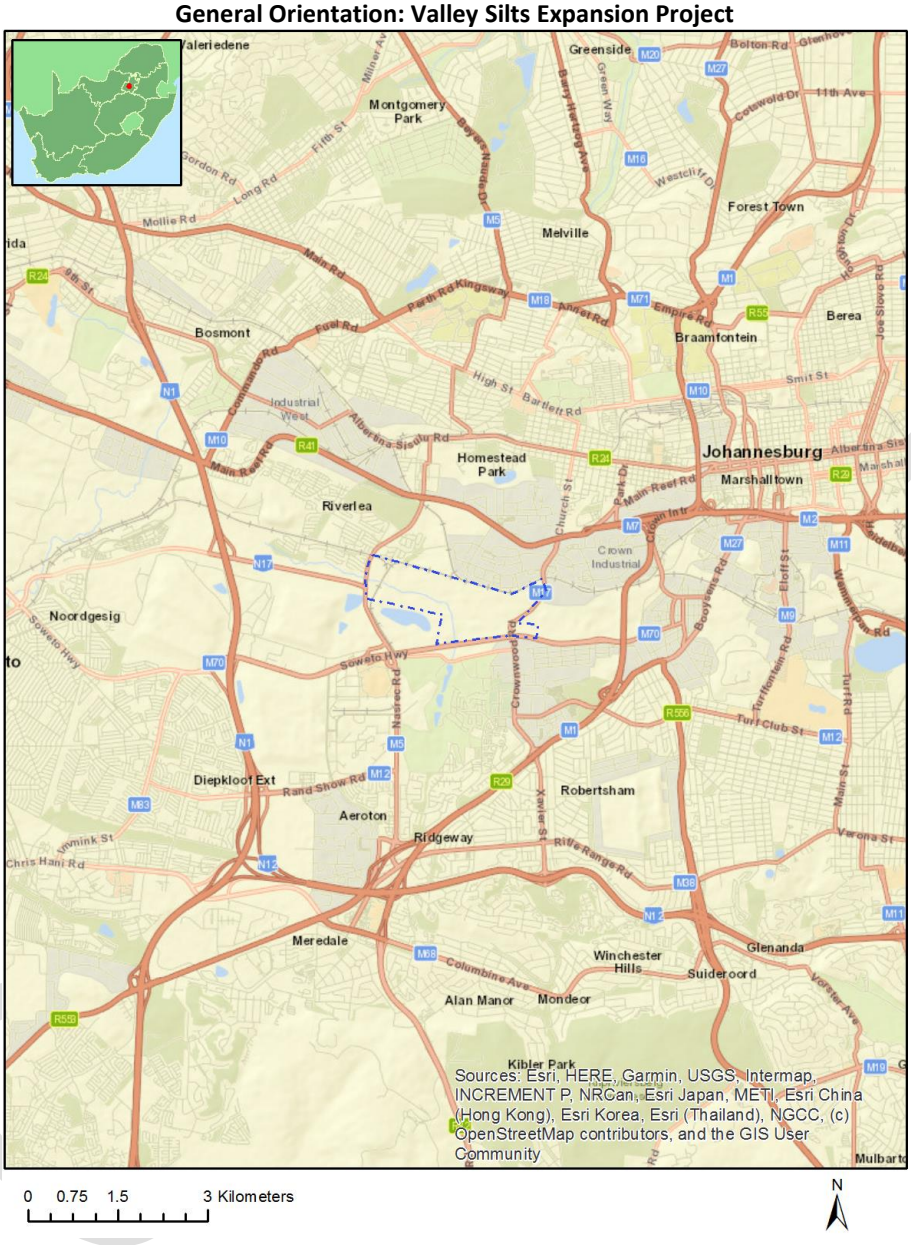
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Proposed Project Location

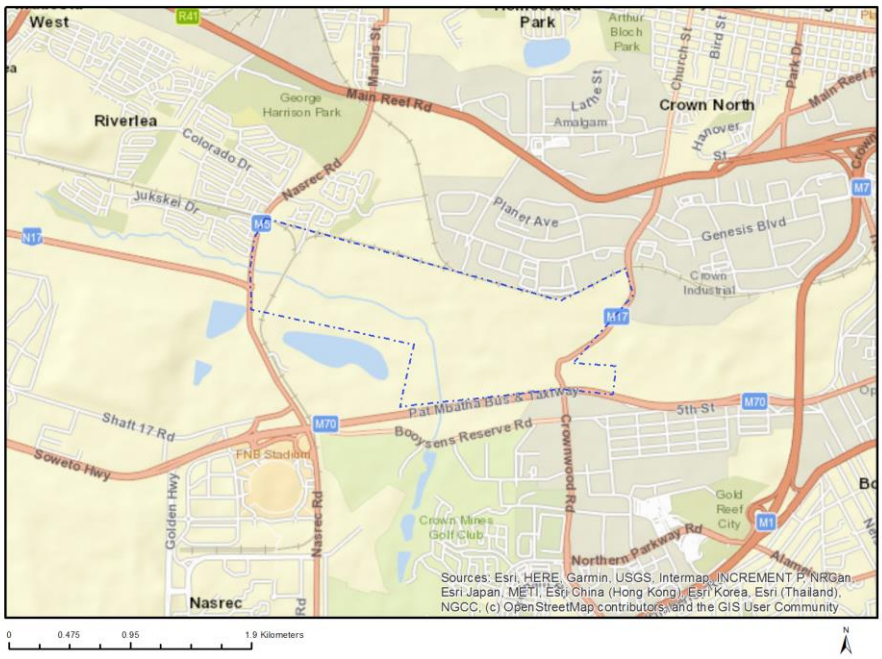
Orientation map 1: General location

General Orientation: Valley Silts Expansion Project



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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	RIVERLEA	999	0	26°13'9.79S	27°58'54.25E	Erven
2	RIVERLEA	988	0	26°13'13.41S	27°58'50.92E	Erven
3	MOOIFONTEIN	225	0	26°13'31.34S	27°57'54.41E	Farm
4	MAYFAIR WEST	221	0	26°12'44.46S	27°59'17.04E	Farm
5		224	297	26°13'9.24S	27°59'9.05E	Farm Portion
6		224	9	26°13'24.59S	27°59'34.89E	Farm Portion
7	MOOIFONTEIN	225	5	26°13'28.92S	27°58'51.88E	Farm Portion
8		224	298	26°13'15.51S	27°59'1.15E	Farm Portion
9		224	300	26°13'13.36S	27°59'2.8E	Farm Portion
10		224	388	26°13'26.37S	28°0'42.13E	Farm Portion
11		224	11	26°13'26.58S	27°59'50.08E	Farm Portion
12		224	299	26°13'14.2S	27°59'2.4E	Farm Portion
13		224	107	26°13'13.51S	27°59'3.51E	Farm Portion
14	MOOIFONTEIN	225	10	26°13'26.06S	27°58'54.36E	Farm Portion
15		224	381	26°13'19.57S	27°58'54.33E	Farm Portion
16		224	380	26°13'9.55S	27°57'48.51E	Farm Portion
17		224	101	26°12'58.18S	27°58'26.18E	Farm Portion
18		224	170	26°13'6.62S	27°59'1.88E	Farm Portion
19		224	201	26°13'16.13S	28°0'25.67E	Farm Portion
20		224	174	26°13'12.08S	27°59'27.42E	Farm Portion
21		224	212	26°13'3.54S	27°58'25.18E	Farm Portion
22		224	288	26°13'17.46S	28°0'20.32E	Farm Portion
23		224	200	26°13'18.8S	27°59'52.6E	Farm Portion
24	MOOIFONTEIN	225	0	26°13'42.19S	27°59'44.22E	Farm Portion
25		224	3	26°12'49S	27°59'22.82E	Farm Portion
26		224	204	26°13'22.16S	28°0'6.84E	Farm Portion
27		224	172	26°13'15.18S	27°59'39.05E	Farm Portion
28		224	173	26°13'9.66S	27°59'15.92E	Farm Portion

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29		224	296	26°13'9.91S	27°59'3.06E	Farm Portion
30		224	106	26°13'14.5S	27°59'2.61E	Farm Portion
31		224	8	26°13'17.75S	27°59'27.36E	Farm Portion

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

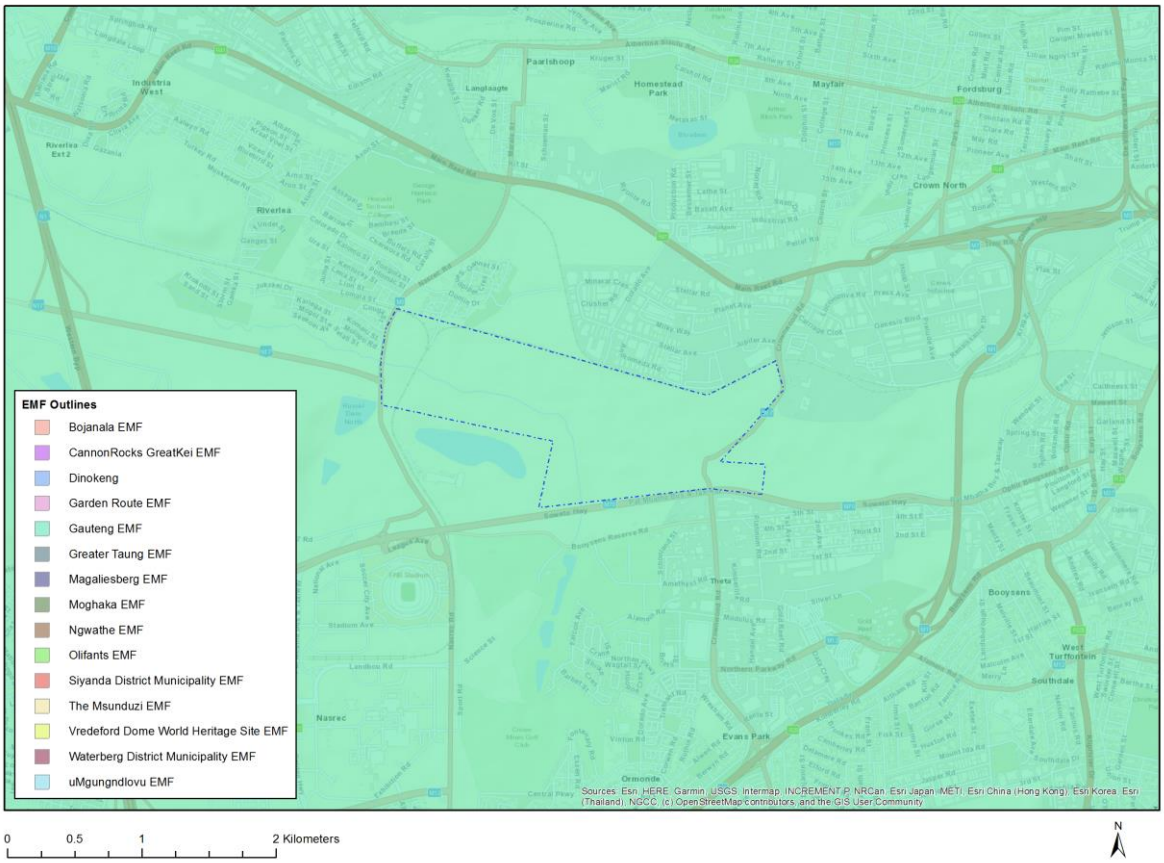
Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	002/15-16/E0152	Solar PV	Approved	8.9
2	14/12/16/3/3/2/825	Solar PV	Approved	26.5
3	12/12/20/2537/AM3	Solar PV	Approved	29.7
4	12/12/20/2147/A1	Solar PV	Approved	26.8
5	12/12/20/2539	Solar PV	Approved	29.5
6	12/12/20/2539/AM1	Solar PV	Approved	29.5
7	12/12/20/2530	Solar PV	Approved	1.4
8	12/12/20/2537/AM1	Solar PV	Approved	29.7
9	12/12/20/2147	Solar PV	Approved	26.8
10	14/12/16/3/3/2/375/AM1	Solar PV	Approved	17.1
11	12/12/20/2551	Solar PV	Approved	1.4

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[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.

Environmental Management Frameworks relevant to the application



Environmental Management Framework	LINK
Gauteng EMF	https://screening.environment.gov.za/ScreeningDownloads/EMF/GPEMF_2021_Gazette_and_summary.pdf

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: **Mining|Mining Right**.

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-Central corridor	https://screening.environment.gov.za/ScreeningDownloads/Developmen

	tZones/Combined_EGI.pdf
Strategic Gas Pipeline Corridors-Phase 3: Richards Bay to Gauteng	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Combined_GAS.pdf
Gauteng EMF-Urban development zone 1	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Zone1_2021.pdf
Gauteng EMF-Industrial and large commercial focus zone 5	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Zone5_2021.pdf
Main Electricity Distribution Substation	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Distribution_Transmission.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	Agricultural Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Agriculture_Assessment_Protocols.pdf
2	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Palaeontology Impact	https://screening.environment.gov.za/ScreeningDownloads/Asse

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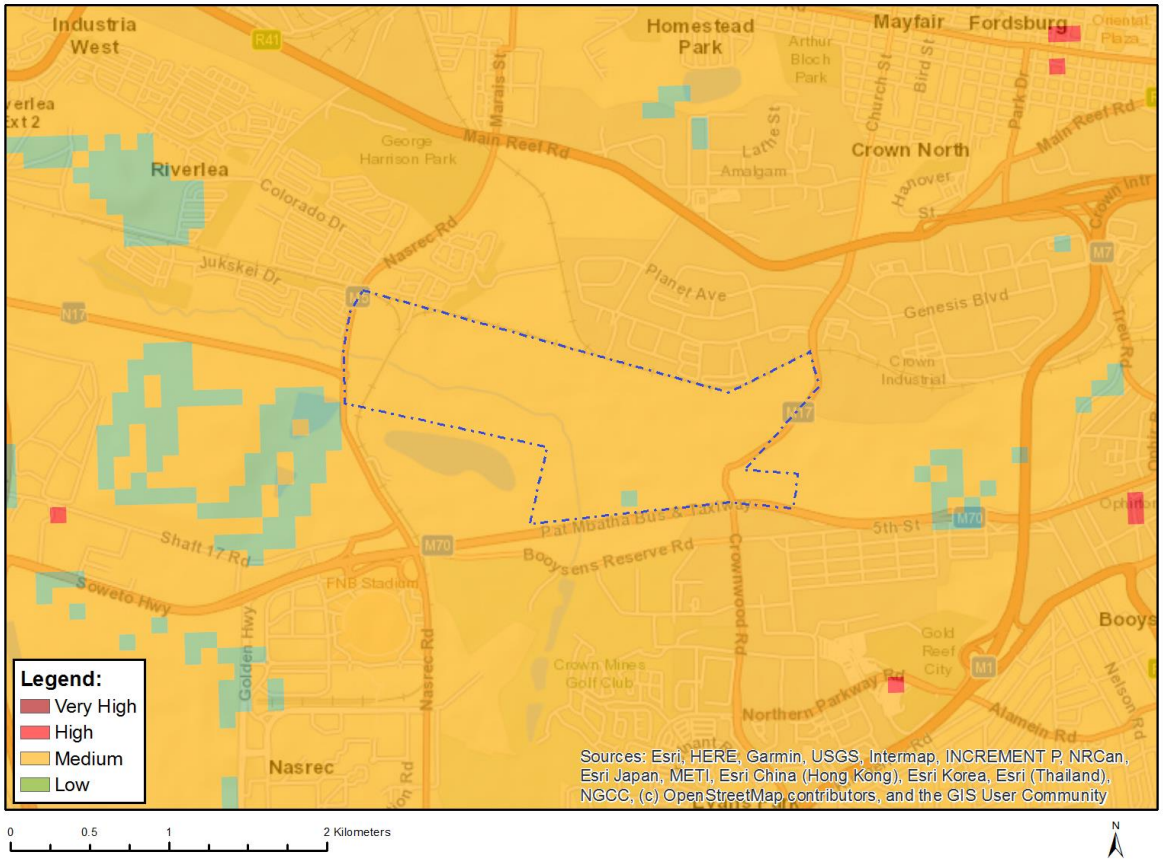
	Assessment	ssmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
5	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
6	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
7	Hydrology Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
8	Noise Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Noise_Impacts_Assessment_Protocol.pdf
9	Radioactivity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
10	Traffic Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
11	Geotechnical Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
12	Climate Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
13	Health Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
14	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
15	Ambient Air Quality Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
16	Seismicity Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
17	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
18	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

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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

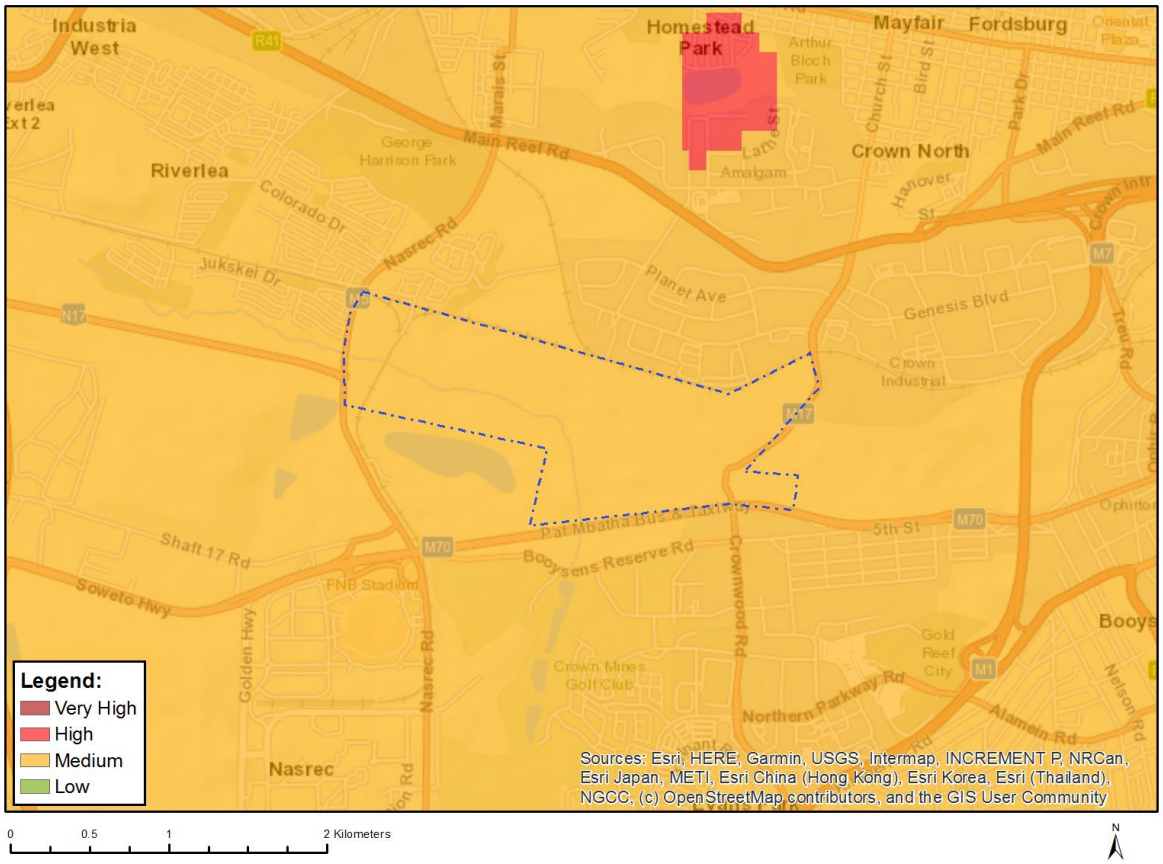


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
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

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



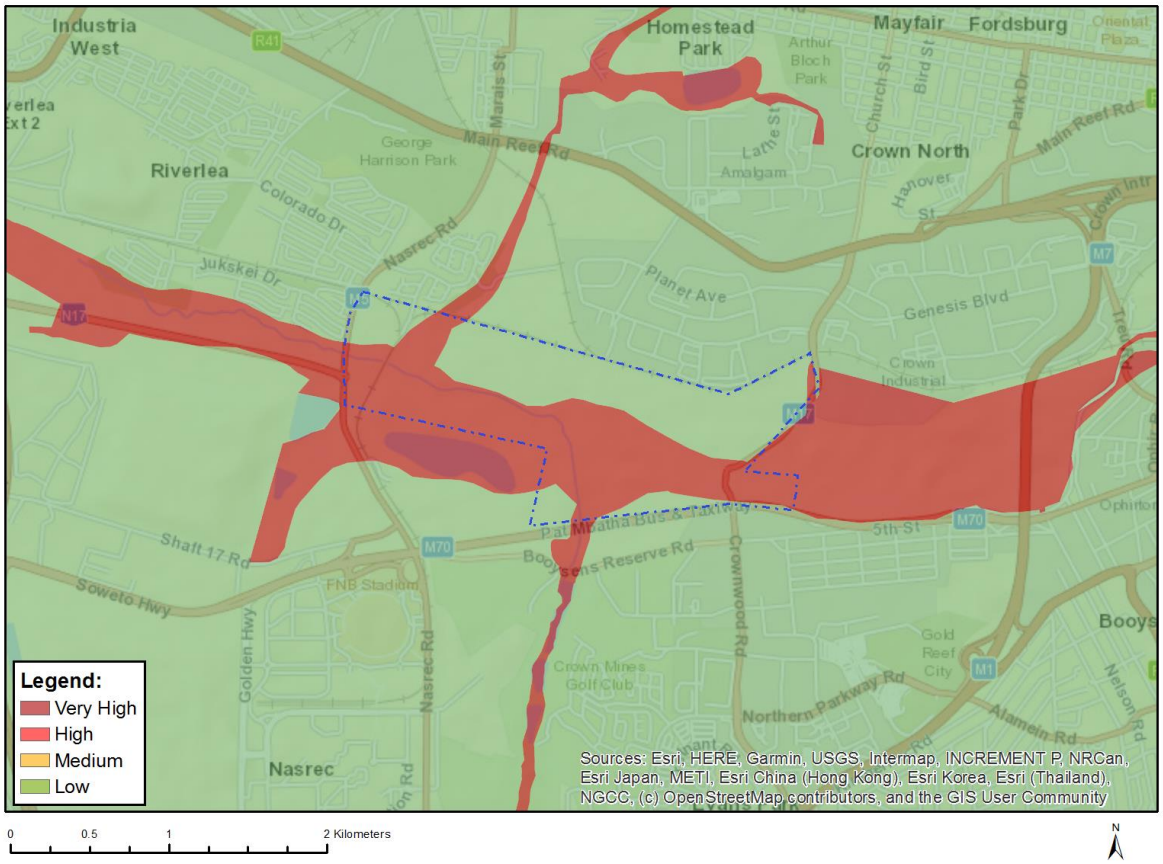
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their 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)
Medium	Aves-Eupodotis senegalensis
Medium	Insecta-Aloeides dentatis dentatis
Medium	Mammalia-Chrysospalax villosus
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Dasymys robertsii
Medium	Mammalia-Hydrictis maculicollis
Medium	Mammalia-Ourebia ourebi ourebi
Medium	Invertebrate-Clonia uvarovi

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

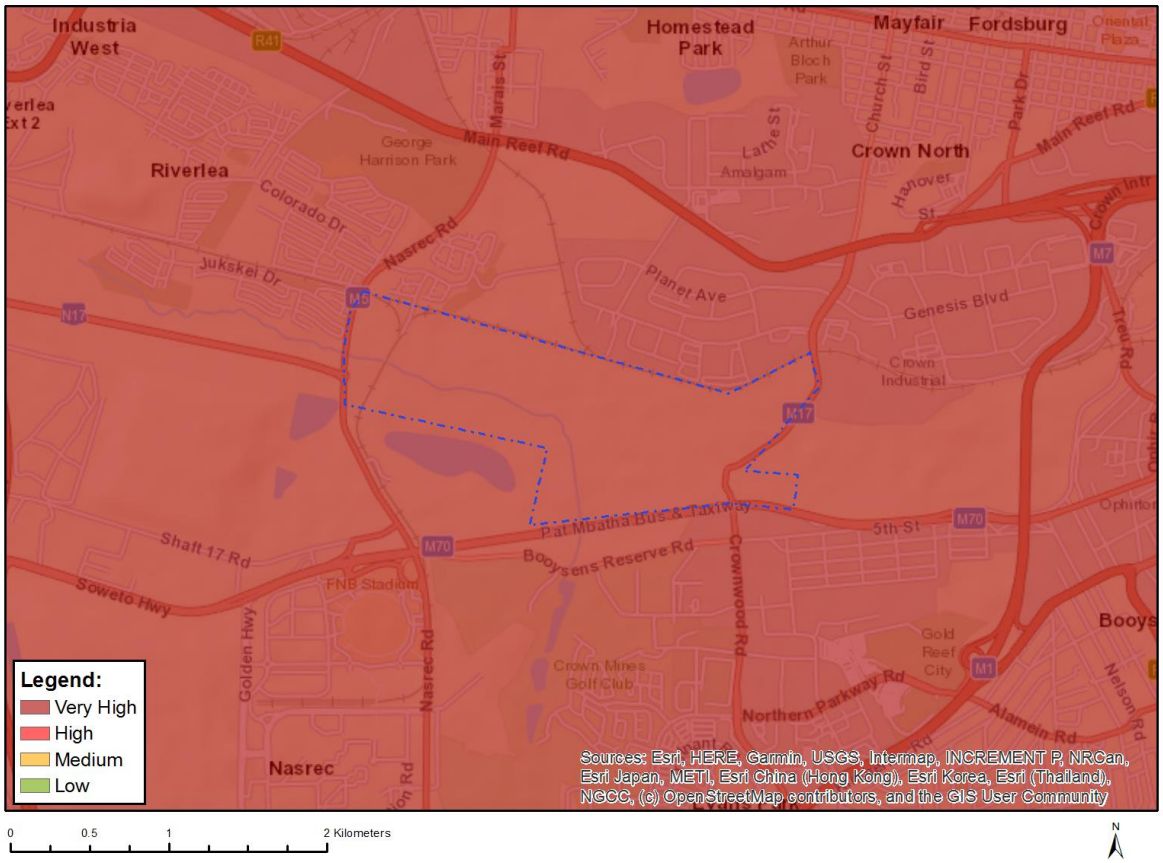


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Wetlands_Dry Highveld Grassland Bioregion (Valley-bottom)

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY



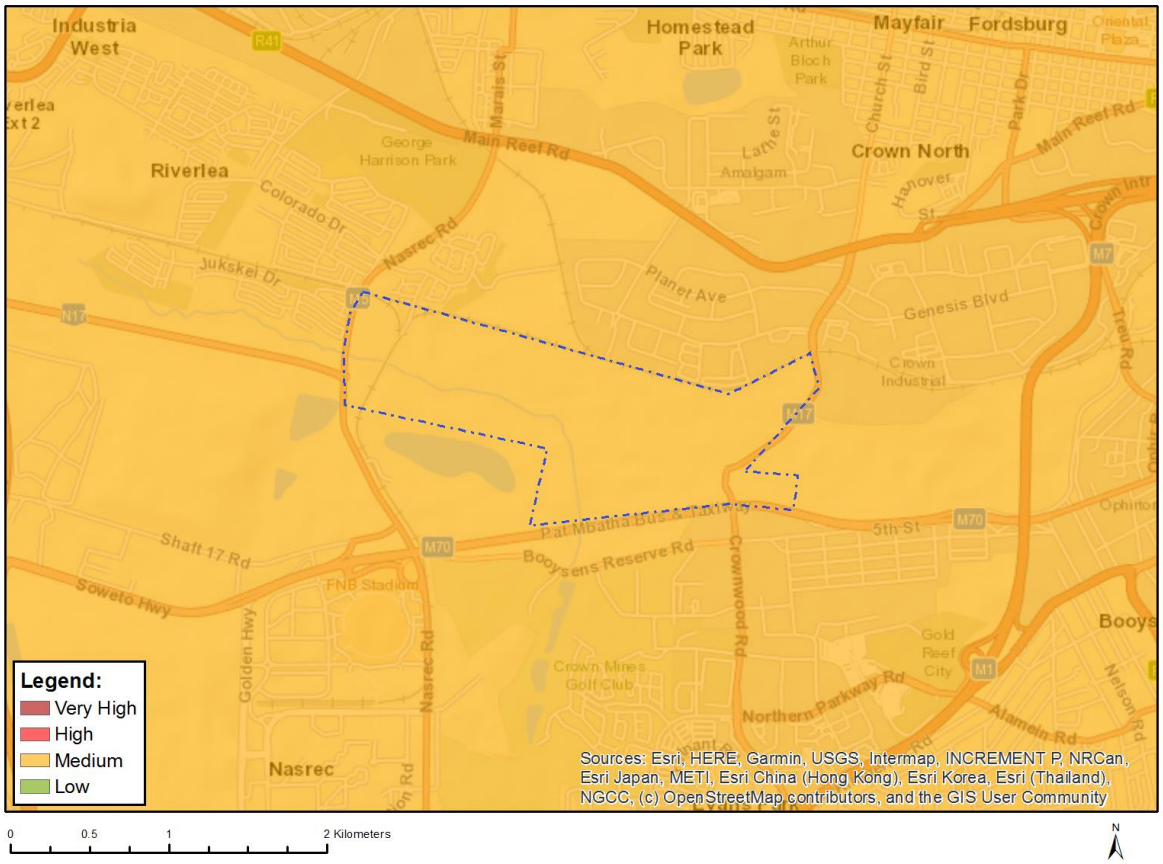
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Within 5km of a Grade I Heritage site
Very High	Within 2km of a Grade II Heritage site
Very High	Within 100m of an Ungraded Heritage site

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MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY



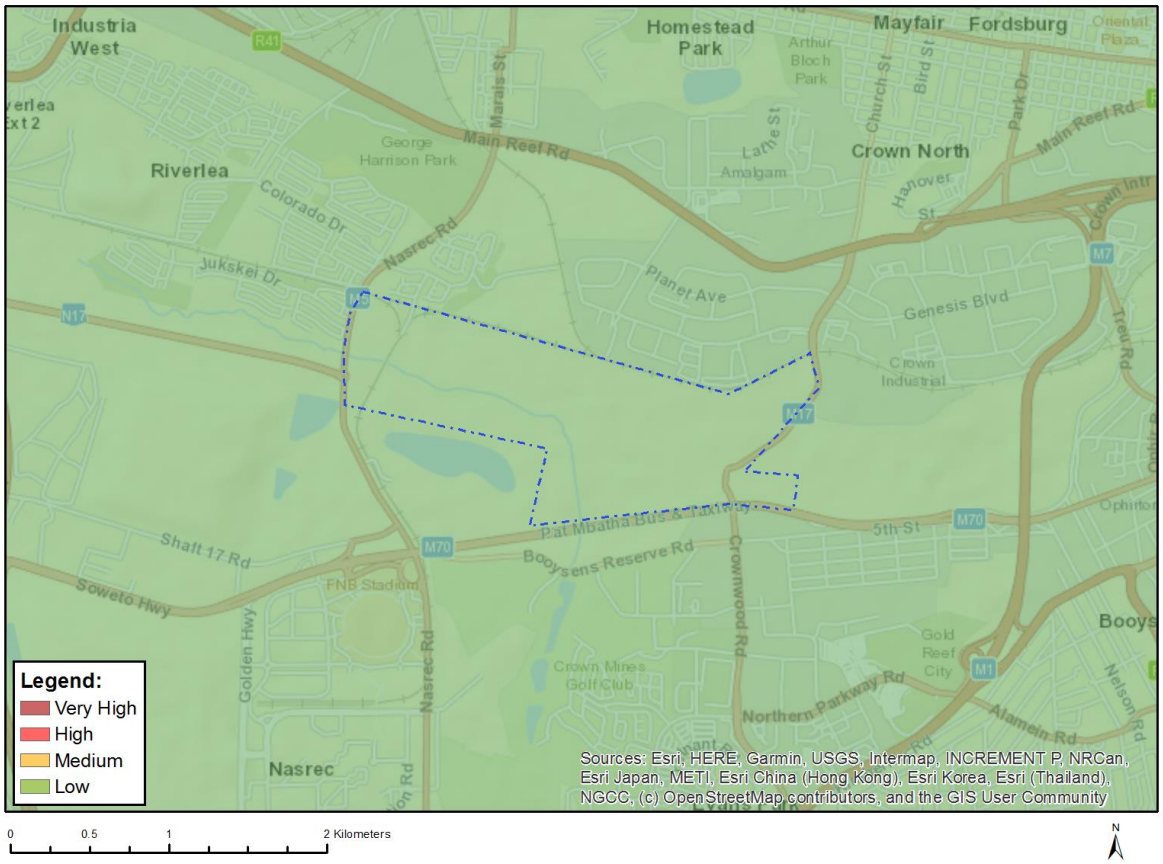
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Between 15 and 35 km from a civil aviation radar
Medium	Between 15 and 35 km from a major civil aviation aerodrome
Medium	Between 8 and 15 km of other civil aviation aerodrome

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MAP OF RELATIVE DEFENCE THEME SENSITIVITY



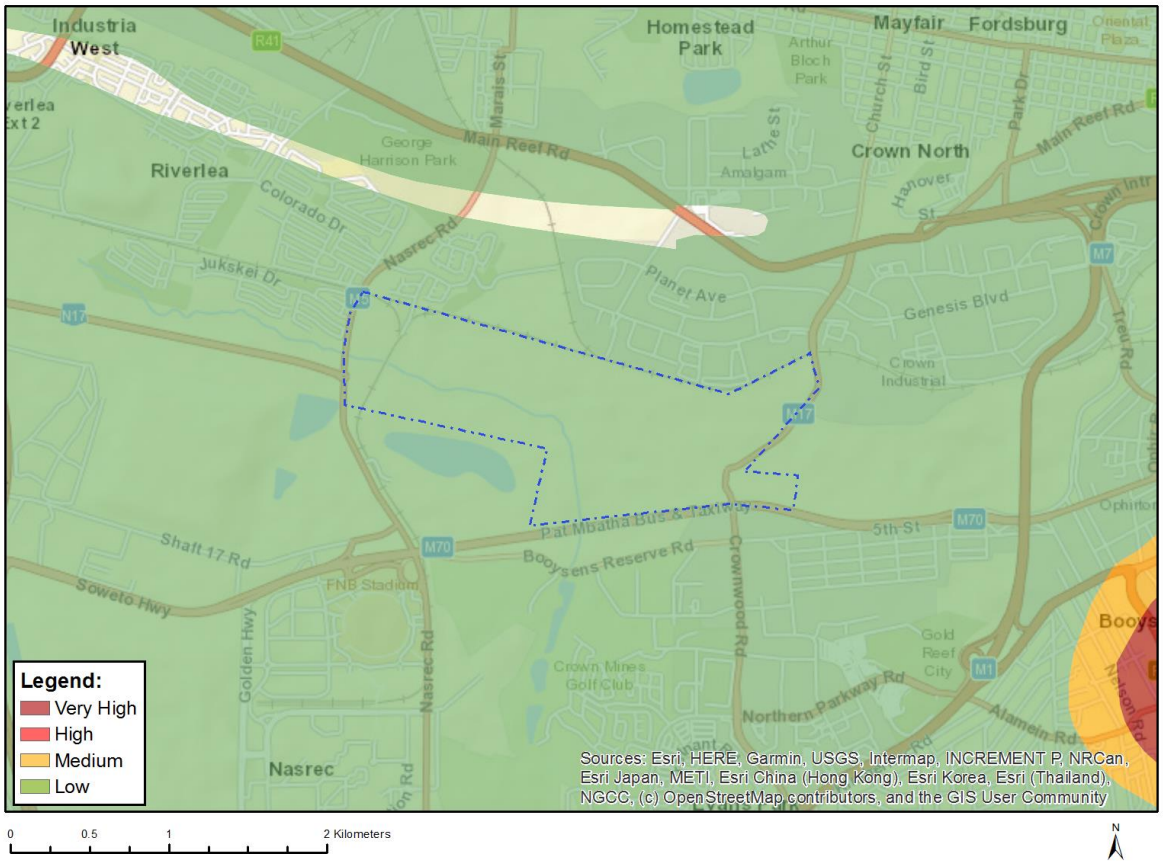
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

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MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



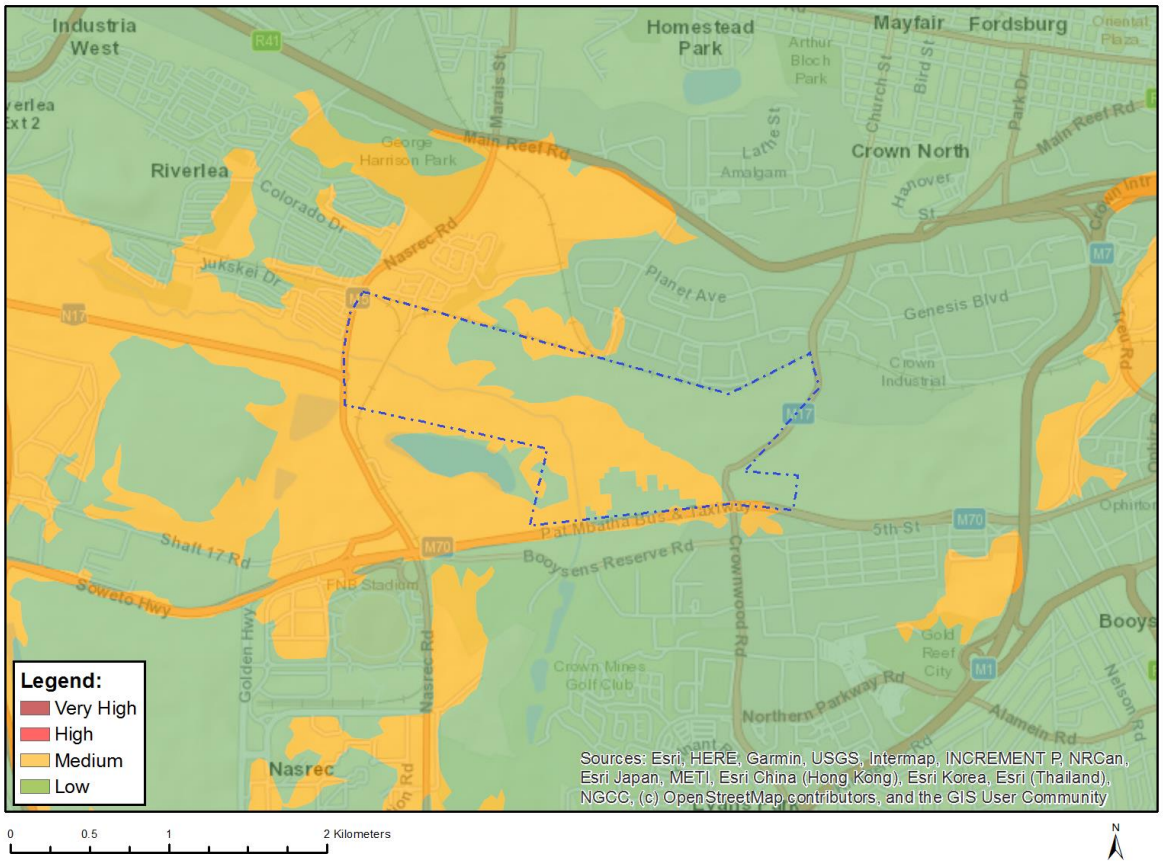
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

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

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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.

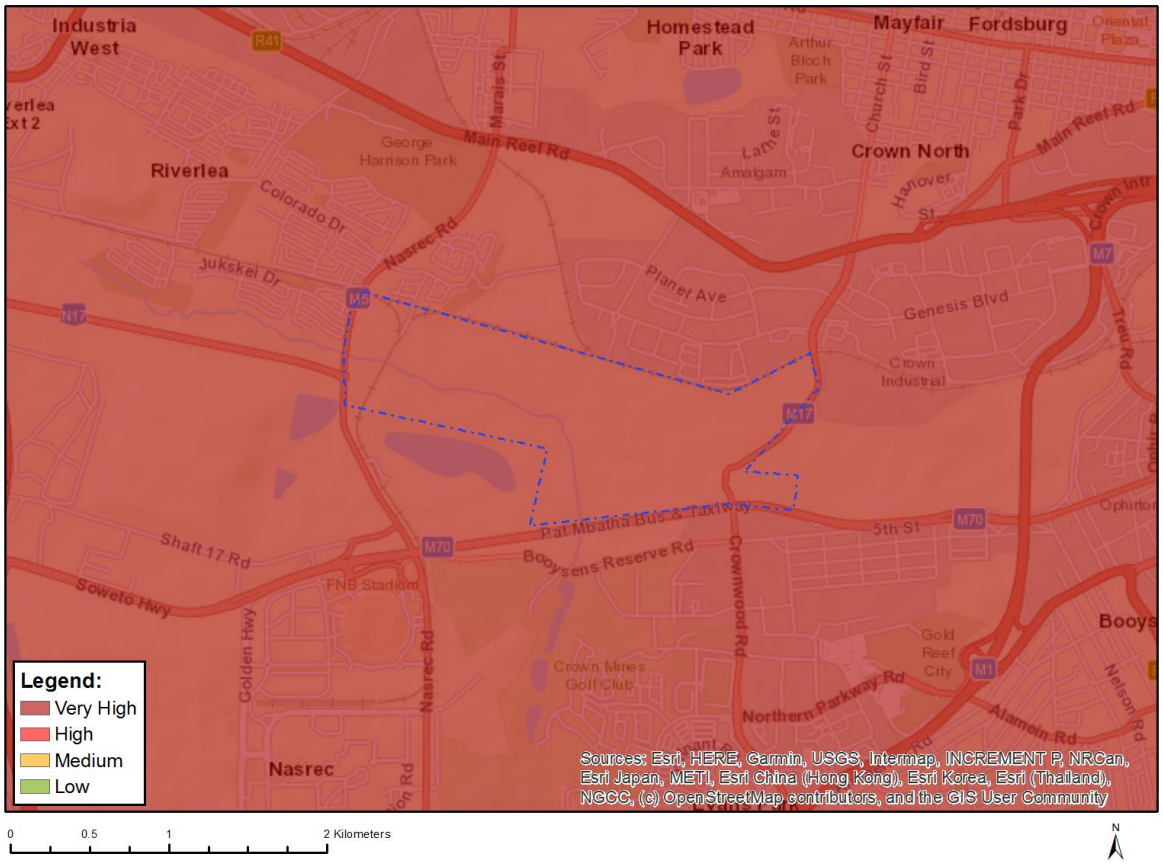
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1252
Medium	Khadia beswickii
Medium	Cineraria longipes
Medium	Sensitive species 691

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16/08/2024

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
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	VU_Soweto Highveld Grassland

Disclaimer applies

APPENDIX D:

Specialist Studies

- ❖ **Appendix D2 – Biodiversity: Terrestrial Ecology**

TERRESTRIAL BIODIVERSITY COMPLIANCE STATEMENT FOR THE PROPOSED VALLEY SILTS EXPANSION PROJECT

City of Johannesburg Metropolitan Municipality, Gauteng Province, South Africa

11/11/2024

Prepared by:

The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Report Name	**TERRESTRIAL BIODIVERSITY COMPLIANCE STATEMENT FOR THE PROPOSED VALLEY SILTS EXPANSION PROJECT**
Specialist Theme	Terrestrial Biodiversity Compliance Statement
Project Reference	Valley Silts Expansion Project
Report Version	Draft 1 / 11/11/2024
Environmental Assessment Practitioner	KONGIWE
Fieldwork & Report Writer	Byron Goris (Cert. Nat. Sci. 170720) 
Reviewer	Andine Erasmus (Cand. Nat. Sci. 164894) 
Reviewer	Carami Burger (SACNASP 121757) 
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

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1 Introduction

1.1 Background

The Biodiversity Company (TBC) was appointed to undertake a terrestrial biodiversity baseline assessment for the proposed Valley Silts Expansion Phase project near NASREC (National Recreation Centre), in Johannesburg, Gauteng Province. The project site is located approximately 1 km north of the FNB (First National Bank) Stadium and approximately 300 m southeast from the Booysens Reserve in the Gauteng Province. The site is located within the City of Johannesburg Metropolitan Municipality. The full mine area, including expansion areas, are collectively referred to as the Project Area of Influence (PAOI) for reporting purposes. A map presenting the regional context of the PAOI can be seen in Figure 1-1 and a map presenting the project layout can be seen in Figure 1-2.

To determine the baseline ecological state of the area and to present a detailed description of the receiving environment, both a desktop assessment as well as a field survey on 7 October 2024, were conducted. Furthermore, the desktop assessment and field survey both involved the detection, identification and description of any locally relevant sensitive receptors and habitats. The manner in which these sensitive features may be affected by the proposed development was also investigated.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations, 2014 (No. 982, 8 December 2014, as amended by GN 326 of 7 April 2017 and GN 517 of 11 June 2021) of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998). The approach has taken cognisance of 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 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 Authorisation”.

- The National Web based Environmental Screening Tool has characterised the terrestrial biodiversity theme for the area as ‘Very High’ sensitivity (National Environmental Screening Tool, 2024).

The purpose of conducting the specialist study is to provide relevant input into the Environmental Authorisation application process, with a focus on the proposed activities and their impacts associated with the project. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Registered Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making as to the ecological viability of the proposed project.

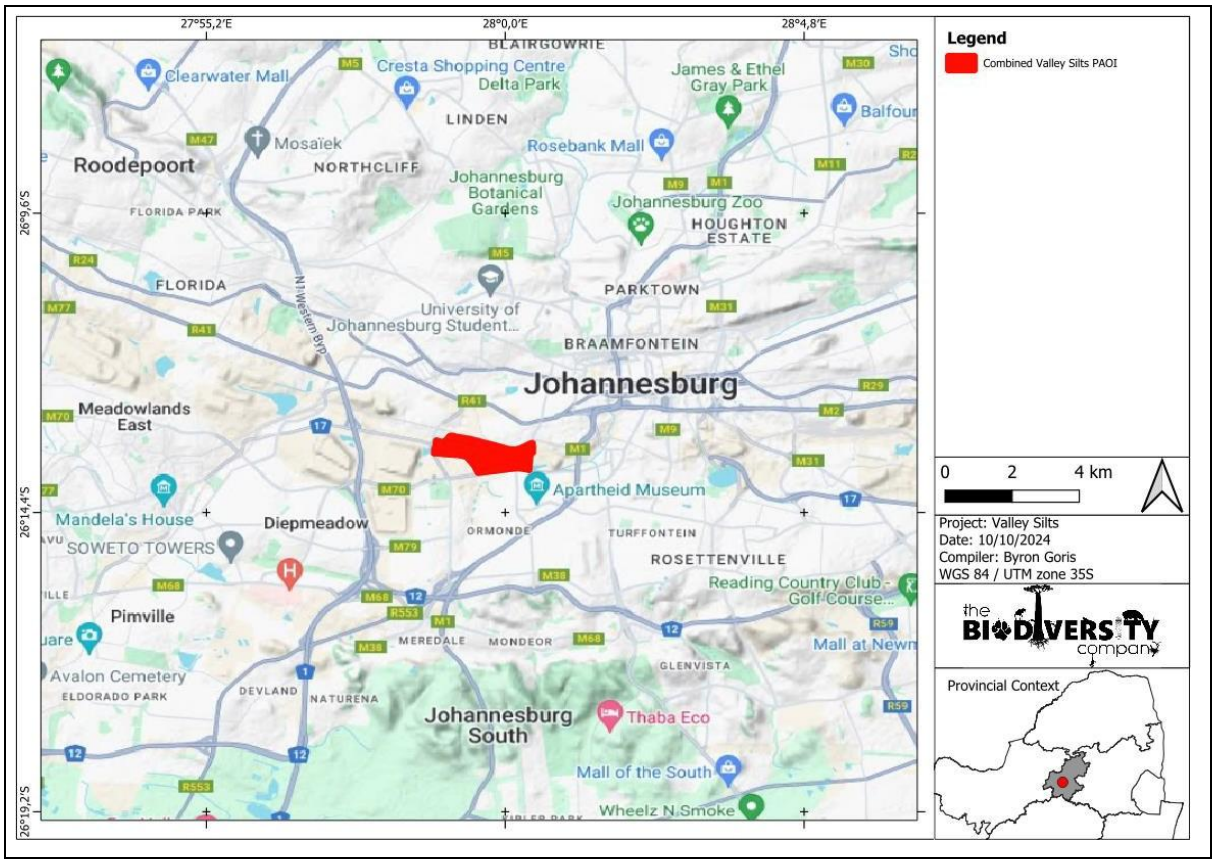


Figure 1-1 Map illustrating the regional context of the Project Area of Influence (PAOI)

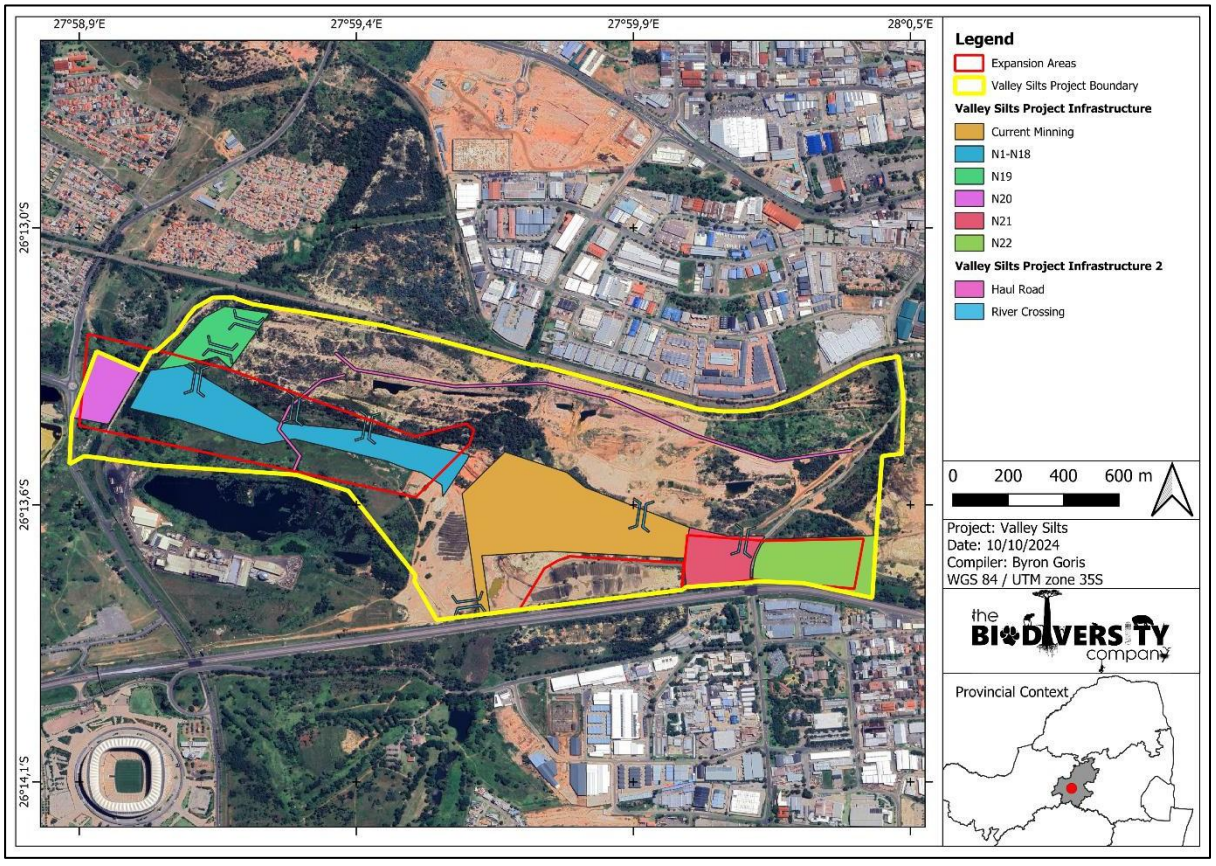


Figure 1-2 Map illustrating the project layout

1.2 Project Description

Ergo Mining (Pty) Ltd (Ergo), a subsidiary of DRDGOLD Limited, holds various Mining Rights (MR) for slimes dams and sand dumps, extending 65 km from western Johannesburg to Eastern Ekurhuleni, with primary activities concentrated in the central and eastern sections of the Witwatersrand mining belt (Kongiwe, 2024).

Furthermore, Ergo has secured an Environmental Authorisation (EA) and an Integrated Water Use License (IWUL) for the mechanical reclamation of gold-bearing silts from the Russell Stream, located north of NASREC near Booysens Reserve in Johannesburg. This is the Valley Silts Project.

The entire Valley Silts project is divided into three primary sectors:

- **Sector 1:** The current approved mining area, extending from the dam wall to the stockpile area near Crownwood Road. This sector is fully operational with established infrastructure, including fenced facilities, solar-powered security lights, haul roads and site offices.
- **Sector 2:** Extends from the dam wall to NASREC Road (N1 to N20 on Figure 1-2).
- **Sector 3:** Comprises blocks N21 and N22 (on Figure 1-2), located on either side of Crownwood Road.

The proposed Valley Silts Expansion project will consist of Sector 2 and Sector 3.

The new activities for the Expansion will include:

- Mining Blocks:
    - The expansion phase will include mining blocks N1 to N22.
- Drying stockpiles:
    - Eight drying stockpile locations are planned to manage the moisture content and oxidation of the mined material.
- Stormwater control berms/paddocks:
    - Berms and paddocks will be installed to protect the river from extraneous ingress.
- River crossings:
    - Eight river crossings will be constructed.
- Haul and site roads
    - Existing roads will be utilized and expanded as necessary.

Exploration trenching will determine the depositional flank extents, and all material will be removed from the natural flow path and flanks. Existing facilities in Sector 1, such as hard parks, cut-off trenches, and sumps, will be utilized for the expansion. Silt traps will be relocated as mining progresses, with the existing sump discharging to the stream.

1.3 Scope of Work

The aim of the biodiversity assessment was to provide information to guide the risk of the proposed activity to the current state of the associated ecosystems within the development area. This was achieved through the following:

- Desktop assessment to identify the ecologically important features within the landscape comprising of terrestrial features;
- Desktop assessment to identify possible Species of Conservation Concern (SCC) that occur within the landscape;
- Field survey to record flora and fauna species, especially Species of Conservation Concern (SCC);
- Determination of the Site Ecological Importance (SEI), also commonly referred to as sensitivity; and
- The prescription of mitigation measures for identified risks.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- It is assumed that all information received from the client and landowner is accurate;
- All datasets accessed and utilised for this assessment are considered to be representative of the most recent and suitable data for the intended purposes;
- The assessment area (PAOI) was based on the footprint areas as provided by the client, and any alterations to the area and/or missing GIS information pertaining to the assessment area would have affected the area surveyed and hence the results of this assessment;
- The project description was based on information provided by the client, and any alterations to the area and/or missing data pertaining to the development would have affected the area surveyed and hence the results of this assessment;
- The area was surveyed during a single site visit, therefore, this assessment does not consider temporal trends (note that the data collected is considered sufficient to derive a meaningful baseline);
- The field survey was conducted on 7 October 2024. The survey was conducted during the early wet season, limiting accurate biodiversity representation. This constitutes a limitation, meaning that certain flora and fauna would not have been present or observable due to seasonal constraints. Due to the modified and disturbed condition of the PAOI and the lack of expected SCCs, this project only necessitates a compliance statement, and the seasonality would unlikely affect the main outcomes of this study. Additionally, some of the construction for the project development is planned for the already ‘Modified’ areas;
- Whilst every effort was made to cover as much of the PAOI as possible, representative sampling was completed, and by its nature it is possible that some plant and animal species that are present within the PAOI were not recorded during the field investigations;
- This assessment was conducted from a terrestrial perspective only and must be considered in conjunction with the accompanying wetland report (TBC, 2024); and

- The GPS used in the assessment has an accuracy of 5 m and consequently any spatial features may be offset by up to 5 m.

1.5 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 Management 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 proposed PAOI is of a 'Very Low' and 'Low' sensitivity. Therefore, this report constitutes a Terrestrial Biodiversity Compliance Statement.

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

Table 1-1 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	7.1
Description of the assumptions and any uncertainties or gaps in knowledge or data	1.4
A baseline profile description of biodiversity and ecosystems of the site	3.1
Site sensitivity verification: Desktop Analysis using satellite imagery and available information	3.1
A statement on the duration, date and season of the site inspection	3.2
Site sensitivity verification: Onsite inspection, include a description of current land use and vegetation found on-site	3.2
Site sensitivity verification: Photographs/evidence of environmental sensitivity	3.2
Screening tool confirmation/dispute: The assessment must verify the "low" sensitivity of the site, in terms of plant, animal, and terrestrial biodiversity themes	3.4.2
Proposed impact management outcomes or monitoring requirements for inclusion in the EMPr	4
Indicate whether or not the proposed development will have any impact on the terrestrial environment, animals and/or plants	5
A signed statement of independence by the specialist	7.3
Specialist details, including a CV	0

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

2 Fieldwork

2.1 Biodiversity Field Assessment

A single season field survey was undertaken on 7 October 2024, which constitutes an early wet season survey, to determine the presence of any local SCC and to achieve the delineation of local habitat types and their associated sensitivities. Effort was made to cover all the different habitat types within the PAOI, within the limits of time, access and security. This site visit is considered sufficient for the project (Figure 2-1).

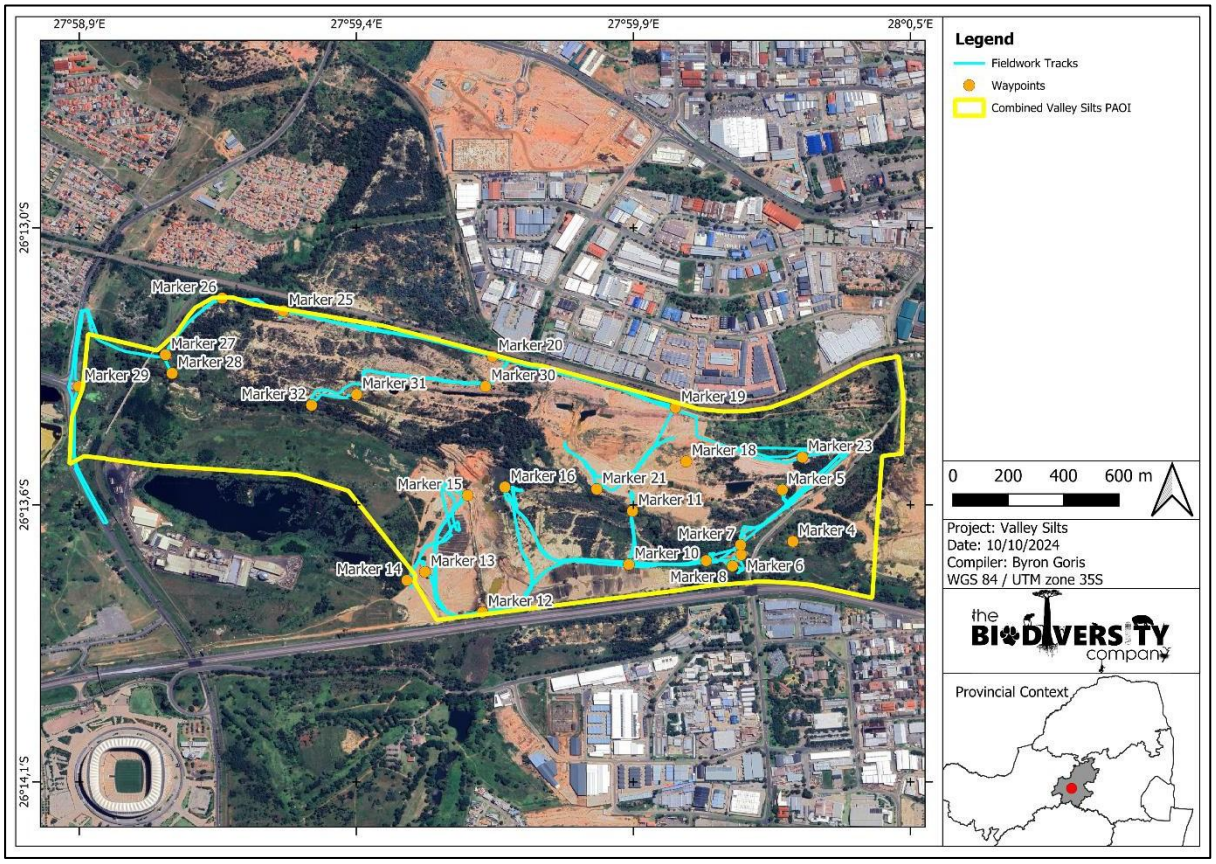


Figure 2-1 Map illustrating the field survey points

3 Results & Discussion

3.1 Ecologically Important Landscape Features

Table 3-1 below has been produced as a result of the spatial data collected and analysed as provided by relevant sources. It presents a summative breakdown of the ecological boundaries considered and the associated relevance that each has to the region or PAOI.

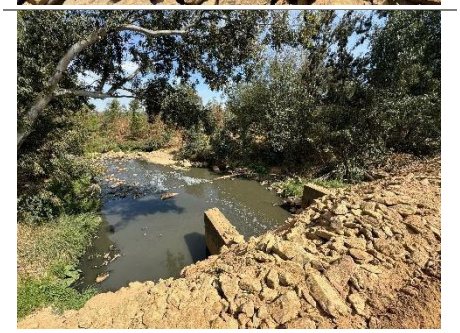
Table 3-1 Summary of relevance of the proposed project to ecologically important landscape features

Desktop Information Considered	Relevance	Reasoning
Ecosystem Threat Status	Relevant	Overlaps with a 'Vulnerable' Ecosystem – Soweto Highveld Grassland (Red List of Ecosystems, 2021).
Ecosystem Protection Level	Relevant	Overlaps with a 'Not Protected' Ecosystem.
Provincial Conservation Plan	Relevant	Overlaps with CBA Important Area, and Ecological Support Area.
SAPAD & SACAD	Relevant	Located 5.5 km from Melville Koppies Nature Reserve, 5.6 km from Klipriviersberg Nature Reserve, and 8.1 km from the Olifantsvlei Nature Reserve – all protected areas; as well as approximately 19.8 km from the nearest conservation area (Walter Sisulu National Botanical Gardens).
Gauteng Ridges	Relevant	Overlaps with a Class 4 Gauteng Ridge.
National Protected Areas Expansion Strategy (NPAES)	Relevant	Overlaps with Priority Focus Areas on the western side of the PAOI (NPAES, 2018).
Key Biodiversity Areas (KBA)	Relevant	Located 17.1 km from the Cradle of Humankind KBA and 29.2 km from the Suikerbosrand KBA.
South African Inventory of Inland Aquatic Ecosystems (SAIIAE)	Relevant	The PAOI and the 500 m regulated area overlaps with an Unchanneled valley-bottom which is 'Not Protected' and 'Critically Endangered (CR)'.
National Freshwater Priority Area	Relevant	The 500 m regulated area overlaps with non-priority (unclassified) seep wetlands.
Strategic Water Source Area (SWSA)	Irrelevant	The PAOI does not overlap with any Strategic Water Source Areas.

3.2 Biodiversity Field Survey

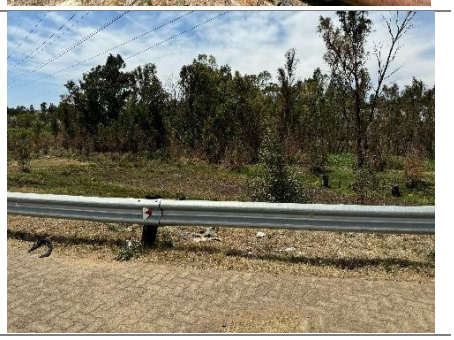
The following sections discuss the results from the field survey that was conducted for the proposed project, which was undertaken on 7 October 2024. A selection of key sample points is described below in Table 3-2.

Table 3-2 Sensitivity summary of the survey points and habitat types delineated within the PAOI

Survey Point	Description	SEI	Photographs
Marker 4 Date: 7/10/2024 GPS Coordinates: 26°13'37.86"S 28° 0'15.06"E	**Modified** High levels of degradation and anthropogenic disturbance is present. This area is impacted by mining activities. Evidence of past vegetation clearing and secondary growth is present. High numbers of alien and invasive plants, such as *Eucalyptus camaldulensis*, *Verbena brasiliensis, V. bonariensis, Bidens pilosa, Tagetes minuta,* and *Erigeron bonariensis,* occur. Dominant species include, *Cynodon dactylon, Pogonarthria squarrosa, Eragrostis curvula* and *Paspalum dilatatum.* Species identifications were limited by seasonality. No flora or fauna SCC were recorded or are expected.	Very Low	 
Marker 7 Date: 7/10/2024 GPS Coordinates: 26°13'38.27"S 28° 0'8.94"E	**Water Resource** This point consists of a channelled valley bottom wetland, which is a non-terrestrial habitat. No flora or fauna SCC recorded, and none expected. More information is available in the accompanying wetland assessment (TBC, 2024).	Low	 

Survey Point	Description	SEI	Photographs
Marker 10 Date: 7/10/2024 GPS Coordinates: 26°13'40.56"S 27°59'55.87"E	**Modified** This area has experienced high levels of degradation and anthropogenic disturbance leading to modification. It is impacted by mining activities. Evidence of past vegetation clearing can be seen, as little to no vegetation remains. No flora or fauna SCC were recorded or are expected.	Very Low	 
Marker 12 Date: 7/10/2024 GPS Coordinates: 26°13'46.15"S 27°59'38.74"E	**Water Resource** This point is characterised by a channelled valley bottom wetland, which is a non-terrestrial habitat. High levels of disturbance from mining activities, as well as a strong presence of alien and invasive plants, such as *Eucalyptus camaldulensis,* is present. No flora or fauna SCC recorded, and none are expected. More information is available in the accompanying wetland assessment (TBC, 2024).	Low	 
Marker 14 Date: 7/10/2024 GPS Coordinates: 26°13'42.42"S 27°59'29.92"E	**Modified** High levels of degradation and anthropogenic disturbance is present here, leading to a modification of the expected natural habitat. Impacts from nearby mining activities are present. Evidence of past vegetation clearing and secondary growth can be seen. High numbers of alien and invasive plants, such as *Eucalyptus camaldulensis*, *Verbena brasiliensis,*	Very Low	

Survey Point	Description	SEI	Photographs
	V. bonariensis, Bidens Pilosa, Tagetes minuta, and *Erigeron bonariensis,* are present. Dominant species include, *Cynodon dactylon, Pogonarthria squarrosa, Eragrostis curvula* and *Paspalum dilatatum.* Species identifications were limited by seasonality. No flora or fauna SCC were recorded or are expected.		
Marker 16 Date: 7/10/2024 GPS Coordinates: 26°13'31.51"S 27°59'41.38"E	**Water Resource** Made up of a channelled valley bottom wetland, which is a non-terrestrial habitat. This area has high levels of disturbance from the mining activities. No vegetation is present. No flora or fauna SCC were recorded and none expected. More information is available in the accompanying wetland assessment (TBC, 2024).	Low	 
Marker 18 Date: 7/10/2024 GPS Coordinates: 26°13'28.51"S 28° 0'2.57"E	**Modified** High levels of degradation and anthropogenic disturbance has led to complete modification of the expected natural habitat. This area is impacted by the mining activities, including vegetation clearance. There is little to no remaining vegetation. No flora or fauna SCC were recorded or are expected.	Very Low	 

Survey Point	Description	SEI	Photographs
Marker 25 Date: 7/10/2024 GPS Coordinates: 26°13'10.90"S 27°59'15.45"E	**Modified** High levels of degradation and anthropogenic disturbance has modified this area. Impacts from the mining activities are evident, as well as past vegetation clearing and secondary growth. High numbers of alien and invasive plants, such as *Eucalyptus camaldulensis*, *Verbena brasiliensis, V. bonariensis, Bidens pilosa, Tagetes minuta,* and *Erigeron bonariensis,* are present throughout this area. Dominant species include, *Cynodon dactylon, Pogonarthria squarrosa, Eragrostis curvula* and *Paspalum dilatatum.* Species identifications were limited by seasonality. No flora or fauna SCC were recorded or are expected.	Very Low	 
Marker 27 Date: 7/10/2024 GPS Coordinates: 26°13'16.03"S 27°59'1.67"E	**Modified** This area has been modified due to high levels of degradation and anthropogenic disturbance. Impacts from the mining activities, pipeline, and bridge construction exist here, as well as past vegetation clearing and secondary growth. High numbers of alien and invasive plants, such as *Eucalyptus camaldulensis*, *Verbena brasiliensis, V. bonariensis, Bidens Pilosa, Tagetes minuta,* and *Erigeron bonariensis,* are present. Dominant species include, *Cynodon dactylon, Pogonarthria squarrosa, Eragrostis curvula* and *Paspalum dilatatum.* Species identifications were limited by seasonality. No flora or fauna SCC were recorded or are expected.	Very Low	 
Marker 29 Date: 7/10/2024 GPS Coordinates: 26°13'19.74"S 27°58'51.53"E	**Modified / Water Resource** This point is characterised by high levels of degradation and anthropogenic disturbance, such as impacts from the mining activities, powerline, and road construction. Evidence of past vegetation clearing and secondary growth can also be seen. High numbers of alien and invasive plants, such as *Eucalyptus camaldulensis*, *Verbena brasiliensis, V.*	Very Low	

Survey Point	Description	SEI	Photographs
	bonariensis, Bidens Pilosa, Tagetes minuta, and *Erigeron bonariensis,* are present. Dominant species include, *Cynodon dactylon, Pogonarthria squarrosa, Eragrostis curvula* and *Paspalum dilatatum.* Species identifications were limited by seasonality. No flora or fauna SCC were recorded or are expected.		
Marker 30 Date: 7/10/2024 GPS Coordinates: 26°13'19.74"S 27°59'39.11"E	**Artificial Water Resource** This point is characterised by quarries with artificial water collection. It is a non-terrestrial habitat. High levels of disturbance from the mining activities, with a strong presence of alien and invasive plants, such as *Eucalyptus camaldulensis*.. No flora or fauna SCC were recorded and none are expected. More information available in the accompanying wetland assessment (TBC, 2024).	Low	 
Marker 32 Date: 7/10/2024 GPS Coordinates: 26°13'21.93"S 27°59'18.76"E	**Modified** This area has been modified due to the high levels of degradation and anthropogenic disturbance. Impacts from mining activities are evident, as well as past vegetation clearing and secondary growth. High numbers of alien and invasive plants, such as *Eucalyptus camaldulensis*, *Verbena brasiliensis, V. bonariensis, Bidens Pilosa, Tagetes minuta,* and *Erigeron bonariensis,* can be seen. Dominant species include, *Cynodon dactylon, Pogonarthria squarrosa, Eragrostis curvula* and *Paspalum dilatatum.* Species identifications were limited by seasonality. No flora or fauna SCC were recorded or are expected.	Very Low	 

3.3 Habitat Assessment

Three (3) main habitat types were identified across the PAOI and include:

- Modified;
- Water Resource; and
- Artificial Water Resource.

The habitat units for the PAOI can be seen delineated in Figure 3-1 and descriptions of the habitat units can be found in Table 3-3.

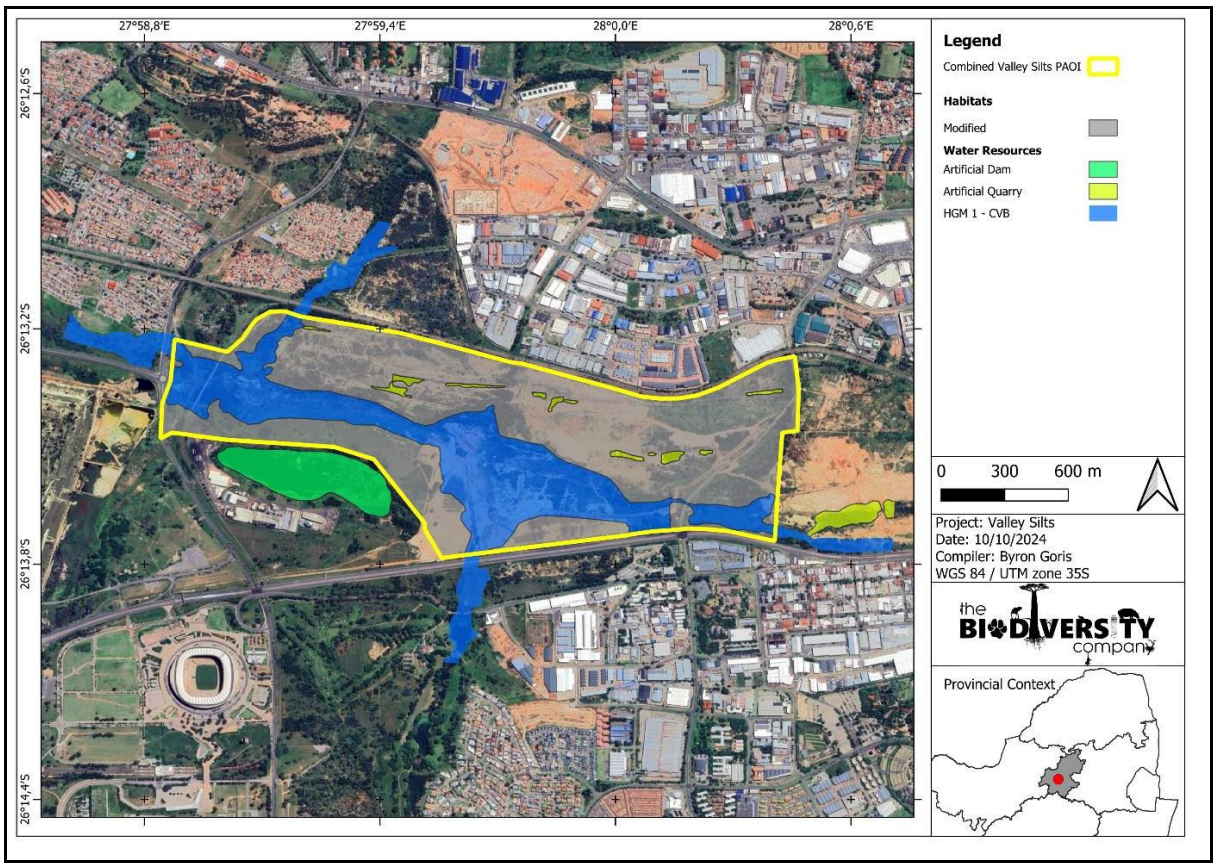


Figure 3-1 Habitats identified within the PAOI

Table 3-3 Table providing descriptions of the habitat types delineated for the PAOI

Habitat	Description and Condition
Modified	This habitat unit includes all areas that maintain little to no native vegetation and/or where anthropogenic activity has substantially modified an area's primary ecological functions and species composition. Within the PAOI, these areas are mostly comprised of roads, mining areas, and other construction activities. These areas include very few, if any, indigenous species and are associated with alien and invasive plant species. No fauna or flora SCC were observed, and none are expected for the habitat unit.
Water Resource	This is a non-terrestrial habitat made up of wetlands and drainage features within the PAOI. Vegetation associated with this habitat unit includes hydrophytes. No fauna or flora SCC were observed, and none are expected for the habitat unit. Additional information regarding this habitat unit may be found in the accompanying wetland assessment (TBC, 2024).
Artificial Water Resource	This is a non-terrestrial habitat made up of artificial wetlands and water features within the PAOI. No fauna or flora SCC were observed, and none are expected for the habitat unit. Additional information regarding this habitat unit may be found in the accompanying wetland assessment (TBC, 2024).

3.4 Site Ecological Importance

Based on the criteria provided in Appendix B of this report, all habitats within the PAOI were assigned a sensitivity category, i.e., a SEI category. The PAOI was categorised as possessing habitats with areas ranging from 'Very Low' to 'Medium' SEI (Table 3-3 and Figure 3-5). This indicates that the findings of this assessment are contrary to the Screening Tool with respect to the Combined Terrestrial Biodiversity Theme sensitivity.

Table 3-4 Summary of habitat types delineated within the PAOI

Habitat Type	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor Resilience	Site Ecological Importance Guidelines
Modified	**Very Low**	**Very Low**	**Very Low**	**Very High**	**Very Low**
	No natural habitat remaining	Several major current negative ecological impacts.		Habitat that can recover rapidly (~ less than 5 years) to restore > 75% of the original species composition and functionality of the receptor functionality	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.
Water Resource	**Low**	**Low**	**Low**	**Low**	**Medium**
	No confirmed or highly likely populations of SCC	Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat		Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Artificial Water Resource	**Low**	**Low**	**Low**	**Medium**	**Low**
	No confirmed or highly likely populations of SCC	Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat		Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.

3.4.1 Desktop Ecological Sensitivity

The following is deduced from the National Web-based Environmental Screening Tool Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended):

- Animal Species Theme sensitivity is High for the proposed development area, due to five (5) medium sensitivity mammal species, two (2) medium sensitivity invertebrate species, and one (1) medium sensitivity avifaunal species possibly occurring in the area (Figure 3-2);

- Plant Species Theme sensitivity is Medium for the proposed development area due to four (4) Medium Sensitivity Plant species which may potentially occur (Figure 3-3); and

- Terrestrial Biodiversity Theme sensitivity is Very High for the proposed development area, due to the PAOI overlapping with the vulnerable (VU) Soweto Highveld Grassland, NPAES areas, CBA 1 & 2, as well as ESA 1 & 2 (Figure 3-4).

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)
Medium	Aves-Eupodotis senegalensis
Medium	Insecta-Aloeides dentatis dentatis
Medium	Mammalia-Chrysospalax villosus
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Dasymys robertsii
Medium	Mammalia-Hydrictis maculicollis
Medium	Mammalia-Ourebia ourebi ourebi
Medium	Invertebrate-Clonia uvarovi

Figure 3-2 Animal Species Theme Sensitivity

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



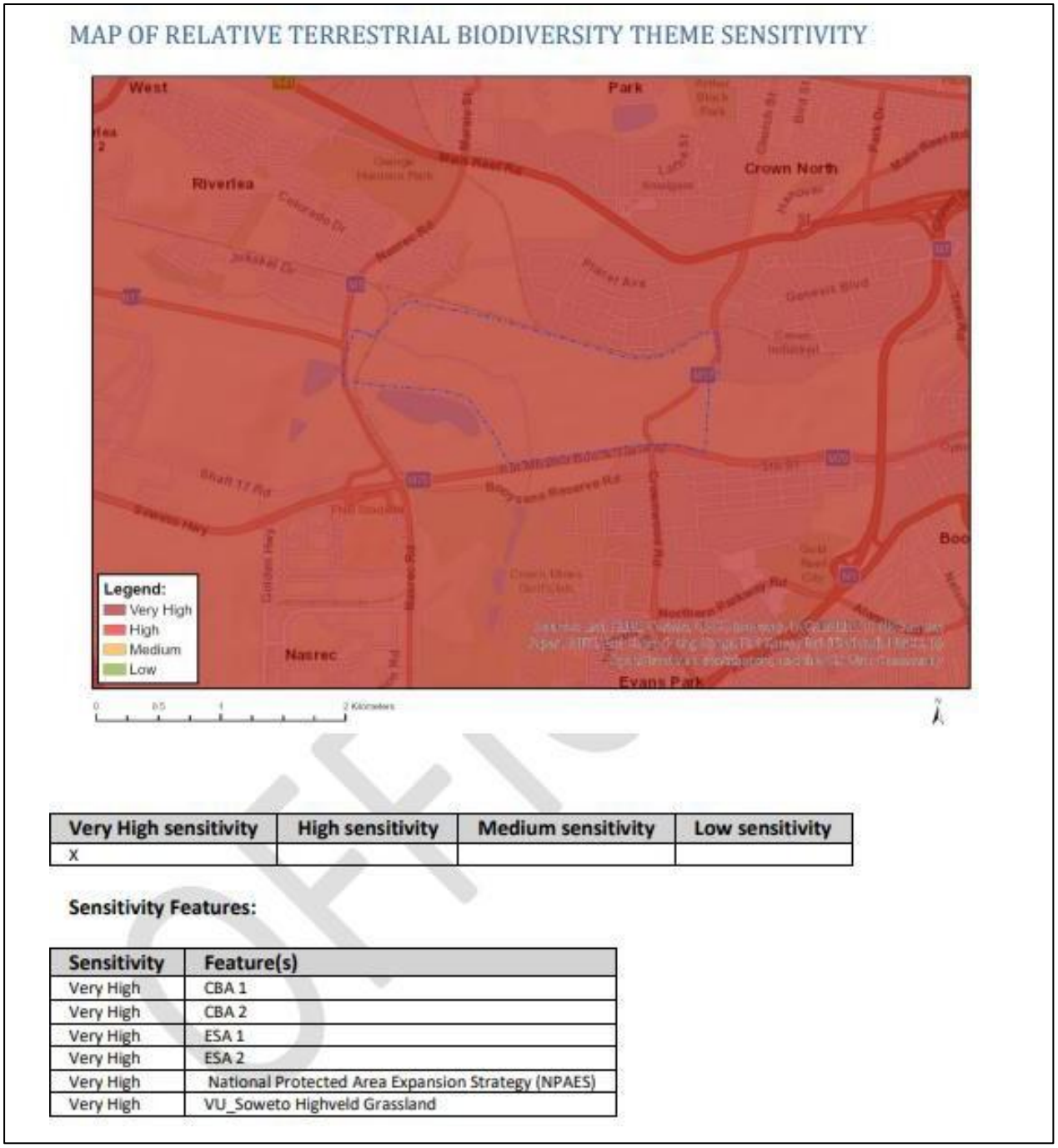
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Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1252
Medium	Khadia beswickii
Medium	Cineraria longipes
Medium	Sensitive species 691

Figure 3-3 Plant Species Theme Sensitivity



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
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	VU_Soweto Highveld Grassland

Figure 3-4 Terrestrial Biodiversity Theme Sensitivity

3.4.2 Fauna Species of Conservation Concern

The Screening Tool indicates that five medium sensitivity mammal species, one medium sensitivity invertebrate species, one medium and one high sensitivity avifaunal species could occur in the general area (Table 3-5). The likelihood of occurrence within the PAOI are included in Table 3-. None have been confirmed for the site during the site assessment and likelihood of occurrence is considered low and highly unlikely.

Please note, as per the best practise guideline that accompanies the Animal and Plant Species Protocol for the screening tool, that the name of the sensitive species may not appear in the final EIA report nor any of the specialist reports released into the public domain. It should be referred

to as sensitive plant or sensitive animal and its threat status may be included, e.g. critically endangered sensitive plant or endangered sensitive animal.

Table 3-5 Threatened fauna species that are expected to occur within the PAOI. VU = Vulnerable; EN = Endangered

Scientific Name	Common Name	Screening Tool Sensitivity	Regional Conservation Status	Likelihood of Occurrence	Reason
Avifauna					
Eupodotis senegalensis	White-bellied Bustard	Medium	VU	Low	Ongoing disturbances
Mammalia					
Dasymys robertsii	Robert's Shaggy Rat	Medium	VU	Low	Wetland heavily disturbed
Chrysospalax villosus	Rough-haired Golden Mole	Medium	VU	Low	High site disturbance levels
Crocidura maquassiensis	Makwassie Musk Shrew	Medium	VU	Low	High site disturbance levels
Hydrictis maculicollis	Spotted-necked Otter	Medium	VU	None	Limited food availability, high disturbance levels in wetland
Ourebia ourebi ourebi	Oribi	Medium	EN	None	High levels of human activity
Invertebrates					
Clonia uvarovi	Uvarov's Clonia	Medium	VU	Low	On-site disturbances; Species prefers tall, woodland savannah

3.4.3 Flora Species of Conservation Concern

The Screening Tool indicates that no threatened flora species are expected to occur within the PAOI. Furthermore, no flora SCC were observed within the PAOI.

Table 3-6 Threatened plant species that are expected to occur within the project area

Species	Common Name	Conservation Status (Regional)	Screening Tool Sensitivity	Likelihood of Occurrence
Khadia beswickii	Khadiwortel	VU	Medium	Low (limited suitable habitat & high anthropogenic impacts/vegetation clearing)
Cineraria longipes	none	VU		Low (limited suitable habitat & high anthropogenic impacts/vegetation clearing)
Sensitive species 1252		VU	Medium	Low (limited suitable habitat & high anthropogenic impacts/vegetation clearing)
Sensitive species 691		EN	Medium	Low (limited suitable habitat & high anthropogenic impacts/vegetation clearing)

3.4.4 Screening Tool Comparison

The allocated sensitivities for each of the relevant themes are either disputed or validated for the overall PAOI in Table 3-7 below. A summative explanation for each result is provided as relevant. The specialist-assigned sensitivity ratings are based largely on the SEI process followed in the previous section, and consideration is given to any observed or likely presence of SCC or protected species. A map illustrating the overall SEI allocations for the PAOI can be seen in Figure 3-5.

Table 3-7 Summary of the screening tool vs specialist assigned sensitivities

Screening Tool Theme	Screening Tool	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Animal Theme	**Medium**	**Low**	Disputed – Habitat exists in a largely degraded or modified state with high levels of anthropogenic disturbance, particularly those associated with the mining activities on site. No SCC observed and unlikely to occur.
Plant Theme	**Medium**	**Low**	Disputed – Habitat exists in a largely degraded or modified state with high levels of anthropogenic disturbance, particularly those associated with the mining activities on site. High numbers of alien and invasive plants. No SCC observed and unlikely to occur.
Terrestrial Theme	**Very High**	**Low**	Disputed – Habitat exists in a largely degraded or modified state with high levels of anthropogenic disturbance, particularly those associated with the mining activities on site, and has therefore lost much of its ecosystem functionality. Habitat will not recover without human intervention and will continue to degrade over time without rehabilitation. No longer representative of a CBA or ESA. No SCC observed and unlikely to occur

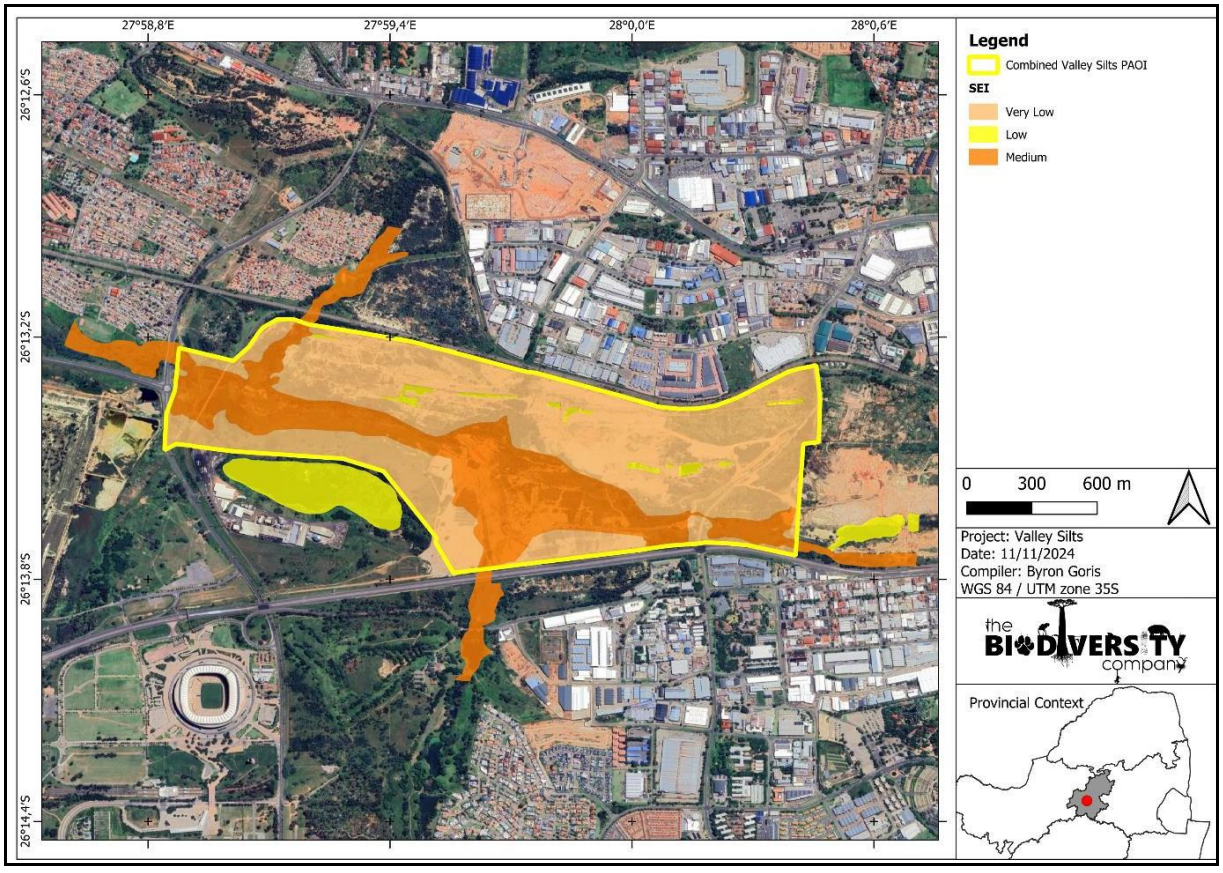


Figure 3-5 Map illustrating the site ecological importance for the PAOI

4 Impact Management and Mitigation Plan

The aim of the management outcomes is to present mitigation actions in such a way that they can be incorporated into the Environmental Management Programme (EMPr), and possible biodiversity management programme, for the project, which should in turn allow for a more successful implementation and auditing of the mitigations and monitoring guidelines. Table 4-1 presents the recommended mitigation measures and the respective time frames, targets, and performance indicators relative to the terrestrial assessment.

The focus of mitigation measures is to reduce the significance of the likely impacts associated with the development, and thereby:

- Prevent the further loss and fragmentation of indigenous vegetation communities within the ecosystem in the vicinity of the PAOI;
- Reduce the negative fragmentation effects of the development and enable the safe movement of fauna species;
- Prevent the direct and indirect loss and disturbance of flora and fauna species and communities, including the negative effects associated with the introduction and proliferation of alien and invasive species; and
- Adequately follow the guidelines for interpreting the Site Ecological Importance ratings assigned to the PAOI.

Table 4-1 Project specific mitigation measures including requirements for timeframes, roles and responsibilities

Management outcome: Vegetation and Habitats				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
Laydown and construction preparation activities (such as cement mixing, temporary toilets, etc.) must be limited to already modified areas and should take up the smallest footprint possible.	Construction Phase	Project manager, Environmental Officer	Development footprint	Ongoing
Areas classified as Medium sensitivity (water resource habitat) must have mitigations applied as stipulated in the accompanying freshwater/wetland assessment.	Life of operation	Project Manager	Medium sensitivity areas	Ongoing
Develop post-mining environments, in conjunction with regional development plans; and the recreation of habitats, where possible; or structure altered landscapes to be compatible with regional habitats.	Life of operation	Project manager, Environmental Officer	Development footprint	Ongoing
It is recommended that areas to be developed/disturbed be specifically demarcated so that during the construction/activity phase, only the demarcated areas be impacted upon.	Construction Phase	Project manager, Environmental Officer	Development footprint	Ongoing
Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should not be fragmented or disturbed further if possible.	Construction Phase	Project manager, Environmental Officer	Development footprint	Ongoing
All vehicles and personnel must make use of existing roads and walking paths as far as possible, especially construction/operational vehicles.	Construction Phase	Project manager, Environmental Officer	Development footprint	Ongoing

The clearing of vegetation must be minimised where possible. All activities must be restricted to within the authorised areas.	Life of operation	Project manager, Environmental Officer	Areas of indigenous vegetation	Ongoing
Materials may not be stored for extended periods of time and must be removed from the PAOI once the construction phase has been concluded. No permanent construction phase structures should be permitted. Construction buildings should preferably be prefabricated or constructed of re-usable/recyclable materials. No storage of vehicles or equipment will be allowed outside of the designated laydown areas.	Construction and Operational Phase	Environmental Officer, Design Engineer, and Contractor	Laydown areas	Ongoing
Areas that are denuded during construction need to be re-vegetated with indigenous vegetation according to a habitat rehabilitation plan, to prevent erosion during flood and wind events and to promote the regeneration of functional habitat. This will also reduce the likelihood of encroachment by alien invasive plant species.	Operational phase	Environmental Officer & Contractor	Assess the state of rehabilitation and encroachment of alien vegetation	Quarterly for up to two years after the closure
A habitat rehabilitation plan must be implemented, and areas of bare ground must be revegetated with species indigenous to the region.	Life of Operation	Project manager, Environmental Officer	Rehabilitation	Ongoing
A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. • Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use. • No servicing of equipment on site unless necessary. • All contaminated soil shall be treated in situ or removed and be placed in containers. • Appropriately contain any generator diesel storage tanks, machinery spills (e.g., accidental spills of hydrocarbons, oils, diesel etc.) in such a way as to prevent them from leaking and entering the environment. • Construction activities and vehicles could cause spillages of lubricants, fuels and waste material negatively affecting the functioning of the ecosystem. • All vehicles and equipment must be maintained, and all re-fueling and servicing of equipment is to take place in demarcated areas outside of the PAOI.	Life of operation	Environmental Officer & Contractor	Spill events, Vehicles dripping.	Ongoing
It must be made an offence for any staff member to remove any indigenous plant species from the PAOI or bring any alien species in. This is to prevent the spread of exotic or alien species or the illegal collection of plants.	Life of operation	Project manager, Environmental Officer	Any instances	Ongoing
All construction waste must be removed from site at the closure of the construction phase.	Construction phase	Environmental Officer & Contractor	Construction waste	During Phase

Storm Water run-off & Discharge Water Quality monitoring • Incorporate green /soft engineering storm water measures. Avoid unnecessary vegetation clearing and avoid preferential surface flow paths; • Cut-off trenches must be incorporated into the design to decrease contamination of watercourses via heavy metals. • Clean and dirty water must be separated. This water should be looked at for treatment and then re-introduced to mitigate losses to the catchment water hydro-dynamics; • All released water must be within DWAF (1996) water quality standards for aquatic ecosystems, and discharge must be managed to avoid scouring and erosion of the receiving systems; • Keep the surface & sub-surface water and storm water that may run off from the mining areas away from the low lying areas, such as wetlands, as well as the surrounding areas. Prevention from leaving the PAOI in an uncontrolled manner; • Implement Storm Water Run-Off & Discharge Water Quality monitoring; • Storage of potential contaminants in bunded areas; and • To at least minimise impacts to water quality, a treatment strategy is required, and the Groundwater report needs to be considered.	Life of operation	Environmental Officer & Design Engineer	Water Quality	Monthly

Management outcome: Fauna				
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Aspect	Frequency
A qualified environmental control officer must be on site when activities begin. Should animals not move out of the area on their own, relevant specialists must be contacted to advise on how the species can be relocated.	Construction Phase	Environmental Officer, Contractor	Presence of any floral or faunal SCC	During phase
Clearing and disturbance activities must be conducted in a progressive linear manner, always outwards and away from the centre of the PAOI and over several days, so as to provide an easy escape route for all small mammals and herpetofauna.	Construction Phase	Environmental Officer & Contractor	Progressive land clearing operations and the movement of fauna	Ongoing
The areas to be disturbed must be specifically and responsibly demarcated to prevent the movement of staff or any individual into the surrounding environments, signs must be put up to enforce this.	Construction/Operational Phase	Project manager, Environmental Officer	Infringement into these areas	Ongoing
The duration of the activities should be minimised to as short a term as possible, to reduce the period of disturbance on fauna.	Construction	Project manager, Environmental Officer & Design Engineer	Construction/Closure Phase	Ongoing

Noise must be kept to an absolute minimum during the evenings and at night to minimise all possible disturbances to reptile species and nocturnal mammals.	Construction/Operational Phase	Environmental Officer	Noise levels	Ongoing
No trapping, killing, or poisoning of any wildlife is to be allowed and **s**igns must be put up to enforce this. Monitoring must take place in this regard.	Life of operation	Environmental Officer	Evidence of trapping etc	Ongoing
Outside lighting should be designed and limited to minimise impacts on fauna. All outside lighting should be directed away from any sensitive areas. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (green/red) lights should be used wherever possible.	Construction/Operational Phase	Project manager, Environmental Officer & Design Engineer	Light pollution and period of light	Ongoing
All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife. Speed limits must be enforced to ensure that road killings and erosion is limited.	Life of operation	Health and Safety Officer	Compliance to the training	Ongoing
Schedule activities and operations during least sensitive periods, to avoid migration, nesting, and breeding seasons. In this case, activities should take place during the day.	Life of operation	Project manager, Environmental Officer & Design Engineer	Activities should take place during the day	Ongoing
Any holes/deep excavations must be dug in a progressive manner and shouldn't be left open overnight. Should any holes remain open overnight they must be properly covered temporarily to ensure that no small fauna species fall in. Holes must be subsequently inspected for fauna prior to backfilling.	Planning and Construction	Environmental Officer & Contractor, Engineer	Presence of trapped animals and open holes	Ongoing
If fencing is required: wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed, the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area.	Planning and construction	Environmental Officer & Contractor, Engineer	Fauna movement corridor	Ongoing

Management outcome: Alien Species

Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Phase	Responsible Party
An Alien Invasive Plant (AIP) Management Plan must be compiled and implemented. This should regularly be updated to reflect the annual changed in AIP composition.	Life of operation	Project manager, Environmental Officer & Contractor	Manage and assess presence and encroachment of alien vegetation	Twice a year
The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas. Footprints of the roads must be kept to prescribed widths.	Construction/Operational Phase	Project manager, Environmental Officer & Contractor	Footprint Area	Life of operation
A pest control plan must be put in place and implemented; it is imperative that poisons not be used to control pests.	Life of operation	Environmental Officer & Health and Safety Officer	Evidence or presence of pests	Life of operation

Management outcome: Dust

Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Phase	Responsible Party

Dust-reducing mitigation measures must be put in place and must be strictly adhered to. This includes the wetting of exposed soft soil surfaces. No non-environmentally friendly suppressants may be used as this could result in the pollution of water sources.	Construction phase	Contractor	Dustfall	Dust monitoring program.

Management outcome: Waste Management

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Phase	Responsible Party
Waste management must be a priority and all waste must be collected and stored effectively and responsibly according to a site-specific waste management plan. Dangerous waste such as metal wires and glass must only be stored in fully sealed and secure containers, before being moved off site as soon as possible.	Life of operation	Environmental Officer & Contractor	Waste Removal	Weekly
Litter, spills, fuels, chemical and human waste in and around the PAOI must be minimised and controlled according to the waste management plan.	Construction/Closure Phase	Environmental Officer & Health and Safety Officer	Presence of Waste	Daily
Cement mixing may not be performed on the ground. It is recommended that only closed side drum or pan type concrete mixers be utilised. Any spills must be immediately contained and isolated from the natural environment, before being removed from site.	Construction Phase	Environmental Officer & Contractor	Cement mixing and spills	Every occurrence
Toilets at the recommended Health and Safety standards must be provided. These should be emptied regularly and once no longer required, they must be pumped dry to prevent leakage into the surrounding environment and removed from site.	Life of operation	Environmental Officer & Health and Safety Officer	Number of toilets per staff member. Waste levels	Daily
The Contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility within every 10 days at least.	Life of operation	Environmental Officer & Health and Safety Officer	Availability of bins and the collection of the waste	Ongoing
Where a registered disposal facility is not available close to the PAOI, the Contractor shall provide a method statement with regards to waste management. Under no circumstances may domestic waste be burned on site or buried on open pits.	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Collection/handling of the waste	Ongoing
Refuse bins will be responsibly emptied and secured. Temporary storage of domestic waste shall be in covered and secured waste skips. Maximum domestic waste storage period will be 10 days.	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Management of bins and collection of waste	Ongoing, every 10 days

Management outcome: Environmental Awareness Training

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Phase	Responsible Party
All personnel and contractors are to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the PAOI to inform contractors and site staff of the presence of protected species, their identification, conservation status and importance, biology, habitat requirements and management	Pre-construction phase	Health and Safety Officer, Environmental Officer	Compliance to the training	Ongoing

requirements in line with the Environmental Authorisation and within the EMPr. Contractors and employees must all undergo the induction and must be made aware of any sensitive areas to be avoided (water resources).				
	Management outcome: Erosion			
Impact Management Actions	**Implementation**		**Monitoring**	
	Phase	Responsible Party	Phase	Responsible Party
Speed limits must be put in place to reduce erosion. Soil surfaces must be wetted as necessary to reduce the dust generated by the project activities. Speed bumps and signs must be erected to enforce slow speeds.	Life of operation	Project manager, Environmental Officer	Water Runoff from road surfaces	Ongoing
Only existing access routes and walking paths may be made use of.	Life of operation	Project manager, Environmental Officer	Routes used within the area	Ongoing
Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events etc.	Life of operation	Project manager, Environmental Officer	Re-establishment of indigenous vegetation	Progressively
A stormwater management plan must be compiled and implemented if necessary.	Life of operation	Project manager, Environmental Officer	Management plan	Before construction phase: Ongoing
Precautions must be taken against the erosion damage that would be caused by unplanned pipe leaks or leaching in general. This involves the installation of leak warning and detection systems, as well as the planting of dense indigenous pioneer grass seeds across all bare earth areas.	Closure Phase/Rehabilitation phase	Environmental Officer & Contractor	Erosion Management and Control/ Leaks	During Phase and Ongoing Monitoring

5 Conclusion

The PAOI exists in a predominantly degraded or modified state, having been subjected to various anthropogenic impacts such as - human and vehicle ingress, invasions and infestations of alien and invasive plants and the effects associated with mining activities within the PAOI. This habitat is unlikely to recover without human intervention and will continue to degrade further without active rehabilitation.

Completion of the terrestrial biodiversity assessment led to the dispute of the 'Very High' classification for the terrestrial biodiversity theme sensitivity as allocated by the National Environmental Screening Tool. The PAOI is instead assigned an overall terrestrial sensitivity of 'Very Low' and 'Low', with water resource sensitivities ranging from 'Low' to 'Medium'. The Terrestrial habitat is no longer representative of VU Soweto Highveld Grassland ecosystem type.

5.1 Impact Statement

The location, state and size of the ecosystem suggests that it is unlikely that any functional habitat or SCCs will be lost as a result of the impacts arising from the proposed activities. However, these assumptions pertain to the terrestrial habitat within the PAOI only and the recommendations and mitigations presented in the accompanying wetland assessment must be strictly adhered to.

5.2 Specialist Opinion

It is the opinion of the specialist that the proposed development is favourable only if all mitigation measures provided in this and other specialist reports are implemented, as well as the following:

- An alien invasion plant (AIP) management plan must be compiled and implemented; and
- A rehabilitation plan must be compiled and implemented for all areas of the PAOI impacted by the project activities.

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7 Appendix Items

7.1 Appendix A: Methods

7.1.1 Desktop Dataset Assessment

7.1.1.1 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:

- National Biodiversity Assessment 2018 (Skowno *et al,* 2019) - The purpose of the National Biodiversity Assessment (NBA) is to assess the state of South Africa's biodiversity based on best available science, with a view to understanding trends over time and informing policy and decision-making across a range of sectors. The NBA deals with all three components of biodiversity: genes, species and ecosystems; and assesses biodiversity and ecosystems across terrestrial, freshwater, estuarine and marine environments. The two headline indicators assessed in the NBA are:
    - Ecosystem Protection Level – indicator of the extent to which ecosystems are adequately 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.
    - Red List of Ecosystems (RLE) 2021 – The list was first published in 2011 and has since been substantially revised by authors Dr Andrew Skowno and Mrs Maphale Monyeki (SANBI, 2022). This list is based on assessments that followed the International Union for Conservation of Nature (IUCN) Red List of Ecosystems Framework (version 1.1) and covers all 456 terrestrial ecosystem types described in South Africa by Mucina and Rutherford (2006). A total of 120 of the 456 terrestrial ecosystem types assessed are categorised as threatened and together make up approximately 10% of the remaining natural habitat in the country. Of these 120 ecosystem types, 55 are Critically Endangered (CR), 51 Endangered (EN) and 14 are Vulnerable (VU). The remainder are categorised as Least Concern (LC) (SANBI, 2022; Skowno & Monyeki, 2021).
- Protected areas:
    - South Africa Protected Areas Database (SAPAD) and South Africa Conservation Areas Database (SACAD) (DFFE, 2023a) – The South African Protected Areas Database (SAPAD) and South Africa Conservation Areas Database (SACAD) contains spatial data for the conservation of South Africa. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. The database is updated on a continuous basis and forms the basis for the Register of Protected Areas which is a legislative requirement under the National Environmental Management: Protected Areas Act, Act 57 of 2003.
    - National Protected Areas Expansion Strategy (NPAES) (DFFE, 2022b) – The National Protected Area Expansion Strategy (NPAES) provides spatial information on areas that are suitable for terrestrial ecosystem protection. These focus areas are large, intact

and unfragmented and are therefore, of high importance for biodiversity, climate resilience and freshwater protection.

- Conservation/Biodiversity Sector Plans:

  The Gauteng Conservation Plan (Version 3.3) (GDARD, 2014b) classified areas within the province on the basis of its contribution to reach 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'.

  Critical Biodiversity Areas (CBAs) are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met.

- Gauteng Ridges

  The quartzite ridges of Gauteng are one of the most important natural assets in this northern province of South Africa. This is because these ridges, and the areas immediately surrounding them, provide unique habitat for a wide variety of fauna and flora, some of which are Red-Listed, rare or endemic species, or in the case of certain plant species, are found nowhere else in South Africa or around the world.

  In order to give practical effect to this policy, the Gauteng Department of Agriculture and Rural Development (GDARD) has classified all ridges in Gauteng into one of four classes, based on the existing extent and percentage of area converted by urban development or disturbed by other human activities. According to GDARD (2019), the ridges within Gauteng may be classified as follows:

  - Class 1 Ridges: 5% or less of the ridge area has been transformed by human activity (Approx. 58% of ridges fall within this category);
  - Class 2 Ridges: Between 6 and 34% of the ridge area has been transformed by human activity (Approx. 23% of ridges fall within this category);
  - Class 3 Ridges: Between 35 and 64% of the ridge area has been transformed by human activity (Approx. 8% of ridges fall within this category); and
  - Class 4 Ridges: Over 65% of the ridge area has been transformed by human activity (Approx. 11% of ridges fall within this category).

  The 2019 Ridges Guideline has defined general guidelines that must be followed with regard to the amount of development that should be permitted on different ridges according to their class. GDARD (2019) stipulates that no development is to be permitted on any class 1 ridge, and varying levels of development may be permissible with regards to the higher ridge classes – depending on the impact level of the proposed activity and the corresponding spatial scale. Buffers and permitted developments are as follows (GDARD, 2019):

  - Class 1 Ridges: Only low impact activities with an ecological footprint of 5% or less in the 200 m buffer zone of the ridge will be supported and no development will be permitted in the ridge itself;

- Class 2 Ridges: Development activities and uses that have a high environmental impact on a Class 2 ridge will not be permitted. Low impact development activities, such as tourism facilities, which comprise of an ecological footprint of 5% or less of the property may be supported (the ecological footprint includes all areas directly impacted on by a development activity, including all paved surfaces, landscaping, property access and service provision). Low impact development activities on a ridge will not be supported where it is feasible to undertake the development on a portion of the property abutting the ridge;

- Class 3 Ridges: The guidelines for Class 2 ridges will be applied to areas of the ridge that have not been significantly impacted on by human activity. The guidelines for Class 3 ridges will be applied to areas of the ridge that have been significantly impacted on by human activity; and

- Class 4 Ridges: Further development activities will not be supported in areas of the ridge where the remaining contiguous extent of natural habitat is 4 ha or more.

- Key Biodiversity Areas (KBAs) (SANBI, 2024) – KBAs are identified using the Global Standard for the Identification of KBAs, developed by the International Union for the Conservation of Nature (IUCN). The standard involves applying five criteria to gauge an area's importance for biodiversity. These criteria consider the presence of threatened species or ecosystems, species with limited global distributions, pristine wilderness, significant biological processes, or irreplaceable biodiversity. Each criterion has specific quantitative thresholds to determine if they are met. As of 2023, over 16,000 KBAs have been identified globally, covering more than 20 million square kilometres. South Africa completed its first comprehensive national assessment in 2023, evaluating over 9,900 species or ecosystem types and identifying 260+ individual KBAs; and

- Freshwater Ecology:

  - Strategic Water Source Areas (SWSAs) (Le Maitre *et al,* 2018) – SWSAs are defined as areas of land that supply a quantity of mean annual surface water runoff in relation to their size and therefore, contribute considerably to the overall water supply of the country. These are key ecological infrastructure assets and the effective protection of surface water SWSAs areas is vital for national security because a lack of water security will compromise national security and human wellbeing.

  - South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al*, 2018) – A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the National Biodiversity Assessment of 2018. It is a collection of data layers that represent the extent of river and inland wetland ecosystem types as well as pressures on these systems.

  - National Freshwater Ecosystem Priority Area (NFEPA) (Nel *et al.,* 2011) – The NFEPA database provides strategic spatial priorities for conserving the country's freshwater ecosystems and associated biodiversity as well as supporting sustainable use of water resources.

7.2 Appendix B: Terrestrial Site Ecological Importance

The different habitat types within the PAOI were delineated and identified based on observations made during the field survey, and information from available satellite imagery. These habitat types were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of SCC and their ecosystem processes.

Site Ecological Importance (SEI) is a function of the Biodiversity Importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present in the Project Area) and Receptor Resilience (RR) (its resilience to impacts).

BI is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor. The criteria for the CI and FI ratings are provided in Table 7-1 and Table 7-2 respectively.

Table 7-1 Summary of Conservation Importance (CI) criteria

Conservation Importance	Fulfilling Criteria
Very High	Confirmed or highly likely occurrence of Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Extremely Rare or CR species that have a global extent of occurrence (EOO) of < 10 km^2. Any area of natural habitat of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent) of natural habitat of an EN ecosystem type. Globally significant populations of congregatory species (> 10% of global population).
High	Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km^2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. Presence of Rare species. Globally significant populations of congregatory species (> 1% but < 10% of global population).
Medium	Confirmed or highly likely occurrence of populations of Near Threatened (NT) species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Any area of natural habitat of threatened ecosystem type with status of VU. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.
Low	No confirmed or highly likely populations of SCC. No confirmed or highly likely populations of range-restricted species. < 50% of receptor contains natural habitat with limited potential to support SCC.
Very Low	No confirmed and highly unlikely populations of SCC. No confirmed and highly unlikely populations of range-restricted species. No natural habitat remaining.

Table 7-2 Summary of Functional Integrity (FI) criteria

Functional Integrity	Fulfilling Criteria
Very High	Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. No or minimal current negative ecological impacts, with no signs of major past disturbance.
High	Large (> 20 ha but < 100 ha) intact area for any conservation status of ecosystem type or > 10 ha for EN ecosystem types. Good habitat connectivity, with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts, with no signs of major past disturbance and good rehabilitation potential.
Medium	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts, with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential.
Low	Small (> 1 ha but < 5 ha) area. Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. Several minor and major current negative ecological impacts.
Very Low	Very small (< 1 ha) area. No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current negative ecological impacts.

BI can be derived from a simple matrix of CI and FI as provided in Table 7-3.

Table 7-3 Matrix used to derive Biodiversity Importance (BI) from Functional Integrity (FI) and Conservation Importance (CI)

Biodiversity Importance		Conservation Importance				
		Very High	**High**	**Medium**	**Low**	**Very Low**
Functional Integrity	**Very High**	Very High	Very High	High	Medium	Low
	High	Very High	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very Low
	Low	Medium	Medium	Low	Low	Very Low
	Very Low	Medium	Low	Very Low	Very Low	Very Low

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor, as summarised in Table 7-4.

Table 7-4 Summary of Receptor Resilience (RR) criteria

Resilience	Fulfilling Criteria
Very High	Habitat that can recover rapidly (~ less than 5 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
High	Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Medium	Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of: (i) remaining at a site even when a disturbance or impact is occurring, or (ii) returning to a site once the disturbance or impact has been removed.
Very Low	Habitat that is unable to recover from major impacts, or species that are unlikely to: (i) remain at a site even when a disturbance or impact is occurring, or (ii) return to a site once the disturbance or impact has been removed.

After the determination of BI and RR, the SEI can be ascertained using the matrix as provided in Table 7-5.

Table 7-5 Matrix used to derive Site Ecological Importance from Receptor Resilience (RR) and Biodiversity Importance (BI)

Site Ecological Importance		Biodiversity Importance				
		Very High	**High**	**Medium**	**Low**	**Very Low**
Receptor Resilience	**Very Low**	Very High	Very High	High	Medium	Low
	Low	Very High	Very High	High	Medium	Very Low
	Medium	Very High	High	Medium	Low	Very Low
	High	High	Medium	Low	Very Low	Very Low
	Very High	Medium	Low	Very Low	Very Low	Very Low

Interpretation of the SEI in the context of the proposed project is provided in Table 7-6.

Table 7-6 Guideline for interpreting Site Ecological Importance in the context of proposed activities

Site Ecological Importance	Interpretation in relation to proposed development activities
Very High	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

The SEI evaluated for each taxon can be combined into a single multi-taxon evaluation of SEI for the assessment area. Either a combination of the maximum SEI for each receptor should be applied, or the SEI may be evaluated only once per receptor but for all necessary taxa simultaneously. For the latter, justification of the SEI for each receptor is based on the criteria that conforms to the highest CI and FI, and the lowest RR across all taxa.

7.3 Appendix C: Specialist Declaration of Independence

I, Byron Goris, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Byron Goris

Environmental Consultant

The Biodiversity Company

November 2024

I, Andine Erasmus, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Andine Erasmus

Terrestrial Ecologist

The Biodiversity Company

November 2024

I, Carami Burger, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Carami Burger

Ecologist

The Biodiversity Company

November 2024

7.4 Appendix D: Specialist CVs



Byron Goris

B.Sc Hons in Global Socio-Ecological Systems Change (Cert. Nat. Sci.)

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Email: byron@thebiodiversitycompany.com
Identity Number: 9904145161083
Date of birth: 14 April 1999

Profile Summary

Environmental work experience across South Africa (2 years).

Theoretical and practical understanding of methodology in both aquatic, terrestrial, and global change ecology.

General training and experience in aspects of conservation, biogeography, and socio-economic sustainability.

Areas of Interest

Ecological systems approaches, global environmental change, socio-economic sustainability, multi/trans-disciplinarity, sports ecology, traditional medicinal plant science.

Key Experience

- Aquatic, Terrestrial, and Wetland Ecological Assessments
- Environmental Field work and basic field methodology
- Business sustainability
- Sports Ecology Research
- Habitat delineation
- Field work and research

Country Experience

South Africa

Nationality

South African

Languages

English – Proficient

Afrikaans – Basic

Qualifications

- BSc (Hons) Animals, Plants, and Environmental Sciences; University of the Witwatersrand
- BSc Biology, University of the Witwatersrand
- Certificated Natural Scientist (170720)

CURRICULUM VITAE: Byron Goris



Andine Erasmus

M.Sc. Zoology

Candidate Natural Scientist 164894

Cell: +27 64 417 6320

Email: andine@thebiodiversitycompany.com

Identity Number: 9504080028089

Date of birth: 8 April 1995

Profile Summary

Work experience in South Africa and Mauritius.

Biodiversity specialist experience in projects related to infrastructure development, renewable energy, mining, and prospecting.

Specific expertise includes terrestrial ecology, including mammals, herpetofauna, avifauna and flora, as well as report writing for environmental compliance, monitoring, management, and rehabilitation.

Areas of Interest

Zoology, Biodiversity, Conservation, Rehabilitation and Marine Biology.

Key Experience

- Terrestrial Ecological Assessments
- Rehabilitation plans and monitoring
- Habitat delineation
- Field work and research
- Environmental Management Programs (EMPr)
- Invasive Species Plans

Country Experience

South Africa

Mauritius

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- MSc Zoology *(Cum Laude)*, University of Pretoria
- BSc (Hons) Zoology, University of Pretoria
- BSc Zoology, University of Pretoria
- Cand Sci Nat (164894)
- Africa Land-Use Training, Grass Identification (2024)

Carami Burger

B.Sc. Honours – Ecological Interactions and Ecosystem Resilience (Cum Laude)

(*Pr Sci Nat*)

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Identity Number: 9606250185084

Date of birth: 25 June 1996



Profile Summary

Working experience in South Africa and Mozambique.

Specialist experience with infrastructure development, road development, renewable energy, mining and prospecting.

Specialist expertise include terrestrial ecology, wetland resources, rehabilitation and management plans, environmental compliance and monitoring.

Areas of Interest

Renewable Energy & Bulk Services Infrastructure Development, Mining, Farming, Sustainability and Conservation.

Key Experience

- Environmental Impact Assessments (EIA)
- Basic Assessments
- Terrestrial Ecological Assessments
- Wetland Delineation and Ecological Assessments
- Environmental Management Programmes (EMPr)
- Rehabilitation Plans
- Invasive Species Plans
- Search and Rescue Plans
- Environmental Compliance Audits
- Water Use License Applications
- Dust Fallout Monitoring
- Water Quality Monitoring

Countries worked in

South Africa

Mozambique

Zambia

Angola

Sierra Leone

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- BSc Hons Ecological Interactions and Ecosystem Resilience.
- BSc Botany and Zoology.
- Pr Sci Nat (121757)

APPENDIX D:

Specialist Studies

- ❖ D3 – Wetlands

WETLAND FUNCTIONAL AND IMPACT ASSESSMENT FOR THE PROPOSED VALLEY SILTS EXPANSION PROJECT

City of Johannesburg Metropolitan Municipality, Gauteng Province, South Africa

10/10/2024

Prepared by:

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Report Name	**WETLAND FUNCTIONAL AND IMPACT ASSESSMENT FOR THE PROPOSED VALLEY SILTS EXPANSION PROJECT**
Specialist Theme	Aquatic Biodiversity Theme
Project Reference	Valley Silts Expansion
Report Version	10/10/2024
Environmental Assessment Practitioner	KONGIWE
Fieldwork & Report Writer	Divan van Rooyen (Can. Sci. Nat. 151272)
Reviewer	Rian Pienaar (SACNASP 135544)
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017 (as amended). We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

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1 Introduction

1.1 Background

The Biodiversity Company was appointed to undertake a wetland functional and impact assessment for the proposed Valley Silts Expansion Phase project near NASREC, in Johannesburg, Gauteng Province. The project site is located approximately 1 km north of the FNB Stadium and approximately 300 m southeast from the Booysens Reserve in the Gauteng Province. The site is located within the City of Johannesburg Metropolitan Municipality. A map presenting the regional context of the 500 m Project Area of Interest (PAOI) can be seen in Figure 1-1.

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 4167 by the Department of Water and Sanitation (DWS) (previously GN 509 of 2016 and GN 3139 of 2023). The said notice was published in the Government Gazette (no. 49833) under Section 39 of the National Water Act (Act no. 36 of 1998) in December 2023, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 4167 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 4167 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM), provided the identified risks are all considered a low risk, and the applicant is listed under Appendix D1 or Appendix D2 of the same notice. This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations (2014) (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the published Government Notices (GN) 320 (20 March 2020) and GN 1150 (30 October 2020) in terms of NEMA, dated 20 March and 30 October 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 Management Act, 1998, when applying for Environmental Authorisation” (Reporting Criteria).

After considering the findings and recommendation provided by the specialist herein, this report should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making regarding the ecological viability of the proposed development and related activities.

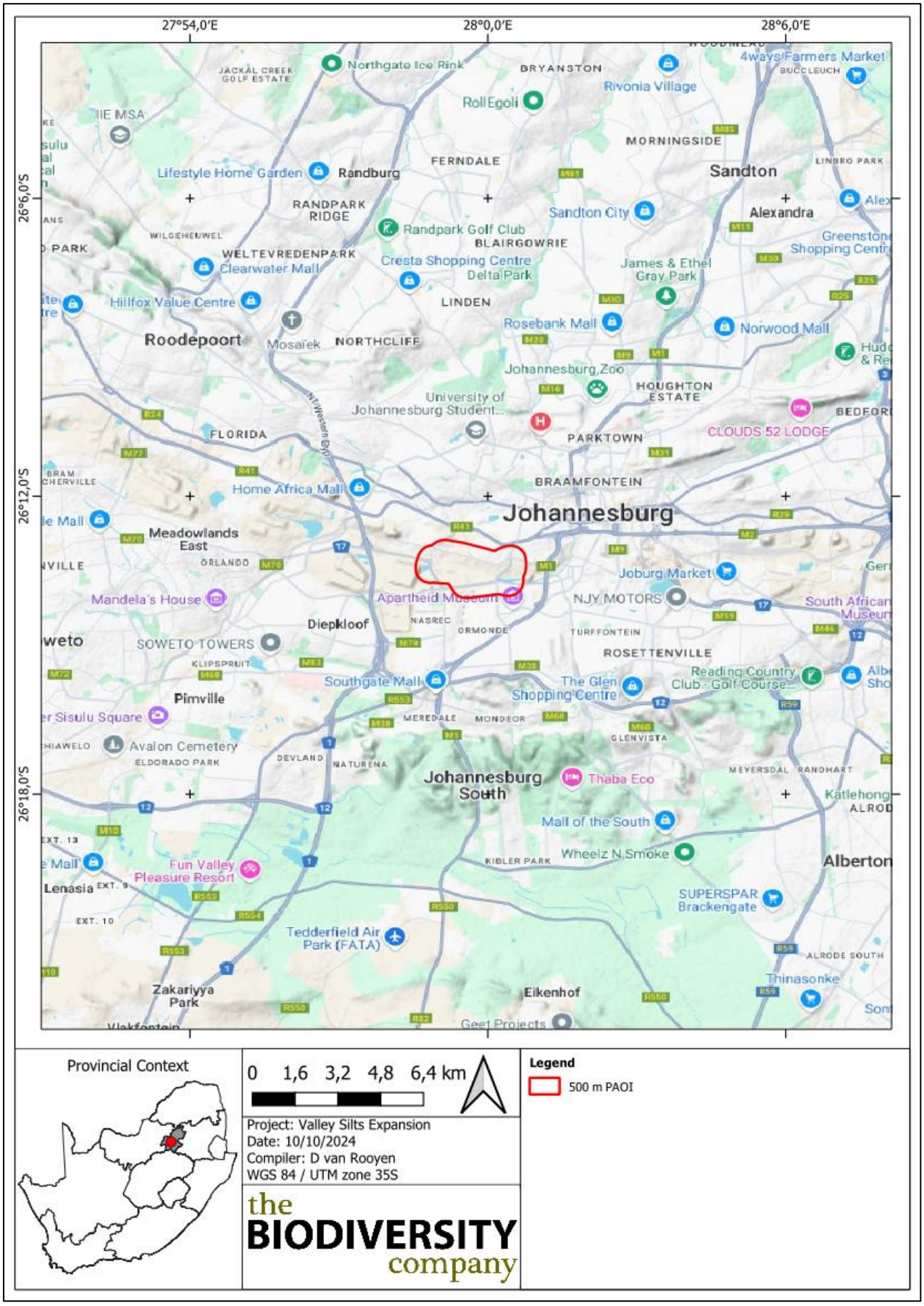


Figure 1-1 Location of the proposed project

1.2 Scope of Work

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- A desktop assessment of available and related datasets to provide context of the freshwater biodiversity of the project area and to indicate potential wetland areas;
- The delineation, classification and assessment of wetlands within 500 m of the project area;
- The provision of recommendations relevant to associated impacts; and
- Report compilation detailing the baseline findings.

1.3 Project Description

Ergo Mining (Pty) Ltd (Ergo), a subsidiary of DRDGOLD Limited, holds various Mining Rights (MR) for slimes dams and sand dumps, extending 65 km from western Johannesburg to Eastern Ekurhuleni, with primary activities concentrated in the central and eastern sections of the Witwatersrand mining belt (Kongiwe, 2024).

Furthermore, Ergo has secured an Environmental Authorisation (EA) and an Integrated Water Use License (IWUL) for the mechanical reclamation of gold-bearing silts from the Russel Stream, located north of NASREC near Booysens Reserve in Johannesburg. This is the Valley Silts Project.

The entire Valley Silts project is divided into three primary sectors:

- **Sector 1:** The current approved mining area, extending from the dam wall to the stockpile area near Crownwood Road. This sector is fully operational with established infrastructure, including fenced facilities, solar-powered security lights, haul roads, and site offices.
- **Sector 2:** Extends from the dam wall to NASREC Road (N1 to N20).
- **Sector 3:** Comprises blocks N21 and N22, located on either side of Crownwood Road.

The proposed Valley Silts Expansion project will consist of Sector 2 and Sector 3 (see Figure 1-2).

The new activities for the Expansion will include:

- Mining Blocks:
    - The expansion phase will include mining blocks N1 to N22.
- Drying stockpiles:
    - Eight drying stockpile locations are planned to manage the moisture content and oxidation of the mined material.
- Stormwater control berms/paddocks:
    - Berms and paddocks will be installed to protect the river from extraneous ingress.
- River crossings:
    - Eight river crossings will be constructed

- Haul and site roads
    - Existing roads will be utilized and expanded as necessary

Exploration trenching will determine the depositional flank extents, and all material will be removed from the natural flow path and flanks. Existing facilities in Sector 1, such as hard parks, cut-off trenches, and sumps, will be utilized for the expansion. Silt traps will be relocated as mining progresses, with the existing sump discharging to the stream.

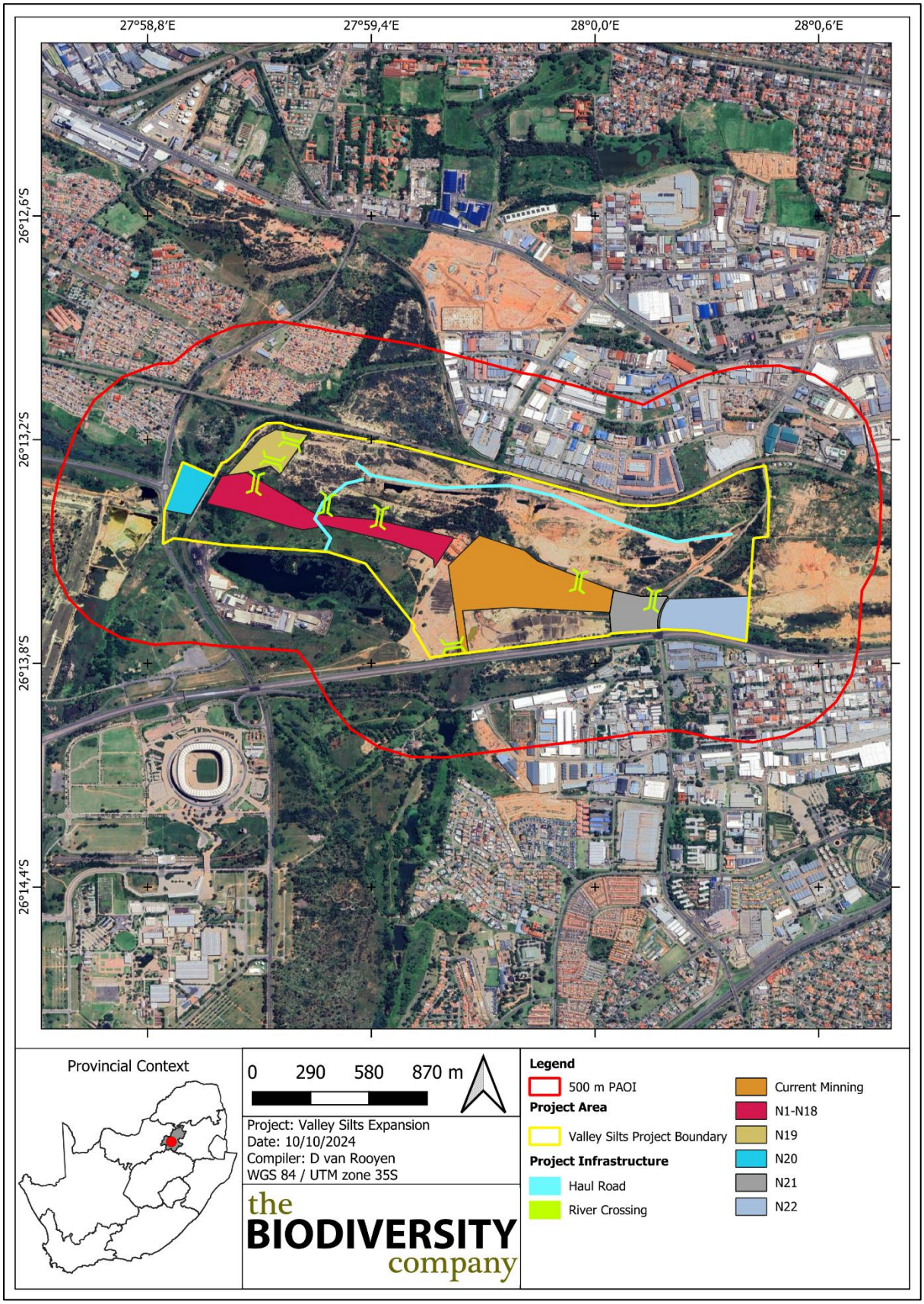


Figure 1-2 Map illustrating the details of the project area

1.4 Assumptions and Limitations

The following aspects were considered as limitations; however, despite these limitations, this wetland assessment is deemed sufficient for the purpose of the Environmental Impact Assessment (EIA):

- It has been assumed that the extent of the project area provided to the specialist is accurate;
- Areas characterised by external wetland indicators have been the focus for this assessment. Areas lacking these characteristics have not been focussed on; and
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by a maximum of five metres to either side.

1.5 Key Legislative Requirements

The legislation, policies and guidelines listed below in Table 1-1 are applicable to the current project. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

Table 1-1 A list of key legislative requirements

Region	Legislation / Guideline	Comment
National	National Environmental Management Act (Act No. 107 of 1998) (NEMA)	To provide for the effective protection and controlled utilisation of the environment and for matters incidental thereto.
	The National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA), Threatened or Protected Species Regulations	The protection of species and ecosystems that warrant protection
	NEMA: Environmental Impact Assessment Regulations (2014), as amended, with cognisance of Appendix 6 requirements in GNR 326 (7 April 2017, as amended).	The minimum criteria for reporting.
	NEMA: Government Notices (GN) 320 (20 March 2020) and GN 1150 (30 October 2020)	Protocol for the specialist assessment and minimum report content requirements.
	National Environmental Management: Waste Act (Act No. 59 of 2008)	The regulation of waste management to protect the environment.
	NWA: Government Notice (GN) 4167 (previously GN 509 of 2016 and GN 3139 of 2023)	Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses and the provision to apply for a General Authorisation subject to usage and outcome of the Risk Assessment Matrix.
	NEM:BA: Alien and Invasive Species Lists (2020) (GN 1003, September 2020)	The regulation and management of alien invasive species.
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)	To provide for control over the utilisation of the natural agricultural resources, including the vegetation and the combating of weeds and invader plants.
Provincial	Transvaal Nature Conservation Ordinance (Act No. 12 of 1998)	To consolidate and amend the laws relating to nature conservation and to provide matters incidental thereto.
	Gauteng Conservation Plan (2022)	The spatial designation of conservation areas and targets within the province.

1.6 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and

- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, 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, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem and not just the water constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

1.7 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017 and June 2021, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Scoping and Environmental Impact Assessment (S&EIA) process depending on the scale of the impact.

1.8 Legislative Framework

In line with the protocol for the specialist assessment and minimum report content requirements for environmental impacts on freshwater 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 Management Act, 1998, when applying for Environmental Authorisation” – the following has been assumed:

- An applicant intending to undertake an activity identified in the scope of this protocol on a site identified on the screening tool as being of:
    - “very high sensitivity” for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment;
    - “low sensitivity” for aquatic biodiversity, must submit an Aquatic Biodiversity Compliance Statement;
    - Where the information gathered from the site sensitivity verification differs from the screening tool designation of “very high” aquatic biodiversity sensitivity, and it is found to be of a “low” sensitivity, an Aquatic Biodiversity Compliance Statement must be submitted; and
    - Similarly, where the information gathered from the site sensitivity verification differs from the screening tool designation of “low” aquatic biodiversity sensitivity, and it is found to be of a “very high” sensitivity, an Aquatic Biodiversity Specialist Assessment must be submitted.

An Aquatic / Freshwater Biodiversity Specialist Assessment Report must contain the information as presented in Table 1-2 below.

Table 1-2 Aquatic Biodiversity Specialist Assessment 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
The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with expertise in the field of aquatic sciences	7.3
Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae	7.3
A signed statement of independence by the specialist(s)	7.3
The assessment must be undertaken on the preferred site and within the proposed development footprint	1.3
A baseline description of the aquatic biodiversity and ecosystems on the site, including: aquatic ecosystem types; presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns.	3.1.5
The threat status of the ecosystem and species as identified by the screening tool	3.6.1
An indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area)	3.1.5
A description of the ecological importance and sensitivity of the aquatic ecosystem including: (a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g., movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and (b) the historic ecological condition (reference) as well as present ecological state of rivers (in- stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater)	3.4.1
The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate	-
Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions: Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal? Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present? How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include: (a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); (b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub-catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns); (c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and (d) to what extent will the risks associated with water uses and related activities change.	4.2
How will the proposed development impact on the functioning of the aquatic feature? This must include: (a) base flows (e.g., too little or too much water in terms of characteristics and requirements of the system); (b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g., seasonal to temporary or permanent; impact of over -abstraction or instream or off stream impoundment of a wetland or river); (c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g., change from an unchanneled valley-bottom wetland to a channelled valley -bottom wetland);	4.2

(d) quality of water (e.g., due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); (e) fragmentation (e.g., road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and (f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g., waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.)	
How will the proposed development impact on key ecosystems regulating and supporting services especially: (a) flood attenuation; (b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage?	4.2
How will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	-
A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment	2.1
The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant	7.1
A description of the assumptions made, any uncertainties or gaps in knowledge or data	1.4
The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant	3.5
Additional environmental impacts expected from the proposed development	-
Any direct, indirect and cumulative impacts of the proposed development on site	**Error! Reference source not found.**
The degree to which impacts and risks can be mitigated	4.2.2
The degree to which the impacts and risks can be reversed	4.2.2
The degree to which the impacts and risks can cause loss of irreplaceable resources	**Error! Reference source not found.**
A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies	7.1.5
Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr)	4.2.2
A motivation must be provided if there were development footprints identified as having a “low” aquatic biodiversity sensitivity and that were not considered appropriate	-
A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not; and	5.2
Any conditions to which this statement is subjected	5.2

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

2 Fieldwork

2.1 Freshwater Biodiversity Field Assessment

A field survey for the area was undertaken on 07 October 2024 (spring), which constitutes an early-wet season survey, to identify the presence of freshwater features (wetlands) and to delineate their spatial extents. Furthermore, to determine vegetation composition of the identified features and the likelihood of features to be used as habitat for fauna. The seasonality is not considered to be a limiting factor to the assessment of which the results are conclusive.

3 Results & Discussion

3.1 Desktop Dataset Assessment

3.1.1 Vegetation Types

The PAOI is situated in the Grassland biome. The grassland biome of South Africa occurs mainly on the high central plateau (Highveld), inland areas of the eastern seaboard, mountainous areas of KwaZulu-Natal and the central parts of the Eastern Cape (Mucina & Rutherford, 2006).

On a fine-scale vegetation type, the PAOI overlaps with Soweto Highveld Grassland (Gm 8; Figure 3-1). The following information pertaining to the above-mentioned vegetation types is noted as per Mucina and Rutherford (2006):

The distribution of the Soweto Highveld Grassland (Gm 8) vegetation type is restricted to Gauteng and Mpumalanga with small portions of this vegetation type occurring in the North-West and Free State provinces. This vegetation type is roughly delineated by the Vaal River, Perdekop in the south-east and the N17 between Johannesburg and Ermelo. The Gm 8 vegetation type extends further westward as far as Randfontein and includes parts of Soweto. The Gm 8 vegetation type surround parts to the south as well, including Vanderbijlpark, Vereeniging and Sasolburg, which is located in the northern most parts of the Free State (Mucina & Rutherford. 2006).

The vegetation within the Gm 8 region is dominated by short to medium-high, dense, tufted grassland which mostly includes *Themeda triandra* within gently to moderately undulating landscapes on the Highveld plateau. Other grass species which occur to a lesser extent include *Eragrostis recemosa*, *Elionurus muticus*, *Tristachya leucothrix* and *Heteropogon contortus* (Mucina & Rutherford, 2006).

The conservation status of the Gm 8 vegetation type is endangered with a target percentage of 24. Half of the area is already transformed into agriculture, mining, urban build-up etc. with a handful of conservation areas still up and running. These include Waldrift, Suikerbosrand and Rolfe's Pan Nature Reserve (just to name a few).

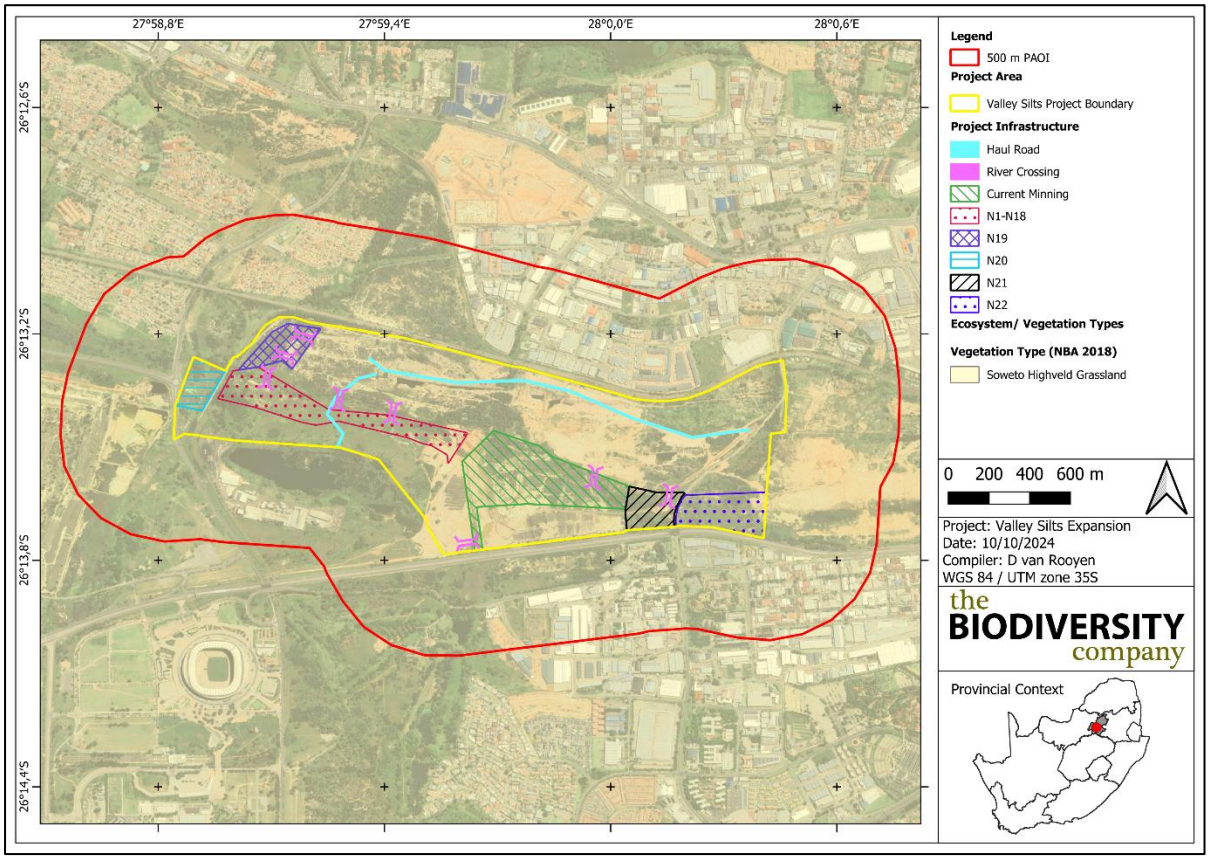


Figure 3-1 Vegetation type associated with the Project Area of Influence

3.1.2 Climate

The mean annual precipitation for this region reaches approximately 662 mm and is characterised by summer rainfall (Mucina & Rutherford, 2006). This area is characterised by high and low extreme temperatures during the summer and winter respectively with frost frequently occurring (Figure 3-2).

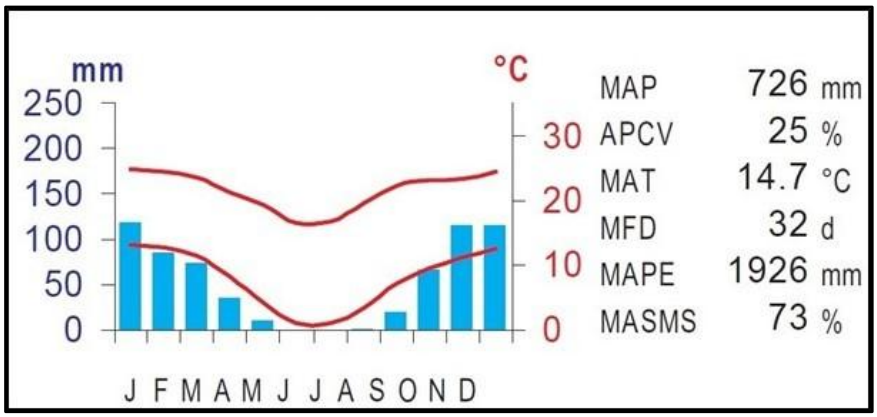


Figure 3-2 Climate for the Soweto Highveld Grassland (Mucina & Rutherford, 2006)

3.1.3 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Ba 35 and Ba 36 land types. According to the land type database (Land Type Survey Staff, 1972 - 2006), the Ba land type is characterised by plinthic catena with upland duplex and margalitic soils being rare. Dystrophic and mesotrophic red soils are widespread (Land Type Survey Staff, 1972 - 2006).

The geology of this area is characterised by the Madzaringwe Formation shale, mudstone and sandstone from the Karoo Supergroup or the Karoo Suite dolerites which feature prominently in this area. To the west, the rocks of Ventersdorp, old Transvaal and Witwatersrand Supergroups are significant with the south being characterised by the Volksrust Formation from the Karoo Supergroup. Deep soils occur in this area and is typically labelled by Ea, Ba and Bb land types (Mucina and Rutherford, 2006).

3.1.4 Hydrological Characteristics

The PAOI falls within the Highveld Ecoregion, within the Vaal Water Management Area (WMA). At a finer scale, the PAOI falls within the C22A quaternary catchment. The fine scale hydrological features are presented in the following section.

3.1.4.1 Topographical River Lines and Inland Water Areas

Four inland water areas have been identified within the proposed project area and its respective PAOI by means of the “2627” and “2628” quarter degree squares topographical river line data set (Figure 3-3). Within the proposed project area and its PAOI, the five inland water areas have been identified as dams, large reservoirs, marsh vleis and a pool. Several non-perennial features were identified within the PAOI and the project area.

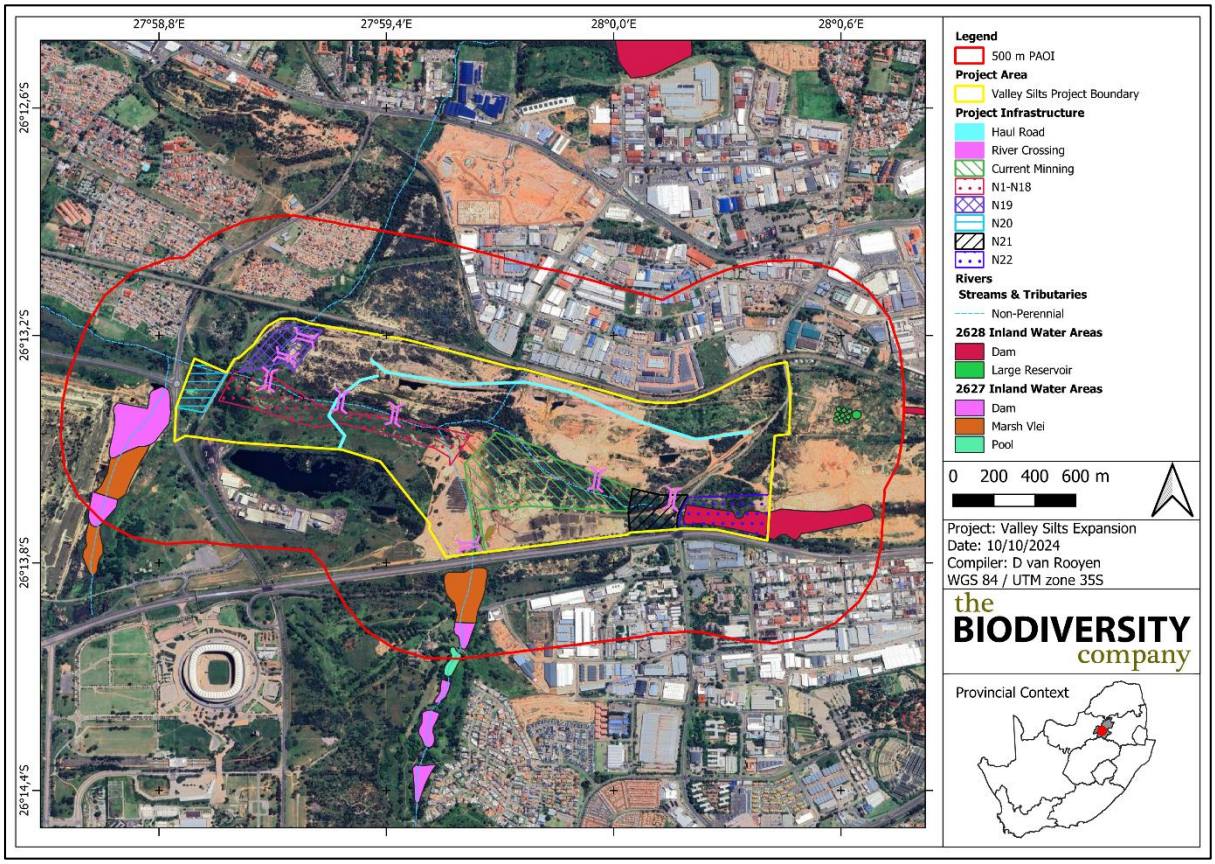


Figure 3-3 Topographical Drainage and Inland Water Areas relevant to the project

3.1.5 Ecologically Important Landscape Features

The GIS analysis pertaining to the relevance of the proposed project to ecologically important landscape features is summarised in Table 3-1.

Table 3-1 Summary of relevance of the proposed project to ecologically important landscape features

Desktop Information Considered	Relevant/Irrelevant	Section
South African Inventory of Inland Aquatic Ecosystems (SAIIAE)	Relevant – PAOI does overlap with NBA water resources	3.1.5.1
National Freshwater Priority Area	Relevant – PAOI overlaps with NFEPA wetlands.	3.1.5.2
Strategic Water Source Areas	Irrelevant – PAOI does not overlap with SWSA.	-
Provincial Conservation Plan	Relevant – POAI does overlap with Aquatic CBA and ESA.	3.1.5.3

3.1.5.1 South African Inventory of Inland Aquatic Ecosystems

One wetland type by means of the SAIIAE was identified within the proposed project area and its respective PAOI. This wetland type was identified as a Unchannelled valley-bottom wetland (Figure 3-4).

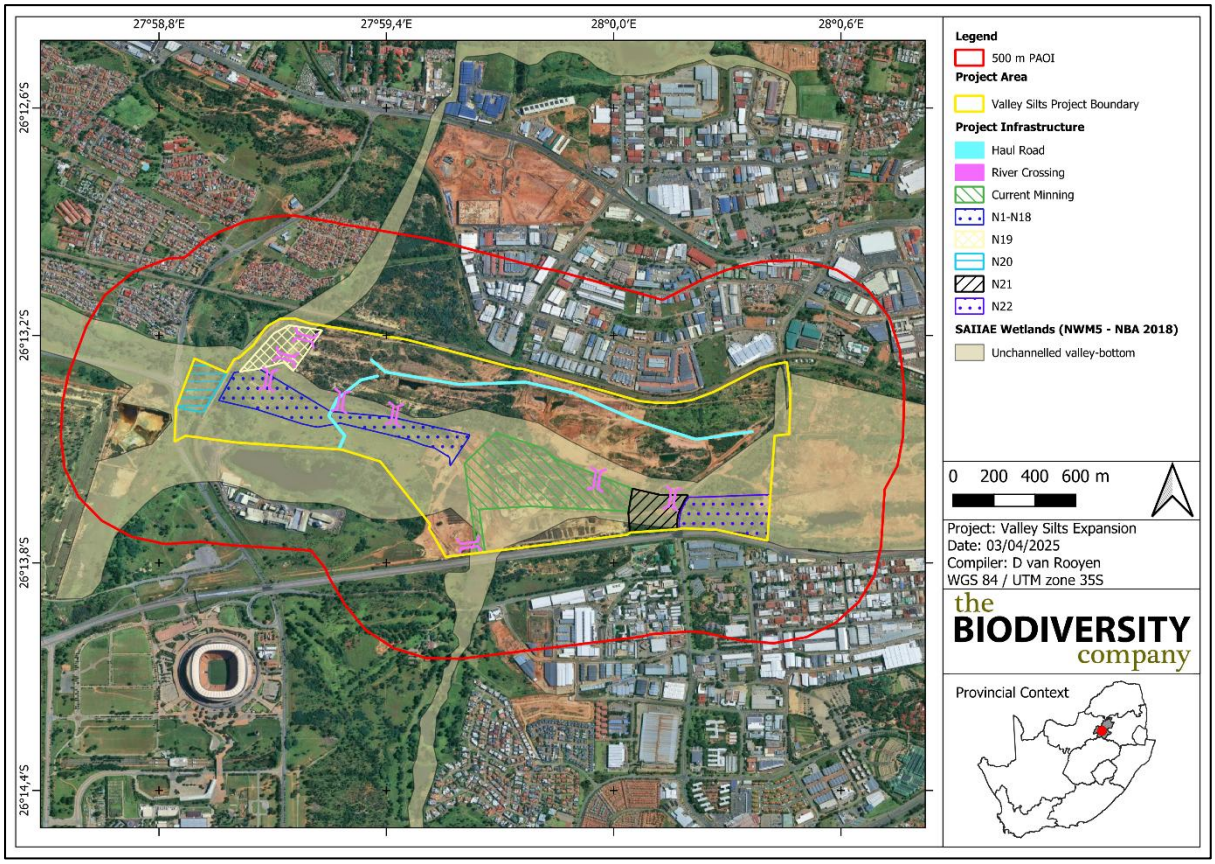


Figure 3-4 South African Inventory of Inland Aquatic Ecosystems of relevance to the project

3.1.5.2 National Freshwater Ecosystem Priority Areas

One NFEPA wetland type was identified within the proposed project area and its respective PAOI, namely a seep wetland (Figure 3-5). Several seep wetlands were identified within the proposed project area and its respective PAOI and were all classified to be either artificial or natural, non-priority wetlands. All artificial wetlands were classified with a condition within the "Z3 – Less than 25% natural land cover remaining" category while all natural wetlands were classified within the "C – between 25-75% of natural land cover remaining" category, as per the dataset.

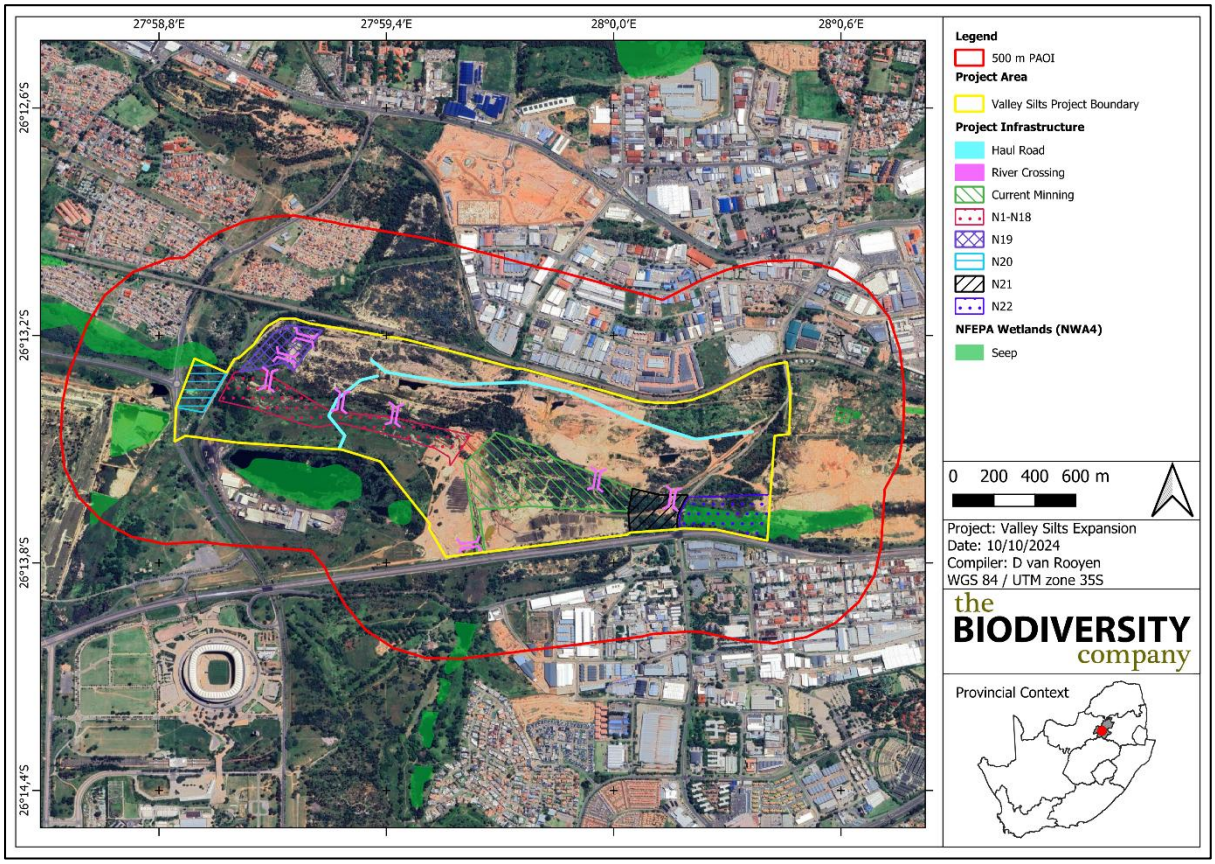


Figure 3-5 NFEPA Wetlands of relevance to the project

3.1.5.3 Gauteng Conservation Plan

The proposed project area is largely within areas designated as Ecological Support Areas (ESA's) with small sections of the proposed project infrastructures within areas classified as Critical Biodiversity Areas (CBA's) as per the Gauteng Conservation Plan spatial dataset (GDARD, 2014; Figure 3-6). It should be noted that the infield site inspection confirmed that the terrestrial habitat exists in a largely degraded or modified state with high levels of anthropogenic disturbance, particularly those associated with the mining activities on site, and has therefore lost much of its ecosystem functionality.

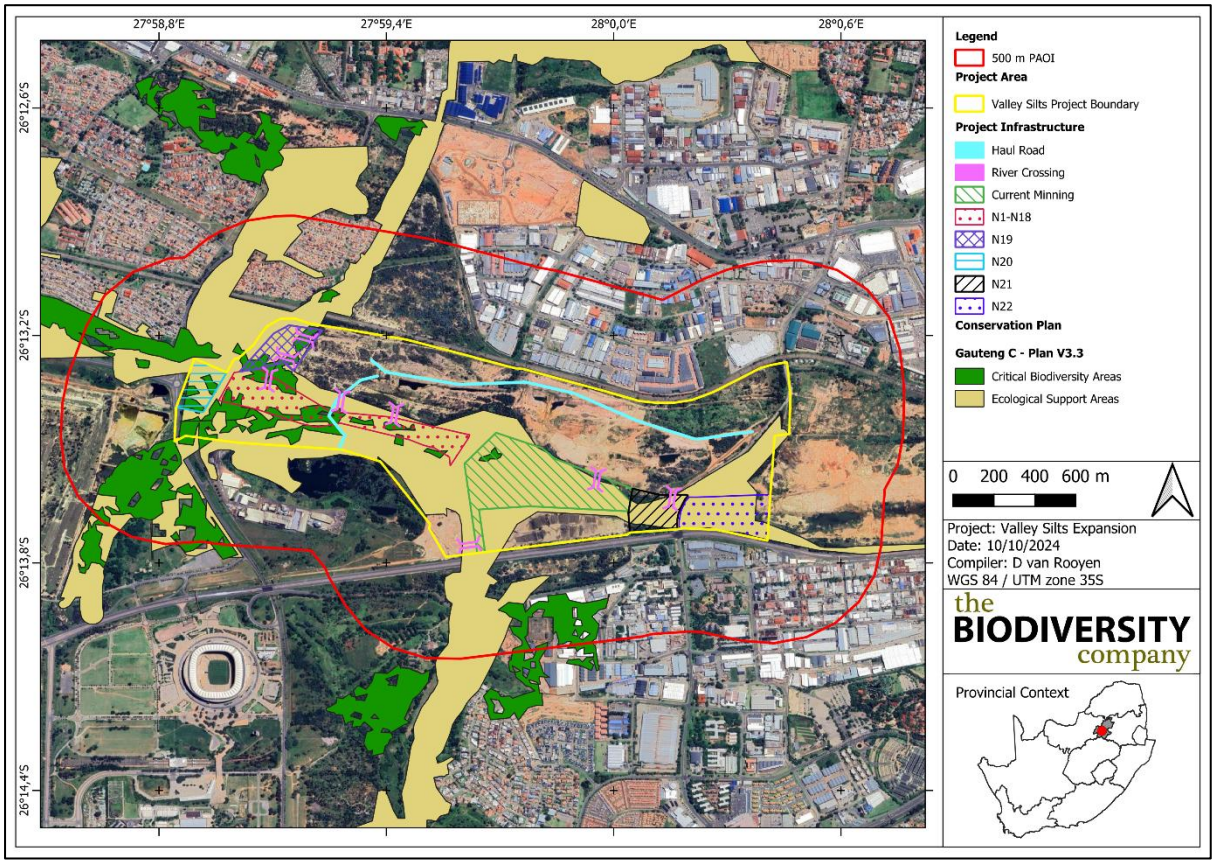


Figure 3-6 Gauteng Conservation Plan in relation to project area

3.2 Wetland Field Survey

3.2.1 Identification and Mapping

Topography and external wetland characteristics such as the presence of hydrophytes was used to identify wetland areas. Commonly encountered hydrophytes within wetland areas of the PAOI included sedges, reeds and grasses (Figure 3-7).



Figure 3-7 Examples of the hydrophytic vegetation encountered within the project area of Influence

3.2.2 Delineation

One wetland type, consisting of one hydrogeomorphic (HGM) unit, has been identified in relation to the proposed project site and its respective PAOI (Figure 3-8 and Figure 3-9). This wetland type has been classified as a channelled valley-bottom (CVB; HGM 1). Wetland functional assessment has only been conducted for natural wetlands.

HGM 1 has been identified to be within the proposed Valley Silts Expansion project area (Figure 3-8). The CVB has been critically modified for a considerable time and has received mine water discharge as well as tailings sediments and the contaminants that accompany it.

Apart from these features, several artificial quarries (as a result of historical mining activities) and one artificial dam were identified within the PAOI and project footprints (Figure 3-8).

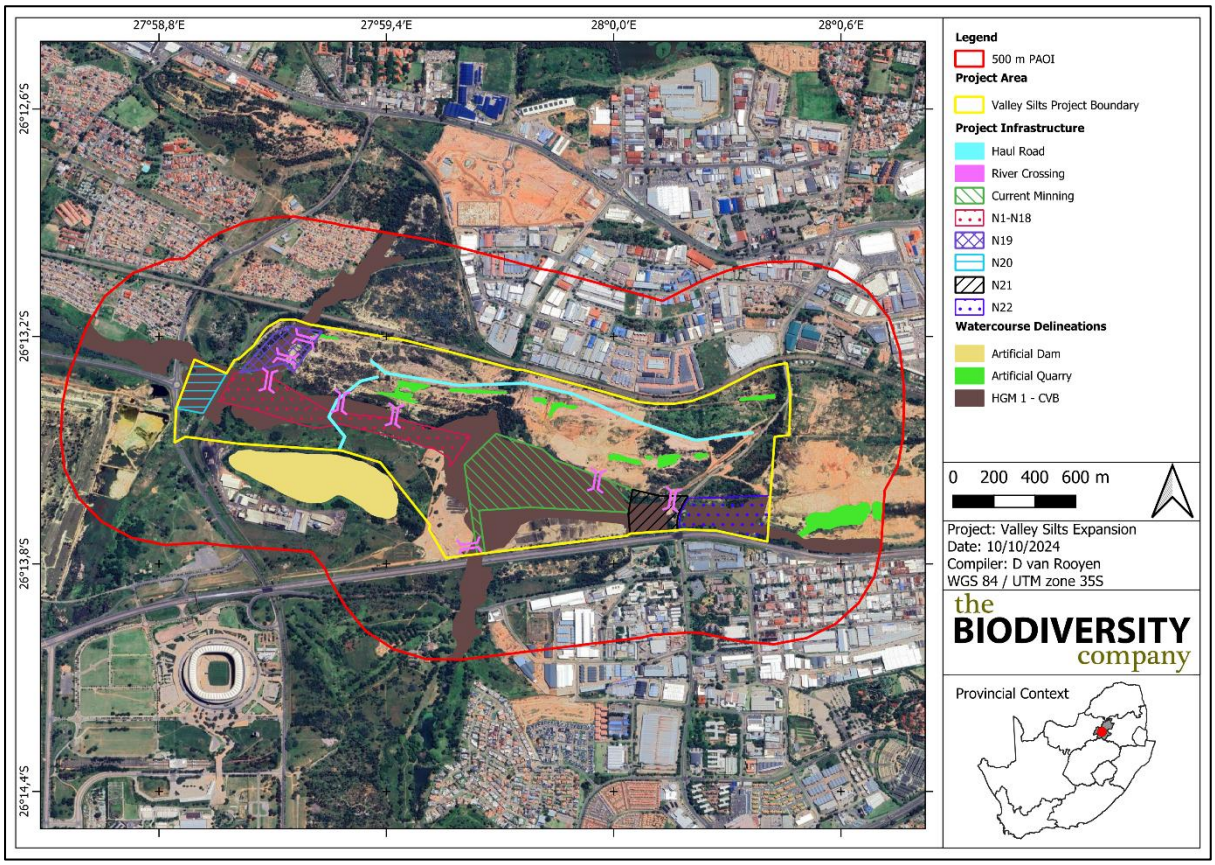


Figure 3-8 Delineation of wetland features within the Proposed Site and Project Area of Influence



Figure 3-9 Examples of the watercourses delineated within the project area. A & B) Artificial Quarries, C and D) Channelled valley-bottom (HGM 1)

3.2.3 Classification and Description

The wetland classification as per SANBI guidelines (Ollis *et al*., 2013) for the Valley Silts Expansion project area is presented in Table 3-2. One wetland type was identified within the project area, consisting of a channelled valley-bottom wetland.

Table 3-2 Wetland classification as per SANBI guideline (Ollis et al., 2013)

Wetland Unit	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Highveld	Mesic Highveld Grassland Group 3	Valley floor	Channelled valley-bottom	N/A	N/A

Channelled valley bottom wetlands are typically found on valley floors with a clearly defined, finite stream channel and lacks floodplain features, referring specifically to meanders. Channelled valley bottom wetlands are known to undergo loss of sediment in cases where the wetlands' slope is steep and the deposition thereof in cases of low relief. Figure 3-10 presents a diagram of a typical channelled valley bottom, showing the dominant movement of water into, through and out of the system.

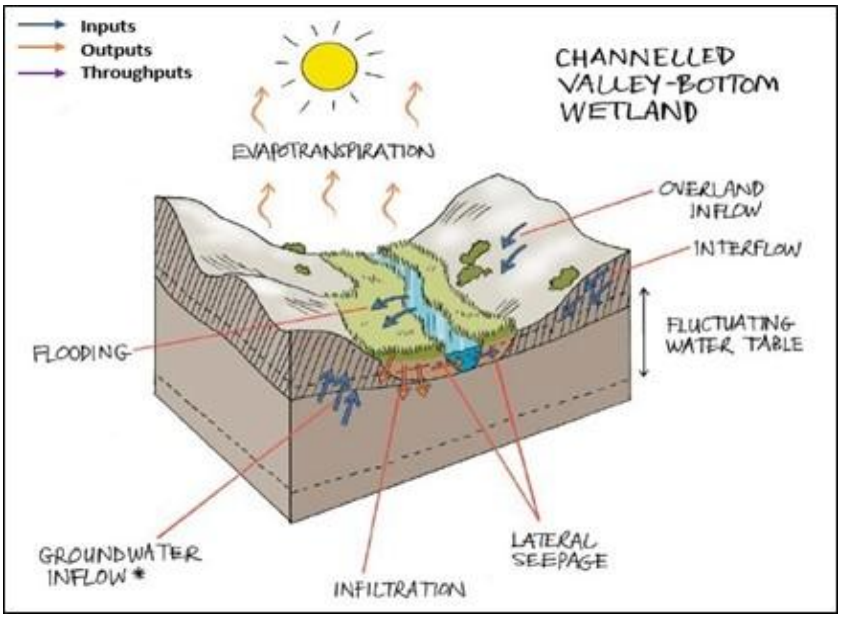


Figure 3-10 Amalgamated diagram of a typical channelled valley bottom, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

The DWAF (2005) manual separates the classification of watercourses into three (3) separate types of channels or sections defined by their position relative to the zone of saturation in the riparian area (Figure 3-11). The classification system separates channels into:

- those that do not have baseflow ('A' Sections);
- those that sometimes have baseflow ('B' Sections) or non-perennial; or
- those that always have baseflow ('C' Sections) or perennial.

The drainage feature on site can be described as "A Section" channels.

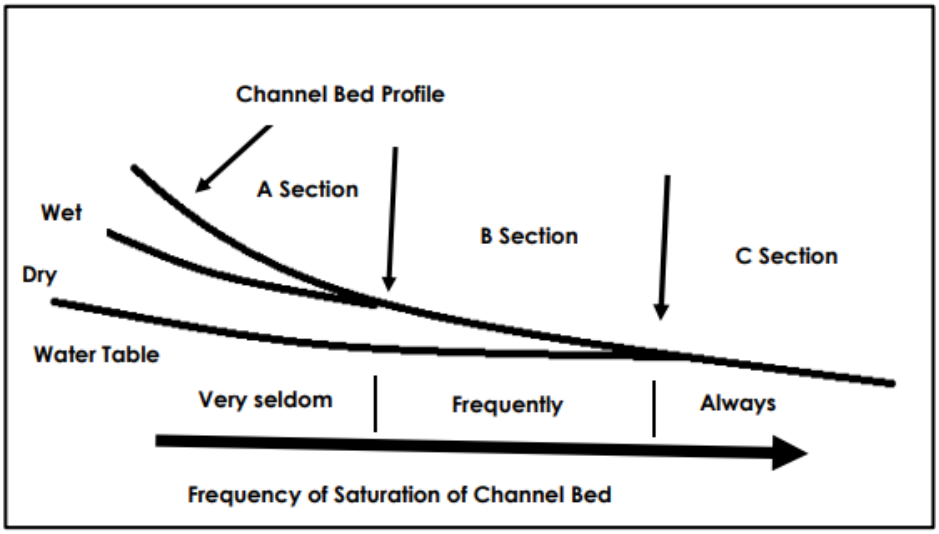


Figure 3-11 Watercourse classifications (DWAF, 2005)

3.3 Risk Screening

Table 3-3 and Figure 3-12 provides the results of risk screening for the delineated wetland and provides motivation for each of the determined categories.

Table 3-3 Risk status of the delineated wetlands

HGM unit	Risk Status	Rationale
HGM 1	At Risk	This HGM unit was identified to be traversed by the project area. The HGM unit has therefore been determined as "At Risk". If the proposed development layout cannot be amended to avoid the wetland and its calculated buffers, it is expected that direct impacts to the wetlands and consequent modifications to the systems will occur.
Artificial watercourses (quarries and dam)	Not at Risk	The artificial watercourses are located in a position of the landscape that allows for potential impacts to be avoided or to be buffered by existing topographic features or infrastructure that allows for the buffering of impacts to the watercourses.

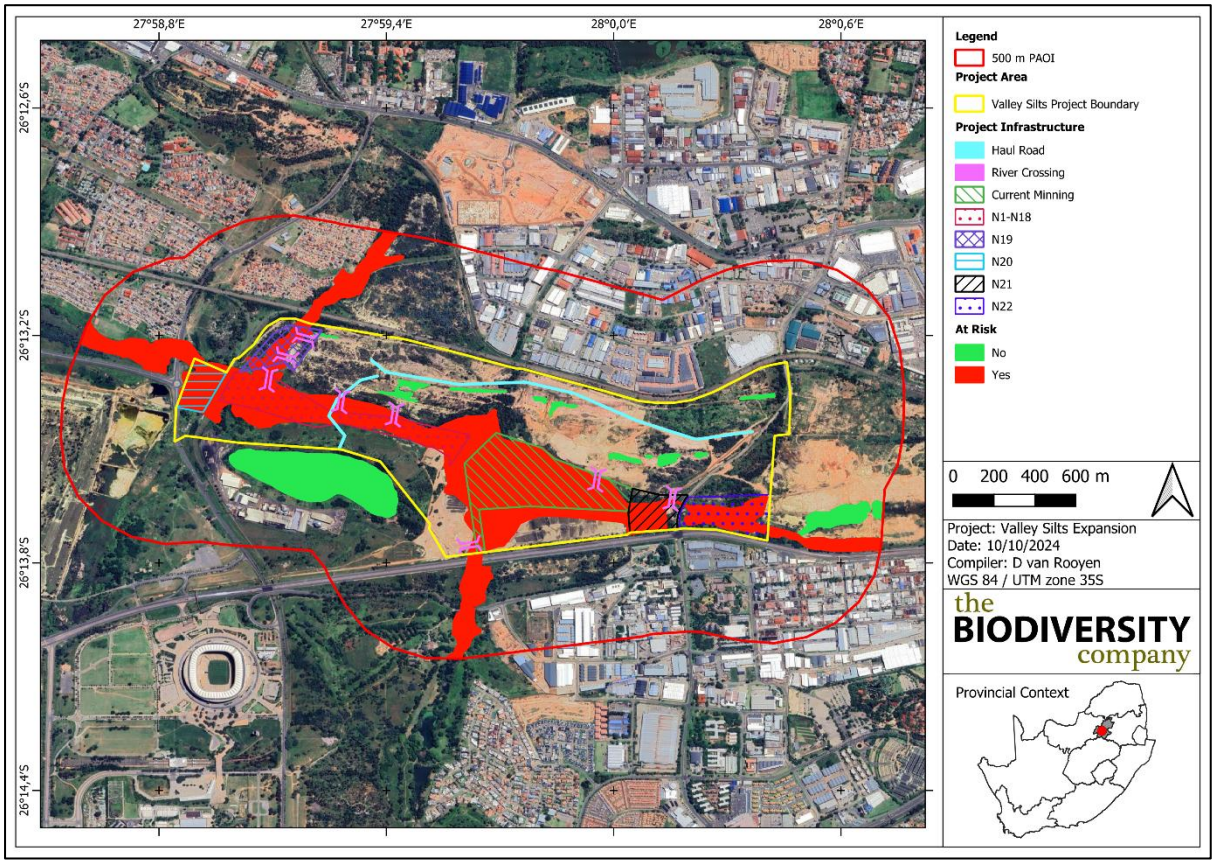


Figure 3-12 Risk status of the delineated wetland and other watercourses

3.4 Functional and Ecological Assessment

Only wetlands at an appreciable level of risk in relation to the proposed project and related activities were considered for the Functional and Ecological Assessments.

3.4.1 Functional Assessment

3.4.1.1 General Functional Description

Channelled valley bottom wetlands tend to contribute less to sediment trapping and flood attenuation than other systems. Channelled valley bottom wetlands are well known to improve the assimilation of toxicants, nitrates and sulphates, especially in cases where sub-surface flows contribute to the system's water source (Kotze *et al*., 2009).

It should be noted that these characteristics are representative of ideal wetland features and may not necessarily represent the characteristics of all wetlands. The functionality of wetlands and the provision of benefits is largely dependent on wetland size and influence from abiotic drivers.

3.4.1.2 Ecosystem Services

The ecosystem services provided by the relevant wetland units on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). The results of the assessment are presented in Table 3-4 and Figure 3-13. Ecosystem services contributing to these scores include flood attenuation, stream flow regulation, nutrient and toxicant assimilation and the maintenance of biodiversity.

HGM 1 was scored within the "Intermediate" ecosystem service score range. HGM 1 being valley-bottom wetland plays an important role in other services such as erosion control, sediment trapping, and toxicant assimilation (from runoff) will be provided at higher rates due to the fact that the wetland is

well-vegetated with hydrophytes. Due to the surrounding landscape being relatively disturbed the wetlands will provide a corridor and refugia for fauna.

The potential for all wetlands to be used for tourism and recreation is unlikely. Furthermore, the direct benefits such as the provisioning of harvestable resources and cultivated foods is unlikely due to the type of vegetation present. The use of the wetlands for cultural benefits and education and research is not supported.

Table 3-4 Summary of the average ecosystem scores of the assessed wetland unit

Wetland Unit					HGM 1
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits		Flood attenuation	3.1
				Streamflow regulation	2.7
			Water Quality enhancement benefits	Sediment trapping	2.8
				Phosphate assimilation	3.2
				Nitrate assimilation	3.0
				Toxicant assimilation	3.2
				Erosion control	3.2
				Carbon storage	2.4
	Direct Benefits	Biodiversity maintenance			1.4
		Provisioning benefits		Provisioning of water for human use	0.9
				Provisioning of harvestable resources	0.8
				Provisioning of cultivated foods	0.8
		Cultural benefits		Cultural heritage	0.0
				Tourism and recreation	0.1
				Education and research	1.0
Overall					28.6
Average					1.91
Class					Intermediate

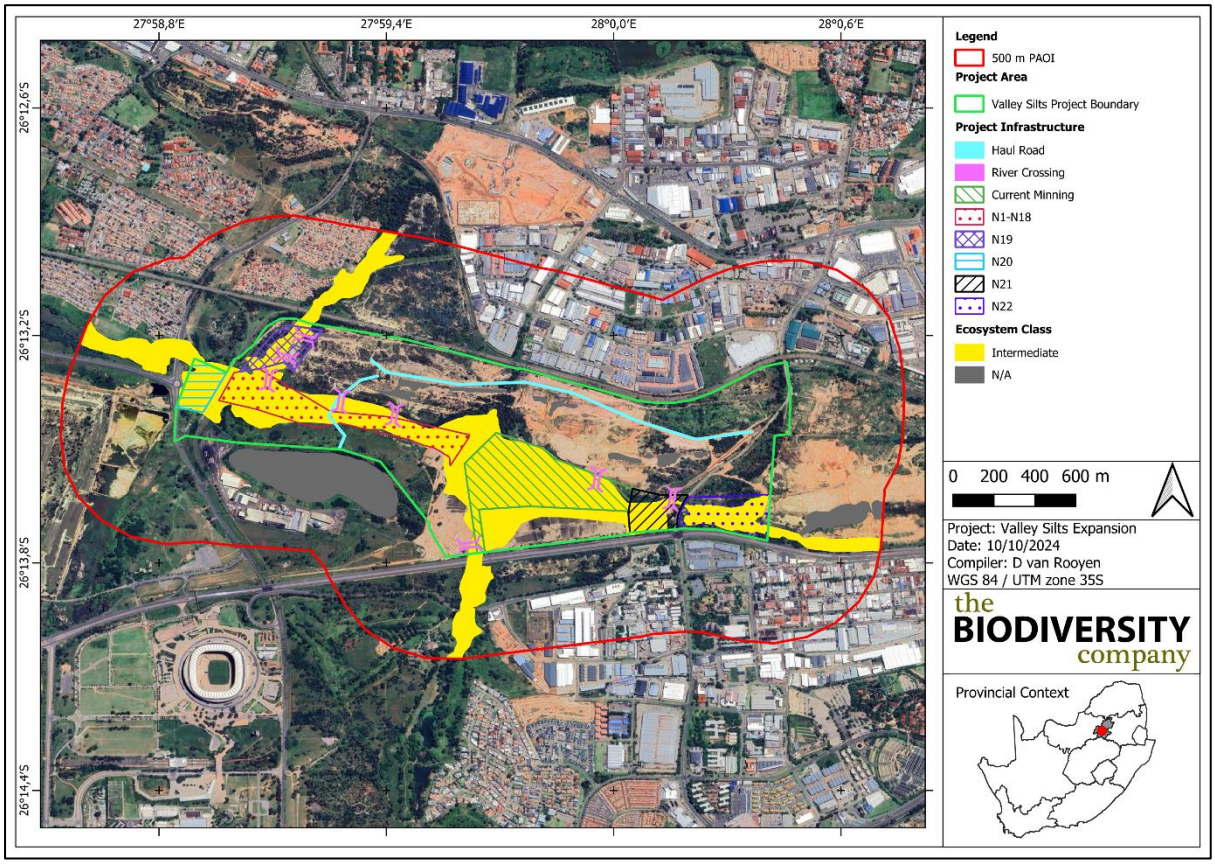


Figure 3-13 Average Ecosystem Service Scores of the assessed wetland unit

3.4.2 Present Ecological State

The wetland has exhibited a high degree of modification resulting from natural physical changes as well as anthropogenically induced impacts at both the local and catchment level. Resultingly, the wetland scored an average Present Ecological State (PES) score within the "F – Critically Modified" PES class. These impacts are further discussed in Section 4.1. The results of the wetland health and integrity assessment is provided in Table 3-5.

Table 3-5 Summative results of the PES Assessment

	Area (ha)	Hydrology		Geomorphology		Vegetation	
		Rating	Score	Rating	Score	Rating	Score
HGM 1	74.41	F: Critically Modified	9.5`	E: Seriously Modified	7.1	E: Seriously Modified	7.2
	Overall PES	8.2		Overall PES Class		F: Critically Modified	

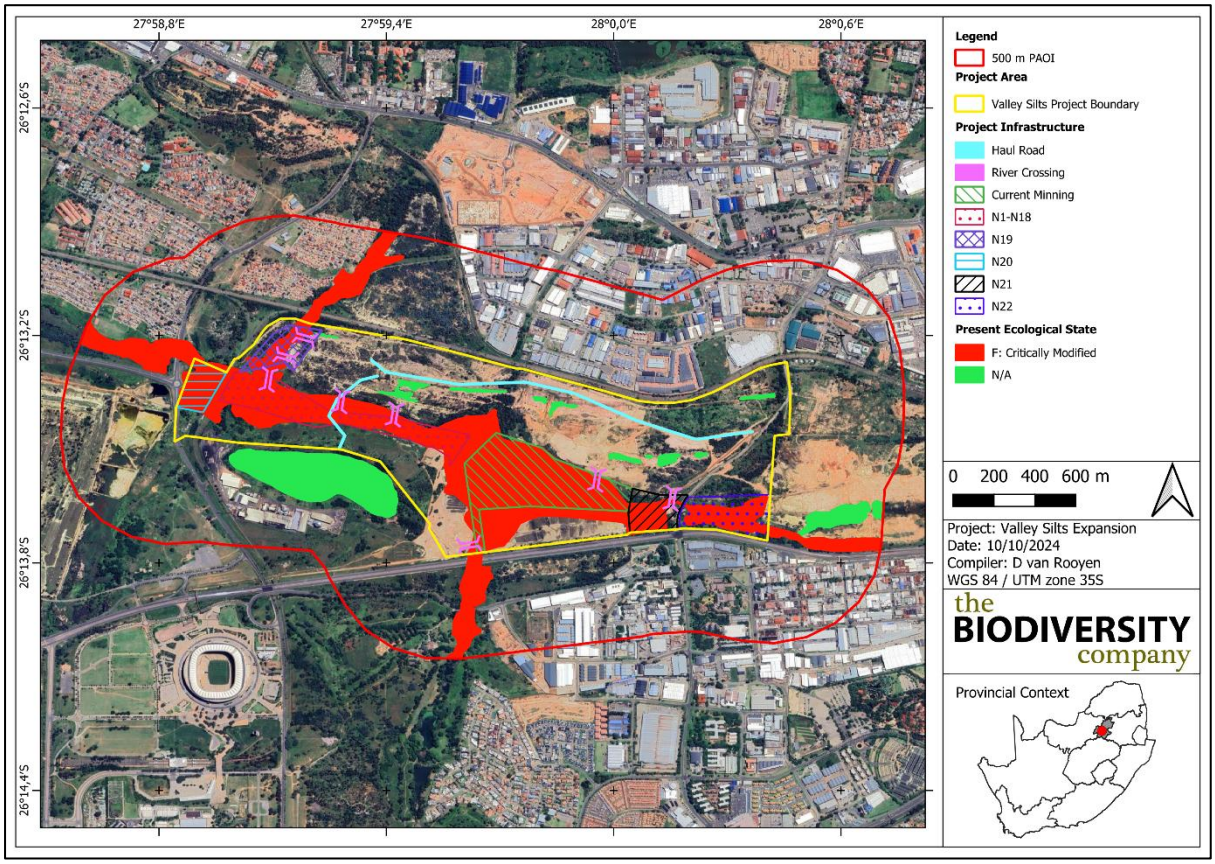


Figure 3-14 Overall present ecological state of delineated wetlands

3.4.3 Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) assessment was applied to the HGM unit in conjunction with the ecosystem service scores in the preceding sections, to assess the levels of sensitivity and ecological importance of the wetland. Various components pertaining to the protection status of a wetland is considered for the EIS, including Strategic Water Source Areas (SWSA), the NFEPA wet veg protection status and the protection status of the wetland itself considering the NBA wetland dataset as displayed in Table 3-6.

The wetlands average EIS score was determined to be within the "Low/Marginal" class due to the wetland experiencing a large degree of modifications and impacts (Figure 3-15). As a result, increased pollution, invasive species, or hydrological alterations have reduced its ecological functionality and biodiversity value which can lead to a lower ecological importance despite its location within CBA's and ESA's. Furthermore, the wetland was classified as critically modified due to historical and ongoing impacts, making it less sensitive to further changes causing a lower sensitivity rating.

Table 3-6 Aspects considered in the Ecological Importance and Sensitivity assessment

HGM Type	NFEPA Wet Veg			NBA Wetlands			SWSA (Y/N)	CBA/ESA (Y/N)
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018	Ecosystem Protection Level		
Channelled valley-bottom	Mesic Highveld Grassland Group 3	Critical	Not protected	F: Critically Modified (Field Visit)	Critical	Not Protected	N	Y

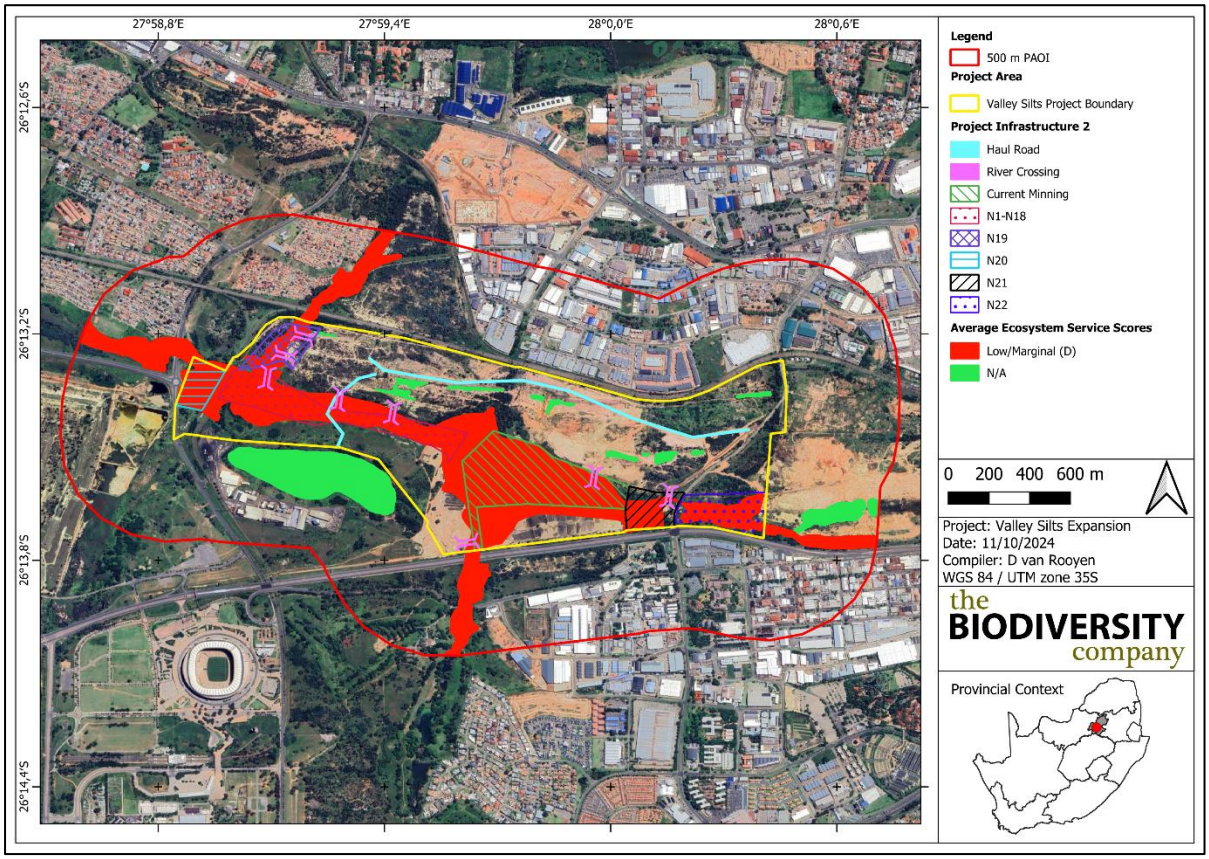


Figure 3-15 Average Ecological Importance and Sensitivity of the assessed wetlands

3.4.4 Recommended Ecological Category and Recommended Management Objective

The Recommended Ecological Category (REC) and Recommended Management Objective (RMO) for the wetland area was determined from the results of the PES and EIS assessments. These assessments indicated that all wetland features within the site, had to an extent, undergone transformation as a result of historical and current impacts. Nevertheless, despite the altered ecological integrity of these systems, they are considered to provide important ecological services. The appropriate REC and RMO estimated for the wetland area is presented in Table 3-7 below.

Table 3-7 Summary of the REC and RMO categories assigned to the relevant wetlands

HGM Unit	REC – RMO
HGM 1	E/F: Maintain

3.5 Buffer Requirements

The buffer requirements for all wetlands within the Valley Silts Expansion project area and PAOI were calculated using the Site-Based Tool: Determination of buffer zone requirements for wetland ecosystems (Macfarlane *et al.,* 2014) together with the "GDARD Requirements for Biodiversity Assessments: Version 2" (GDARD, 2012) were used to determine the appropriate watercourse buffer zones for the proposed project. The recommended buffer zones were calculated and are presented in Table 3-8 below. The soil type and erodibility within the wetland was also considered in this assessment and contributed to the calculated buffer widths.

For the purposes of the report and figures, only the buffers of wetlands partially or wholly overlapping with the development area are shown. The pre-mitigation buffer for HGM unit 1 was calculated to be 35

m. With the implementation of mitigation measure these buffer widths may be reduced to 30 m (Figure 3-16).

Importantly, the project will not avoid the buffer zones as the removal of silts will occur within the HGM unit. Therefore, these buffer zones serve as a guideline to restore the affected areas within the buffer zones to their natural state in the post-activity stages.

Table 3-8 Buffer requirements for the relevant wetland features

Aspect	Pre-Mitigation	Post-Mitigation
HGM 1	35 m	30 m

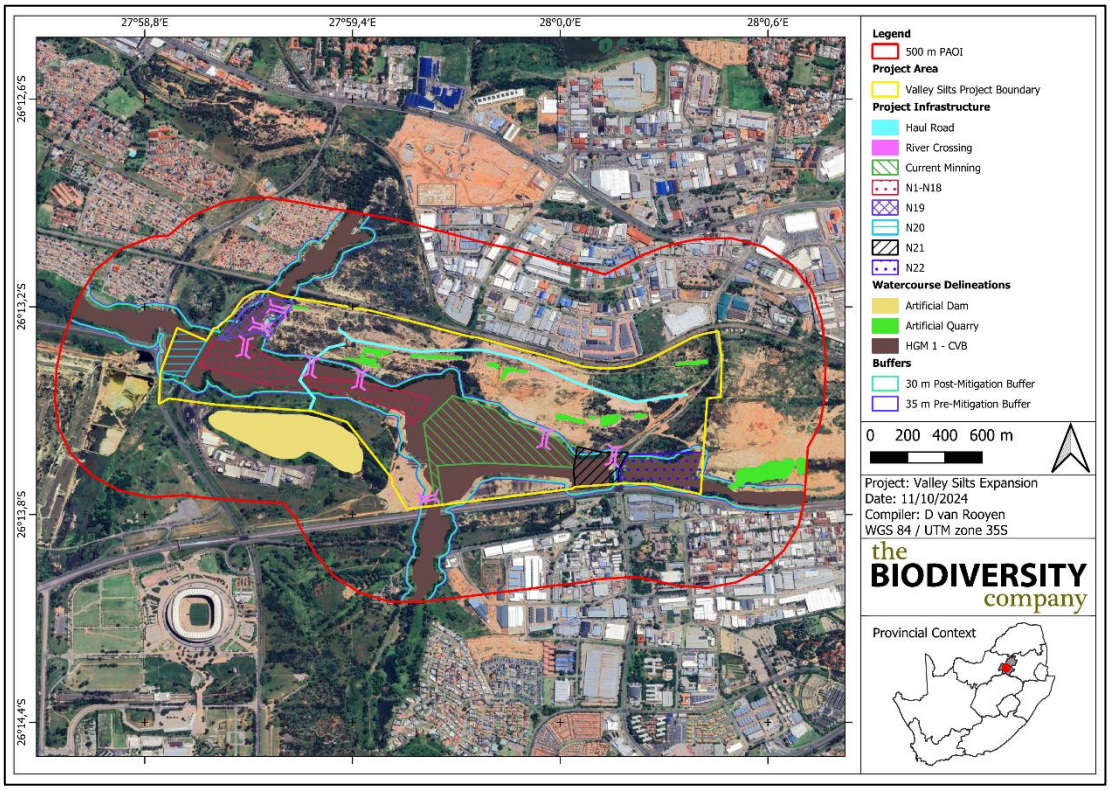


Figure 3-16 Recommended Buffers for the identified wetlands at risk in relation to the proposed development

3.5.1 Regulation Zones

Table 3-9 presents the legislated zones of regulation that would be applicable to the wetland areas.

In accordance with General Notice (GN) 509 of 2016 as it relates to the NWA (1998), a regulated area of a watercourse for Section 21 (c) and 21 (i) of the NWA, 1998 means the outer edge of the 1 in 100 year flood or where no flood line has been determined it means 100 m from the edge of a watercourse or a 500 m radius from the delineated boundary (extent) of any wetland or pan.

Listed activities in terms of the NEMA (1998), (Act 107 of 1998) EIA Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation.

Table 3-9 Legislated zones of regulation

Regulatory authorisation required	Zone of applicability

Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). Department of Water and Sanitation (DWS)	In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as: 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; 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; or a 500 m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended.	Activity 12 of Listing Notice 1 (GN R983) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) states that: The development of: (xii) Infrastructure or structures with a physical footprint of 100 square metres or more; Where such development occurs— Within a watercourse; In front of a development setback; or If no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse. Excluding – … (dd) where such development occurs within an urban area… Activity 19 of Listing Notice 1 (GN R983) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA regulations, 2014 (as amended) states "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."

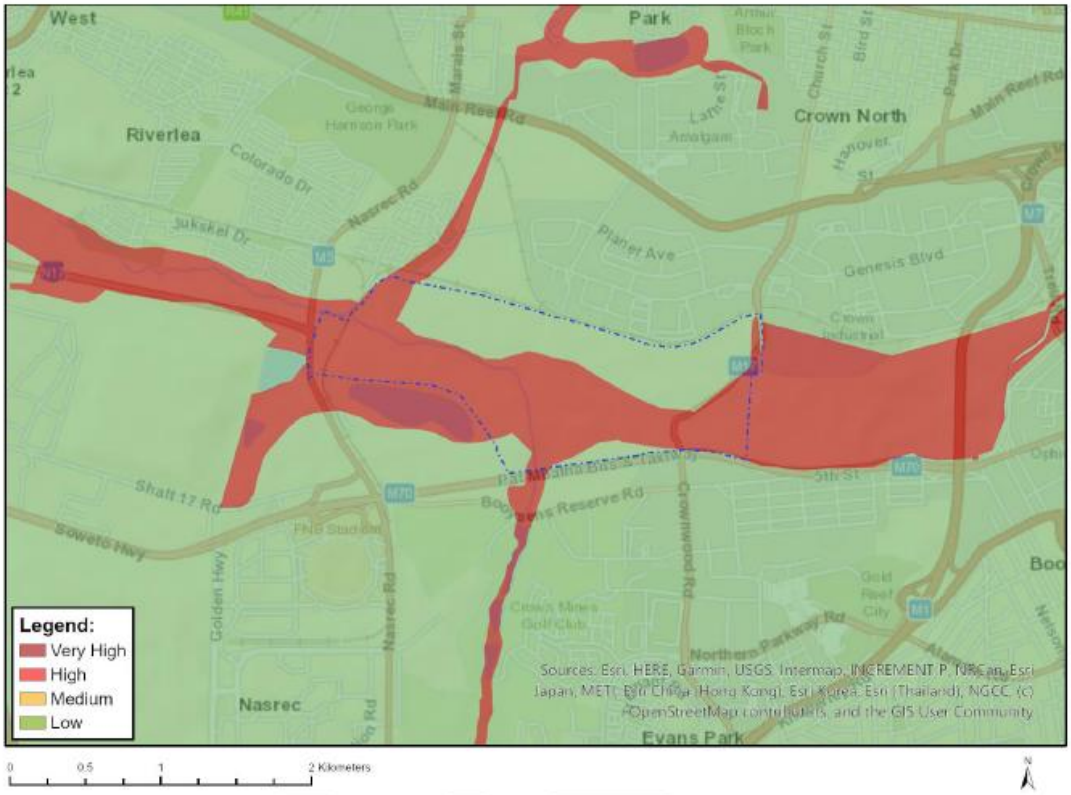
3.6 Site Sensitivity Verification

3.6.1 Desktop Ecological Senstivity

The following is deduced from the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended):

- The National Web-based Environmental Screening Tool has characterised the Aquatic Biodiversity Theme sensitivity as "Very High" for Valley Silts Expansion project area (Figure 3-17).

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	Wetlands_Dry Highveld Grassland Bioregion (Valley-bottom)

Figure 3-17 The Aquatic Biodiversity Theme Sensitivity for the proposed Valley Silts Expansion project (National Environmental Web-based Screening Tool (DEA, 2024))

3.6.2 Screening Tool Comparison

The allocated sensitivities for each of the relevant themes are either disputed or validated for the assessed areas in Table 3-10 below. A summative explanation for each result is provided as relevant. The specialist-assigned sensitivity ratings are based largely on the PES and EIS assessment processes followed in the previous section, and consideration is given to any observed or likely presence of sensitive fauna and flora. A map highlighting the Freshwater Sensitivities for the PAOI is depicted in Figure 3-18.

Table 3-10 Summary of the screening tool vs specialist assigned sensitivities

Features	Screening Tool Theme	Environmental Screening Tool Sensitivity	Specialist Sensitivity	Tool Validated or Disputed by Specialist - Reasoning
HGM 1	Aquatic Biodiversity Theme	Very High	High	Screening Tool Sensitivity Disputed. Rationale for the specialist assigned 'High' rating: The wetland system has experienced historical impact related to mining as well as from the surrounding developments in the catchment. The wetland is perceived to be seasonal as surface water was observed in the wetland. Wetland vegetation within the system was abundant. The ecosystem services these wetlands provide together with the PES and EIS have contributed towards determining the sensitivity rating. The wetland has therefore been assigned a 'High' sensitivity rating.
Artificial watercourses	Aquatic Biodiversity Theme	Low	Low	Screening Tool Sensitivity Validated. Rationale for the specialist assigned 'Low' rating: These watercourses were all artificially created through mining activities and other developments such as the Gauteng Oil and Cake Milll. Therefore, a "Low" sensitivity has been assigned for these areas in relation to freshwater biodiversity.
Remaining Area	Aquatic Biodiversity Theme	Low	Low	Screening Tool Sensitivity Validated. Rationale for the specialist assigned 'Low' rating: Much of the area has been historically modified through mining and other developments. The proposed activities are not anticipated to significantly modify the hydrological characteristics of the entire area; therefore a "Low" sensitivity has been assigned for these areas in relation to freshwater biodiversity.

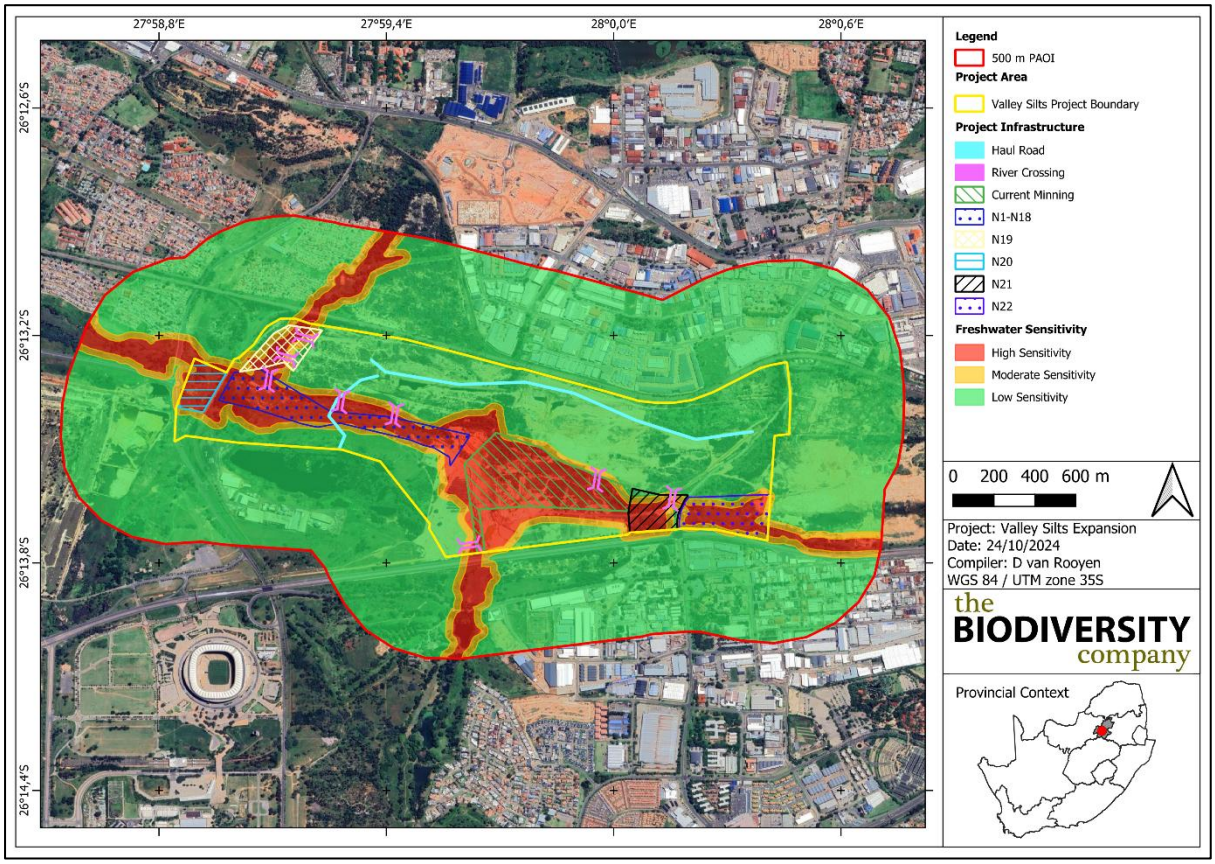


Figure 3-18 Sensitivity Map for the project area of interest

4 Risk and Impact Assessment

4.1 Current Impacts to Freshwater Biodiversity

The assessed wetlands exhibit impacts at local scale. These impacts result from present and historical land use relating to agricultural practices and access roads as well as artificial dams which have transformed the wetland habitats and has altered their natural hydrological regime and vegetation composition. The list below refers to the present-day local impacts observed within the assessed wetland areas:

- Wetland disturbance from other mining, development of infrastructure and foot traffic;
- Altered hydrological inputs resulting from changes to the surrounding landscape;
- Altered geomorphology from historical mining practices and development of infrastructure in close proximity to wetlands;
- Loss of wetland vegetation from continual disturbances, historical land use and the establishment of alien invasive flora species in some approaches of the wetlands; and
- Wetland degradation from mining activities and development of infrastructure.

Alternatives Considered

No alternatives were considered for the project.

4.2 Quantitative Risk and Impact Assessment

The Risk / Impact Assessment considered the direct and indirect impacts to the wetland system. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 4-1). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology, and phasing to avoid impacts.

Three levels of risk have been identified and considered for the overall risk assessment, these include high, medium, and low risks. High risk refers to wetland areas where the impacts will only occur inside the wetland itself. Medium risk refers to wetland areas where the impacts will only occur inside the wetlands buffer and not on the wetlands themselves. Low risks are wetland systems where both the wetlands and their buffers are avoided by the proposed activities. These risks can be lowered through following the appropriate mitigation measures.

For this assessment, the specialist was provided with the proposed footprint for the Valley Silts Expansion. The specialist focussed on the wetland within and close to the proposed site.

It is assumed that the proposed development will avoid the delineated wetland and its respective buffer zones. Emphasis was therefore placed on minimising impacts by means of mitigation.

A Risk / Impact Assessment was undertaken for the proposed development.

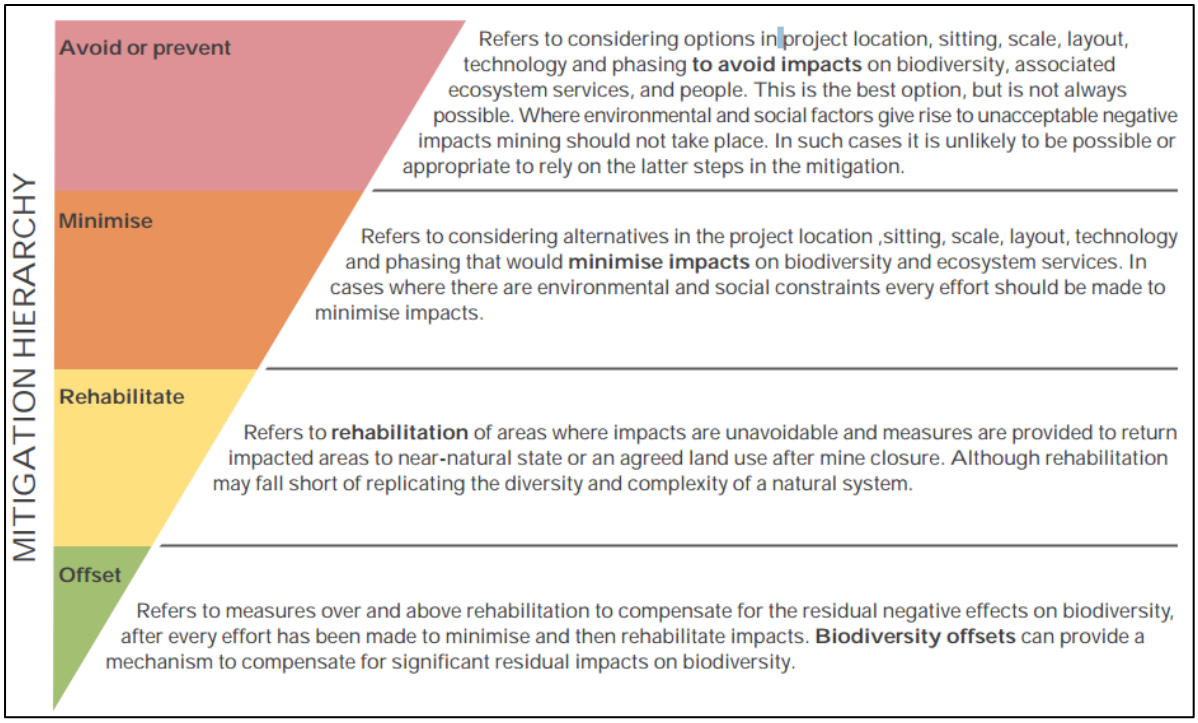


Figure 4-1 The mitigation hierarchy as described by the DEA (2013)

4.2.1 Potential Aniticipated Impacts

Table 4-1 illustrates the potential aspects expected to threaten the integrity of sensitive receptors during the proposed activities. The pre- and post- mitigation significance ratings have been calculated considering various parameters, these results are presented in the subsequent tables (Table 4-2).

Table 4-1 Aspects and impacts relevant to the proposed activity

Phases	Activity	Impact
Construction of mining infrastructure	Excavation	Loss of wetlands and associated organic material and vegetation through site excavation
		Increased contamination of downstream watercourse through the upheaval and liberation of toxins accumulated / trapped in the sediments
		Flow impediment leading to flooding, backlogging or wetland drowning upstream of the expansion activities
		Flow concentration leading to increased erosion and scouring downstream of the expansion activities
		Sedimentation and increased turbidity in downstream watercourses
	Drying and hauling	Altered hydrological regimes from increased bare surfaces and altered topography with subsequent increase in overland flow and flood peaks
		Potential loss / disturbance of wetland soil and vegetation
		Impaired water quality of the Russel Stream with leachate from the drying area
	Operation of machinery and equipment and vehicle movement	Altered hydrological regimes from hardened surfaces arising from compacted surfaces attributed to the use of machinery and equipment
		Increase in erosion and sedimentation of receiving systems attributed to altered hydrological regimes
		Impaired water quality from contamination of water resources by stochastics spills and leaks from machinery and equipment (e.g., fuel and machine oils)
		Loss or degradation of ecosystem services attributed to the above-mentioned impacts
	River Crossings	Altered hydrological regimes from channelling or diversion of flow during crossing preparation and installation and, from compacted surfaces attributed to the use of heavy machinery
		Increase in erosion and sedimentation of receiving systems attributed to altered hydrological regimes
		Establishment and proliferation of alien vegetation from disturbances related to installation of infrastructure
		Impaired water quality attributed to the above-mentioned impacts and from contamination by polluted runoff
		Loss or degradation of ecosystem services
	Landscaping	Final landscaping and reshaping
Operation of mining infrastructure	Vehicle Traffic	Potential contamination of wetlands from polluted runoff
		Wetland pollution from indiscriminate dumping of litter

	Stormwater	Operation of stormwater management (runoff generated from hardened surfaces)
Decommissioning of mining infrastructure	Rehabilitation	Potential loss or degradation of wetlands through inappropriate closure
	Landscaping	Final landscaping and concurrent rehabilitation

Given the current layout received, it is expected that the project will pose "Moderate" post-mitigation risks to the wetland due to the proposed footprint boundary overlapping with the wetland and its respective buffer zones.

It is expected that the project will pose "Moderate" post-mitigation risks provided that the suggested mitigations are implemented. Should the wetland areas and their respective post-mitigation buffers be avoided by the proposed development, the greatest risk to the wetlands is anticipated to be from the increased surface water runoff from mining infrastructure which will alter the hydrodynamics of the system and has the potential to adversely affect water quality. However, the impact of this can still be mitigated to a large degree by demarcating all wetland areas and avoid any placement of materials or movement within the wetland areas. It should be noted that much of the wetland and the buffer has already exhibited disturbance and in this instance, it would be practical to avoid areas within the wetland and buffer that do not already exhibit extensive disturbance.

Table 4-2 Summative results of the Risk Assessment conducted for the proposed project

Phase	Activity	Impact	Significance (max = 100)	Risk Rating	Confidence level
CONSTRUCTION	Excavation	Loss of wetlands and associated organic material and vegetation through site excavation	**33,6**	**M**	High
		Increased contamination of downstream watercourse through the upheaval and liberation of toxins accumulated / trapped in the sediments	**33,6**	**M**	High
		Flow impediment leading to flooding, backlogging or wetland drowning upstream of the expansion activities	**16,8**	**L**	High
		Flow concentration leading to increased erosion and scouring downstream of the expansion activities	**16,8**	**L**	High
		Sedimentation and increased turbidity in downstream watercourses	**38,4**	**M**	High
	Drying and hauling	Altered hydrological regimes from increased bare surfaces and altered topography with subsequent increase in overland flow and flood peaks	**16,8**	**L**	High
		Potential loss / disturbance of wetland soil and vegetation	**21,6**	**L**	High
		Impaired water quality of the Russel Stream with leachate from the drying area	**31,2**	**M**	High
	Operation of machinery and equipment and vehicle movement.	Altered hydrological regimes from hardened surfaces arising from compacted surfaces attributed to the use of machinery and equipment	**33,6**	**M**	High
		Increase in erosion and sedimentation of receiving systems attributed to altered hydrological regimes	**38,4**	**M**	High

		Impaired water quality from contamination of water resources by stochastics spills and leaks from machinery and equipment (e.g., fuel and machine oils)	**26,4**	**L**	High
		Loss or degradation of ecosystem services attributed to the above-mentioned impacts	**21,6**	**L**	High
	River Crossings	Altered hydrological regimes from channelling or diversion of flow during crossing preparation and installation and, from compacted surfaces attributed to the use of heavy machinery	**26,4**	**L**	High
		Increase in erosion and sedimentation of receiving systems attributed to altered hydrological regimes	**26,4**	**L**	High
		Establishment and proliferation of alien vegetation from disturbances related to installation of infrastructure	**31,2**	**M**	High
		Impaired water quality attributed to the above-mentioned impacts and from contamination by polluted runoff	**31,2**	**M**	High
		Loss or degradation of ecosystem services	**26,4**	**L**	High
	Landscaping	Final landscaping and reshaping	**-42**	**+**	High
OPERATIONAL	Vehicle traffic.	Potential contamination of wetlands from polluted runoff	**26,4**	**L**	High
		Wetland pollution from indiscriminate dumping of litter	**19,8**	**L**	High
	Stormwater	Operation of stormwater management (runoff generated from hardened surfaces)	**26,4**	**L**	High
DECOMMISSIONING	Rehabilitation	Potential loss or degradation of wetlands through inappropriate closure	**14,4**	**L**	High
	Landscaping	Final landscaping and concurrent rehabilitation	**-30**	**+**	High

4.2.2 Mitigation Measures

In light of the expected impacts from proposed activities the following mitigation measures have been proposed to lower the intensity of the impacts on the ecological integrity of the wetlands.

The focus of mitigation measures should be to reduce the significance of potential environmental impacts associated with the proposed development and thereby to:

- Prevent the unnecessary destruction and fragmentation of the vegetation community of the wetland areas; and
- Limit the construction area to the defined project areas and only impact those areas where it is unavoidable to do so otherwise.

4.2.2.1 General Mitigation Measures

The following general mitigation measures are provided in addition to the aforementioned mitigation:

- Construction activities must take place during the low flow period (as much as possible). In addition to this, basic stormwater structures such as berms must be designed and implemented prior to and throughout the duration of the construction activities;

- A qualified Hydrologist with experience in arid areas must develop a suitable and adaptive Stormwater management plan to ensure no erosion takes place and that clean water reports back to the local watercourses;

- The water resources outside of the specific project site area must be avoided;

- Prevent uncontrolled access of vehicles through the watercourse that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;

- Laydown yards, camps and storage areas must be beyond the watercourse and associated buffer areas.

- Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the drainage systems;

- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;

- All chemicals and toxicants to be used for the construction must be stored outside the watercourses and in a bunded area;

- Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) or construction materials on site (e.g. concrete) in such a way as to prevent them leaking and entering the environment;

- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;

- Mixing of concrete must under no circumstances take place within the drainage systems. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished;

- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;

- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. These should not be placed near any watercourse or in buffer zones. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);

- The haul road and associated road margins, and silt traps must be inspected on a monthly basis for signs of erosion. When erosion is observed, the area should be rehabilitated within 7 days. In addition, inspections following a >50 mm/ 24 hr rainfall event must occur within 7 days of the event;

- No dumping of construction material on-site may take place;

- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported; and

- Make sure all excess consumables and building materials / rubble are removed from site and deposited at an appropriate waste facility.

5 Conclusion

One HGM type (CVB) was identified within the proposed project area and its respective PAOI, consisting of one HGM unit which will be at risk given the current project footprint. In addition, a few artificial quarries and one large artificial dam were identified within the PAOI.

A summary of the ecological results for the features are displayed in the table below (Table 5-1). HGM 1 was given a 30 m Buffer using the Site-Based Tool: Determination of buffer zone requirements for wetland ecosystems (Macfarlane *et al.,* 2014) together with the "GDARD Requirements for Biodiversity Assessments: Version 2" (GDARD, 2012) were used to determine the appropriate watercourse buffer zones for the proposed project.

Table 5-1 Ecological characteristics and buffer requirements of the freshwater features within the Valley Silts Expansion Project Area

Aspect	Present Ecological State	Ecological Importance and Sensitivity (EIS)	Buffer Requirement
HGM 1 – Channelled valley bottom	F – Critically Modified	Low/Marginal	30 m

5.1 Risk and Impact Statement

The overall residual risk of the proposed development was calculated to be "Moderate" given that the proposed area for development intersect wetland features.

5.2 Specialist Opinion

A wetland feature was identified within the Project Site itself, which does coincide with the screening tool findings as screening tool findings indicated "Very High" sensitivity for the project footprint. Therefore, considering the assessment findings, no fatal flaws are evident for the proposed project at this stage. It is the opinion of the specialists that the delineated freshwater habitats should be used to inform the final layout of the project, with avoidance of the delineated freshwater habitats being imperative in reducing potential impact on the systems. The project can be favourably considered for authorisation given that the removal of silts from the system will provide an opportunity to rehabilitate the watercourse in the post-activity stages which will be beneficial to the system in the long-term.

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7 Appendix Items

7.1 Appendix A – Methodology

7.1.1 Desktop Dataset Assessment

The desktop assessment was undertaken using Geographic Information System (GIS) to access, view and overlay the latest available related datasets with the project area. The information represented within the datasets was used to develop the relevant digital maps used to identify potentially environmentally sensitive areas. These datasets and their respective dates of publishing are provided below:

- Vegetation Types - Vegetation Map of South Africa, Lesotho and Swaziland (SANBI, 2018 & Mucina and Rutherford 2006);
- Soils and Geology - Land Types Database (Land Type Survey Staff, 1972 - 2006); and
- Topographical Inland Water Areas and River Lines (based on the 1994 1:500 000 topographic maps as per the Chief Directorate of the National Geo-spatial Information).

7.1.1.1 Vegetation Types - Vegetation Map of South Africa, Lesotho and Swaziland

The Vegetation Map of South Africa, Lesotho and Swaziland (SANBI, 2018) is the latest and updated version of the maps published in earlier time such as those presented by Mucina and Rutherford (2006) and those presented in the National Biodiversity Assessment (2011). The map provides spatial details on the representative vegetation of South Africa and is complemented in this report using information from Strelitzia (Mucina & Rutherford, 2006) to provide insight on the landscape features, biogeography, climate, geology, and soils of the project area.

7.1.1.2 Soils and Geology - Land Type Database

The Land Type Survey provides information on the soils, terrain, climate, and geology of areas within South Africa. The data includes the pedological classification of soils and is used in this report to provide insight on the common soil forms associated with aquatic or freshwater systems of a particular area.

7.1.1.3 Topographical River Lines and Inland Water Areas

Topographical Inland Water Areas and River Lines for South Africa are based on the topographic maps dated 1994 as per the National Geo-spatial Information. These datasets are used in this report to provide insight on potential wetland areas and serves to highlight the location and extent of drainage features, dams, wetlands, reservoirs and other relevant inland waterbodies.

7.1.1.4 Ecologically Important Landscape Features

The datasets listed below were incorporated to establish the relation between the project and ecologically important or sensitive freshwater entities. Emphasis was placed around the following spatial datasets:

- South African Inventory of Inland Aquatic Ecosystems (SAIIAE), NBA 2018 Rivers and Wetlands (Van Deventer *et al.,* 2019);
- National Freshwater Priority Areas, Rivers and Wetlands, 2011 (Nel *et al.,* 2011); and
- Strategic Water Source Areas, 2021 (Lötter & Le Maitre, 2021).

7.1.1.4.1 The South African Inventory of Inland Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the 2018 NBA, the SAIIAE is a collection of spatial data layers that represent the extent of river and inland wetland ecosystem types as well as the pressures on these systems. The same two headline indicators, and their associated categorisations, are applied as with the terrestrial ecosystem NBA, namely Ecosystem Threat Status and Ecosystem Protection Level. The Ecosystem Threat Status of river and wetland ecosystem types are based on the extent to which each ecosystem type had been altered from its natural condition.

7.1.1.4.2 National Freshwater Ecosystem Priority Areas, Rivers and Wetlands

In an attempt to better conserve aquatic ecosystems, South Africa has categorised its inland aquatic systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs). The FEPAs are intended to be conservation support tools and it is envisioned that they will guide the effective implementation of measures to achieve the National Environment Management: Biodiversity Act's biodiversity conservation goals (Nel *et al.,* 2011).

7.1.2 Wetland Field Survey

7.1.2.1 Identification and Mapping

The wetland areas were delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 7-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- 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 soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

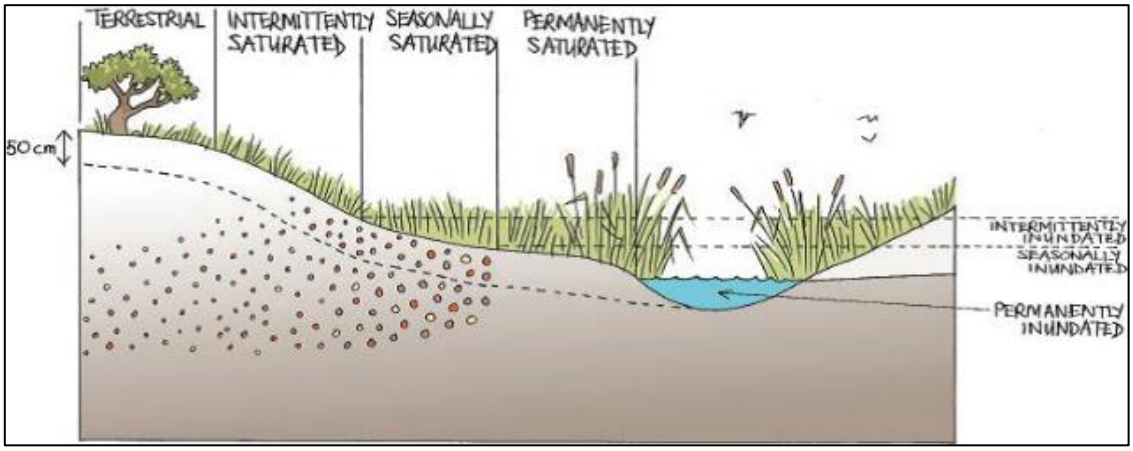


Figure 7-1 Cross section of a wetland, indicating how the soil wetness and vegetation indicators respond to changes in topography (Ollis et al. 2013)

7.1.2.2 Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project area. These delineations are then illustrated by means of maps accompanied by descriptions.

7.1.2.3 Classification and Description

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and then also includes structural features at the lower levels of classification (Ollis *et al.,* 2013).

7.1.3 Risk Screening

A risk screening procedure which considers the general topography of the proposed area in conjunction with the spatial proximity of the natural wetlands to the proposed areas of development was used to determine the 'Risk Status' of the delineated wetlands. Two broad categories are included in the screening process which classify wetlands to be 'At Risk' or 'Not at Risk'.

7.1.4 Wetland Functional and Ecological Assessment

7.1.4.1 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. Eco Services serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al.,* 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 7-1).

Table 7-1 Classes for determining the likely extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low

1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

7.1.4.2 Present Ecological Status

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 7-2.

Table 7-2 The Present Ecological Status categories (Macfarlane et al., 2007)

Impact Category	Description	Impact Score Range	PES
None	Unmodified, natural	0 to 0.9	A
Small	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.	1.0 to 1.9	B
Moderate	Moderately Modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2.0 to 3.9	C
Large	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	D
Serious	Seriously Modified. The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6.0 to 7.9	E
Critical	Critical Modification. The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10	F

7.1.4.3 Ecological Importance and Sensitivity

The importance and sensitivity of water resources is determined in order establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Ecological Importance and Sensitivity (EIS) category as listed in Table 7-3.

Table 7-3 Description of Ecological Importance and Sensitivity categories

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	A
High	2.1 to 3.0	B
Moderate	1.1 to 2.0	C
Low Marginal	< 1.0	D

7.1.4.4 Recommended Ecological Category and Recommended Management Objective

The Recommended Ecological Category (REC) and Recommended Management Objective (RMO) (Table 7-4) was determined based on the results obtained from the PES and EIS of the assessed wetlands, with the objective of recommending how a water resource should be managed. This is achieved by either maintaining or improving the ecological integrity of the wetland in order to ensure continued ecological functionality (DWA, 1999).

Table 7-4 Recommended Ecological Category and Recommended Management Objectives for water resources based on Present Ecological State and Ecological Importance and Sensitivity scores

		Ecological Importance and Sensitivity			
		Very High	***High***	***Moderate***	***Low***
PES	***A (Pristine)***	A Maintain	A Maintain	A Maintain	A Maintain
	B (Natural)	A Improve	A/B Improve	B Maintain	B Maintain
	C (Good)	A Improve	B/C Improve	C Maintain	C Maintain
	D (Fair)	C Improve	C/D Improve	D Maintain	D Maintain
	E/F (Poor)	D Improve	E/F Improve	E/F Maintain	E/F Maintain

7.1.5 Buffer Requirements

The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity. The "GDARD Requirements for Biodiversity Assessments: Version 2" was used to provide a buffer zone for wetlands and rivers located within rural and urban areas (GDARD, 2012).

7.1.6 Site Sensitivty Verification

The baseline aquatic / freshwater sensitivity of the project area was obtained using the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended). The allocated sensitivities for each of the relevant themes are either disputed or validated for the assessed areas based on the specialist assigned Ecological Importance and Sensitivity of the different systems (where applicable), with consideration been given to the presence of observed or likely sensitive fauna and flora.

7.2 Appendix B – Risk and Impact Assessment

The Department of Water and Sanitation (DWS) risk matrix assesses impacts in terms of consequence and likelihood. The significance of the impact is rated according to the classes presented in Table 7-5.

Table 7-5 Significance ratings matrix

Rating	Class	Management Description
1 – 29	(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.
30 – 60	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. Wetlands are excluded.
61 – 100	(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.

7.3 Appendix C – Specialist Declaration of Independence

I, Divan van Rooyen, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Divan van Rooyen

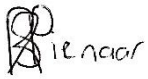
Freshwater Ecologist

The Biodiversity Company

October 2024

I, Rian Pienaar, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Rian Pienaar

Ecologist

The Biodiversity Company

October 2024

7.4 Appendix D – Specialist CVs

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Identity Number: 9312205072085
Date of birth: 20 December 1993



Profile Summary

Working experience throughout Southern Africa

Specialist experience with mining, WWTW's and construction.

Specialist expertise include wetlands resources, aquatic ecology and ecotoxicology.

Areas of Interest

Mining, Seismic Surveys, Renewable Energy, Bulk Services Infrastructure Development & WWTW's.

Key Experience

- Environmental Impact Assessments (EIA)
- Environmental Management Programmes (EMP)
- Wetland delineations and ecological assessments
- Rehabilitation Plans and Monitoring
- Aquatic biomonitoring

Country Experience

South Africa

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- PhD (North-West University of Potchefstroom) – Environmental Science with Aquatic Ecosystem Health
- MSc (North-West University of Potchefstroom) – Environmental Science (Ecological Remediation and Sustainable Management)
- BSc Honours (North-West University of Potchefstroom) – Environmental Science with Ecological Remediation and Sustainable Management
- BSc Environmental sciences
- Can Sci Nat (151272)

Rian Pienaar

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Date of birth: 23 May 1994



Profile Summary

Working experience throughout Southern Africa

Specialist experience with mining, construction and agriculture.

Specialist expertise include wetlands resources, aquatic ecology, parasitology and ecotoxicology.

Areas of Interest

Mining, Oil & Gas, Renewable Energy & Bulk Services Infrastructure Development, Farming, Land Contamination, Sustainability and Conservation.

Key Experience

- Environmental Impact Assessments (EIA)
- Environmental Management Programmes (EMP)
- Wetland delineations and ecological assessments
- Rehabilitation Plans and Monitoring
- Soil classification
- Agriculture potential assessments
- Land contamination assessments

Country Experience

South Africa

Mozambique

Botswana

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- MSc (North-West University of Potchefstroom) – Environmental Science (Cum Lauda)
- BSc Honours (North-West University of Potchefstroom) – Environmental Science with Aquatic ecosystem heath.
- BSc Environmental sciences
- Pri Sci Nat (135544)

APPENDIX D:

Specialist Studies

- ❖ **Appendix D4 – Air Quality**

Air Quality Impact Assessment for the Valley Silts Expansion Project

GONDWANA
ENVIRONMENTAL SOLUTIONS

DOCUMENT CONTROL	
CLIENT:	Kongiwe Environmental (Pty) Ltd
PROJECT NUMBER:	2024-GESI-0892
REPORT TITLE:	Air Quality Impact Assessment for the Valley Silts Expansion Project
REPORT NUMBER:	RN_2404682
REVISION NUMBER:	00
DATE SUBMITTED:	09 December 2024
AUTHORS:	Anja van Basten Martin van Nierop Njabulo Luyanda Mahlobo
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Executive Summary

Gondwana Environmental Solutions International (GESI) was appointed by Kongiwe Environmental (Pty) Ltd (Kongiwe) to undertake an air quality impact assessment (AQIA) of the reclamation of the gold bearing silts from the Russell Stream (otherwise referred to as the Klipspruit), situated north of the Soweto Highway, and mostly between Nasrec Road and Crownwood Road. The objective of the AQIA is to evaluate the impact of the project on the ambient air quality of the surrounding areas.

The most significant pollutant that is generated from the project is particulate matter (PM). Particulate matter with an aerodynamic diameter of less than 2.5 micrometres (µm) ($PM_{2.5}$) and particulate matter with an aerodynamic diameter of less than 10µm (PM_{10}) are criteria pollutants and are therefore subject to legislated control. Ambient concentrations of criteria pollutants are of significance in terms of their potential to impact human health and the broader environment. To estimate ambient concentrations of $PM_{2.5}$ and PM_{10}, air dispersion modelling was undertaken using AERMOD, the United States Environmental Protection Agency's preferred regulatory model for both simple and complex terrain.

Dispersion simulations were undertaken to determine ambient concentrations of $PM_{2.5}$ and PM_{10} resulting from hauling and from materials handling. Approximately 120 000 wet tons of silt will be moved from the valley to a drying area per month and approximately 103 200 tons of material will be moved from the drying area to the City Deep plant through the Crownwood Road exit per month.

Suspension of particulate matter will be caused by haul trucks travelling between the reclamation areas in the valley and the drying areas, and also from the drying areas to the exit at Crownwood Road. Furthermore, silt will be handled several times in the reclamation process. However, the moisture content will keep emissions to a minimum for most of the materials handling. Therefore, only emissions from the final turning of the silt in the drying area and loading onto trucks for transport were included.

Four scenarios were simulated to represent the drying areas closest to sensitive receptors as well as the longest access roads required for haulage. The following conclusions can be made from the modelling results: Exceedances of the PM_{10} and $PM_{2.5}$ 24-hour National Ambient Air Quality Standard (NAAQS) can be expected beyond the Valley Silts Expansion footprint under worst-case meteorological conditions. The areas exposed to exceedances, however, are not expected to extend as far as sensitive receptors. Increases in ambient concentrations of particulate matter mostly affects the closest residents of Riverlea situated to the east of Nasrec Road, and to a lesser extent the Crown industrial area to the north and the Theta industrial area to the south of the project area. Although the maximum modelled concentrations for these receptors are less than 50% of the NAAQS, additional care should be

taken in drying area 1 and drying area 3, as ambient concentrations of particulate matter are already high in the City of Johannesburg metropolitan area, and cumulative emissions from other sources in the area were not included in the modelling.

The air quality impacts from the Valley Silts Expansion project can be mitigated in the following ways:

- In drying area 1, haul roads should be kept as far from the northern boundary as possible to reduce the impact on the Riverlea residential area. Ideally this drying area should be relocated further eastwards.
- In drying area 3, haul roads should be kept as far from the southern boundary as possible to reduce the impact on the Theta industrial area to the south.
- Temporary storage piles for the scalped reeds should be kept to a minimum.
- The drop height for loading haul trucks after the silt has been dried should be kept to a minimum.

Furthermore, dust fallout rates must be monitored. Currently, only the Stockwell monitoring station is close enough to give an indication of the impact of dust emissions from the Valley Silts Expansion area. It is recommended that a monitoring network of six dustfall samplers be installed on the boundary of the project area. If the emissions from the reclamation activities cause the pre-operational phase dustfall levels to rise above the limits set by the National Dust Control Regulations, chemical stabilisation or wet suppression mitigation methods should be used on all unpaved roads.

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List of Abbreviations

ADT	-	Articulated Dump Truck
AQIA	-	Air Quality Impact Assessment
AQMP	-	Air Quality Management Plan
DFFE	-	Department of Forestry, Fisheries and the Environment
Mg	-	Megagram (1 Mg = 10^6 g = 10^3 kg = 1 t)
NAAQS	-	National Ambient Air Quality Standard
NAQI	-	National Air Quality Index
NEMA	-	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM:AQA	-	National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
PM_{10}	-	Particulate matter with an aerodynamic diameter of less than 10 µm
$PM_{2.5}$	-	Particulate matter with an aerodynamic diameter of less than 2.5 µm
SAAQIS	-	South African Air Quality Information System
SAWS	-	South African Weather Service
TSF	-	Tailings Storage Facility
TSP	-	Total Suspended Particulates
µg/m³	-	Micrograms per cubic metre
µm	-	Micrometres
US EPA	-	United States Environmental Protection Agency
VKT	-	Vehicle Kilometre Travelled
WHO	-	World Health Organisation
WRF	-	Weather Research and Forecasting Model

1 FACILITY AND MODELLERS' INFORMATION

1.1 Project Identification and Information

Ergo Mining (Pty) Ltd (Ergo) holds an existing mining right (the Crown Mining Right) in respect of the Valley Silts project area. It obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) to reclaim gold bearing silts from the Russell Stream (otherwise referred to as the Klipspruit), situated north of Nasrec near Booysens Reserve (Kongiwe, 2024). The removal of silts within the already approved area has been ongoing for a period of time and as such, there is now a requirement to prepare the remaining area fully to maintain an efficient reclamation operation, as well as a sustainable feed source to the process plant.

Kongiwe Environmental (Pty) Ltd (Kongiwe) is undertaking the Environmental Impact Assessment for the project and has appointed Gondwana Environmental Solutions International to undertake an air quality impact assessment (AQIA) for the project. Brief CVs of the specialists working on the AQIA and their declarations of independence are included in Appendix C and Appendix D.

1.2 Project Background

1.2.1 Objectives of the Assessment

The objective of the AQIA is to evaluate the impact on ambient air quality caused by the mechanical removal of silt from the Russell Stream and associated haulage, drying and turning processes in preparation for gold reclamation.

Particulate matter (PM) is the most significant pollutant that is generated from the mechanical removal of silts, hauling of material, turning of the silts in the drying process (until 30% to 40% moisture content) , and loading thematarial. Smaller particles (particles with an aerodynamic diameter smaller than 10µm (PM_{10}) and smaller than 2.5µm ($PM_{2.5}$)) are subsets of the total suspended particulates (TSP). PM_{10} and $PM_{2.5}$ are a health concern because these fine particles can be breathed into the lungs. The larger particles of TSP, on the other hand, are primarily a nuisance factor. $PM_{2.5}$ and PM_{10} are criteria pollutants. Maximum permissible ambient air quality concentrations of these pollutants have been prescribed in the National Ambient Air Quality Standards (NAAQS) (Government Notice No. 1210, 2009; Government Notice No. 486, 2012).

Dispersion simulations were used to determine ambient air concentrations of PM_{10} and $PM_{2.5}$ resulting from hauling in the Valley Silts Expansion project area and materials handling

operations at the drying sites. The predicted ambient air concentrations were then evaluated against the relevant NAAQS.

1.2.2 Overview of the Reclamation Process

It has been found that gold bearing silts in the Russell Stream valley originated from surface runoff causing erosion of the surrounding slimes dams and sand dumps from the surrounding mining areas (Kongiwe, 2019). The silt will be mechanically removed from project area at a maximum removal rate of 120 000 wet tons per month. 30-ton Articulated Dump Trucks (ADT) will be used to transport and stockpile the silts from the Russell Stream (Kongiwe, 2024). The silts will be left to dry in stockpiles in designated drying areas. Silts will have up to a 40% moisture content when hauled and are not expected to be fully dried out (Kongiwe, 2024). From there, tipper trucks will be used to load and transport the dried tailings/silts to the City Deep plant for pre-processing. The trucks transporting the material will follow Crownwood Road northwards until it reaches Main Reef Road. From there they will turn eastwards on Main Reef Road, and then join the M2 East. The trucks will then follow the M2 until they reach Heidelberg Road which is followed to the City Deep Plant where the silt is offloaded (Kongiwe, 2024).

1.3 Project Location and Layout

1.3.1 Area Maps

The Valley Silts Expansion project area is situated in the City of Johannesburg Metropolitan Municipality. It lies approximately 3 km south-west of the Johannesburg city centre (Figure 1). The project area is surrounded by a mixture of residential suburbs and industrial areas (Figure 2). The closest residential suburb is Riverlea to the west and north-west of the project area. The Langlaagte, Theta and Booysens Reserve industrial areas are situated to the south, and the Crown industrial area is located to the north-east of the project area. The closest sensitive receptors are the Crown Mines Primary School, the Wilhelmina Hoskins Primary School and the Riverlea Primary and High Schools which all lie more than 1.5 km from the project area. There are many schools, clinics and hospitals within a 10 km radius (Figure 3).

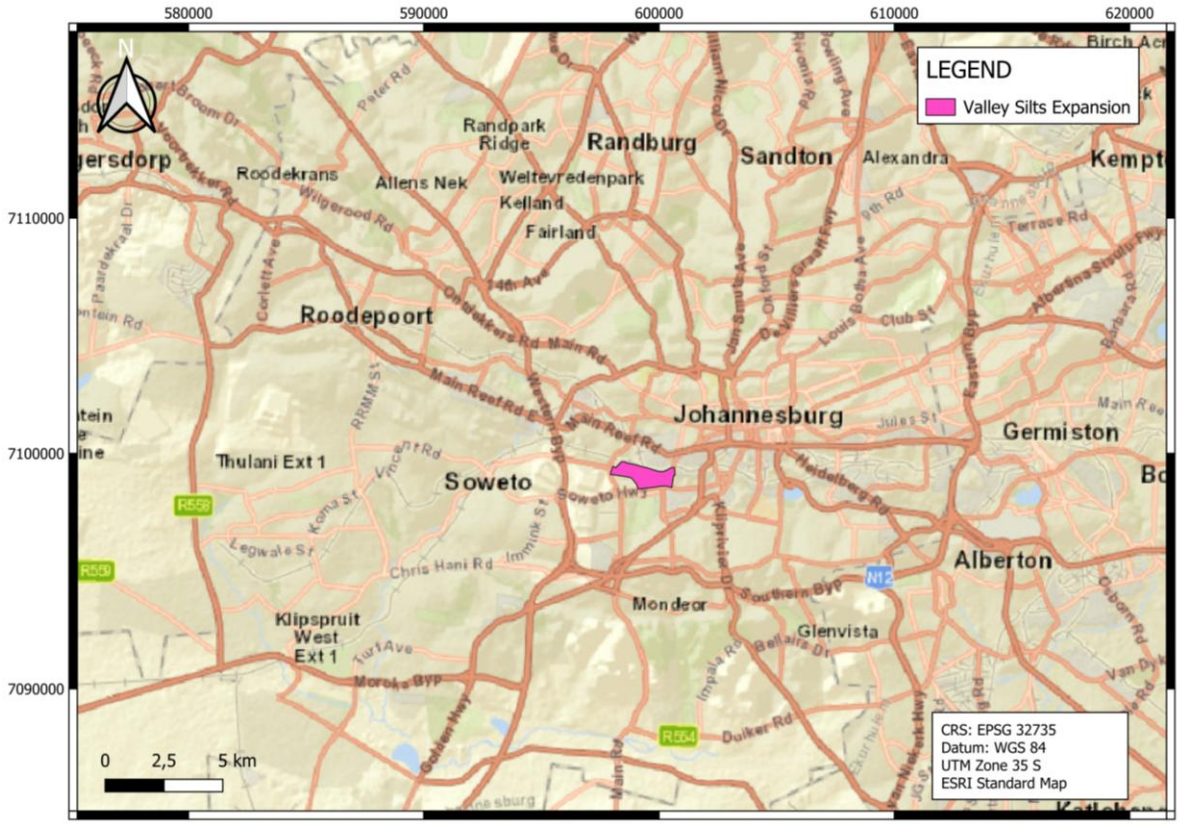


Figure 1: Location of the Valley Silts Expansion project area.

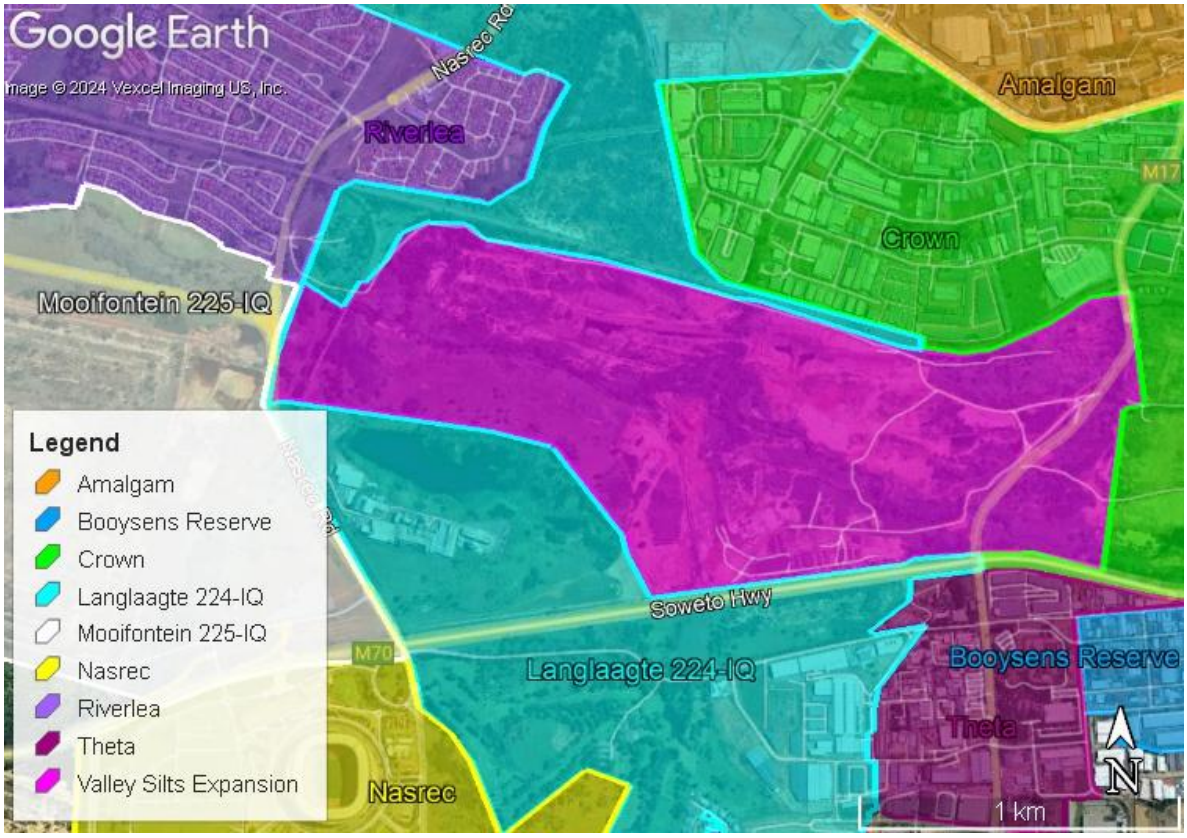


Figure 2: Location of Valley Silts Expansion in relation to surrounding residential suburbs.

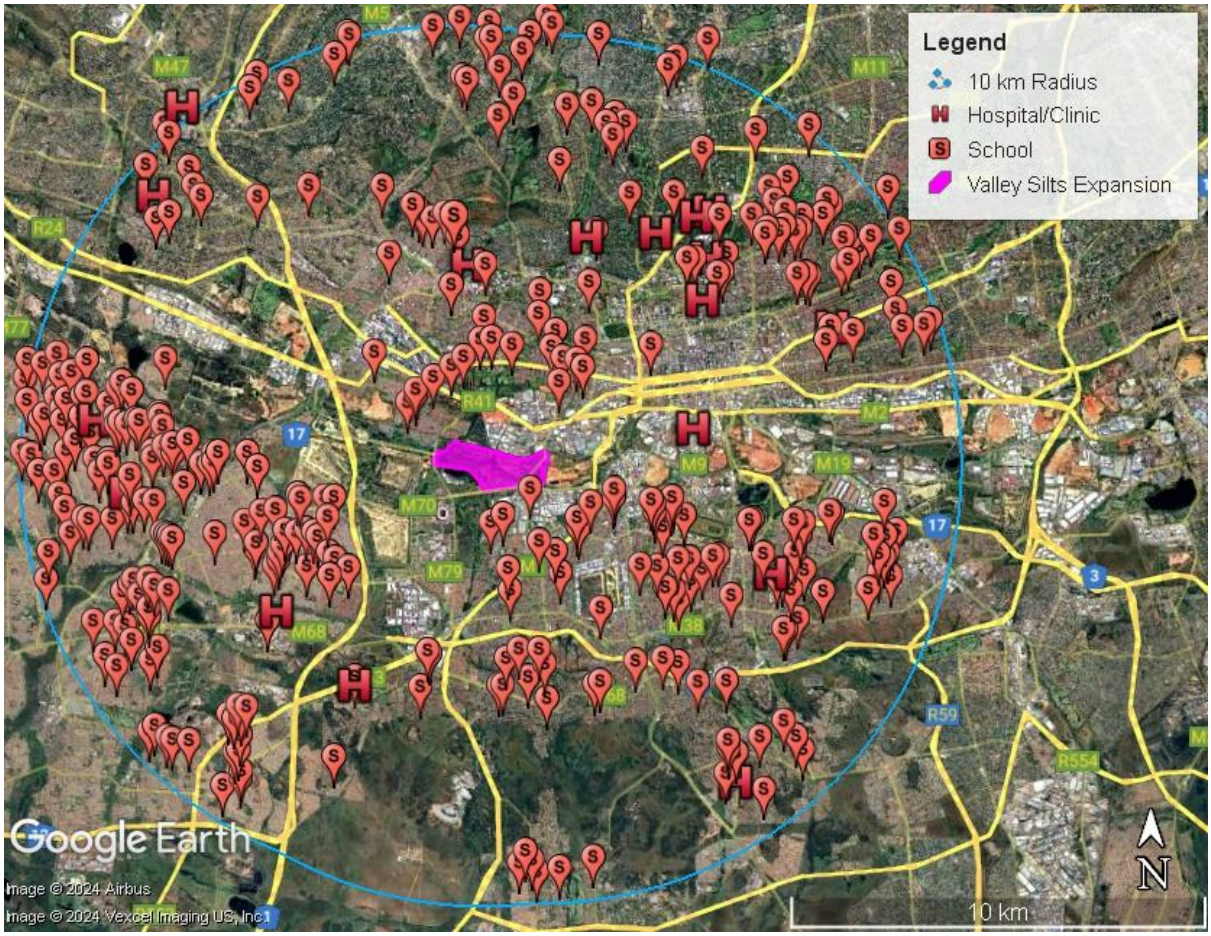


Figure 3: Sensitive receptors within a radius of 10 km from the Valley Silts Expansion project area.

Other large sources of particulate matter in the area include two TSFs which lie to the west of the project area, one TSF to the south-west and another to the south-east. There are several industrial areas that lie within 5 km that may contribute to ambient concentrations of particulate matter. The Robinson Landfill Site is also a potential source of particulate emissions in the area (Figure 4). There are many Ergo dust fallout monitoring stations and one air quality monitoring station within 5 km of the Valley Silts project area (Figure 4).

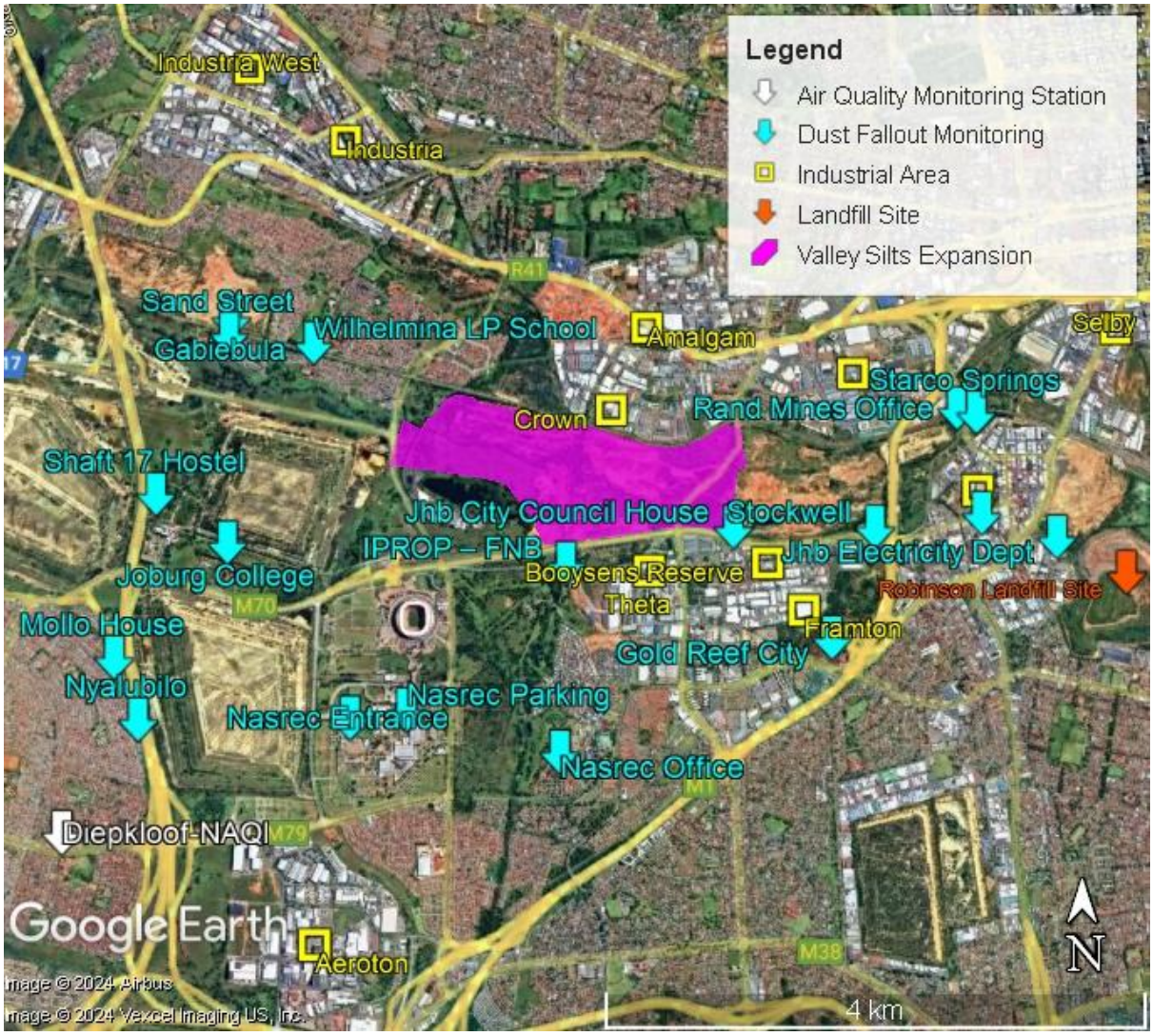


Figure 4: Industrial areas and monitoring stations in the vicinity of the Valley Silts Expansion project area

The topography immediately surrounding the site is gently undulating with no prominent topographic features in the project area. There are ridges lying parallel to, and approximately 7 km to the north and to the south of, the project area (Figure 5).

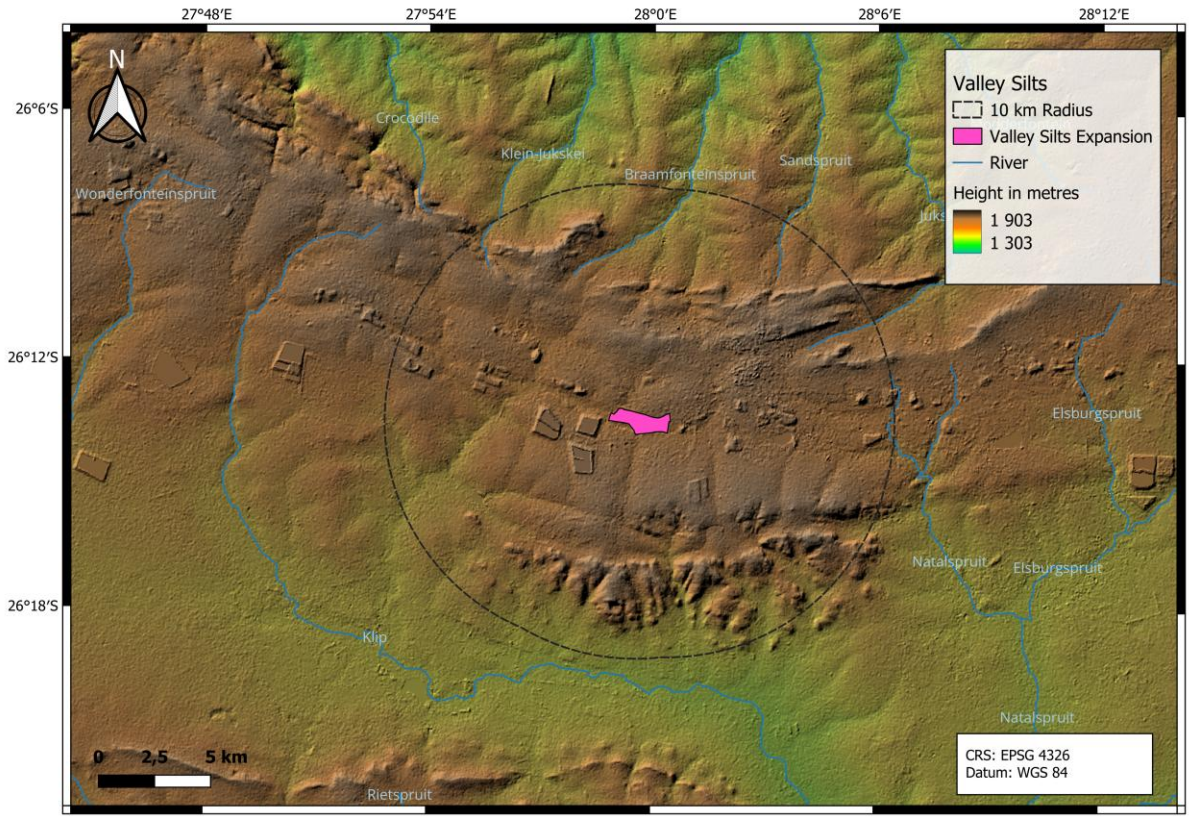


Figure 5: Topography surrounding the Valley Silts Expansion project area.

1.3.2 Project Layout

The expansion project area stretches from Nasrec Road in the west, along the Russell Stream (otherwise referred to as the Klipspruit) valley to Crownwood Road in the east, with one block being located beyond and to the east of Crownwood Road. The project area is surrounded by industrial, commercial, residential and undeveloped land. The closest residential area to the project is Riverlea to the north-west of the project area.

The layout of the roads used for the modelling is shown in Figure 6 and Figure 7 with access to the valley and drying areas from Crownwood Road. The areas where drying will take place are also illustrated. Three drying areas were simulated in the modelling. The drying area labelled 1 was chosen because of its proximity to the Riverlea residential area. The drying area labelled 2 was chosen because it represents the longest distance from the exit onto Crownwood Road, and hence will result in the greatest hauling emissions. The drying area labelled 3 was chosen because of its proximity to the Theta industrial area to the south.

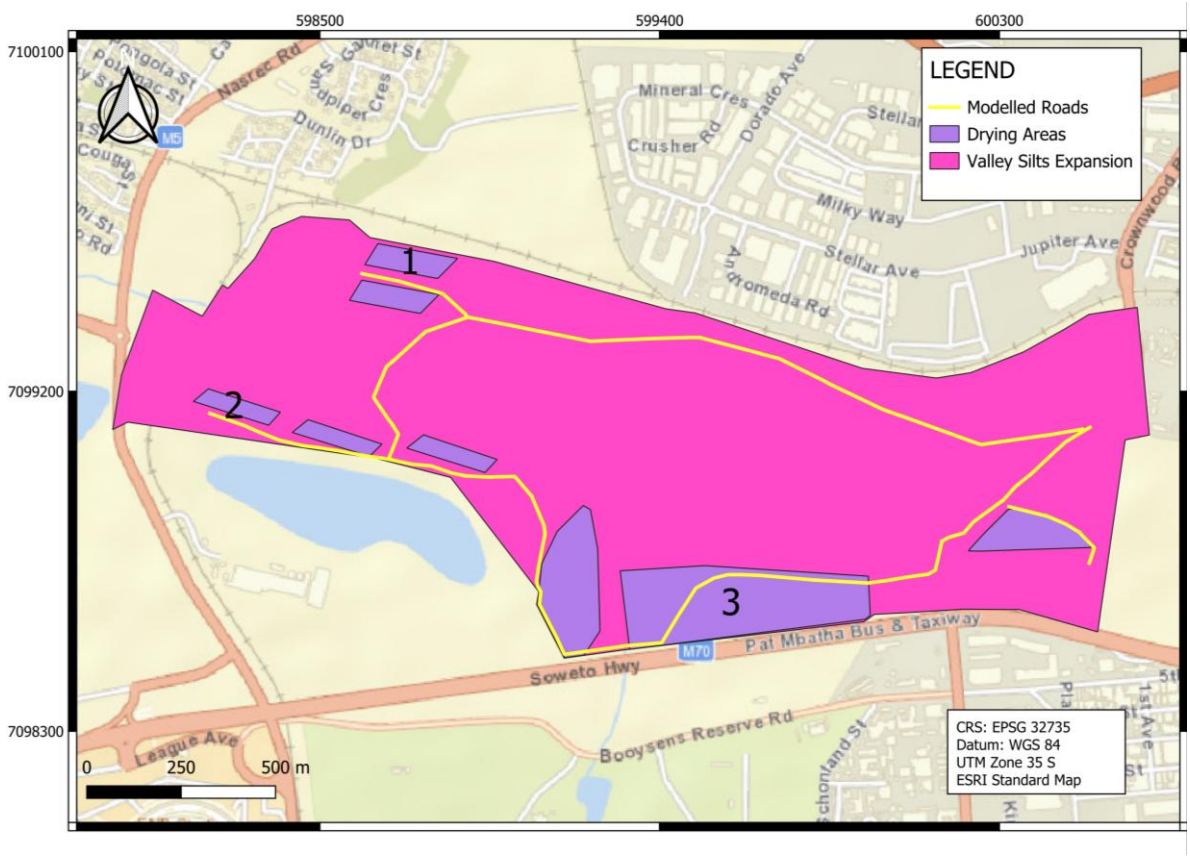


Figure 6: Layout of the Valley Silts Expansion project area with drying areas and the modelled access roads leading from Crownwood Road.

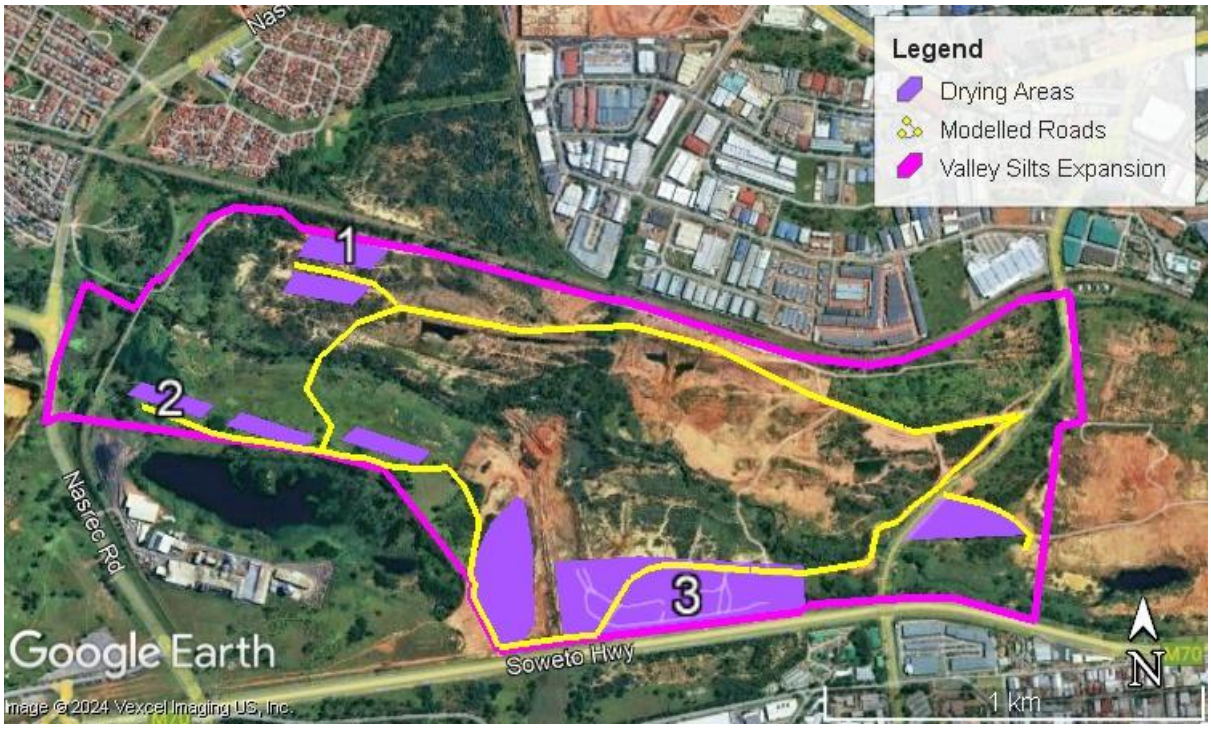


Figure 7: Aerial view of the modelled drying areas and modelled roads.

1.4 Geophysical Data

Urban or rural classification for the modelling domain is important because dispersion rates differ between urban and rural areas. The combination of greater surface roughness (more buildings / structures to generate turbulent mixing) and the greater amount of heat released from the surface in an urban area (generates buoyancy-induced mixing) produces greater rates of dispersion.

Table 1: Identification and classification of land-use types (Auer Jr., 1978).

Urban Land Use			
Type	**Use and Structures**	**Vegetation**	**Percentage Vegetation Cover**
I1	Heavy Industrial Major chemical, steel and fabrication industries	Grass and tree growth extremely rare.	<5%
I2	Light-moderate industrial Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally, 1-3 story buildings, flat roofs.	Very limited grass, trees almost absent.	<5%
C1	Commercial Office and apartment buildings, hotels; >10 story heights, flat roofs.	Limited grass and trees.	<15%
R2	Compact Residential	Limited lawn sizes and shade trees.	<30%
R3	Compact Residential	Limited lawn sizes, old established shade trees.	<35%
Rural Land Use			
Type	**Use and Structures**	**Vegetation**	**Percentage Vegetation Cover**
R1	Common Residential Single family dwellings.	Abundant grass lawns and light-moderately wooded.	>70%
R4	Estate Residences Expansive family dwellings on multi-acre tracts.	Abundant grass lawns and lightly wooded.	>80%
A1	Metropolitan Natural Major parks, golf courses, cemeteries, campuses.	Nearly total grass and lightly wooded.	>95%
A2	Agricultural Rural	Crops	>95%
A3	Undeveloped Uncultivated wasteland	Mostly wild grasses and weeds, lightly wooded.	>90%
A4	Undeveloped Rural	Heavily wooded.	>95%
A5	Water surfaces		

The South African modelling Code of Practice (Government Notice No. R533, 2014) recommends the Auer method (Auer Jr., 1978) as the preferred method for determining the urban / rural classification. The Auer land-use categories are presented in Table 1.

The modelling Code of Practice recommends that if more than 50% of the area within a 3-km radius of the facility is classified as rural, then rural dispersion coefficients are to be used in the dispersion modelling analysis. Conversely, if more than 50% of the area is urban, urban dispersion coefficients are used. This method is in line with US EPA modelling guidelines (US EPA, 2005).

Approximately 44% of the area surrounding the Valley Silts Expansion project, is open ground. This equates to category A3 in the Auer classification, which is a rural land use type. Approximately 18% is light to moderate industrial, which equates to the category I2 urban land use type in the Auer classification. The remainder of the land use is mostly residential with single-family dwellings which equates to category R1 in the Auer classification, which is a rural land use type. Although some of the residential areas have gardens that have largely been filled with informal structures, the designation of rural is considered appropriate for the Valley Silts Expansion modelling application.

1.5 Elevation Data

AERMOD requires elevation data that conveys the features of the surrounding terrain to calculate its effect on the dispersion of pollutants. Shuttle Radar Topography Mission (SRTM) 1 arc second Digital Elevation Terrain Data - Global was downloaded from the U.S. Geological Survey website for this project. The data is in GeoTIFF format with 1 arc second (approximately 30-meter) postings and 1° x 1° tiles. The NASA SRTM obtained elevation data on a near-global scale using radar interferometry. The NASA Version 3.0 SRTM Global 1 arc second product is void-filled using elevation data from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model 2 (GDEM2), the USGS Global Multi-resolution Terrain Elevation Data (GMTED) 2010, and the USGS National Elevation Dataset (NED).

2 EMISSIONS CHARACTERISATION

The maximum concentrations of PM_{10} and $PM_{2.5}$, originating from any project, that can be expected to be found suspended in the air surrounding the site, are calculated by means of the following series of steps:

- First, an emissions inventory is compiled. This identifies all the potential sources of air pollutants**.**
- Secondly, a set of predictive emission factors is established to quantify the emissions from each source. For this purpose, the comprehensive set of emission factors and emission factor equations published by the United States Environmental Protection Agency (US EPA) in its AP-42 document *Compilation of Air Pollution Emission Factors* (US EPA, 1995) may be used. These emission factors are usually expressed as the weight of pollutant emitted per unit area, weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate matter emitted per square metre of road constructed). In most cases, these factors are averages of all available data of acceptable quality (from source test data, material balance studies, and engineering estimates), and are generally assumed to be representative of long-term averages for all facilities in the source category.
- Thirdly, emission rates are calculated. While the emission factor specifies the quantity of pollutant that can be expected to be emitted from a particular activity, the emission rate is calculated by multiplying the emission factor by how much of that activity is executed at the source in question. The emission rate gives the number of grams of pollutant emitted from the activity in one second. The emission rates from all the sources are added together to calculate the total emission rate from the facility.
  The general equation for emissions estimation is:

$$E = A * EF * \left(1 - \frac{ER}{100}\right)$$

  Where:
  E = emissions
  A = activity rate
  EF = emission factor
  ER = overall emission reduction efficiency (%)
- Finally, the dispersion of the emissions is simulated using AERMOD, to predict maximum ground level concentrations of particulate pollutants resulting from the activities and to determine the zones of influence around the emission sources.

2.1 Emissions Inventory

The activities associated with emissions of $PM_{2.5}$ and PM_{10} in the project are outlined below.

a) Construction activities

Construction of buildings and roads is a source of dust emissions that may have a substantial temporary impact on local air quality. However, it is expected that there will be minimal construction activities associated with the Valley Silts Expansion project as facilities from the first phase will be utilised for the expansion. New facilities for the expansion project will only include culverts and haul and site roads (Kongiwe, 2024). As far as possible, existing access roads will be utilised, and where this is not possible, these will be constructed as a two-by-two roadway, operating in both directions (Kongiwe, 2024). Ground clearing and earth moving will also be required for the new reclamation blocks, new drying stockpiles and paddocks.

b) Vehicle emissions

Vehicle-entrained dust emissions caused by vehicles moving across unpaved roads represent the largest source of emissions for the Valley Silts Expansion project. When a vehicle travels on an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. The main source of emissions is from the suspension of this loose material on the road surface as particles are lifted and dropped from the rolling wheels and kept in suspension by the turbulent air caused by the passing vehicle. This is a concern for any areas which lie close to project haul routes between the reclamation areas in the valley and the drying areas and also between the drying areas and the exit at Crownwood Road.

c) Emissions from materials handling operations

Silt will be handled several times in the reclamation process. There will be mechanical scalping in the valley to remove reeds. The silt will then be loaded onto 30-ton ADTs. It will be unloaded in the drying area where it will be turned for drying purposes. Stones and coarse material will be separated out. Once dry, the silt will be loaded on-road tipper trucks for hauling to the City Deep plant. However, the moisture content will keep emissions to a minimum for most of these stages. Significant materials handling emissions are, therefore, only expected from the final turning of the silt in the drying area and loading onto trucks for transport.

2.2 Operating Scenarios for Emission Units

Emission units were only prepared for the reclamation phase of this project. Too many assumptions would have to be made to evaluate emissions from the end of the project rehabilitation phase.

2.3 Source and Emission Parameters

Both emission factors and empirically derived predictive emission factor equations were used for this project. Emission factors require activity rates to quantify the pollutant released into the atmosphere. Predictive emission factor equations require inputs of parameters that are specific to the site being evaluated as well as activity rates to quantify emissions. The parameters used for the modelling are documented in Table 2. The emission factor equations and the background to the selection of some of the site parameters are outlined below.

Table 2: Parameters used for the modelling.

Site parameters	Units	Total
Assumed silt content of unpaved roads	%	40
Mass fraction of $PM_{2.5}$ used for modelling PM_{10}	%	29
Average particle density for modelling	g/cm^3	2.75
30-ton ADT empty weight	kg	16 200
30-ton ADT total rated load	kg	46 200
30-ton ADT transport height	m	2.30
30-ton ADT maximum travel speed	km/h	55
Maximum wet silt moved per month	t	120 000
Assumed dry silt moved per month	t	103 200
Working days in a year	days	365
Single shift, daylight hours only	hrs	8
Haul road width	m	10
Modelled haul road width of plume	m	16.00
Modelled haul road top of plume height	m	3.91
Modelled haul road source release height	m	1.96
Initial σ_y parameter	m	7.44
Initial σ_z parameter	m	1.82

Particle density

The composition of TSFs of the Witwatersrand include quartz (70%-80%), mica (10%), chlorite and chloritoid (9%-18%) and pyrite (1%-2%) (Kongiwe Environmental (Pty) Ltd, 2018). This is supported in part by the findings of De Jesus et al. (1987) who reported quartz contents of 80-90%, pyrophyllite contents of max 16% and sericite contents of max 2% in tailings material. The average particle densities of quartz, mica, chloritoid pyrophyllite and sericite powder are

2.65, 2.80, 3.54, 2.84, and 16.00 g/cm^3 respectively. The weighted average particle density for tailings material will, therefore, be between 2.77 and 2.9 g/cm^3. The average particle density of soil is 2.63 g/cm^3. The material being excavated as well as the on-site roads are expected to be mixture of TSF material and soil, therefore an average density of the two together of 2.75 g/cm^3 was used for the modelling of emissions from the on-site roads and from materials handling operations.

2.4 Emissions Rates

2.4.1 Emission Rates from Hauling Silt on Unpaved Roads

Although particulate emissions from roads would include direct emissions in the form of exhaust, brake wear and tyre wear emissions, the main source of emissions is from the resuspension of loose material on the road surface. When a vehicle travels on an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed (US EPA, 1995).

In terms of the South African modelling code (Government Notice No. R533, 2014), traffic carrying materials processed at a facility must be modelled as part of the facility. The roads must include the portion of the roads that are not publicly accessible. The exact routes for hauling of the silt were not known, therefore, these had to be assumed for the modelling (Figure 6 and Figure 7).

Fugitive dust emissions from unpaved roads depend on traffic volumes, average vehicle speed, mean vehicle weight, road surface silt content, and road surface moisture. For vehicles traveling on unpaved surfaces at industrial sites, emissions can be estimated from the following equation (US EPA, 1995 c13s2.2):

$$E = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}$$

Where: k, a and b are empirical constants

k = 0.15 for $PM_{2.5}$, 1.5 for PM_{10}, 4.9 for TSP

a = 0.9 for $PM_{2.5}$ and for PM_{10}, 0.7 for TSP

b = 0.45

E = size specific emission factor (lb/VMT)

s = surface material silt content (%)

W = mean vehicle weight (tons)

According to the Udden–Wentworth scale (Wentworth, 1922), silt particles range between 3.9 and 62.5 µm, that is, larger than clay but smaller than sand particles. ISO 14688 grades silt

between 2 and 63 µm. The silt content of TSFs in Gauteng is approximately 77% and of soil 27% (Appendix E and Appendix F). The Valley Silts Expansion area should have a silt content somewhere between the two. An average silt content of 40% was assumed for the emission rate calculations from all haul roads in the project area.

The weight of the haul trucks was taken as the operational weight of a 30-ton ADT (Table 2).

Haul roads were modelled as adjacent volume sources as recommended by the US EPA haul road workgroup for all haul roads, except for cases where ambient air receptors are within the volume's exclusion zone i.e. ((2.15 x Sigma Y) + 1 meter) from the center of the volume (US EPA, 2012). The following configuration was used, as recommended by the workgroup:

- Top of Plume Height – 1.7 x Vehicle Height.
- Volume Source Release Height – 0.5 x Top of Plume Height.
- Width of Plume – Vehicle Width + 6m for single lane roadways / Road Width + 6m for two lane roadways.
- Initial Sigma Z – Top of Plume / 2.15 (AERMOD User's Guide, Table 3-1 for use when modeling multiple volumes).
- Initial Sigma Y – Width of Plume / 2.15 (AERMOD User's Guide, Table 3-1).
- Emissions input as g/s.

The road emissions were modelled as a series of volume sources at 200 m intervals. The parameters used are given in Table 2. Vehicle-entrained dust emissions from the unpaved haul roads within the proposed Valley Silts project area represent a significant source of fugitive dust for the project (Table 3).

Table 3: Emission rates from truck hauling of silt.

Activity	Unit	PM_{10}	$PM_{2.5}$
Annual emission rate from resuspended road surface material.	t $year^{-1}$	327[a]	32.74[a]

Note:

a. Based on the US EPA emission factor equation for vehicles travelling on unpaved roads at industrial sites (US EPA, 1995).

2.4.2 Emission Rates from Materials Handling

Silt will be handled several times in the reclamation process. However, the moisture content will keep emissions to a minimum for most of these stages. Materials handling emissions were, therefore, only calculated from the final turning of the silt in the drying area and loading onto 30-ton articulated dump trucks for hauling to the City Deep plant. The US EPA emission factor equation for aggregate handling and storage piles was used (US EPA, 2006 c13s0204).

Either adding aggregate material to a storage pile or removing it usually involves dropping the material onto a receiving surface. Truck dumping on the pile or loading out from the pile to a truck with a front-end loader are examples of batch drop operations. Turning of the silt for drying was assumed to also be a batch drop operation with similar emissions. Materials handling, emissions were estimated using the following equation (US EPA, 2006 c13s0204):

$$E = k(0.0016)\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}(kg/megagram[Mg])$$

Where:
E = emission factor
K = particle size multiplier (dimensionless)
U = mean wind speed (m/s)
M = material moisture content (%)

The particle size multiplier depends on the aerodynamic particle size. For PM_{10} and $Pm_{2.5}$, the multipliers are 0.053 and 0.35, respectively. The lowest moisture content of the range of source conditions supplied by the US EPA for this equation, of 0.25%, was used. The highest wind speed of 5 m/s predicted by the WRF model was used. This produced an emission factor for PM_{10} of 0.03 kg per Megagram of materials handled.

The US EPA (US EPA, 1995) generalized particle size distribution recommends that, for emissions generated through either the movement of the material or the interaction of the material with mechanical devices, 15% of the PM_{10} is in the size range of $PM_{2.5}$. This yields a $PM_{2.5}$ emission factor of 0.005 kg per Megagram of materials handled. Using the $PM_{2.5}$ particle size multiplier in the above equation, yields the same emission factor.

Table 4: Emission rates from materials handling.

Activity	Unit	PM_{10}	$PM_{2.5}$
Annual emission rate from silt handling and transfer in the drying area.	t year^{-1}	74.30[a]	11.15[a]

Note:

a. Based on the US EPA emission factor for aggregate handling and storage piles (US EPA, 2006 c13s0204).

3 METEOROLOGICAL DATA

Horizontal dispersion of atmospheric pollutants is a function of the prevailing wind characteristics at any site, while the vertical dispersion of pollution is largely a function of the stability of the atmosphere and the depth of the surface mixing layer. By day, vertical mixing due to incoming solar radiation is most efficient at dispersing pollutants. At night a surface temperature inversion may develop which decreases the dispersion potential. Pollutants tend to accumulate near the point of release under these conditions, particularly if they are released close to ground level.

Similarly, the dispersion potential is generally poorer on winter nights than on summer nights. In summer, solar radiation and unstable atmospheric conditions result in mixing of the atmosphere and rapid dispersion of pollutants. Summer rainfall also aids in removing pollutants through wet deposition. In contrast, winter is characterised by atmospheric stability caused by the persistent high-pressure system over South Africa. This dominant high-pressure system results in subsidence, causing clear skies and a pronounced temperature inversion over the central plateau region. This inversion layer traps the pollutants in the lower atmosphere, which results in reduced dispersion and a poorer ambient air quality. Preston-Whyte and Tyson (Preston-Whyte & Tyson, 1988) describe the atmospheric conditions in the winter months as highly unfavourable for the dispersion of atmospheric pollutants.

Mechanical turbulence is another contributor to dispersion of pollutants. Mechanical turbulence is a function of a combination of the wind speed and surface roughness. Thus, higher wind speeds facilitate the vertical dilution of pollutants as well as the distance of downwind transport.

3.1 Surface Data

The preferred data for modelling would be data collected on site. This, however, is very seldom feasible given that three years of both surface and upper air meteorological data is required. To substitute for, or supplement, measured data, the modelling Code of Practice (Government Notice No. R533, 2014) recommends the use of data from numerical models. For this project Weather Research and Forecasting Model (WRF) meteorological data was used in line with the Code of Practice. The WRF is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications which reflects recent advances in physics, numerics, and data assimilation contributed by developers from the expansive research community. AERMET (version 23132) was used to pre-process the data for input into AERMOD (version 23132).

AERMOD contains routines that allow the model to handle missing meteorological data in the processing of short-term averages. The model treats missing meteorological data and calms

by setting the concentration values to zero for that hour. It calculates the short-term averages according to EPA's calms policy, as set forth in the Guideline. Calms and missing values are tracked separately for the purpose of flagging the short-term averages. An average that includes a calm hour is flagged with a 'c', an average that includes a missing hour is flagged with an 'm', and an average that includes both calm and missing hours is flagged with a 'b'. If the number of hours of missing meteorological data exceeds 10 percent of the total number of hours for a given model run, a cautionary message is written to the main output file (US EPA, 2016).

Wind roses graphically present wind conditions over a period of time at a specific location. Wind roses for the project are presented in Figure 8 to Figure 10 below. In the wind roses, the length of each spoke represents the percentage of time that the wind blew from that direction during the period. The percentage scale is presented on the concentric grey lines (the circle scale increment is indicated on each of the wind roses). Each spoke is divided by colour into wind speed ranges.

The predominant winds at the Valley Silts Expansion project area (as given by the WRF data for the period from 2021 to 2023) are from the north-north-westerly direction for approximately 12% of the time, followed by the north-westerly and south-south-westerly directions (Figure 8). The highest number of winds with speeds greater than 4 m/s are expected from the north-westerly direction. The average hourly wind speed predicted by the WRF model is approximately 1.5 m/s. Calm conditions (wind speeds below 0.5 m/s) are predicted for approximately 0.9 % of the time.

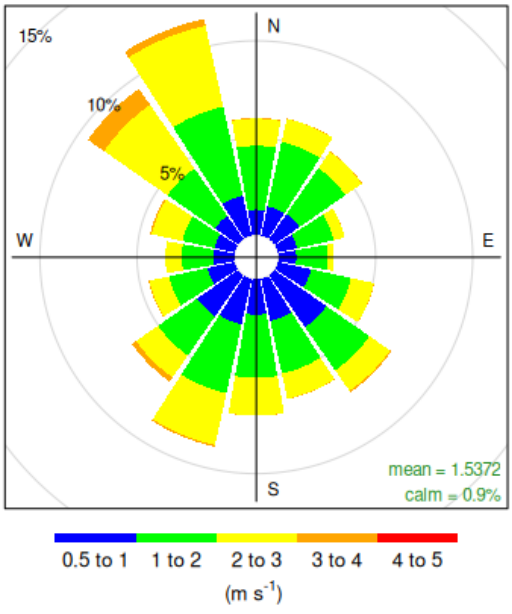


Figure 8: Wind rose of the average winds produced by the WRF model for the Valley Silts Expansion project area for the years 2021-2023.

There is a clear diurnal variation in the predominant wind direction. During the day, most winds originate from a north-westerly direction, while at night most winds blow from the north-north-westerly direction. Most frequent winds with speeds above 4 m/s are expected from a north-westerly direction during the day. There are very few winds expected with speeds above 3 m/s at night. On average, calm conditions are expected for approximately 1 % of the time during the day, and average wind speeds are approximately 1.8 m/s. During the night, calm conditions are expected for approximately 0.8 % of the time, and average wind speeds are approximately 1.3 m/s (Figure 9).

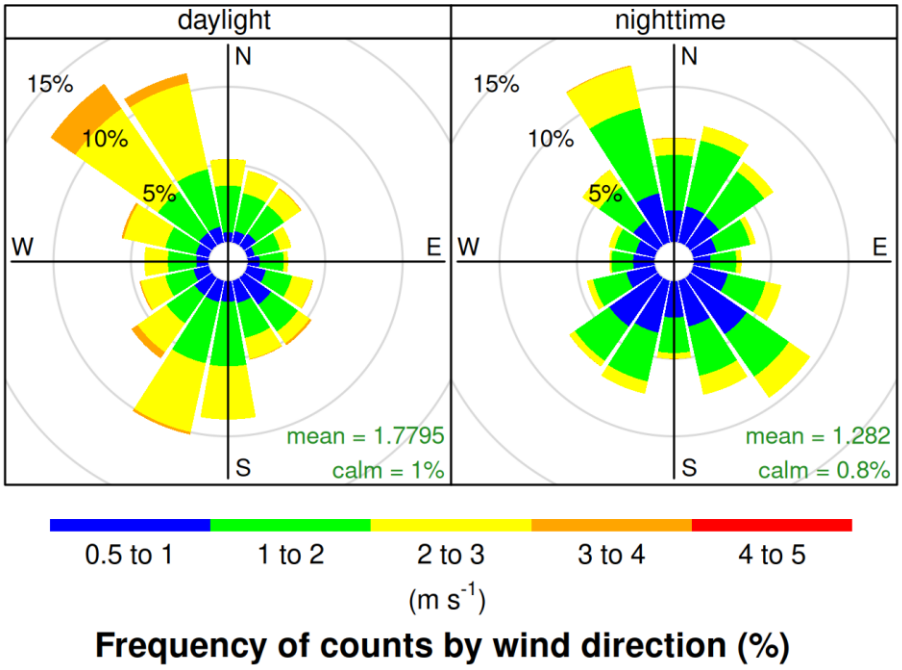


Figure 9: Diurnal wind roses predicted by the WRF model for the Valley Silts Expansion Project area for the years 2021-2023.

The seasonal variations in wind direction for the Valley Silts Expansion project area are illustrated in Figure 10. The predominant wind direction in spring and summer is from the north-north-westerly direction. During autumn, the predominant wind direction is from the south-south-west, while in winter, it is from the north-westerly direction. Most winds with speeds over 3 m/s tend to be from the north-west in all seasons. Average wind speeds are highest in spring, and most of the calm conditions are experienced in autumn.

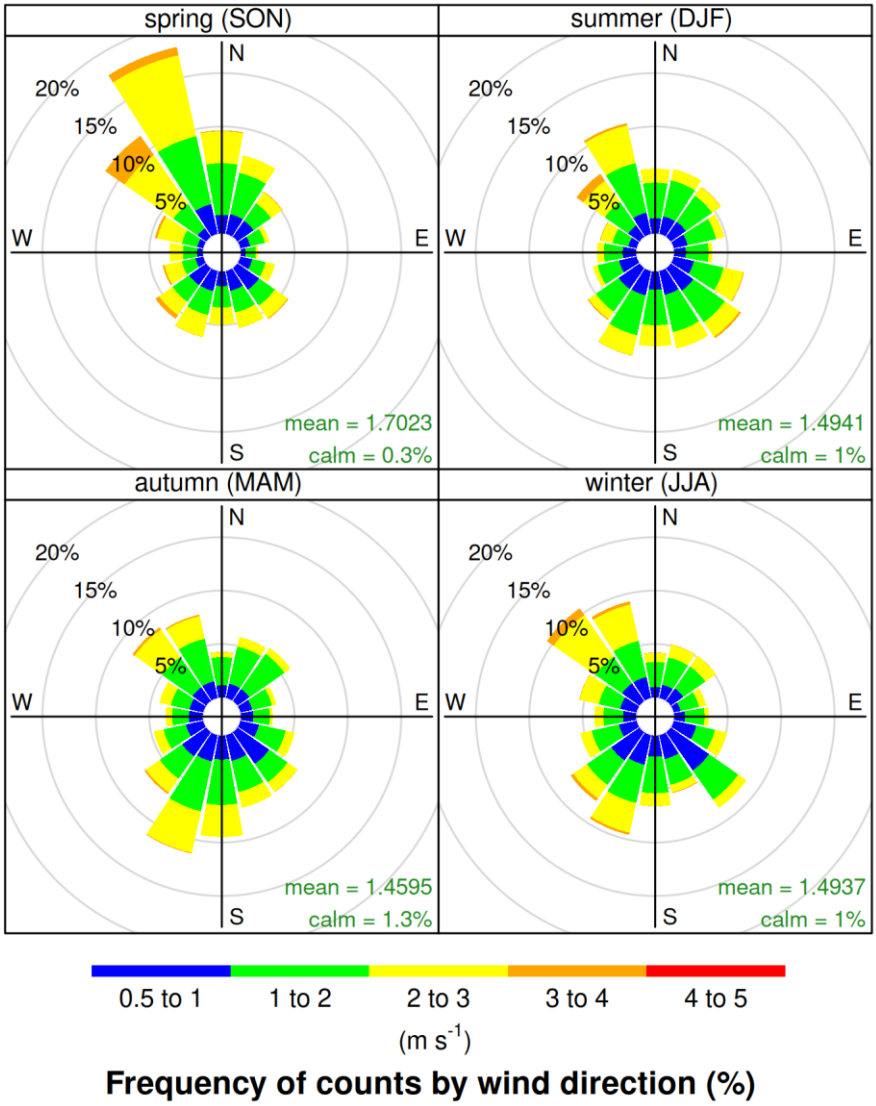


Figure 10: Seasonal wind roses of winds predicted by the WRF model for the Valley Silts Expansion project area for the years 2021-2023.

3.2 Upper Air Data

The preferred data for modelling would be data collected on site. This, however, is very seldom feasible given that three years of both surface and upper air meteorological data is required. To substitute for, or supplement, measured data, the Modelling Code of Practice recommends the use of data from numerical models. For this project Weather Research and Forecasting Model (WRF) meteorological data was used in line with the Modelling Code of Practice (Government Notice No. R533, 2014).

4 AMBIENT AIR QUALITY

4.1 Air Quality Legislation and Standards

Air quality in South Africa is governed under the National Environmental Management: Air Quality Act, 2004 (NEM:AQA) (Act No. 39, 2004). The main objective of the Act is to ensure the protection of the environment and human health through reasonable measures of air pollution control within the sustainable (economic, social and ecological) development framework. The NEM:AQA shifted some of the approach of air quality management from source-based control to receptor-based control. With receptor-based control the ambient air quality of receptors is the factor which is used to determine the compliance of the emission source. The measured, or expected, ambient air quality of receptors is compared to National Standards. These standards prescribe the maximum ambient concentrations of pollutants permitted (and the number of exceedances allowed) during a specified time period in a defined area. If the air quality standards are exceeded, the ambient air quality is poor and the potential for health effects is greatest. The ambient air quality standards, therefore, provide a basis for protecting public health from adverse effects of air pollution and for eliminating, or reducing to a minimum, those contaminants of air that are known, or likely, to be hazardous to human health and wellbeing (WHO, 2000). The South African National Ambient Air Quality Standards for PM_{10} (particulate matter with an aerodynamic diameter of less than 10 µm) were published in 2009 (Government Notice No. 1210, 2009) in terms of Section 9(1) of the NEM:AQA (Table 5). The National Ambient Air Quality Standards for $PM_{2.5}$ (particulate matter with an aerodynamic diameter of less than 2.5 µm) were published in 2012 (Government Notice No. 486, 2012) (Table 5). In terms of the NEM:AQA, local government is responsible for air quality management, control and enforcement. This includes the control of all major sources, including mining, industrial, vehicle and domestic sources, in terms of ambient air concentrations. District and Metropolitan Municipalities are the licensing authorities. Provincial government is primarily responsible for ambient monitoring and ensuring municipalities fulfil their legal obligations and national government is primarily the policy maker and co-ordinator.

Table 5: National Standards for Ambient Air Quality for PM_{10} (Government Notice No. 1210, 2009) and for $PM_{2.5}$ (Government Notice No. 486, 2012).

National Ambient Air Quality Standards for Particulate Matter (PM_{10})			
Averaging period	**Concentration (µg/m³)**	**Frequency Of Exceedance**	**Compliance Date**
24 hours	75	4	1 January 2015
1 year	40	0	1 January 2015
The reference method for the determination of the PM_{10} fraction of suspended particulate matter shall be EN 12341.			

National Ambient Air Quality Standards for Particulate Matter ($PM_{2.5}$)			
Averaging Period	**Concentration ($\mu g/m^3$)**	**Frequency Of Exceedance**	**Compliance Date**
24 hours	40	4	1 January 2016 – 31 December 2029
24 hours	25	4	1 January 2030
1 year	20	0	1 January 2016 – 31 December 2029
1 year	15	0	1 January 2030
The reference method for the determination of the $PM_{2.5}$ fraction of suspended particulate matter shall be EN 14907.			

The acceptable dustfall rates as set out in the National Dust Control Regulations (Government Notice No. 517, 2018) are shown in Table 6.

Table 6: National Dust Control Regulations (Government Notice No. 517, 2018).

Level	Dustfall Rate (D) ($mg/m^2/day$) (30-days average)	Permitted Frequency of Exceeding Dustfall Rate
Residential area	D < 600	Two within a year, not sequential months.
Non-residential area	600 < D < 1 200	Two within a year, not sequential months.

The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognised body.

4.2 Background Concentrations

The proposed Valley Silts Expansion project is located in the City of Johannesburg Metropolitan Municipality, in Gauteng Province. The City of Johannesburg AQMP found exceedances of both the PM_{10} and $PM_{2.5}$ NAAQS (CoJ, 2017). They found that fine particulate concentrations are elevated throughout much of the city, however, concentrations are highest in low-income areas. The emissions inventory showed that there are several sectors that emit pollutants which affect the ambient air quality of the city. These include biogenic VOC (Because Johannesburg has the world's largest urban forest, the emission of volatile organic compounds from this forest ecosystem are significant.); biomass burning (The burning of organic matter in natural or manmade fires such as veld fires.); aircraft emissions; household fuel combustion for cooking and heating; windblown dust from TSFs; industrial sources; on-road vehicles; and waste treatment. Figure 11 shows the relative contribution of each of these sources to the overall load of criteria pollutants in the air. Household fuel burning and TSFs are the largest sources of particulate emissions in the city, followed by

emissions from biomass burning, industries (not fully quantified in this emissions inventory due to lack of data) and a small amount from vehicles.

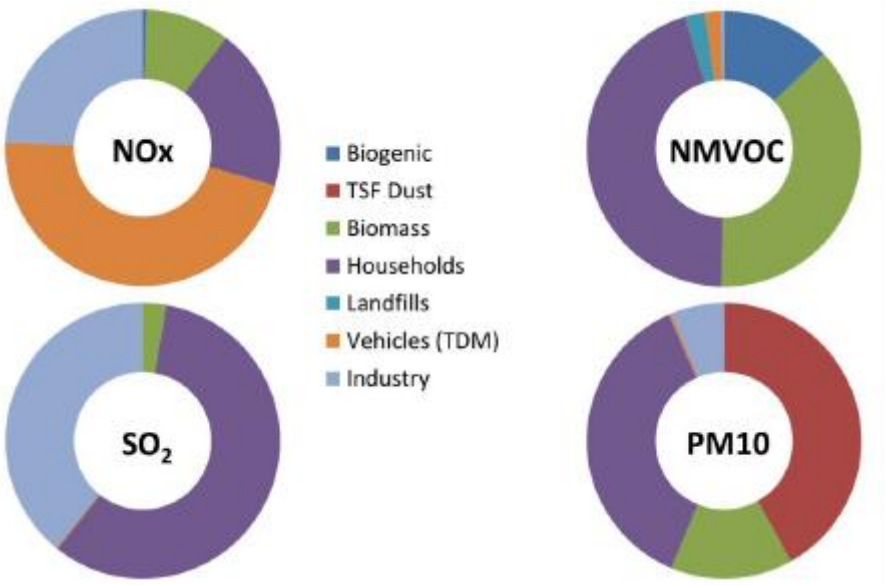


Figure 11: Summary of sector contribution to total annual criteria pollutant emissions within the City of Johannesburg (CoJ, 2017).

There are many dust fallout monitoring stations and one air quality monitoring station within a 5 km radius of the Valley Silts Expansion project area (Figure 4). Although some of these stations are currently not in operation, the large number of dust fallout monitoring stations are an indication of the concern for air quality in the area. The graph of the measured average dust deposition rates at four of the operational monitoring stations in the area (Figure 12) illustrates that there have been no exceedances of the National Dustfall Standard of 600 mg/m^2/day for these residential areas in the period from January 2024 to March 2024. Only the Stockwell monitoring station is close enough to give an indication of the impact of dust emissions from the Valley Silts Expansion area.

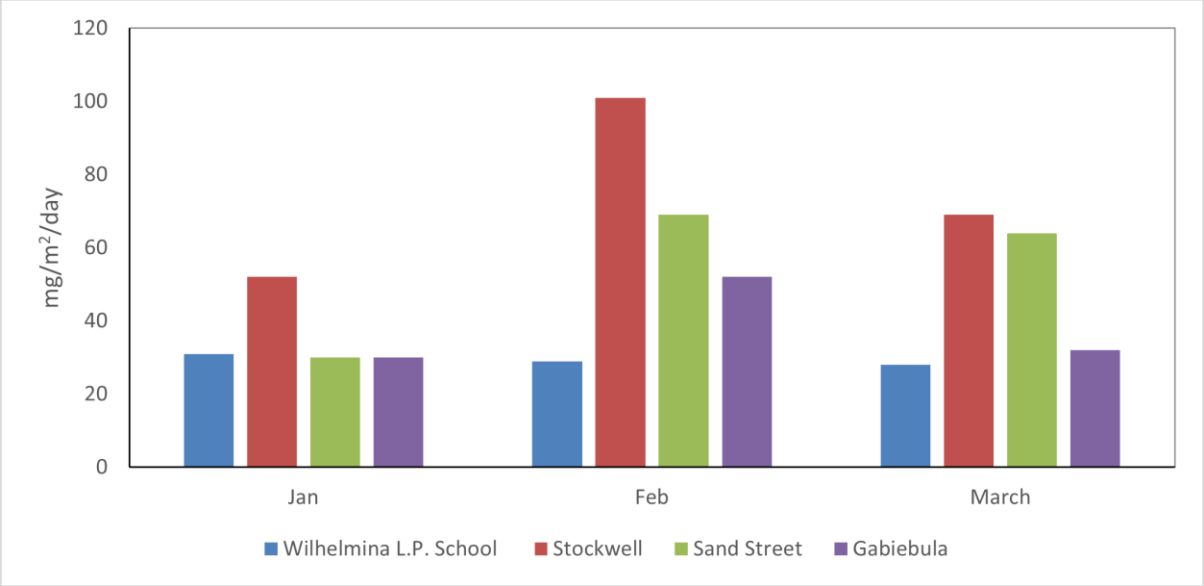


Figure 12: Monthly average dust deposition rates from January 2024 to March 2024.

Figure 13 illustrates the measured average daily PM_{10} and $PM_{2.5}$ ambient concentrations at the Diepkloof National Air Quality Index (NAQI) monitoring station, compiled on the South African Air Quality Information System (SAAQIS) website. The graph shows high ambient concentrations of these criteria pollutants, with several exceedances of the NAAQS. Although the Diepkloof air quality monitoring station lies approximately 4 km away from the Valley Silts Expansion project area, and therefore cannot be considered to represent the air quality of the project area, it does provide an indication of the expected air quality in this area.

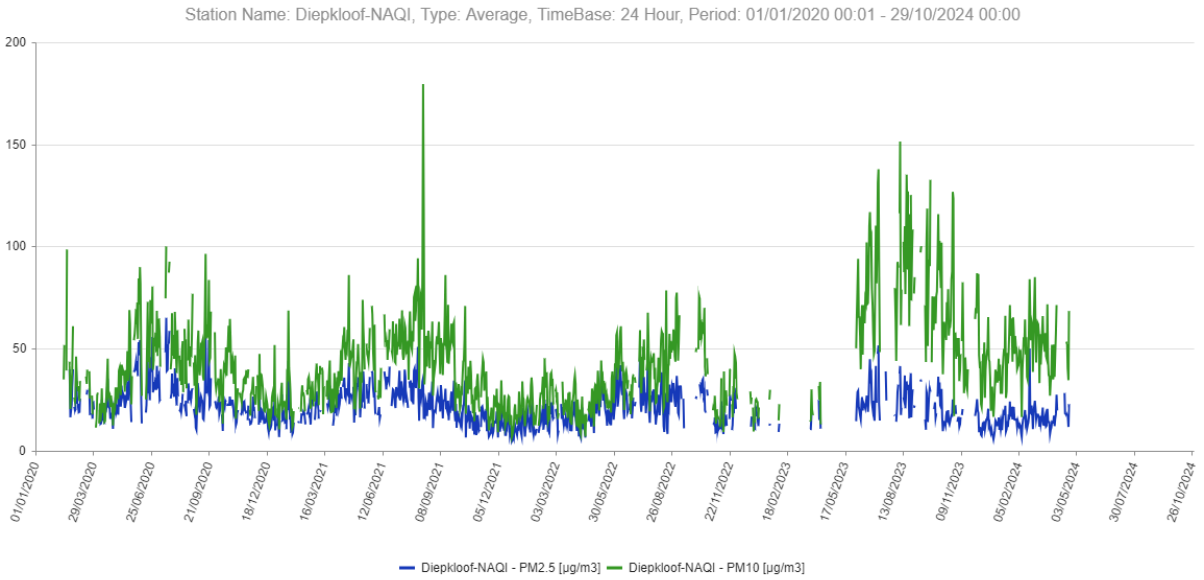


Figure 13: Daily average PM_{10} and $PM_{2.5}$ concentrations for the Diepkloof-NAQI monitoring station for 2020-2024 (SAAQIS, 2024).

5 MODELLING PROCEDURES

5.1 Model Overview

Dispersion models are used to predict the ambient concentration in the air of pollutants emitted to the atmosphere from a variety of processes. Ambient concentrations are computed as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources. Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments and emission control requirements.

Three Levels of Assessment are defined in the Regulations Regarding Air Dispersion Modelling (Government Notice No. R533, 2014). The assessment of impact as a result of emissions from this project was considered to fall within the scope of a Level 2 assessment. Level 2 assessment are used for air quality impact assessments in standard / generic licence or amendment processes where: The distribution of pollutant concentrations and depositions are required in time and space; Pollutant dispersion can be reasonably treated by a straight-line, steady-state, Gaussian plume model with first order chemical transformation; Emissions are from sources where the greatest impacts are in less than 50 km downwind.

AERMOD is a steady-state plume dispersion model developed by The American Meteorological Society / Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC). It has been adopted as the EPA's preferred regulatory model for both simple and complex terrain. AERMOD incorporates air dispersion based on planetary boundary layer (PBL) turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. AERMOD is the recommended model for Level 2 assessments in the Code of Practice (Government Notice No. R533, 2014). The modelling system consists of one main program (AERMOD) and two pre-processors (AERMET and AERMAP). The versions of these programs used in this project are: AERMAP Version 18081, AERMET Version 23132 and AERMOD version 23132.

AERMOD requires elevation data that conveys the features of the surrounding terrain to calculate its effect on the dispersion of pollutants. Shuttle Radar Topography Mission (SRTM) 1 arc second Digital Elevation Terrain Data - Global was downloaded from the U.S. Geological Survey website for this project. AERMAP uses this data to establish the base elevation at each source and receptor. It then searches for the terrain height and location that has the greatest influence on dispersion for each individual receptor. This height is the referred to as the hill height scale. Both the base elevation and hill height scale data are produced by AERMAP as a file or files which can be directly inserted into an AERMOD input control file. The elevation data is used by

AERMOD to capture the essential physics of dispersion in complex terrain when calculating air pollutant concentrations at individual receptors (Cimorelli, et al., 2004).

The basic purpose of AERMET is to use meteorological measurements, representative of the modelling domain, to compute certain boundary layer parameters used to estimate profiles of wind, turbulence and temperature. AERMET uses these parameters to generate profiles of the needed meteorological variables. In addition, AERMET passes all meteorological observations to AERMOD. Surface characteristics in the form of albedo, surface roughness and Bowen ratio, plus standard meteorological observations (wind speed, wind direction, temperature, and cloud cover), are input to AERMET. AERMET then calculates the PBL parameters: friction velocity, Monin-Obukhov length, convective velocity scale, temperature scale, mixing height, and surface heat flux. AERMOD is designed to run with a minimum of observed meteorological parameters (Cimorelli, et al., 2004). Modelled data from the Weather Research and Forecasting (WRF) Model was used to initialize the AERMET pre-processor in this project.

Electronic input and output files for the modelling for AERMAP, AERMET and AERMOD have been submitted with this report. A list of these files is included in Section 7.2.

5.2 Emission Scenarios Modelled

Dispersion simulations were undertaken to determine ambient concentrations of $PM_{2.5}$ and PM_{10} resulting from activities related to the Valley Silts Expansion project. 120 000 wet tons of silt will be moved from the valley to the drying area per month and approximately 103 200 tons of dried silt will be moved from the drying areas to the City Deep plant per month. The following scenarios were simulated:

- Drying area 1 used for drying (Figure 7). Northern access road used between the drying area and Crownwood Road.
- Drying area 2 used for drying (Figure 7). Northern access road used between the drying area and Crownwood Road.
- Drying area 2 used for drying (Figure 7). Southern access road used between the drying area and Crownwood Road.
- Drying area 3 used for drying (Figure 7). Southern access road used between the drying area and Crownwood Road.

Emissions of particulate matter from turning of the silt to aid drying; loading of haul trucks after drying; and vehicle entrainment of dust were included in all four scenarios.

5.3 Mitigation Measures

The following mitigation methods are recommended:

- In drying area 1, haul roads should be kept as far from the northern boundary as possible to reduce the impact on the Riverlea residential area. Ideally this drying area should be relocated further eastwards.
- In drying area 3, haul roads should be kept as far from the southern boundary as possible to reduce the impact on the Theta industrial area to the south.
- Temporary storage piles for the scalped reeds should be kept to a minimum.
- The drop height for loading haul trucks after the silt has been dried should be kept to a minimum.

If dust monitoring indicates that exceedances of the National Dust Control Regulations are being caused by the project, chemical stabilisation or wet suppression mitigation methods should be used on all unpaved roads.

5.4 Model Settings

The US EPA regulatory default model settings were used. These include:

- Elevated terrain algorithms requiring input of terrain height data.
- Calms processing routines.
- Missing data processing routines.

Other settings:

- Albedo: 0.01
- Bowen ratio by month: 8.34, 8.93, 8.55, 8.71, 8.95, 9.18, 9.39, 9.30, 9.44, 9.10, 9.51, 9.29
- Surface roughness length by month: 0.80002, 0.80001, 0.80002, 0.80001, 0.80002, 0.80001, 0.80002, 0.80002, 0.80001, 0.80002, 0.80001, 0.80002
- Emissions from materials handling and transfer were simulated as an area source.
- Roads were simulated as adjacent volume sources as recommended by the US EPA haul road workgroup (US EPA, 2012).

5.5 Receptor Grids

A cartesian receptor grid was used for the modelling of the Valley Silts Expansion area. Receptors were spaced at 50 m intervals up to 5 km from the centre point. The UTM coordinates of the centre point are: 599458.00 m E, 7098922.00 m S.

Five discrete receptors were included in the modelling to illustrate the impact of emissions from the Valley Silts Expansion area on the surrounding area. The location of the modelled discrete receptors is shown in Figure 14, with their elevation and coordinates presented in

Table 7. Receptor 1 represents the closest houses to the west of the Valley Silts Expansion area in the Riverlea suburb. Receptor 2 represents the closest houses to the north-west in the Riverlea suburb. Receptor 3 represents the closest industrial area to the north and Receptor 4 represents the closest industrial area to the south-east. Receptor 5 represents the closest houses to the south of the Valley Silts Expansion area in the Ormonde suburb, and Receptor 6 represents the Crown Mines Primary School to the south-east which is the closest school to the Valley Silts Expansion area.

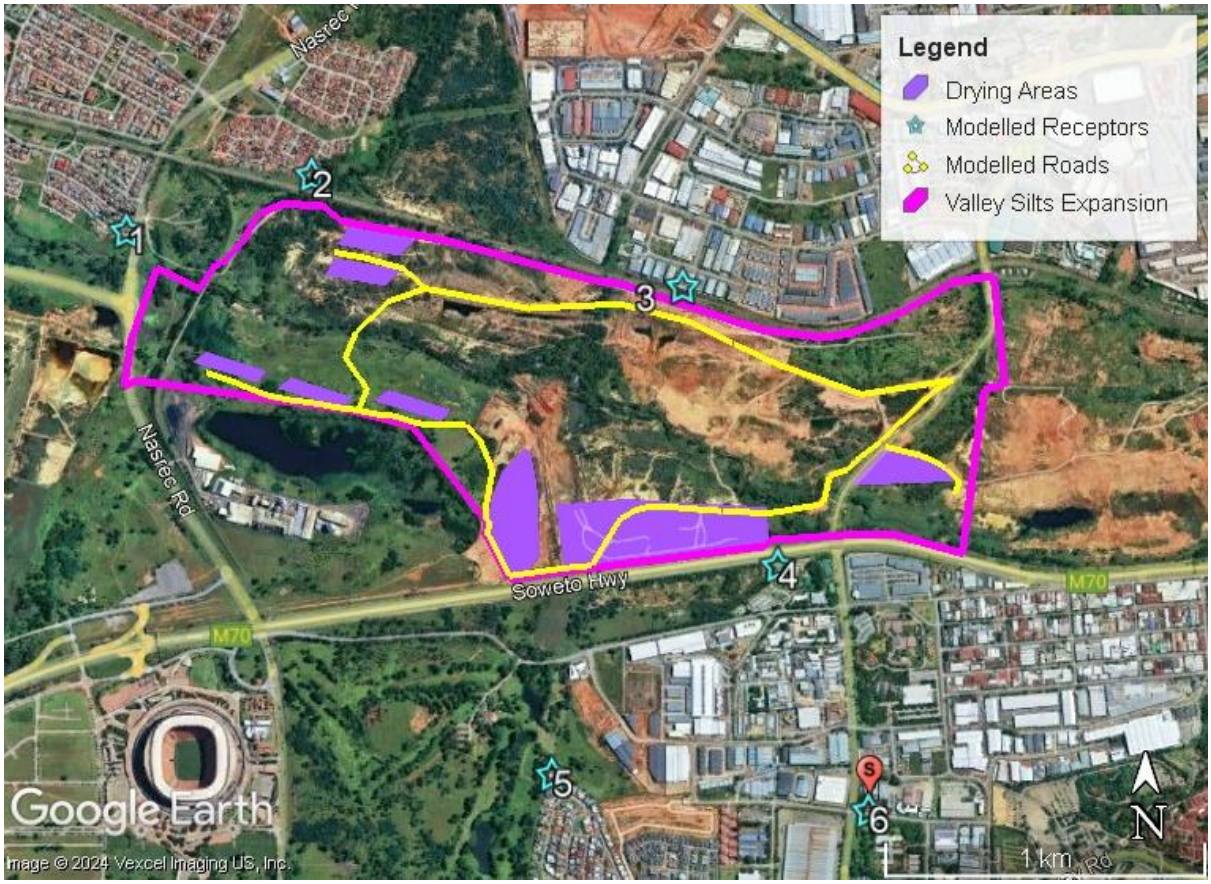


Figure 14: Location of the modelled discrete receptors.

Table 7: UTM coordinates and elevation of modelled receptors.

Modelled Receptor	Description	UTM Coordinates	Elevation (m)
1	Closest Riverlea houses to the west	597963.00 m E 7099585.00 m S	1735.00
2	Closest Riverlea houses to the north-west	598542.00 m E 7099754.00 m S	1688.00
3	Crown industrial area	599696.00 m E 7099399.00 m S	1706.38
4	Theta industrial area	599986.00 m E 7098531.00 m S	1682.90
5	Closest Ormonde houses	599277.00 m E 7097890.00 m S	1683.24
6	Crown Mines Primary School	600263.64 m E 7097770.67 m S	1711.73

5.6 Assumptions and Limitations

- Construction of roads is a substantial temporary source of PM emissions. As far as possible, existing access roads will be utilised for the project, and where this is not possible, these will be constructed as a two-by-two roadway, operating in both directions. Intersections will be properly designed to provide safe entry and exit into the mining area (Kongiwe, 2024). However, the position and extent of road building was not known at the time of compiling this report.
- Vehicle-entrained dust emissions from the haul roads were modelled as a series of volume sources at 200 m intervals.
- For each modelling scenario, it was assumed that the total daily maximum of 120 000 wet tons would be hauled from the closest valley area to the modelled drying area. In addition, it was assumed that 103 200 tons of dry silt would then be hauled from the drying area to the Crownwood Road exit. The amount of dry silt hauled was based on the percentage weight difference between wet and dry soil (Zekkos, Woods , & Grizi, 2013).
- The modelling was based on operating times of 7 days a week, 8 hours a day. Any change to the operating times may affect the expected impacts.

6 AIR QUALITY IMPACT ASSESSMENT RESULTS

Dispersion simulations were undertaken to determine ambient concentrations of $PM_{2.5}$ and PM_{10} resulting from the Valley Silts Expansion project. The dispersion of particulate matter was modelled up to 5 km from the centre of the project area.

The isopleths of the modelling results for $PM_{2.5}$ and PM_{10} are given in Figure 15 to Figure 22 below. The red isopleths represent the NAAQS, therefore, all areas on the maps that lie within the red coloured isopleth can be expected to experience exceedances of the relevant National Standards

It should be noted that isopleth plots reflecting the 24-hour averaging periods contain the 99^{th} percentile or the average of the fifth-highest predicted ground level concentrations, over the three-year period for which simulations were undertaken. In other words, the model calculates the fifth-highest concentration at each receptor for each year modelled, and then averages those fifth-highest concentrations at each receptor across the three years of meteorological data for plotting. This is in line with the NAAQS which allows for four exceedances per year. Concentrations are presented in $\mu g/m^{-3}$.

6.1 Drying Area 1 with Northern Access Road Modelling Results

6.1.1 Modelling Results Figures

The isopleths illustrating the worst-case concentrations expected over the surrounding areas resulting from emissions from materials handling in drying area 1; hauling of wet silt from the valley to drying area 1; and hauling of dried silt along the northern access road from drying area 1 to the Crownwood Road exit; are presented in Figure 15 and Figure 16.

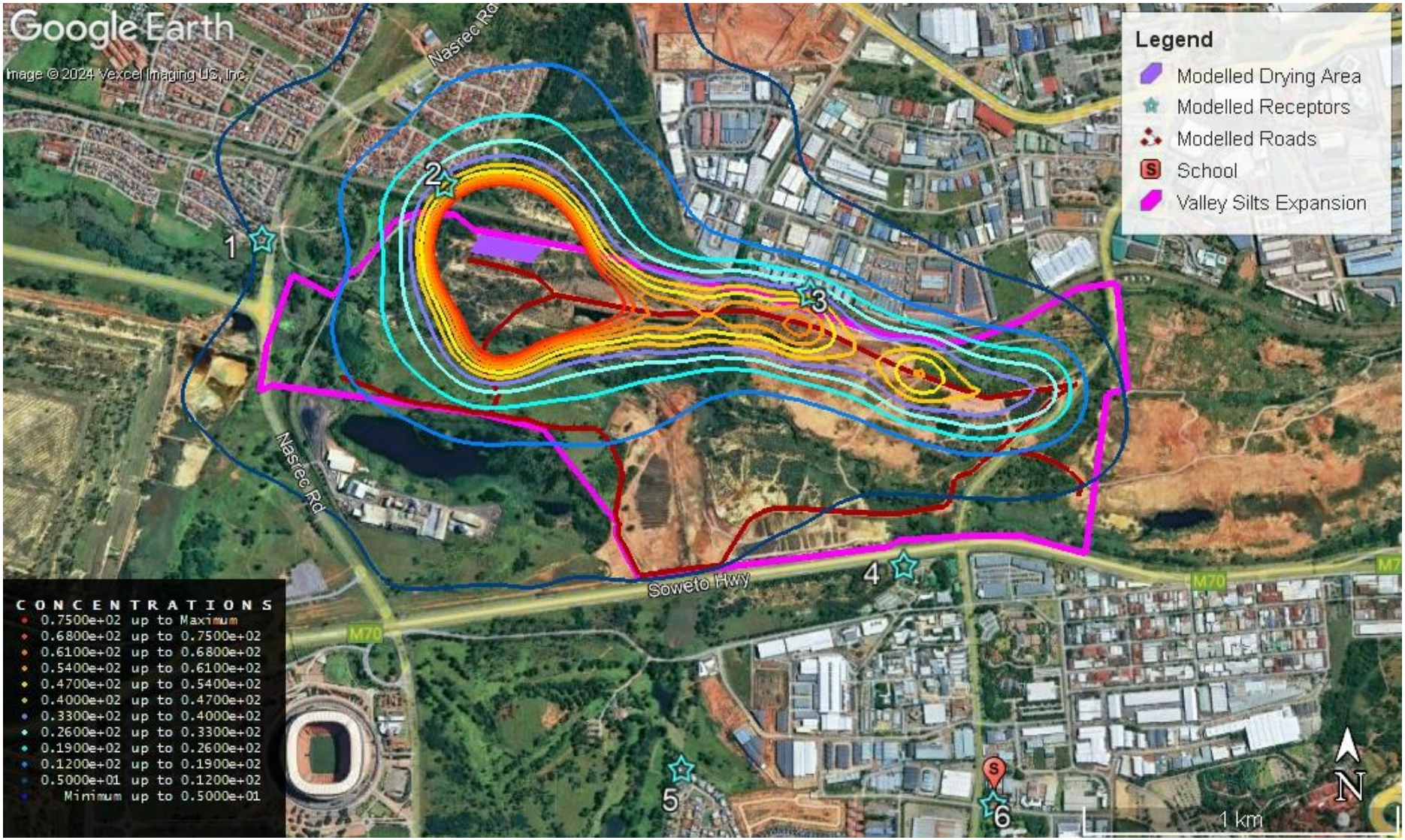


Figure 15: Modelled prediction of highest 24-hour average PM_{10} concentrations resulting from drying area 1 and associated hauling.

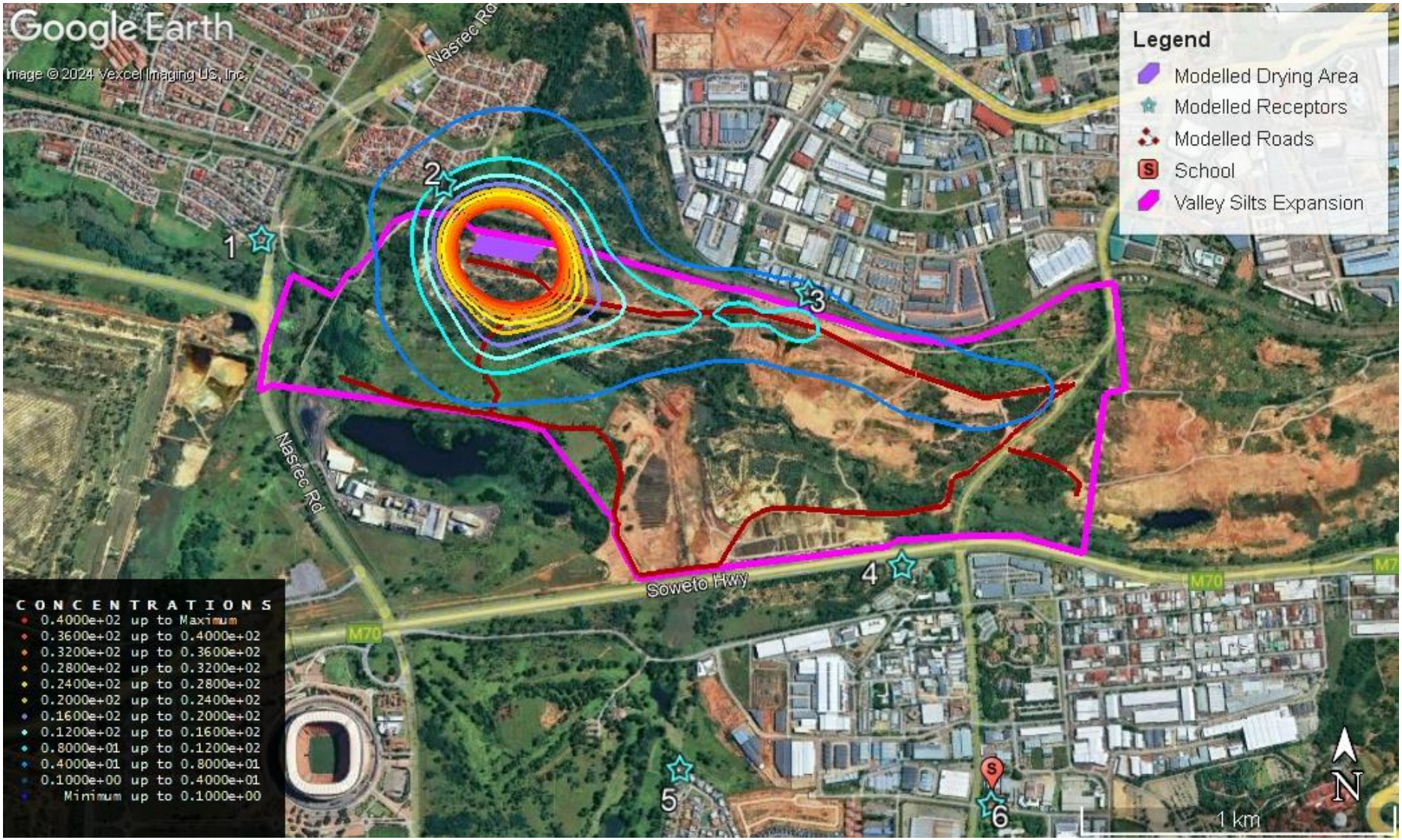


Figure 16: Modelled prediction of highest 24-hour average $PM_{2.5}$ concentrations resulting from drying area 1 and associated hauling.

6.1.2 Modelling Results Table

Table 8: Maximum modelled concentrations at the discrete receptors.

Averaging Time	Discrete Receptor	Date of Maximum Modelled Concentration	Maximum Modelled Concentration (µg/m³)	NAAQS (µg/m³)
PM_{10} 24 hours (99th percentile)	1	25-12-2021	4.86	75
	2	19-02-2023	30.84	
	3	16-05-2022	18.58	
	4	13-01-2022	3.65c	
	5	08-06-2021	2.19	
	6	04-04-2022	1.76c	
$PM_{2.5}$ 24 hours (99th percentile)	1	25-12-2021	1.14	40
	2	15-01-2022	7.31	
	3	10-12-2022	3.50c	
	4	04-03-2023	0.82	
	5	27-05-2023	0.47	
	6	23-06-2022	0.35	

Note: An average that includes a calm hour is flagged with a 'c'.

6.1.3 Evaluation of the Modelling Results

- The modelled highest daily average concentrations of PM_{10} indicate that exceedances of the national daily standard of 75µg/m³ can be expected around the drying area and associated roads under worst-case meteorological conditions. Exceedances extend up to approximately 160 m beyond the Valley Silts Expansion footprint, to the north of the drying area (Figure 15). This mostly affects the ambient concentrations of particulate matter experienced by the closest residents of Riverlea, and to a lesser extent the Crown industrial area to the north; although none of the modelled receptors are expected to experience ambient concentrations exceeding the NAAQS on worst-case days (Table 8).
- The modelled highest daily average concentrations of $PM_{2.5}$ indicate exceedances of the national daily standard of 40µg/m³ can be expected up to approximately 90 m beyond the Valley Silts Expansion footprint, to the north of the drying area under worst-case meteorological conditions (Figure 16). This affects the ambient concentrations of particulate matter experienced by the closest residents of Riverlea to the east of Nasrec Road, although none of the modelled receptors are expected to experience ambient concentrations exceeding the NAAQS on worst-case days (Table 8).

6.2 Drying Area 2 with Northen Access Road Modelling Results

6.2.1 Modelling Results Figures

The isopleths illustrating the worst-case concentrations expected over the surrounding areas resulting from emissions from materials handling in drying area 2; hauling of wet silt from the valley to drying area 2; and hauling of dried silt along the northern access road from drying area 2 to the Crownwood Road exit; are presented in Figure 17 and Figure 18.

Drying Area 2 with Northern Access Road

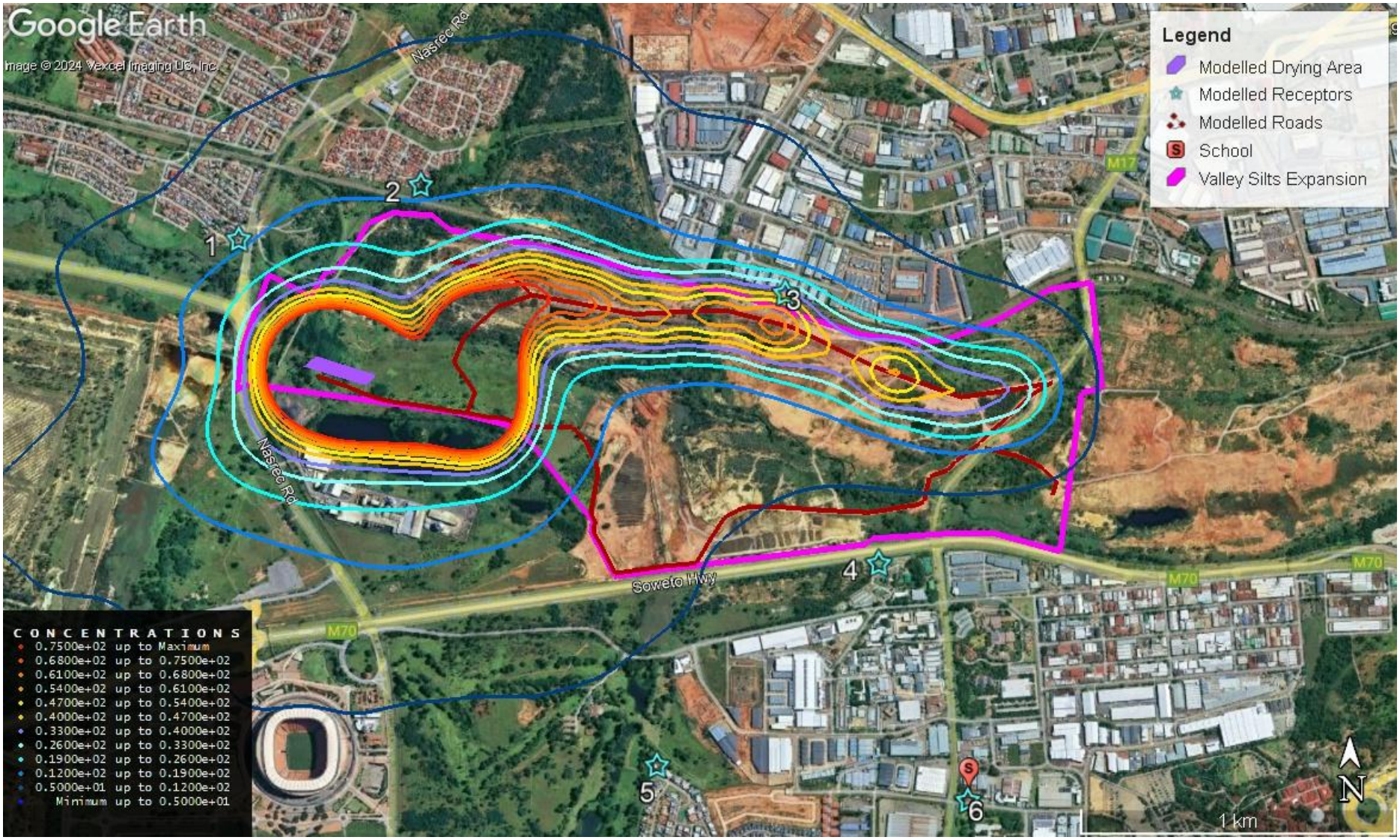


Figure 17: Modelled prediction of highest 24-hour average PM_{10} concentrations resulting from drying area 2 and associated hauling using the northern access road.

Drying Area 2 with Northern Access Road

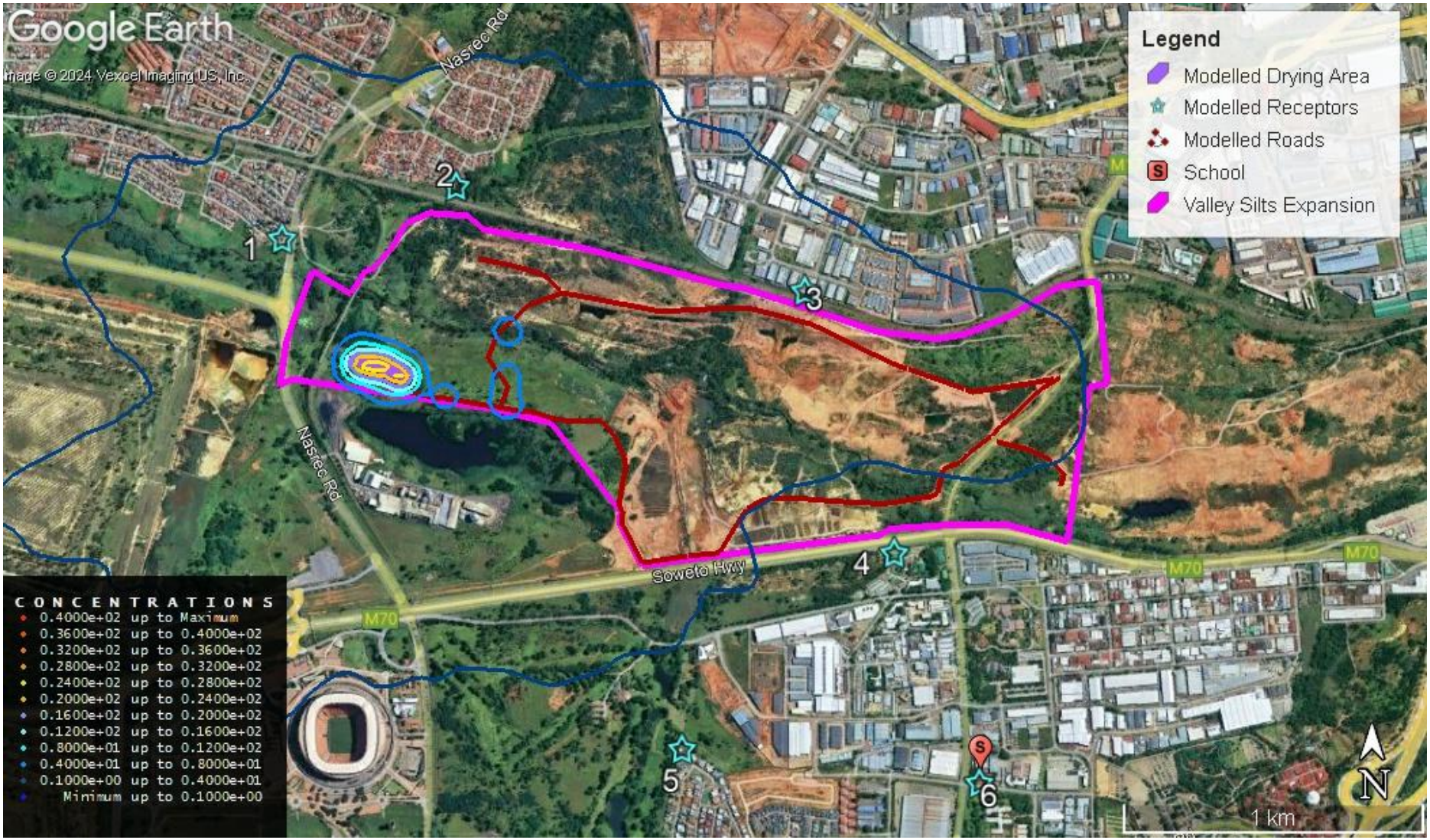


Figure 18: Modelled prediction of highest 24-hour average $PM_{2.5}$ concentrations resulting from drying area 2 and associated hauling using the northern access road.

6.2.2 Modelling Results Table

Table 9: Maximum modelled concentrations at the discrete receptors.

Averaging Time	Discrete Receptor	Date of Maximum Modelled Concentration	Maximum Modelled Concentration (µg/m³)	NAAQS (µg/m³)
PM_{10} 24 hours (99th percentile)	1	19-10-2021	10.04	75
	2	26-05-2022	9.76	
	3	10-02-2023	18.85c	
	4	29-05-2022	3.17	
	5	07-06-2023	3.51	
	6	30-06-2021	1.88	
$PM_{2.5}$ 24 hours (99th percentile)	1	07-05-2023	0.25c	40
	2	08-01-2021	0.22	
	3	05-03-2022	0.34	
	4	23-03-2021	0.06c	
	5	06-06-2023	0.07	
	6	10-02-2023	0.05c	

Note: An average that includes a calm hour is flagged with a 'c'.

6.2.3 Evaluation of the Modelling Results

- The modelled highest daily average concentrations of PM_{10} indicate that exceedances of the national daily standard of 75µg/m³ can be expected up to approximately 130 m beyond the Valley Silts Expansion footprint, south of the drying area under worst-case meteorological conditions (Figure 17). The exceedances occur in areas of bare land within the footprint of the Valley Silts Expansion project area and over a waterbody to the south. None of the modelled receptors are expected to experience ambient concentrations exceeding the NAAQS on worst-case days (Table 9).
- The modelled highest daily average concentrations of $PM_{2.5}$ indicate that no exceedances of the national daily standard of 40µg/m³ can be expected, under worst-case meteorological conditions (Figure 18).

6.3 Drying Area 2 with Southern Access Road Modelling Results

6.3.1 Modelling Results Figures

The isopleths illustrating the worst-case concentrations expected over the surrounding areas resulting from emissions from materials handling in drying area 2; hauling of wet silt from the valley to drying area 2; and hauling of dried silt along the southern access road from drying area 2 to the Crownwood Road exit; are presented in Figure 19 and Figure 20.

Drying Area 2 with Southern Access Road

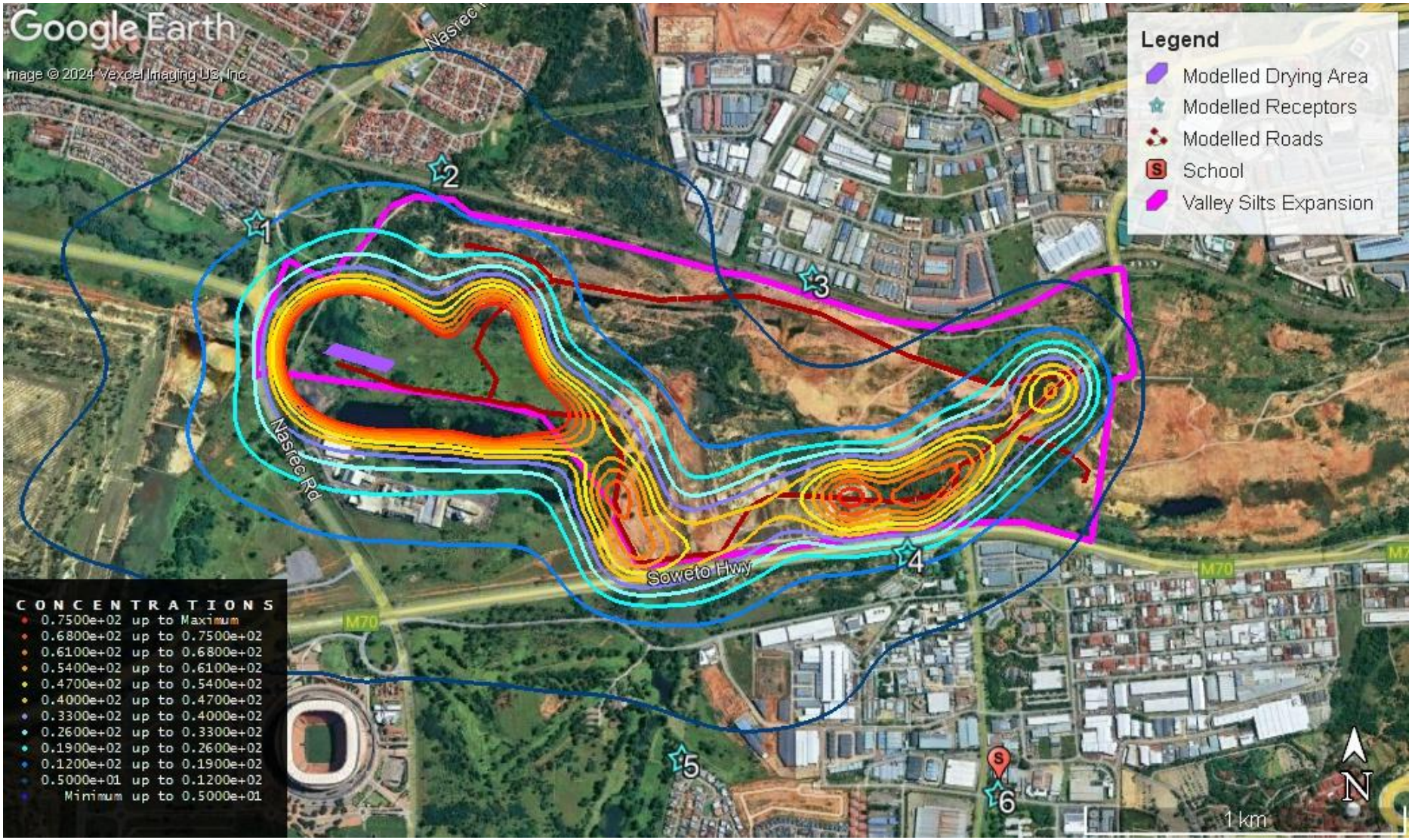


Figure 19: Modelled prediction of highest 24-hour average PM_{10} concentrations resulting from drying area 2 and associated hauling using the southern access road.

Drying Area 2 with Southern Access Road

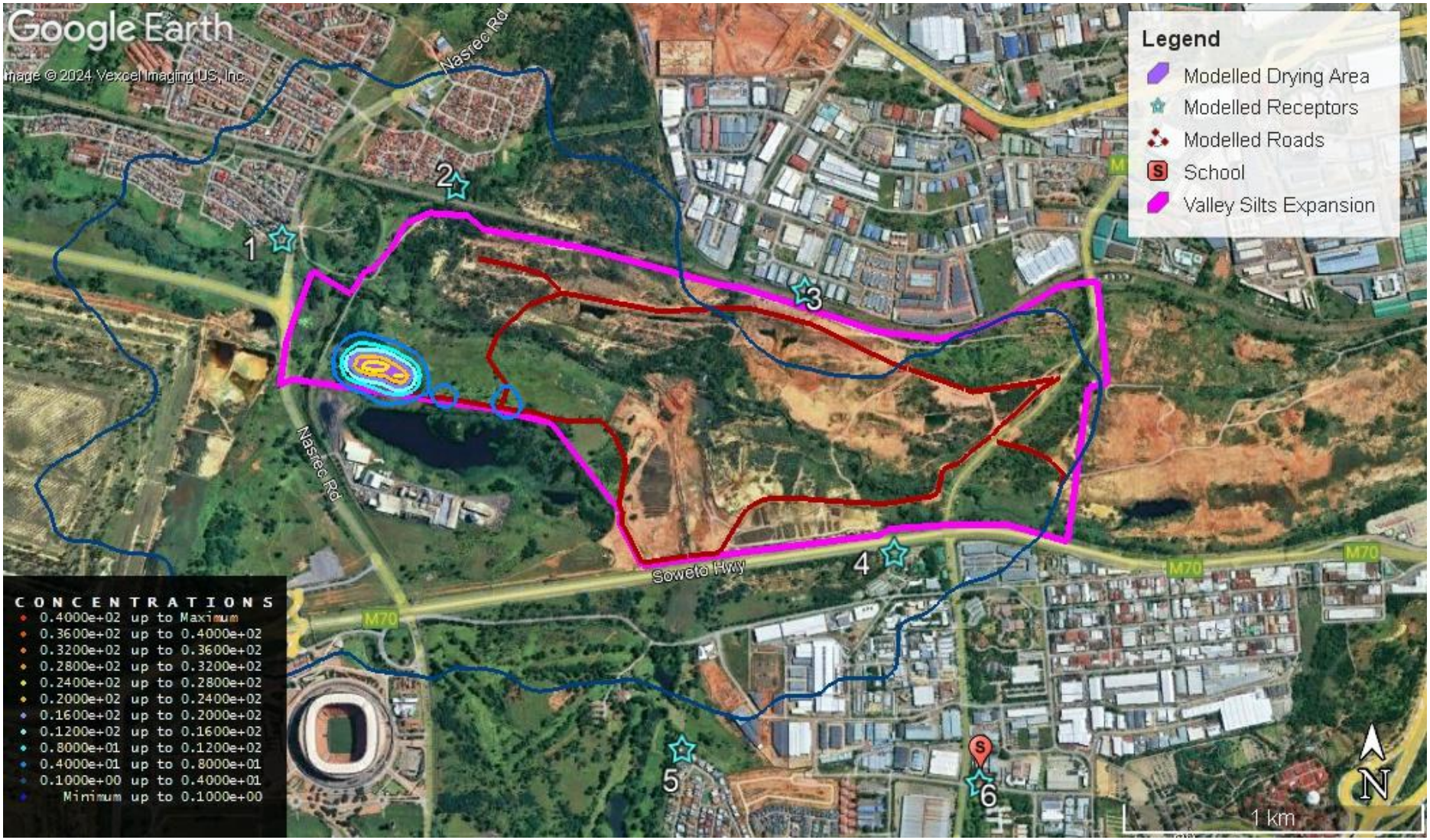


Figure 20: Modelled prediction of highest 24-hour average $PM_{2.5}$ concentrations resulting from drying area 2 and associated hauling using the southern access road.

6.3.2 Modelling Results Table

Table 10: Maximum modelled concentrations at the discrete receptors.

Averaging Time	Discrete Receptor	Date of Maximum Modelled Concentration	Maximum Modelled Concentration (µg/m^3)	NAAQS (µg/m^3)
PM_{10} 24 hours (99th percentile)	1	28-10-2021	10.44c	75
	2	14-02-2023	9.34c	
	3	15-03-2022	3.42c	
	4	09-02-2021	11.55c	
	5	06-06-2023	4.02	
	6	25-06-2022	3.01	
$PM_{2.5}$ 24 hours (99th percentile)	1	07-05-2023	0.26c	40
	2	09-02-2021	0.21	
	3	14-02-2021	0.07	
	4	18-02-2022	0.22	
	5	12-01-2022	0.07c	
	6	04-03-2023	0.07c	

Note: An average that includes a calm hour is flagged with a 'c'.

6.3.3 Evaluation of the Modelling Results

- The modelled highest daily average concentrations of PM_{10} indicate that exceedances of the national daily standard of 75µg/m^3 can be expected up to approximately 130 m beyond the Valley Silts Expansion footprint, south of the drying area under worst-case meteorological conditions (Figure 19). The exceedances occur in areas of bare land within the footprint of the Valley Silts Expansion and a waterbody to the south of the western drying area. None of the modelled receptors are expected to experience ambient concentrations exceeding the NAAQS on worst-case days (Table 10).
- The modelled highest daily average concentrations of $PM_{2.5}$ indicate that no exceedances of the national daily standard of 40µg/m^3 can be expected, even under worst-case meteorological conditions (Figure 20).

6.4 Drying Area 3 with Southern Access Road Modelling Results

6.4.1 Modelling Results Figures

The isopleths illustrating the worst-case concentrations expected over the surrounding areas resulting from emissions from materials handling in drying area 3; hauling of wet silt from the valley to drying area 3; and hauling of dried silt along the southern access road from drying area 3 to the Crownwood Road exit; are presented in Figure 21 and Figure 22. Hauling from the drying area to the east of Crownwood Road was also included in this scenario.

Drying Area 3 with Southern Access Road

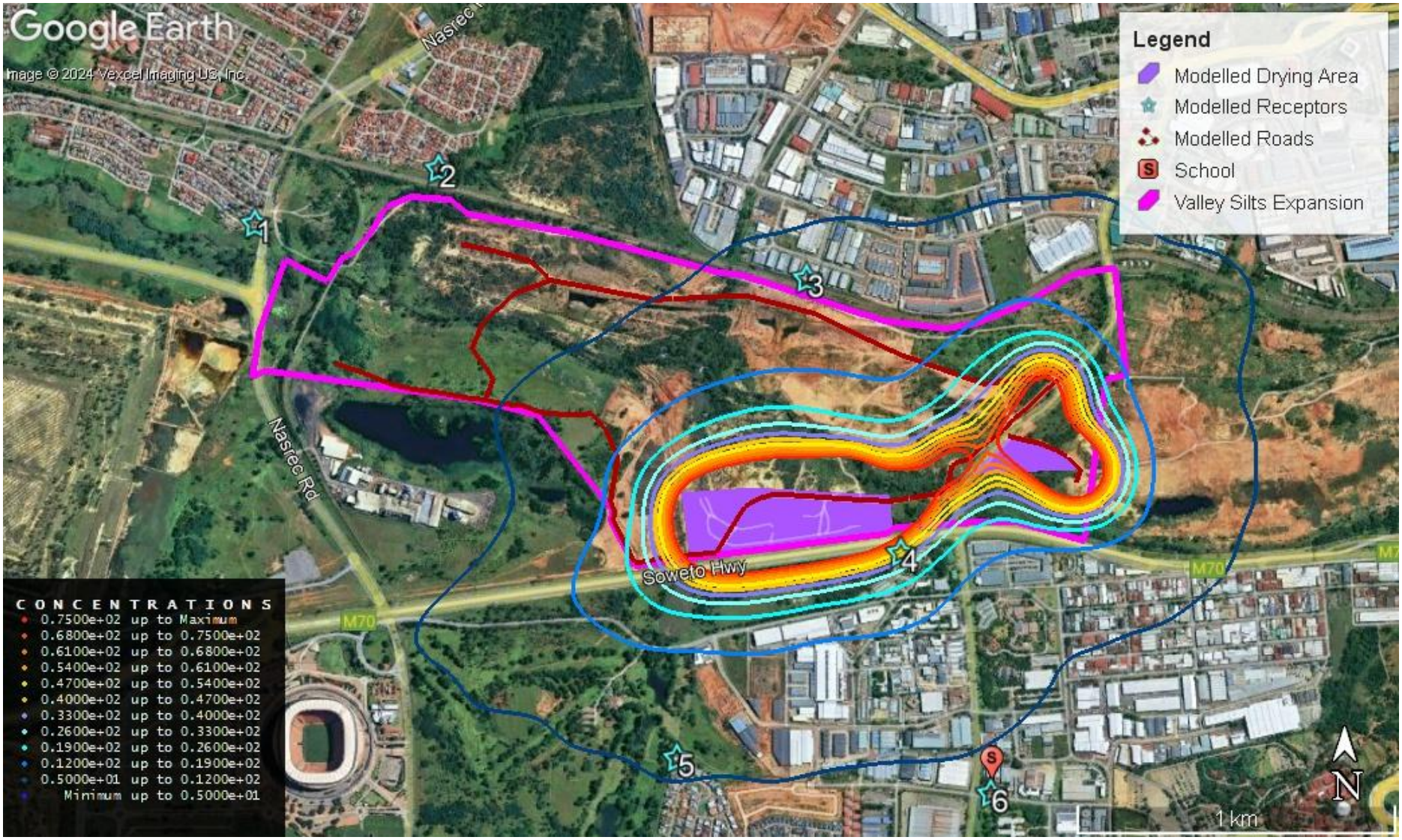


Figure 21: Modelled prediction of highest 24-hour average PM_{10} concentrations resulting from drying area 3 and associated hauling using the southern access road.

Drying Area 3 with Southern Access Road

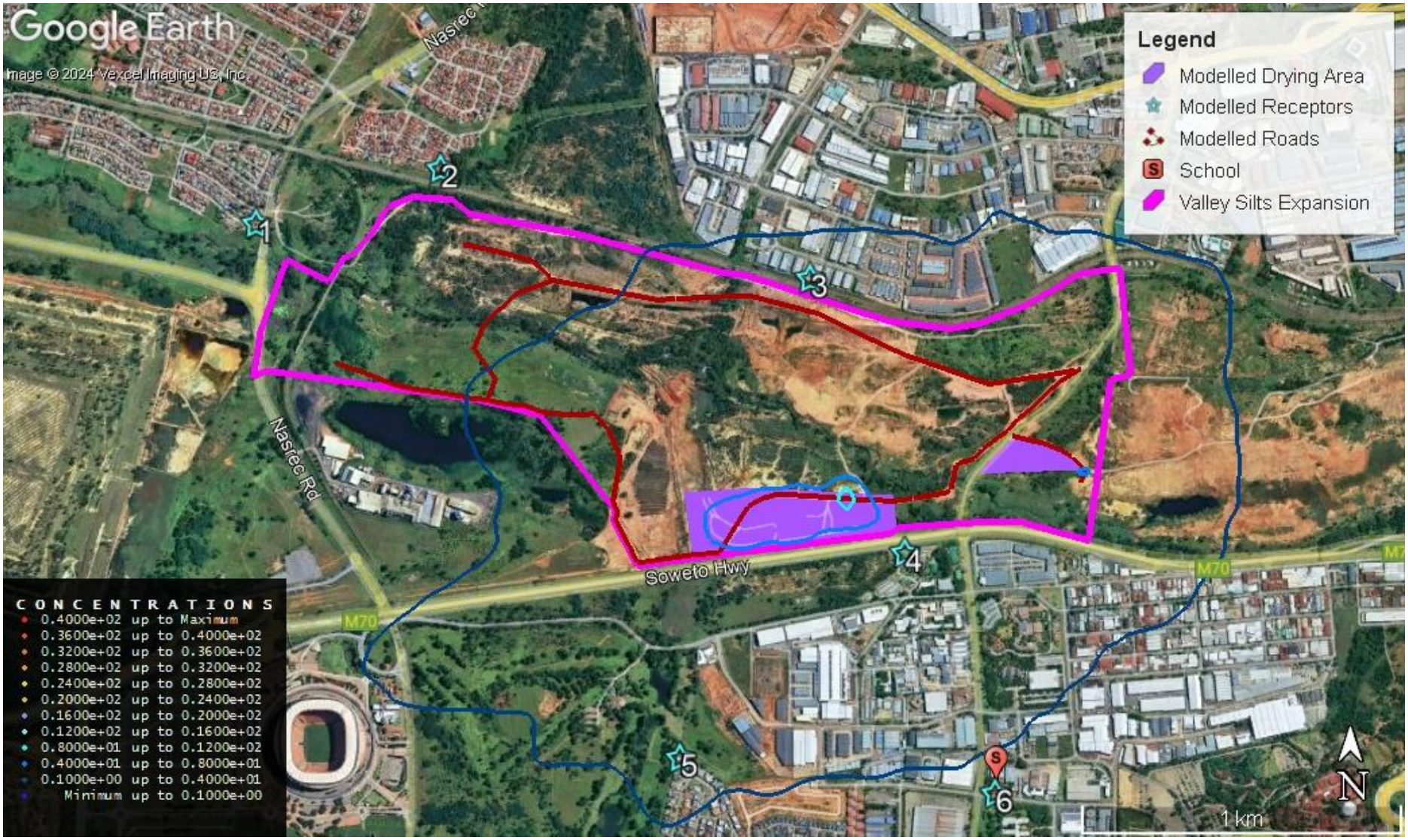


Figure 22: Modelled prediction of highest 24-hour average $PM_{2.5}$ concentrations resulting from drying area 3 and associated hauling using the southern access road.

6.4.2 Modelling Results Table

Table 11: Maximum modelled concentrations at the discrete receptors.

Averaging Time	Discrete Receptor	Date of Maximum Modelled Concentration	Maximum Modelled Concentration (µg/m³)	NAAQS (µg/m³)
PM_{10} 24 hours (99th percentile)	1	19-04-2022	1.47	75
	2	03-06-2021	1.59	
	3	30-06-2023	6.75	
	4	25-06-2022	29.69	
	5	20-06-2022	5.69	
	6	16-08-2021	4.26	
$PM_{2.5}$ 24 hours (99th percentile)	1	18-02-2023	0.03	40
	2	07-05-2023	0.04c	
	3	11-06-2021	0.13c	
	4	18-02-2022	0.67	
	5	02-02-2023	0.14	
	6	06-06-2023	0.08	

Note: An average that includes a calm hour is flagged with a 'c'.

6.4.3 Evaluation of the Modelling Results

- The modelled highest daily average concentrations of PM_{10} indicate that exceedances of the national daily standard of 75µg/m³ can be expected on windy days approximately 60 m beond the Valley Silts Expansion footprint, south of the drying area, under worst-case meteorological conditions (Figure 21). This mostly affects the ambient concentrations of particulate matter experienced by the Theta Industrial area to the south; although none of the modelled receptors are expected to experience ambient concentrations exceeding the NAAQS on worst-case days (Table 11).
- The modelled highest daily average concentrations of $PM_{2.5}$ indicate that no exceedances of the national daily standard of 40µg/m³ can be expected, even under worst-case meteorological conditions (Figure 22).

7 AMBIENT IMPACT SUPPORTING DOCUMENTATION

7.1 Warning and Informational Messages in Output Files

7.1.1 AERMAP

OU W450 NEDCHK:Parameter not found in TIFF file. TiffTag: 274
OU W470 NEDCHK:Unexpected datum for NED file encountered: WGS84
OU W473 NEDCHK:Default elevation units of METERS used; NED file: 1

These warning messages are a result of the SRTM input files not being the standard NED files for the USA.

7.1.2 AERMOD

ME W187 MEOPEN: ADJ_U* Option for Stable Low Winds used in AERMET
ME W182 MEOPEN: MMIF-generated meteorological inputs were used
ME W181 MEOPEN: BULKRN Delta-T & SolarRad option for SBL was used with MMIF
ME W531 MEOPEN: CAUTION! Met Station ID Missing from SURFFILE for SURFDATA

The warning messages occur because WRF modelled data is used and South Africa does not have Met Station IDs comparable to those used in the USA.

7.2 Electronic Files Submitted with the Report

AERMAP input files

aermap.inp
s27_e027_1arc_v3
s27_e028_1arc_v3

AERMAP output files

aermap.out
aermap.rec

AERMET input files

AERMOD.AERSFC.DAT
AERMOD.FSL
AERMOD.IN1

AERMET output files

AERMOD.OU1
AERMOD.PFL

AERMOD.SFC

AERMOD input files

AERMOD.PFL
AERMOD.SFC
DryingArea1_PM2.5.inp
DryingArea2N_PM2.5.inp
DryingArea2S_PM2.5.inp
DryingArea3_PM2.5.inp
DryingArea1_PM10.inp
DryingArea2N_PM10.inp
DryingArea2S_PM10.inp
DryingArea3_PM10.inp

AERMOD output files

DryingArea1_PM2.5.out
DryingArea2N_PM2.5.out
DryingArea2S_PM2.5.out
DryingArea3_PM2.5.out
DryingArea1_PM10.out
DryingArea2N_PM10.out
DryingArea2S_PM10.out
DryingArea3_PM10.out

AERMOD plot files

PM2.5_24hrVSiltsENH5H.plt
PM2.5_24hrVSiltsEWNH5H.plt
PM2.5_24hrVSiltsEWSH5H.plt
PM2.5_24hrVSiltsEEH5H.plt
PM10_24hrVSiltsENH5H.plt
PM10_24hrVSiltsEWNH5H.plt
PM10_24hrVSiltsEWSH5H.plt
PM10_24hrVSiltsEEH5H.plt

8 DUST FALLOUT MONITORING PROGRAMME

A concern was raised at the public participation meetings regarding cumulative air quality impacts from several projects in the vicinity of Riverlea. To assess the air quality impacts of particulate emissions from the Valley Silts Expansion project, ongoing dust fallout monitoring must be undertaken. Four monitoring stations, approximately equally distant from each other, is the minimum required by ASTM D1739 (ASTM, 2017) for each area or zone to be monitored. It is recommended that a monitoring network of six dustfall samplers be installed on the boundary of the project area. The samplers must be operated in accordance with the National Dust Control Regulations (Government Notice No. R827, 2013) and the proposed revised regulations once these are promulgated. The dustfall monitoring should be used as an indicator as to the extent of the impacts from the Valley Silts Project and whether the mitigation measures are sufficiently effective. As part of this monitoring programme, monthly reports must be produced. If the measured dustfall shows a marked increase from pre-operational phase levels, and the new dustfall rates exceed the regulated dustfall rate (Table 6), continuous PM_{10} monitoring in the residential area may be used to give a direct indication of health impacts experienced by the community. Furthermore, wet suppression or chemical stabilisation of all unpaved roads must be undertaken immediately to further mitigate emissions until dustfall rates are brought back into compliance with the National Dust Control Regulations. This emphasises the importance of monitoring (both in summer and in winter) prior to commencement of reclamation activities, as the development of a baseline will make it possible to more accurately evaluate the project's actual contribution to dustfall levels and by inference to ambient concentrations of PM. Currently, only the Stockwell monitoring station is close enough to give an indication of the impact of dust emissions from the Valley Silts Expansion area.

9 CONCLUSIONS AND RECOMMENDATIONS

An air quality impact assessment was undertaken to evaluate the impact on ambient air quality caused by the mechanical removal of silt from the Russell Stream and associated haulage; silt turning for drying; and truck loading processes for haulage to the processing plant. $PM_{2.5}$ and PM_{10} represent the main criteria pollutants of concern.

Four scenarios were simulated to represent the drying areas closest to sensitive receptors as well as the longest access roads required for haulage. The following conclusions can be made from the modelling results: Exceedances of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS can be expected beyond the Valley Silts Expansion footprint under worst-case meteorological conditions. The areas exposed to exceedances, however, are not expected to extend as far as sensitive receptors. Increases in ambient concentrations of particulate matter mostly affect the closest residents of Riverlea situated to the east of Nasrec Road, and to a lesser extent the Crown industrial area to the north and the Theta industrial area to the south of the project

area. Although the maximum modelled concentrations for these receptors are less than 50% of the NAAQS, additional care should be taken in drying area 1 and drying area 3, as the cumulative emissions from other sources in the area were not included in the modelling.

The air quality impacts from the Valley Silts Expansion project can be mitigated in the following ways:

- In drying area 1, haul roads should be kept as far from the northern boundary as possible to reduce the impact on the Riverlea residential area. Ideally this drying area should be relocated further eastwards.
- In drying area 3, haul roads should be kept as far from the southern boundary as possible to reduce the impact on the Theta industrial area to the south.
- Temporary storage piles for the scalped reeds should be kept to a minimum.
- The drop height for loading haul trucks after the silt has been dried should be kept to a minimum.

Furthermore, dust fallout rates must be monitored and if the emissions from the reclamation activities cause the pre-operational phase dustfall levels to rise above the limits set by the National Dust Control Regulations, chemical stabilisation or wet suppression mitigation methods should be used on all unpaved roads.

The impact on the environment surrounding the proposed project area is summarised in the impact assessment table below (Table 12). The impact assessment methodology is outlined in Appendix A.

Table 12: Air Quality Impact Assessment Matrix of the Valley Silts Expansion Project.

Impact Assessment Matrix	
Impact Description	Hauling of silt, turning of silt in the drying process and loading of dried silt onto haul trucks causes the emission of particulate matter into the air, thus increasing existing ambient air concentrations of criteria pollutants (both PM_{10} and $PM_{2.5}$) at receptors.
Acceptable rating level	**PM_{10}** • 24-hour Average Concentrations: National Ambient Air Quality Standard of 75µg/m^3 • Annual Average Concentrations: National Ambient Air Quality Standard of 40µg/m^3 **$PM_{2.5}$** • 24-hour Average Concentrations: National Ambient Air Quality Standard of 40µg/m^3 • Annual Average Concentrations: National Ambient Air Quality Standard of 20µg/m^3
Magnitude	**Moderate negative:** Because of the proximity of some roads and some of the drying areas to the project boundary, worst-case conditions together with cumulative concentrations may lead to the NAAQS being exceeded over parts of the residential area of Riverlea to the east of Nasrec Road; the Crown industrial area to the north and the Theta industrial area to the south of the Valley Silts Expansion footprint.
Duration	**Medium Term:** There is a possibility of the ambient air concentrations exceeding the NAAQS in different areas for periods longer than 18 months depending on the location of drying areas used.
Spatial Scale	**Local:** Dispersion of emissions from the project are not expected to extend beyond 1 km from the project boundary.
Consequence	**Medium**
Probability	**Possible:** Although mitigation measures will reduce the probability of exceedances of the NAAQS caused by the reclamation activities, cumulative ambient concentrations may still lead to exceedances.
Significance of Air Quality Impact	**Medium**
Mitigation	Haul roads in drying area 1 should be kept as far from the northern boundary as possible to reduce the impact on the Riverlea residential area. Ideally this drying area should be relocated further eastwards. Also, in drying area 3 haul roads should be kept as far from the southern boundary as possible to reduce the impact on the Theta industrial area to the south. Wet suppression / chemical stabilization of unpaved haul roads are possible additional mitigation measures. The drop height for loading of dried silt onto haul trucks should be kept to a minimum.
Cumulative Impact	Emissions from the reclamation of the Valley Silts Expansion project are expected to temporarily increase ambient concentrations of PM_{10} and $PM_{2.5}$ in the areas close to the project boundary. Concentrations of these criteria pollutants are already high in the City of Johannesburg metropolitan area.

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Appendix A. Methodology Used in Determining the Significance of Environmental Impacts

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined below, used to evaluate impact significance.

The impact significance rating system is presented in **Table 13** and involves three parts:

Part A: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/ population and duration.
Part B: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A.
Part C: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from **Part B**) and the probability of occurrence.

Table 13: Significance Rating Methodology

PART A: DEFINING CONSEQUENCE IN TERMS OF MAGNITUDE, DURATION AND SPATIAL SCALE *Use these definitions to define the consequence in Part B*		
Impact Characteristics	**Definition**	**Criteria**
MAGNITUDE	Major -	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate -	Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor -	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded
	Minor +	Minor improvement; change not measurable; or threshold never exceeded
	Moderate +	Moderate improvement; within or better than the threshold; or no observed reaction
	Major +	Substantial improvement; within or better than the threshold; or favourable publicity
SPATIAL SCALE OR POPULATION	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral,

		catchment, topographic
	National/ International	Nationally or beyond
DURATION	Short term	Up to 18 months.
	Medium term	18 months to 5 years
	Long term	Longer than 5 years

PART B: DETERMINING CONSEQUENCE RATING

Rate consequence based on definition of magnitude, spatial extent and duration

			SPATIAL SCALE/ POPULATION		
			Site or Local	**Regional**	**National/ international**
MAGNITUDE					
Minor	**DURATION**	**Long term**	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	**DURATION**	**Long term**	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium
Major	**DURATION**	**Long term**	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

PART C: DETERMINING SIGNIFICANCE RATING

Rate significance based on consequence and probability

		CONSEQUENCE		
		Low	**Medium**	**High**
PROBABILITY (of exposure to impacts)	**Definite**	Medium	Medium	High
	Possible	Low	Medium	High
	Unlikely	Low	Low	Medium

Appendix B. Health Effects of Particulate Air Pollutants

There are an increasing number of research studies highlighting the impact of gases and air pollutants on humans. Many of these emissions, even in small quantities, have adverse effects on workers and neighbouring residents alike.

Particles can be classified by their aerodynamic properties into coarse particles, PM_{10} and fine particles, $PM_{2.5}$ (Harrison & Van Grieken, 1998). The fine particles contain the secondarily formed aerosols such as sulphates and nitrates, combustion particles and re-condensed organic and metal vapours. The coarse particles contain earth crust materials and fugitive dust from roads and industries (Fenger, 2002). Both the amount of fine dust and the chemical and mineralogical composition of the dust will dictate the potential for health impacts (Schwegler, 2006). Nevertheless, fine particles will have a health impact regardless of their mineralogical composition.

Particulate air pollution is associated with respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms and an increase in hospital admissions. Inhalable PM also leads to increased mortality from cardiovascular and respiratory diseases and from lung cancer (WHO, 2013). Particle size is important for health because it controls where in the respiratory system a given particle is deposited. Fine particles are thought to be more damaging to human health than coarse particles, as they are able to penetrate deeper into the lungs (Manahan, 1991). Larger particles are deposited into the extrathoracic part of the respiratory tract while smaller particles are deposited into the smaller airways leading to the respiratory bronchioles (WHO, 2000).

In the past, daily particulate concentrations were in the range 100 to 1000µg/m^3 whereas in more recent times, daily concentrations are between 10 and 100µg/m^3. However, overall, exposure-response can be described as curvilinear, with small absolute changes in exposure at the low end of the curve having similar effects on mortality to large absolute changes at the high end (WHO, 2000). Both short-term and long-term exposure to particulate matter in the air can have health impacts (Table 14).

Table 14: Short-term and long-term health effects associated with exposure to PM (WHO, 2004).

Pollutant	Short-term exposure	Long-term exposure
Particulate matter	• Lung inflammatory reactions • Respiratory symptoms • Adverse effects on the cardiovascular system • Increase in medication usage • Increase in hospital admissions • Increase in mortality	• Increase in lower respiratory symptoms • Reduction in lung function in children • Increase in chronic obstructive pulmonary disease • Reduction in lung function in adults • Reduction in life expectancy • Reduction in lung function development

Short-term exposure

There is good evidence that short-term exposure to particulate matter is associated with health effects (WHO, 2013). Health effects associated with short-term exposure to particulates include increases in lower respiratory symptoms, medication use and small reductions in lung function. Susceptible groups with pre-existing lung or heart disease, as well as elderly people and children, are particularly vulnerable. For example, exposure to particulate matter affects lung development in children, including reversible deficits in lung function as well as chronically reduced lung growth rate and a deficit in long-term lung function (WHO, 2011). There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur (WHO, 2013).

Long-term exposure

Long-term exposure to low concentrations (~10µg/m^3) of particulates is associated with mortality and other chronic effects such as increased rates of bronchitis and reduced lung function (WHO, 2000). Studies have indicated an association between lung function, chronic respiratory disease and airborne particles. Relative risk estimates suggest an 11% increase in cough and bronchitis rates for each 10µg/m^3 increase in annual average particulate concentrations (WHO, 2000). Based on studies conducted in the USA, Europe and Canada, mortality is estimated to increase by 0.2–0.6% per 10 µg/m^3 of PM_{10} (WHO, 2005; Samoli, et al., 2008). $PM_{2.5}$ is a higher risk factor than the coarse part of PM_{10} (particles in the 2.5–10 µm range), especially as a consequence of long-term exposure. Long-term exposure to $PM_{2.5}$ is associated with an increase in the long-term risk of cardiopulmonary mortality by 6–13% per 10 µg/m^3 of $PM_{2.5}$ (Beelen, et al., 2008; Krewski, et al., 2009; Pope III, et al., 2002).

Appendix C. CV Summaries of the Specialists

Dr Martin van Nierop

Dr Martin van Nierop has a doctorate in Chemical Engineering from the University of the Witwatersrand, Johannesburg. While studying for his doctorate, Dr van Nierop was employed at the University as a research officer. Dr van Nierop became interested in research management, and he managed a number of large contract research projects at the University. One of these was a study of the Brown Haze air pollution problem over Cape Town. The project was conducted by the Climatology Research Group under the leadership of Dr Stuart Piketh during 2003. Dr van Nierop became the managing director of Gondwana Environmental Solutions International in 2004, and he has been involved in many atmospheric impact assessment studies since then.

Anja van Basten

Anja van Basten completed her BA Honours degree in Physical Geography, Cum Laude, at the University of the Witwatersrand in 1988. Anja has worked for Gondwana Environmental Solutions since June 2009. In this time, she completed more than 50 Air Quality Impact Assessments with dispersion modelling using both AERMOD and CALPUFF. Emissions sources assessed include mines, tailings storage facilities, foundries, crematoria, asphalt plants, tyre pyrolysis plants, charcoal plants, landfills, organic chemicals industries, glass manufacturers, and residential, commercial, and industrial developments. Other environmental projects have included a bottom-up vehicle emissions inventory; provincial emissions inventories; a wastewater treatment works odour assessment; and air quality management plans, dust management plans and environmental management plans at facility, municipal and provincial levels.

Appendix D. Declarations of Independence

I, Martin van Nierop, declare that:

- I act as the independent air quality practitioner in this application.
- I have expertise in conducting air quality impact assessments, including knowledge of the National Environmental Management Act (NEMA) (Act No. 107, 1998) and its amendments, the Environmental Impact Assessment (EIA) Regulations, as amended (Government Notice No. R982, 2014; Government Notice No. 326, 2017) and any guidelines that have relevance to the proposed activity.
- I will comply with the NEMA, and the EIA Regulations.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that ar*e not favourable to the application*.
- I will take into account, to the extent possible, the matters listed in the National Environmental Management: Air Quality Act, 2004 (NEM:AQA) (Act No. 39, 2004); Listed Activities established in terms of the NEM:AQA (Government Notice No. 248, 2010; Government Notice No. 551, 2015); National Ambient Air Quality Standards (NAAQS) established in terms of the NEM:AQA (Government Notice No. 1210, 2009; Government Notice No. 486, 2012); Priority Areas established in terms of the NEM:AQA (Government Notice No. 365, 2006; Government Notice No. 1123, 2007; Government Notice No. 494, 2012); and Regulations Regarding Air Dispersion Modelling (Government Notice No. R533, 2014) developed in terms of the NEM:AQA, when preparing the Air Quality Impact Assessment report relating to the application.
- I undertake to disclose to the applicant, registered interested and affected parties 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 declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- 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.
- All the information submitted by me for the purposes of the application is true and correct to the best of my knowledge.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 48(1)(a) of the EIA Regulations, as amended, 2017 (Government Notice No. R982, 2014; Government Notice No. 326, 2017).

SIGNATURE: 

I, Anja van Basten, declare that:

- I act as the independent air quality practitioner in this application.
- I have expertise in conducting air quality impact assessments, including knowledge of the National Environmental Management Act (NEMA) (Act No. 107, 1998) and its amendments, the Environmental Impact Assessment (EIA) Regulations, as amended (Government Notice No. R982, 2014; Government Notice No. 326, 2017) and any guidelines that have relevance to the proposed activity.
- I will comply with the NEMA, and the EIA Regulations.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that ar*e not favourable to the application*.
- I will take into account, to the extent possible, the matters listed in the National Environmental Management: Air Quality Act, 2004 (NEM:AQA) (Act No. 39, 2004); Listed Activities established in terms of the NEM:AQA (Government Notice No. 248, 2010; Government Notice No. 551, 2015); National Ambient Air Quality Standards (NAAQS) established in terms of the NEM:AQA (Government Notice No. 1210, 2009; Government Notice No. 486, 2012); Priority Areas established in terms of the NEM:AQA (Government Notice No. 365, 2006; Government Notice No. 1123, 2007; Government Notice No. 494, 2012); and Regulations Regarding Air Dispersion Modelling (Government Notice No. R533, 2014) developed in terms of the NEM:AQA, when preparing the Air Quality Impact Assessment report relating to the application.
- I undertake to disclose to the applicant, registered interested and affected parties 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 declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- 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.
- All the information submitted by me for the purposes of the application is true and correct to the best of my knowledge.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of Regulation 48(1)(a) of the EIA Regulations, as amended, 2017 (Government Notice No. R982, 2014; Government Notice No. 326, 2017).

SIGNATURE:



Appendix E. Particle Size Distribution of a Gauteng TSF.

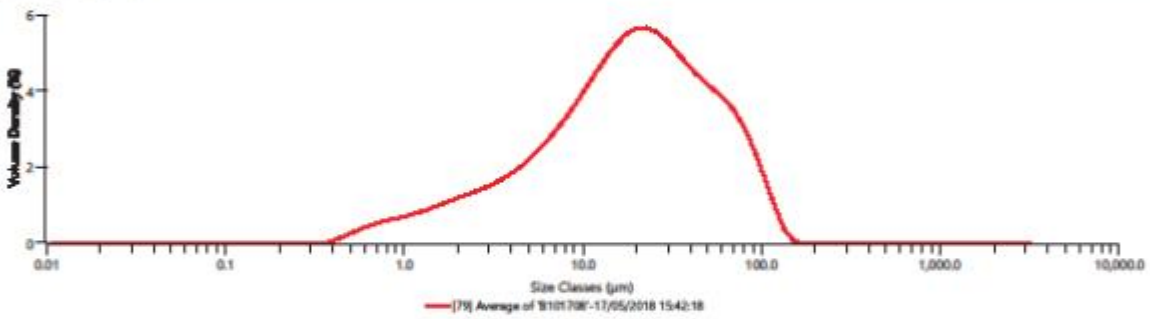
Micron Scientific

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Measurement Details		Measurement Details	
Sample Name	Average of 'B101708'	**Measurement Date Time**	17/05/2018 15:42:18
SDS	3540	**Analysis Date Time**	17/05/2018 15:42:18
SOP File Name	Default + 60us.msop	**Original Record Number**	79
Analysis		**Analysis**	
Particle Name	Default 1.0	**Particle Refractive Index**	1,520
Dispersant Name	Water	**Dispersant Refractive Index**	1,330
Particle Absorption Index	1,000	**Laser Obscuration**	6,60 %
Weighted Residual	0,89 %	**Scattering Model**	Mie
Analysis Model	General Purpose	**Analysis Sensitivity**	Normal
Result		**Result**	
Concentration	0,0058 %	**Span**	3,376
Uniformity	1,002	**Result Units**	Volume
Specific Surface Area	812,0 m^2/kg	**Dv (10)**	2,94 µm
D [3,2]	7,04 µm	**Dv (50)**	18,9 µm
D [4,3]	27,5 µm	**Dv (90)**	66,7 µm

Frequency (compatible)



Result

Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under
0,0100	0,00	0,0995	0,00	0,991	2,44	9,86	29,36	98,1	97,51	976	100,00
0,0114	0,00	0,113	0,00	1,13	3,04	11,2	32,78	111	98,93	1110	100,00
0,0129	0,00	0,128	0,00	1,28	3,70	12,7	36,53	127	99,74	1260	100,00
0,0147	0,00	0,146	0,00	1,45	4,44	14,5	40,61	144	100,00	1430	100,00
0,0167	0,00	0,166	0,00	1,65	5,25	16,4	44,98	163	100,00	1630	100,00
0,0189	0,00	0,188	0,00	1,88	6,16	18,7	49,57	186	100,00	1850	100,00
0,0215	0,00	0,214	0,00	2,13	7,14	21,2	54,28	211	100,00	2100	100,00
0,0244	0,00	0,243	0,00	2,42	8,20	24,1	59,02	240	100,00	2390	100,00
0,0278	0,00	0,276	0,00	2,75	9,35	27,4	63,67	272	100,00	2710	100,00
0,0315	0,00	0,314	0,00	3,12	10,58	31,1	68,14	310	100,00	3080	100,00
0,0358	0,00	0,357	0,00	3,55	11,92	35,3	72,36	352	100,00	3500	100,00
0,0407	0,00	0,405	0,00	4,03	13,39	40,1	76,33	400	100,00		
0,0463	0,00	0,460	0,10	4,58	15,00	45,6	80,06	454	100,00		
0,0526	0,00	0,523	0,29	5,21	16,79	51,8	83,58	516	100,00		
0,0597	0,00	0,594	0,57	5,92	18,79	58,9	86,92	586	100,00		
0,0679	0,00	0,675	0,95	6,72	21,01	66,9	90,07	666	100,00		
0,0771	0,00	0,767	1,39	7,64	23,50	76,0	92,97	756	100,00		
0,0876	0,00	0,872	1,89	8,68	26,28	86,4	95,49	859	100,00		

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Appendix F. Particle Size Distribution of a Gauteng Soil Sample.

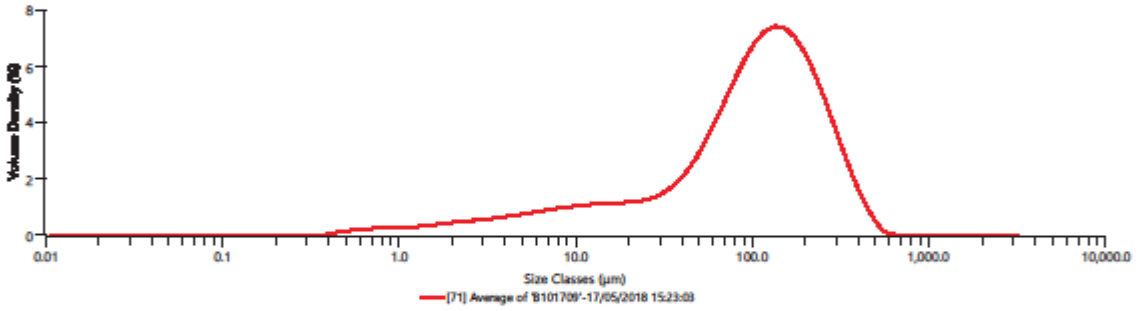
Micron Scientific

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Measurement Details		Measurement Details	
Sample Name	Average of 'B101709'	**Measurement Date Time**	17/05/2018 15:23:03
SDS	3538	**Analysis Date Time**	17/05/2018 15:23:03
SOP File Name	Default + 60us.msop	**Original Record Number**	71
Analysis		**Analysis**	
Particle Name	Default 1.0	**Particle Refractive Index**	1,520
Dispersant Name	Water	**Dispersant Refractive Index**	1,330
Particle Absorption Index	1,000	**Laser Obscuration**	13,02 %
Weighted Residual	0,19 %	**Scattering Model**	Mie
Analysis Model	General Purpose	**Analysis Sensitivity**	Normal
Result		**Result**	
Concentration	0,0282 %	**Span**	2,406
Uniformity	0,728	**Result Units**	Volume
Specific Surface Area	333,5 m^2/kg	**Dv (10)**	9,53 µm
D [3,2]	17,1 µm	**Dv (50)**	106 µm
D [4,3]	125 µm	**Dv (90)**	265 µm

Frequency (compatible)



Result

Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under	Size (µm)	% Volume Under
0,0100	0,00	0,0995	0,00	0,991	1,18	9,86	10,23	98,1	46,41	976	100,00
0,0114	0,00	0,113	0,00	1,13	1,41	11,2	11,11	111	52,16	1110	100,00
0,0129	0,00	0,128	0,00	1,28	1,65	12,7	12,01	127	58,24	1260	100,00
0,0147	0,00	0,146	0,00	1,45	1,92	14,5	12,94	144	64,45	1430	100,00
0,0167	0,00	0,166	0,00	1,65	2,23	16,4	13,88	163	70,61	1630	100,00
0,0189	0,00	0,188	0,00	1,88	2,56	18,7	14,84	186	76,50	1850	100,00
0,0215	0,00	0,214	0,00	2,13	2,94	21,2	15,81	211	81,94	2100	100,00
0,0244	0,00	0,243	0,00	2,42	3,34	24,1	16,82	240	86,77	2390	100,00
0,0278	0,00	0,276	0,00	2,75	3,77	27,4	17,88	272	90,87	2710	100,00
0,0315	0,00	0,314	0,00	3,12	4,23	31,1	19,04	310	94,16	3080	100,00
0,0358	0,00	0,357	0,00	3,55	4,73	35,3	20,36	352	96,64	3500	100,00
0,0407	0,00	0,405	0,00	4,03	5,26	40,1	21,92	400	98,33		
0,0463	0,00	0,460	0,07	4,58	5,83	45,6	23,80	454	99,36		
0,0526	0,00	0,523	0,19	5,21	6,44	51,8	26,12	516	99,88		
0,0597	0,00	0,594	0,35	5,92	7,11	58,9	28,95	586	99,97		
0,0679	0,00	0,675	0,54	6,72	7,82	66,9	32,38	666	100,00		
0,0771	0,00	0,767	0,74	7,64	8,58	76,0	36,44	756	100,00		
0,0876	0,00	0,872	0,96	8,68	9,38	86,4	41,14	859	100,00		

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APPENDIX D:

Specialist Studies

- ❖ Appendix D5 – Surface Water

Surface Water Hydrological Study for the Proposed Valley Silts Expansion Project

Project Number:

KON008

Prepared for:

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February 2025

DOCUMENT CONTROL

Project Name	Surface Water Hydrological Study for the Proposed Valley Silts Expansion Project
Report Type	Hydrological Study
Client	Kongiwe Environmental (Pty) Ltd
Project Number	KON036
Report Number	02
Report Status	Draft
Submission Date	February 2025
Author	Andy Pirie (Senior Hydrologist, M.Sc., *Pr.Sci.Nat.114988*)
Author Signature	

DISCLAIMER

The opinions, results and findings expressed in this report, are based on the author's best scientific knowledge, as well as on the information supplied to Hydrospatial as part of the project. The accuracy of the results and conclusions in this report, are reliant on the accuracy and completeness of the supplied information. Hydrospatial does not accept responsibility for any errors or omissions in the supplied information, and does not accept any consequential liability arising from commercial decisions or actions resulting from them.

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DECLARATION OF INDEPENDENCE

I, Andy Pirie declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have the expertise in conducting the specialist study relevant to this application, including knowledge of the various Acts, regulations and any guidelines that have relevance to the proposed project;
- I will comply with the Acts, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Andy Pirie
Senior Hydrologist
Pr.Sci.Nat (reg no. 114988)

ACRONYMS AND ABBREVIATIONS

ADT	Articulated Dump Truck
AMD	Acid Mine Drainage
BPG	Best Practice Guideline
CBD	Central Business District
COD	Chemical Oxygen Demand
CoJ	City of Johannesburg
CV	Curriculum Vitae
CMA	Catchment Management Agencies
DEM	Digital Elevation Model
DTM	Digital Terrain Model
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EC	Electrical Conductivity
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
GIS	Geographical Information Systems
GN R704	Government Notice No. 704
ha	Hectares
km	Kilometres
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mamsl	metres above mean sea level
mcm	Million cubic metres
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MR	Mining Right
m^2	Square metres
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
Pr.Sci.Nat.	Professional Natural Scientist
SANRAL	South African National Roads Agency Limited
SANS	South African National Standard
SWMP	Stormwater Management Plan
SANS	South African National Standards
SACNASP	South African Council for Natural Scientific Professions
SCS	Soil Conservation Service
SDF	Standard Design Flood
S-PAN	Symon's Pan
SS	Suspended Solids

Tc	Time of concentration
TDS	Total Dissolved Solids
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
WR2012	Water Resources of South Africa, 2012 Study
WUL	Water Use Licence
WULA	Water Use Licence Application
WMAs	Water Management Areas
WRC	Water Research Commission

EXECUTIVE SUMMARY

Introduction and Background

Hydrospatial (Pty) Ltd was appointed by Kongiwe Environmental (Pty) Ltd to conduct a surface water hydrological study for the proposed Valley Silts Expansion Project (hereafter referred to as the "Project"). This report provides the surface water specialist study required for the Environmental Impact Assessment (EIA) and Water Use Licence Application (WULA) processes.

The Project is located 5.5 kilometres (km) south-west of the Johannesburg Central Business District (CBD) area, and 8 km south-east of Florida in the Gauteng Province, between Nasrec Road in the west and Crownwood Road in the east.

Ergo Mining (Pty) Ltd (hereafter "Ergo"), a subsidiary of DRDGOLD Limited, obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of NASREC near Booysens Reserve, in Johannesburg. This is referred to as the Valley Silts Project. The mining authorisation for the Valley Silts Project, falls within Ergo's Mining Right (MR): GP 184 MR, and has been an ongoing operation for a period of time, and as such, to maintain an efficient mining operation, as well as a sustainable feed source to the process plant, it is necessary to prepare for the recovery of the remaining silts in the Russell Stream.

The Valley Silts resource has three primary sectors. The current approved mining area is Sector 1 and extends from the old dam wall to the end of the stockpile area near Crownwood Road in the east. Construction and site establishment at Sector 1 commenced in October 2022, with the mining of silt beginning in May 2023. The Expansion Project will consist of Sector 2 and Sector 3. Sector 2 consists of mining blocks N1 to N20, which extends from the old dam wall to Nasrec Road in the west. Sector 3 consists of mining blocks N21 and N22, located on either side of Crownwood Road in the east.

The gold bearing silts will be mechanically excavated from the Project area. Excavators will be used to excavate the silt, which will be loaded onto 30-ton Articulated Dump Trucks (ADTs). The ADTs will transport the silt to designated stockpile areas. Silts will have up to a 40% moisture content when hauled and are not expected to be fully dried out, but will be dried on the stockpile areas. The dried silts will be loaded onto tipper trucks and transported to the City Deep plant for pre-processing. The trucks transporting the material will follow Crownwood Road until it reaches Main Reef Road and then join the M2 East. The trucks will then follow the M2 until they reach Heidelberg Road which is followed to the City Deep Plant where they will be offloaded.

The following infrastructure is proposed:

- Mining blocks (N1 to N22);
- Drying stockpiles (8 locations);
- Stormwater control berms/paddocks;
- River crossings (8); and

- Haul and site roads.

Exploration trenching will determine the depositional flank extents, and all material will be removed from the natural flow path as well as the flanks. Since mining exceeds the delivery rate to the process plant, stockpile areas are required for temporary storage. The stockpiles will be moved in a sequential manner due to the moisture content, the drying process, as well as oxidation. Paddocks and stormwater controls are required to protect the river from any extraneous ingress. The current facilities in Sector 1 will be utilised for the remaining expansion areas. Hard park, cut off trenches and sumps are pre-installed and are appropriate for further use. Existing silt traps will move as the mining blocks progress. The existing sump will discharge to the stream as is the case with the current operation.

Once the silts have been removed from the targeted areas, decommissioning will commence with the removal of all associated vehicles and infrastructure from the site, as well as the removal of berms, paddocks, diversion trenches, infrastructure and anything else installed during construction and operational phases. Rehabilitation will take place as and when excavation progresses to other target areas. Care will be taken to ensure that the material and excavated soil required for backfilling are free of contamination from hydrocarbons. Ergo aims to rehabilitate the Valley Silts area by shaping the areas where silt was removed and making the area free draining. Thereafter, appropriate species will be planted to stabilise the soil.

The anticipated life span of the Project is approximately 5 years. The silt removal is planned to take place over a three-year period, with rehabilitation taking up to 2 years.

Scope of Work

The scope of work included the following:

- Description of the baseline (current) surface water hydrology in terms of water quality and quantity. The purpose of the baseline is to ensure that a thorough understanding of the pre-mining surface water conditions is provided;
- Development of conceptual Stormwater Management Plans (SWMP) in accordance with the DWS BPG G1: Storm Water Management and GN R704 regulations. The primary purpose of the SWMP is to ensure that clean (non-impacted mine water) and dirty water (mine impacted water) are clearly separated in accordance with the above-mentioned guideline and regulations;
- An assessment of the potential surface water impacts and possible mitigation measures; and
- Development of monitoring plans that can be used to monitor potential impacts resulting from the proposed Project.

Baseline Hydrology

The area has a Mean Annual Precipitation (MAP) of 799 mm. Rainfall is highest over the summer months of November to March, and lowest over the winter months of May to September. The Mean Annual Evaporation (MAE) of the area is 1 272 mm. Evaporation is highest over the months of September to March, and lowest over the cooler months of April to August.

The Project is located in the Vaal WMA, within quaternary catchment C22A in the Klip River Catchment. A number of small non-perennial tributaries drain the surrounding suburbs, industrial areas, mine dumps, and the western portion of the Johannesburg CBD into the Russell Stream. The Russell Stream flows in a north-westerly direction and is a tributary of the Klip River, which flows into the Vaal River above the Vaal Barrage, near the town of Vereeniging. The accumulation of sediment over years has resulted in the Russell Stream being deflected to the north. Furthermore, the large amount of sediment that has accumulated in the Russell Stream valley has resulted in regular flooding, particularly at the suburb of Riverlea.

The topography varies from 1 800 metres above mean sea level (mamsl) in north-eastern corner of the Russell Stream catchment, to 1 640 mamsl towards the west at the outlet of the catchment. The catchment is dominated by flat slopes (slopes less than 10 %), with an average catchment slope of 7.5 %. Moderate slopes (10 to 30 %) occur along the sides of the Russell Stream valley, whilst steep slopes in excess of 30 %, occur along the sides of the old mining dumps within the catchment.

The Russell Stream catchment is dominated by residential, industrial and commercial areas. Several historic mine dumps occur within the catchment. Reclamation mining activities (mining of old dumps) are evident along the northern boundary of the Project area.

The WRSM/Pitman model was set up to estimate the monthly runoff for the Russell Stream catchment. The catchment has an estimated Mean Annual Runoff (MAR) of 9.15 million cubic metres (mcm). Runoff is highest over the high rainfall months of November to March, and lowest over the months of May to September.

Surface water quality data for the area was obtained from the following sources:

- Ergo's quarterly water quality monitoring programme;
- Monitoring undertaken by the City of Johannesburg (CoJ) and DWS along the Russell Stream, which was downloaded from the Klip River Forum website; and
- The Council Geoscience's report: Contamination of wetlands by Witwatersrand gold mines – processes and the economic potential of gold in wetlands (Council for Geosciences, 2005). Water quality and sediment sampling from the report were assessed.

Based on monitoring undertaken by Ergo as well as the DWS, the water quality of the Russell Stream has a neutral pH of approximately 7.2, dissolved salts within the ideal range of the Klip River catchment guideline limits, high nutrient and *E.coli* levels, elevated Suspended Solids, as well as at times elevated metals in terms of Iron, Manganese, Aluminium, Nickel and Arsenic. Uranium was found to be within limits.

Based on the current water quality available, it appears that the current mining operation at Sector 1 is not having a significant impact on the water quality of the Russell Stream. This is likely due to current measures that are implemented onsite, such as berms that contain runoff from dirty areas, as well as silt traps that settle out silt.

Floodline Determination

According to GN R704 Regulations, no infrastructure should be placed within the 1:50 and 1:100 year floodlines, or within a 100 m horizontal distance of a watercourse (whichever is the greatest), unless exemption is obtained from the DWS. The 1:50 and 1:100 year floodlines were determined for the Russell Stream. The following proposed infrastructure is impacted by either the floodlines or 100 m stream buffer:

- Mining blocks N1 – N22;
- Drying stockpiles to the north, south and west of the current mining area as well as to the north of mining block N22;
- All river crossings;
- Sump;
- Overflow channel;
- Channel and two silt traps; and
- Paddocks to the north and south of mining blocks N1-N18.

The following is recommended:

- Berms should be placed along the downslope side of the mining blocks and drying stockpiles to prevent flooding. The berms should be constructed to withstand a 1:100 year flood at a height above the floodline; and
- It is recommended that exemption from GN R704 is applied for, for the infrastructure items listed above, which are located within the floodlines and 100 m watercourse buffer.

Conceptual Stormwater Management Plan

A conceptual SWMP was designed for the mining area as well as for the stockpiling area. The purpose of the SWMP is to ensure that clean and dirty water runoff are adequately separated, in accordance with GN R704 regulations. The SWMP was designed to ensure that clean water is diverted away from dirty areas, and that dirty water runoff from the operational areas is captured, contained and managed.

It is proposed that berms are constructed around the mining blocks, to capture and contain dirty runoff from these areas. Runoff and seepage from the stockpile areas will be captured and contained in downslope paddocks. Upslope clean water runoff will be diverted via berms around the mining and stockpile areas and into the Russell Stream.

Berms are further proposed to be constructed along the banks of the Russell Stream, to prevent flooding of the mining and stockpile areas.

Surface Water Impact Assessment

The impact assessment indicated that the identified impacts would have a medium significance pre-mitigation, and that they can be mitigated to a low significance post-mitigation. More details on the impact assessment can be found under section 6.

Monitoring Plans

Monitoring plans for surface water quality and stormwater infrastructure are provided under section 7.

Conclusions and Recommendations

In conclusion, the most important aspect to prevent negative impacts from a surface water perspective, is to ensure that a sound stormwater management plan is implemented prior to the commencement of mining activities, in accordance with the conditions stipulated in GN R704. Maintenance of stormwater measures is of utmost importance and should be conducted as outlined in section 7. Furthermore, water quality monitoring must continue upstream and downstream of the proposed mining and stockpiling areas. The removal of the silt is expected to have a positive impact in the long-term on the water quality and flood levels of the Russell Stream, provided that rehabilitation is successfully implemented.

The following provides a summary of the key recommendations:

- The SWMP detailed under section 5 is implemented, and that all conditions specified in GN R704 are strictly adhered to;
- It is recommended that exemption from GN R704 is applied for, for the mining and stockpiling areas, which are located within the floodlines and 100 m stream buffer;
- The recommendations and mitigation measures provided under section 6 are implemented; and
- The monitoring plans provided under section 7 are implemented.

1 INTRODUCTION AND BACKGROUND

1.1 Terms of Reference

Hydrospatial (Pty) Ltd was appointed by Kongiwe Environmental (Pty) Ltd to conduct a surface water hydrological study for the proposed Valley Silts Expansion Project (hereafter referred to as the "Project"). This report provides the surface water specialist study required for the Environmental Impact Assessment (EIA) and Water Use Licence Application (WULA) processes.

1.2 Project Location

The Project is located 5.5 kilometres (km) south-west of the Johannesburg Central Business District (CBD) area, and 8 km south-east of Florida in the Gauteng Province. The Project area is located within the Russell Stream valley, between Nasrec Road in the west and Crownwood Road in the east. Figure 1-1 indicates the location of the Project.

1.3 Project Description

Ergo Mining (Pty) Ltd (hereafter "Ergo"), a subsidiary of DRDGOLD Limited, obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of NASREC near Booysens Reserve, in Johannesburg. This is referred to as the Valley Silts Project. The mining authorisation for the Valley Silts Project, falls within Mining Right (MR): GP 184 MR, and has been an ongoing operation for a period of time, and as such, to maintain an efficient mining operation, as well as a sustainable feed source to the process plant, it is necessary to prepare for the recovery of the remaining silts in the Russell Stream.

The Valley Silts resource has three primary sectors (please refer to Figure 1-2). The current approved mining area is Sector 1 and extends from the old dam wall to the end of the stockpile area near Crownwood Road in the east. Construction and site establishment at Sector 1 commenced in October 2022, with the mining of silt beginning in May 2023. The Expansion Project will consist of Sector 2 and Sector 3. Sector 2 consists of mining blocks N1 to N20, which extends from the old dam wall to Nasrec Road in the west. Sector 3 consists of mining blocks N21 and N22, located on either side of Crownwood Road in the east.

1.3.1 Mining Process

The gold bearing silts will be mechanically excavated from the Project area. Excavators will be used to excavate the silt, which will be loaded onto 30-ton Articulated Dump Trucks (ADTs). The ADTs will transport the silt to designated stockpile areas. Silts will have up to a 40% moisture content when hauled and are not expected to be fully dried out but will be dried on the stockpile areas. The dried silts will be loaded onto tipper trucks and transported to the City Deep plant for pre-processing. The trucks transporting the material will follow Crownwood Road until it reaches Main Reef Road and then join the M2 East. The trucks will then follow the M2 until they reach Heidelberg Road which is followed to the City Deep Plant where they will be offloaded.

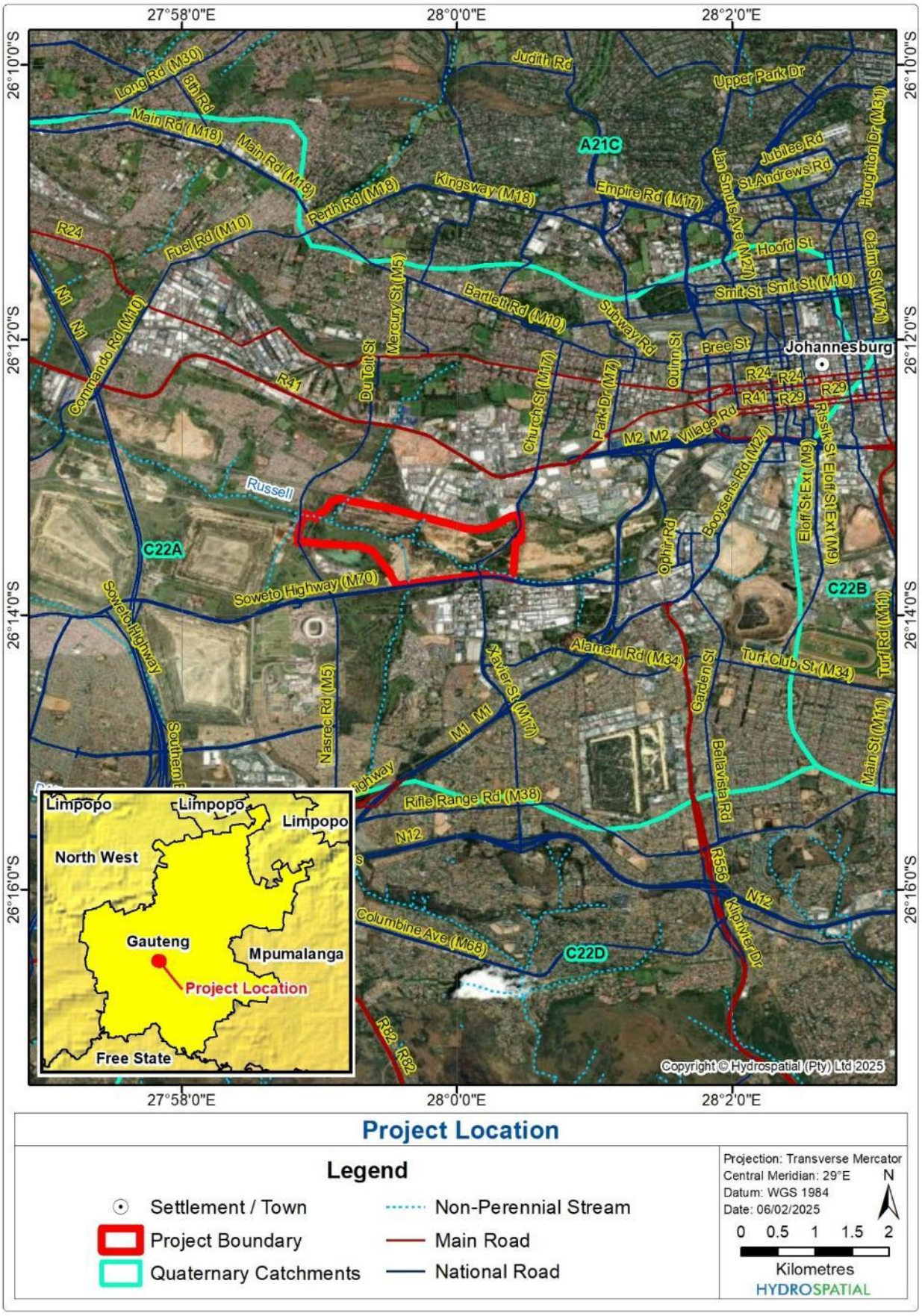


Figure 1-1: Project location

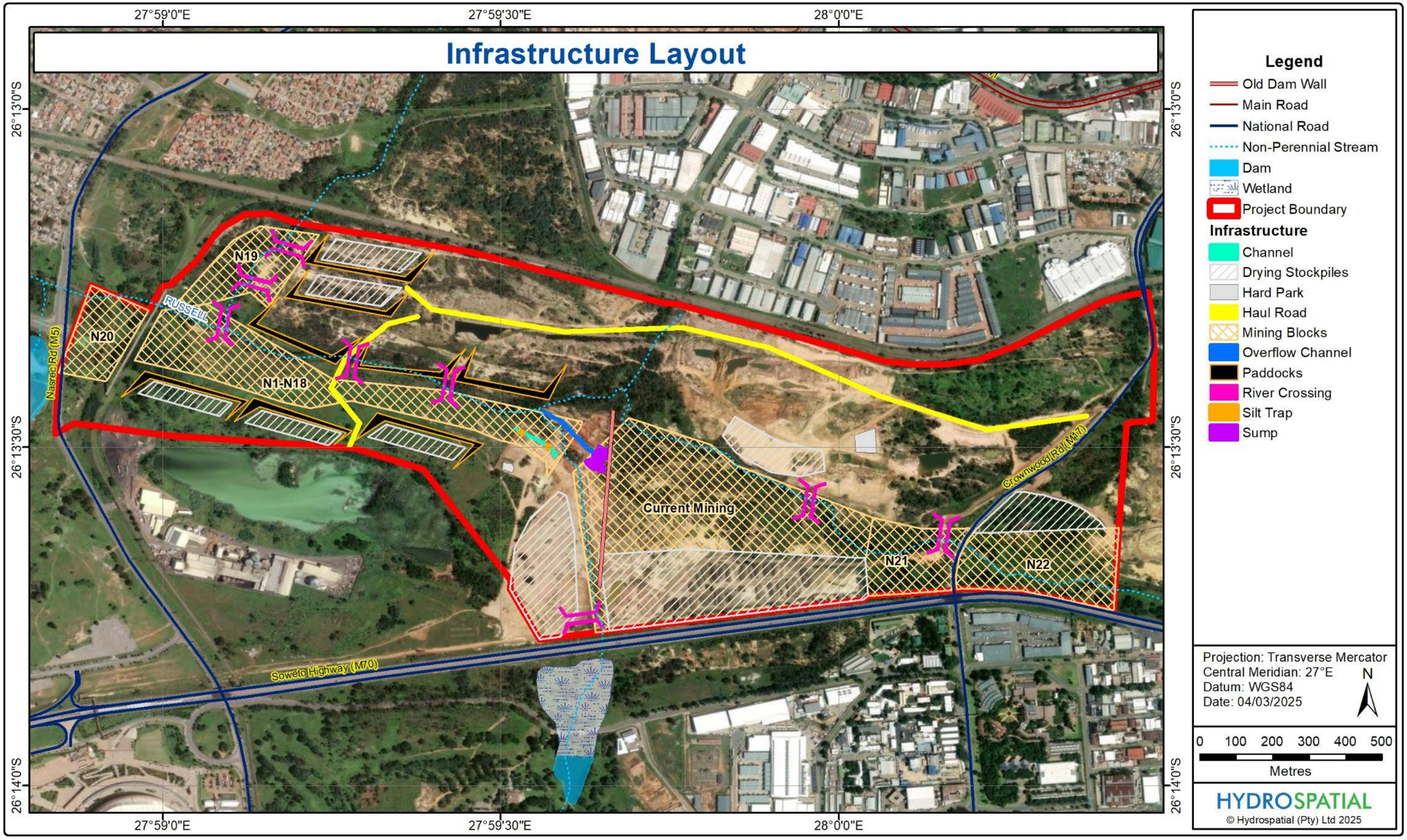


Figure 1-2: Infrastructure layout

1.3.2 Proposed Infrastructure

The following infrastructure is proposed:

- Mining blocks (N1 to N22);
- Drying stockpiles (8 locations);
- Stormwater control berms/paddocks;
- River crossings (8); and
- Haul and site roads.

Exploration trenching will determine the depositional flank extents, and all material will be removed from the natural flow path as well as the flanks. Since mining exceeds the delivery rate to the process plant, stockpile areas are required for temporary storage. The stockpiles will be moved in a sequential manner due to the moisture content, the drying process, as well as oxidation. Paddocks and stormwater controls are required to protect the river from any extraneous ingress, and these will be installed as indicated on Figure 1-2. The current facilities in Sector 1 will be utilised for the remaining expansion areas. Hard park, cut off trenches and sumps are pre-installed and are appropriate for further use. Existing silt traps will move as the mining blocks progress. The existing sump will discharge to the stream as is the case with the current operation.

1.3.3 Site Access

The Valley Silts Project is located within the Russell Stream valley, near Booysens Reserve. The project area stretches from New Canada Road, following the valley south east, past the Nasrec Road bridge and past Crownwood Road until the stream meets the M1.

Access to the site is directly off Crownwood Road. This access to the site is approximately 440 m to the south of the intersection with Jupiter Road. The access is 10 m wide, with one lane ‘IN’ and one lane ‘OUT’. Traffic from Crownwood Road (M17) has the right of way and a ‘STOP’ condition is implemented.

As far as possible, existing access roads will be utilised, and where this is not possible, these will be constructed as a two-by-two roadway, operating in both directions. Intersections will be properly designed to provide safe entry and exit into the mining area. Approvals from the provincial road’s authority will be obtained where necessary.

1.3.4 Life of Mine

The anticipated life span of the Project is approximately 5 years. The silt removal is planned to take place over a three-year period, with rehabilitation taking up to 2 years.

1.3.5 Water Management

The Project will not require water for the mechanical excavation of gold bearing silts. Potable drinking water will be sourced from the municipality and will be available to employees on site.

The clean stormwater runoff from the area to the south of the drying sites will be diverted using a stormwater diversion drain (or berm) around the area to the west. Stormwater from the north will flow via properly constructed inlets into the Russell Stream. Temporary berms will be constructed along the banks of the channel. These banks will be raised in sections to retain

flood flow and prevent flooding of any of the reclamation area during excessive rainfall. The raised riverbanks and berms will be able to contain a 1:50 year storm event.

Dirty stormwater will be contained in existing paddocks on the drying sites. Should the paddocks reach capacity, the excess stormwater will need to be released into the Russell Stream, as is done at the current mining operation.

Stormwater from the mined-out areas flows to a sump. Water from the sump is used for dust suppression. Should the sump reach capacity it will overflow via a channel into the Russell Stream, as is currently done at the existing operation.

1.3.6 Waste Management

No domestic or industrial disposal sites are required. There will be bins on-site for any domestic waste generated.

1.3.7 Rehabilitation

Once the silts have been removed from the targeted areas, decommissioning will commence with the removal of all associated vehicles and infrastructure from the site, as well as the removal of berms, paddocks, diversion trenches, infrastructure, and anything else installed during construction and operational phases.

Regarding the safety of both the public and the employees, Ergo has completed a workers' safety assessment as well as a public safety assessment. The public safety assessment for all the proposed operations of Ergo are currently being updated. This is being done in relation to the requirements of the National Nuclear Regulator.

Rehabilitation will take place as and when excavation progresses to other target areas. Care will be taken to ensure that the material and excavated soil required for backfilling are free of contamination from hydrocarbons. Ergo aims to rehabilitate the Valley Silts area by shaping the areas where silt was removed and making the area free draining. Thereafter, appropriate species will be planted to stabilise the soil.

Post-decommissioning activities will entail the assessment of rehabilitation and will address any further rehabilitation requirements. Monitoring must occur for at least five years after decommissioning and rehabilitation, or until satisfactory results are achieved.

Maintenance will specifically need to focus on the rehabilitated areas. Furthermore, groundwater and surface water monitoring will have to take place in the area surrounding the Project. It has been recommended that the groundwater is monitored for at least a period of five years on a quarterly basis after closure. The monitoring process will be used to assess whether the rehabilitation process has been successful or not, and to provide an indication that no further deterioration on groundwater quality is foreseen. Water infrastructure (channels, berms and paddocks) should be monitored on a monthly basis during the dry season, and on a weekly basis during the wet season. They should further be monitored immediately after any large storm events. Should blockages, silted up structures or breaches occur, immediate action should be undertaken to remove debris and repair breaches. Monitoring should be undertaken by the onsite Environmental Officer (EO) or maintenance manager.

Maintenance will specifically focus on the rehabilitated in accordance with the approved Environmental Management Programme. Continuous erosion monitoring of rehabilitated areas and slopes should be undertaken and zones with excessive erosion should be identified. The cause of the erosion should be identified and rectified. Zones with erosion will need to be repaired with topsoil.

1.4 Legal Requirements and Guidelines

The following key legislative requirements and guidelines are relevant to this study:

- National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Regulations on the Use of Water for Mining and Related Activities aimed at the Protection of Water Resources (published under Government Notice 704 (GN R704) in Government Gazette 20119, 4 June 1999);
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated Environmental Impact Assessment (EIA) 2014 Regulations;
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); and
- Department of Water and Sanitation (DWS) Best Practice Guideline (BPG) documents.

1.5 Site Investigation

A site investigation was undertaken on 19 November 2024. The purpose of the site investigation was to assess the hydrological characteristics of the Project area.

1.6 Details of the Specialist

The study was carried out by Andy Pirie who is a senior hydrologist at Hydrospatial (Pty) Ltd. Andy graduated with a Master of Science (M.Sc.) in Water Resource Management (cum laude). He has successfully completed numerous surface water hydrological studies for environmental impact assessments and water use licence applications. He is registered as a Professional Natural Scientist (Pr.Sci.Nat) (registration number: 114988) in Water Resources Science with the South African Council for Natural Scientific Professions (SACNASP). Work experience includes rainfall – runoff modelling, floodline determinations, stormwater management plans, water and salt balance modelling, setup of water monitoring networks and programmes, analysis of surface water quality and quantity, and surface water specialist studies for environmental and social impact assessments. He has worked on projects in South Africa, Cameroon, Senegal, Mali, Democratic Republic of the Congo (DRC), Botswana, Zambia and Namibia. A curriculum vitae is provided in Appendix A.

2 SCOPE OF WORK

The scope of work included the following:

- Description of the baseline (current) surface water hydrology in terms of water quality and quantity. The purpose of the baseline is to ensure that a thorough understanding of the pre-mining surface water conditions is provided;

- Development of conceptual Stormwater Management Plans (SWMP) in accordance with the DWS BPG G1: Storm Water Management and GN R704 regulations. The primary purpose of the SWMP is to ensure that clean (non-impacted mine water) and dirty water (mine impacted water) are clearly separated in accordance with the above-mentioned guideline and regulations;
- An assessment of the potential surface water impacts and possible mitigation measures; and
- Development of monitoring plans that can be used to monitor potential impacts resulting from the proposed Project.

3 BASELINE HYDROLOGY

3.1 Climate

3.1.1 Rainfall

Monthly patched rainfall data for weather station 0476040 W, located 7 km north-east of the Project, was adopted to represent the rainfall of the Project area. Monthly rainfall data was available for the period of October 1915 to September 2010, and was downloaded from the WR2012 website. The mean monthly rainfall is indicated in Figure 3-1. The area has a Mean Annual Precipitation of 799 mm. Rainfall is highest over the summer months of November to March and lowest over the months of May to September.

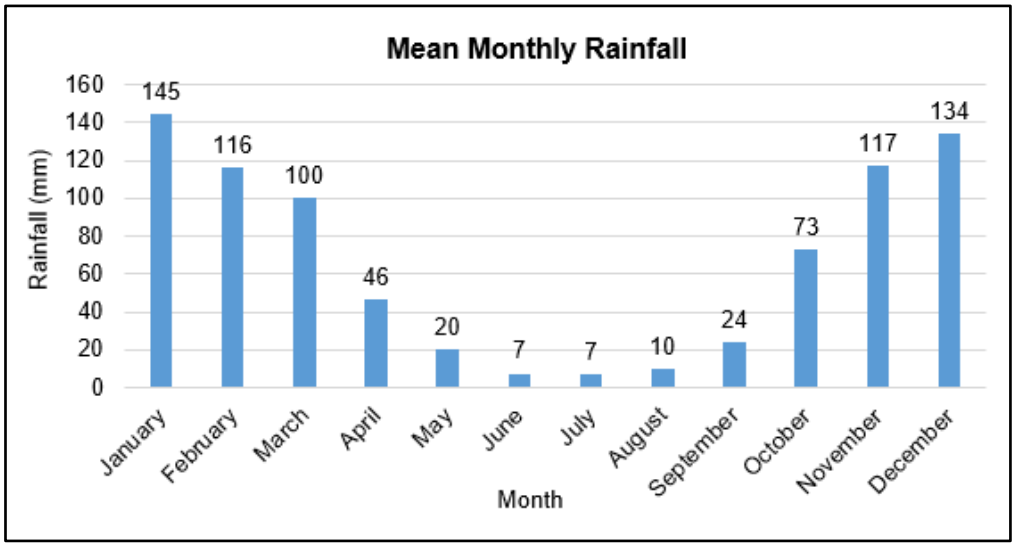


Figure 3-1: Monthly rainfall data for the Project area

The storm rainfall depths for the centre position of the Project area were extracted from the Design Rainfall Estimation in South Africa software programme (Smithers and Schulze, 2002). The programme uses the six closest rainfall stations to a user specified coordinate, to calculate the storm rainfall depths. The extracted storm rainfall depths for the Project are indicated in Table 3-1.

Table 3-1: Storm rainfall depths for the Project area

Storm Duration	Return Period / Storm Rainfall Depth (mm)						
min / hr / day	1:2 yr	1:5 yr	1:10 yr	1:20 yr	1:50 yr	1:100 yr	1:200 yr
5 min	9	12	15	17	21	25	28
10 min	13	18	21	25	31	36	41
15 min	16	22	26	31	38	44	50
30 min	20	28	34	40	49	56	65
45 min	23	32	39	46	56	65	75
1 hr	26	36	43	51	63	72	83
1.5 hr	30	41	50	59	72	84	96
2 hr	33	46	55	65	80	93	106
4 hr	40	55	66	78	96	111	127
6 hr	44	61	74	87	107	124	142
8 hr	48	66	80	94	115	133	153
10 hr	51	70	84	100	122	141	162
12 hr	53	73	88	105	128	148	170
16 hr	57	79	95	113	138	160	183
20 hr	61	84	101	120	147	169	194
24 hr	64	88	106	125	154	178	204
1 day	55	76	92	109	133	154	177
2 day	68	94	113	134	164	190	218
3 day	77	106	128	151	185	214	246
4 day	83	115	139	165	202	233	268
5 day	89	123	149	176	216	249	286
6 day	94	130	157	186	228	263	302
7 day	99	136	164	195	239	276	316

3.1.2 Evaporation

Evaporation data was obtained from the DWS weather station C2E007, located 18 km south-west of the Project area. C2E007 measures evaporation using a Symon's Pan (S-Pan). S-Pan evaporation measurements are not a true reflection of evaporation from natural open water bodies, as the water temperatures in the S-Pan are higher, resulting in higher evaporation rates. To convert S-Pan measurements to open water evaporation, monthly open water

evaporation conversion factors were used, which were obtained from the WR2012 study. The adopted monthly evaporation for the Project is indicated in Table 3-2. Evaporation is highest over the months of September to March, and lowest over the cooler months of April to August.

Table 3-2: Symons Pan and open water evaporation for the Project

Month	S-Pan Evaporation (mm)	Evaporation Factor	Open Water Evaporation (mm)
January	169	0.84	142
February	138	0.88	122
March	129	0.88	113
April	102	0.88	89
May	85	0.87	74
June	68	0.85	57
July	75	0.83	63
August	106	0.81	86
September	145	0.81	117
October	163	0.81	132
November	166	0.82	136
December	170	0.83	141
Total	**1 515**	N/A	**1 272**

3.2 Hydrological Setting

3.2.1 Regional Catchments and Drainage

The DWS and the Surface Water Resources of South Africa studies (WR90, WR2005 and WR2012) have divided South Africa into primary, secondary, tertiary and quaternary catchments. Primary catchments are the largest defined catchments for South Africa, of which there are 22, and are assigned a letter ranging from A – X (excluding O). Secondary catchments are subdivisions of the primary catchments, and are the second largest catchments in South Africa, and are assigned the primary catchment letter within which they are located, and a number e.g. A5 (secondary catchment 5 located within primary catchment A). Similarly, tertiary catchments are subdivisions of secondary catchments, and are represented for example by A53 (tertiary catchment 3 located within secondary catchment A5). Lastly, quaternary catchments are the smallest defined catchments and are assigned the tertiary catchment number, along with a quaternary catchment letter e.g. A53D (quaternary catchment D located within tertiary catchment A53).

Further to the above, the DWS has divided South Africa into 9 Water Management Areas (WMAs), which are managed by separate Catchment Management Agencies (CMA). The 9

WMAs include the Limpopo, Olifants, Inkomati-Usuthu, Pongola-Mtamvuna, Vaal, Orange, Mzimvubu-Tsitsikamma, Breede-Gouritz and Berg-Olifants.

The Project is located in the Vaal WMA, within quaternary catchment C22A in the Klip River Catchment. A number of small tributaries drain the surrounding suburbs, industrial areas and the western portion of the Johannesburg CBD into the Russell Stream. The Russell Stream flows through the Project area in a north-westerly direction and is a tributary of the Klip River, which flows into the Vaal River above the Vaal Barrage, near the town of Vereeniging. The accumulation of sediment over years has resulted in the Russell Stream being deflected to the north of its original course. Furthermore, the large amount of sediment that has accumulated in the Russell Stream valley has resulted in regular flooding, particularly at the suburb of Riverlea.

3.2.2 Topography

Figure 3-3 indicates the topography of the Russell Stream catchment. The elevation varies from 1 800 metres above mean sea level (mamsl) in north-eastern corner of the catchment, to 1 640 mamsl towards the west at the outlet of the catchment. The catchment is dominated by flat slopes (slopes less than 10 %), with an average catchment slope of 7.5 %. Moderate slopes (10 to 30 %) occur along the sides of the Russell Stream valley, whilst steep slopes in excess of 30 %, occur along the sides of the old mining dumps within the catchment area.

3.2.3 Land Cover/Use

The Russell Stream catchment is dominated by residential, industrial and commercial areas. Several historic mine dumps occur within the catchment. Reclamation mining activities (mining of old dumps) are evident along the northern boundary of the Project area.

3.3 Surface Water Runoff

Gauging stations with streamflow data were not available for the Russell Stream, and therefore, the WRSM/Pitman model was setup to estimate the monthly runoff for the catchment. The simulated monthly runoff was compared to measured flows at surrounding gauging stations with good comparison. The simulated mean monthly runoff is indicated in Figure 3-2. The catchment has an estimated Mean Annual Runoff (MAR) of 9.15 million cubic metres (mcm). Runoff is highest over the high rainfall months of November to March, and lowest over the months of May to September.

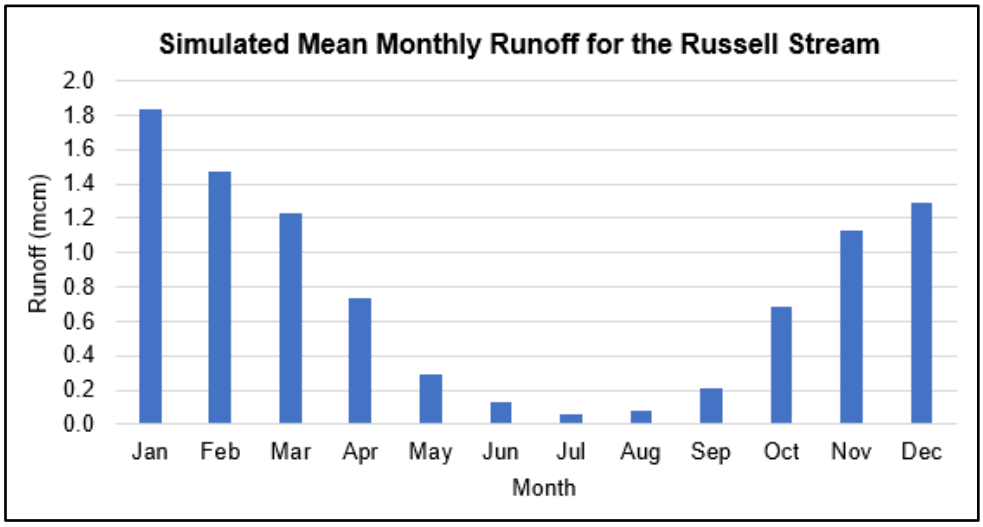


Figure 3-2: Simulated mean monthly runoff for the Russell Stream catchment

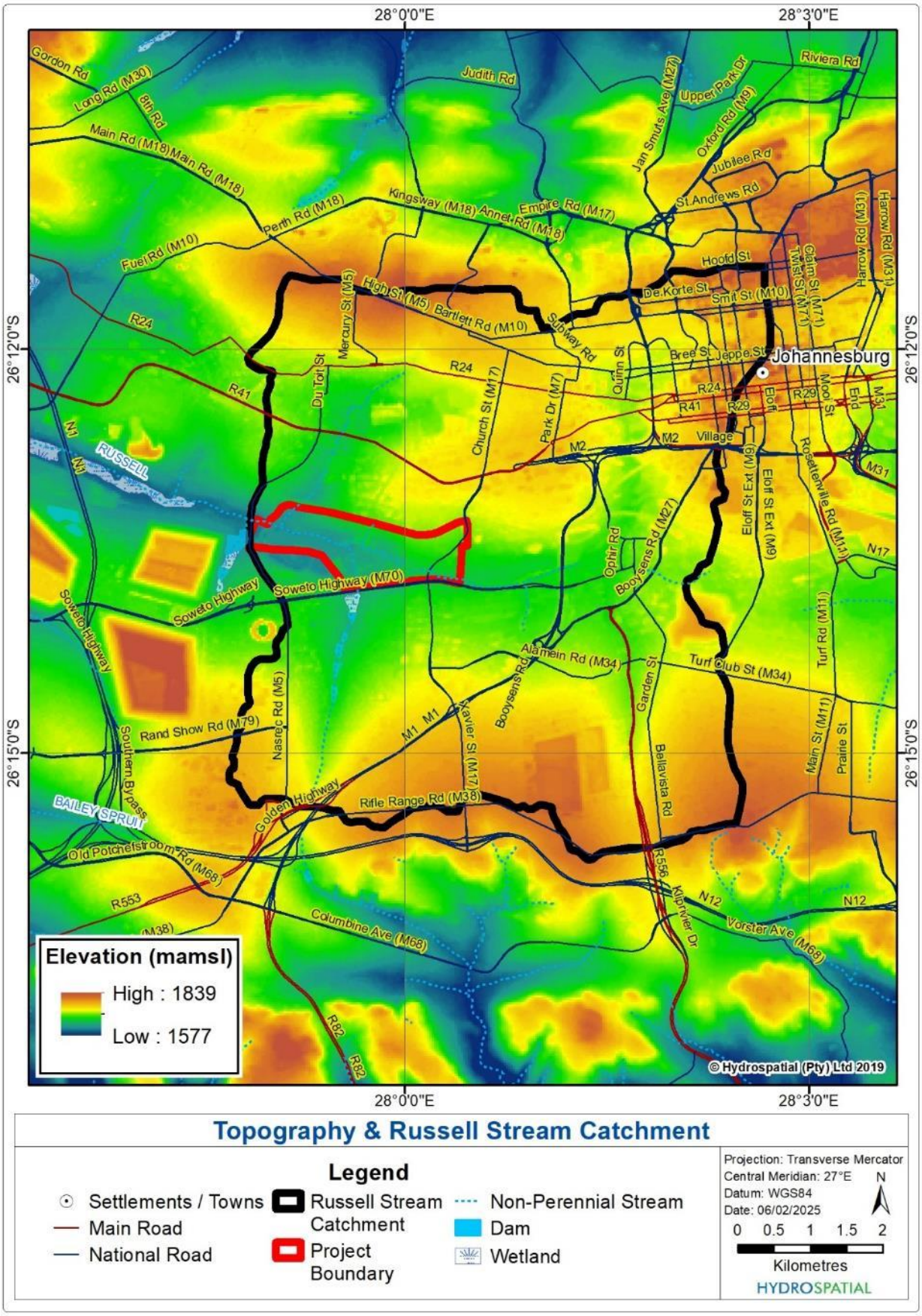


Figure 3-3: Topography

3.4 Surface Water Quality

3.4.1 Data Sources

Water quality data for the area was obtained from the following sources:

- Water quality monitoring undertaken by Ergo;
- Monitoring undertaken by the DWS along the Russell Stream, which was downloaded from the Klip River Forum website (https://reservoir.org.za/klip-river-forum/#toggle-id-4-closed); and
- The Council Geoscience's report: Contamination of wetlands by Witwatersrand gold mines – processes and the economic potential of gold in wetlands (Council for Geosciences, 2005). Water quality and sediment sampling from the report were assessed.

3.4.2 Monitoring Locations

Details of the monitoring locations are summarised in Table 3-3 and their locations are shown on Figure 3-4.

Table 3-3: Summary of the surface water quality monitoring locations

Monitoring Location	Monitored by	Monitoring Period Assessed	Location from Project	Location Description	Latitude*	Longitude*
CR1	Ergo	Jun 2021 – Jan 2025	Upstream of Project	Russell Stream - Lake Road	-26.226111°	28.024167°
CR4	Ergo	Jun 2021 – Jan 2025	Upstream of Project	Small bridge at CGR (Crownwood Road)	-26.226667°	28.002778°
CR7	Ergo	Jun 2021 – Jan 2025	Downstream of Project	Russell Stream - bridge at Randshow Road (Riverlea)	-26.220556°	27.981667°
CR11	Ergo	Jun 2021 – Jan 2025	Downstream of Project	New Canada Road bridge	-26.210556°	27.952778°
DWS1	DWS	Apr 2014 – Sep 2024	Downstream of Project	Russell Stream at New Canada Road	-26.211111°	27.951944°
JV04/077	Council for Geoscience (2005)	Sep 2004	Downstream of Project	Russell Stream at New Canada Road	-26.21042°	27.9525°
JV04/091	Council for Geoscience (2005)	Oct 2004	Upstream of Project	Russell Stream at Crownwood Road	-26.227222°	28.002333°
JV04/095	Council for Geoscience (2005)	Oct 2004	–	Mooifontein TSF PCDs	-26.223139°	27.979028°

Monitoring Location	Monitored by	Monitoring Period Assessed	Location from Project	Location Description	Latitude*	Longitude*
JV04/096	Council for Geoscience (2005)	Oct 2004	–	Mooifontein TSF PCDs	-26.223139°	27.979028°

* Coordinates in decimal degrees, geographic coordinate system, WGS84 datum

3.4.3 Guideline Limits

The water quality was compared to the Klip River catchment guideline limits, as the Russell Stream is located within the Klip River catchment. Where there were no parameter limits specified for the Klip River catchment, the South African National Standard (SANS) 241:2015 Drinking Water Quality limits were used. The guideline limits are described below.

3.4.3.1 Klip River Catchment Guideline Limits

The Klip River catchment guideline limits are specified as follows:

- **Ideal** – this is the range that results should ideally fall within;
- **Acceptable** – results that fall within this range are acceptable but not ideal;
- **Tolerable** – results that fall within this range are tolerable; and
- **Unacceptable** – results that fall within this range are unacceptable.

Results exceeding the Klip River catchment tolerable and unacceptable limits, are coloured in yellow and red respectively in Table 3-4 to Table 3-9.

3.4.3.2 SANS 241:2015 Drinking Water Quality Limits

SANS 241:2015 is generally used for water quality comparison purposes, albeit providing stringent limits that are required for drinking water purposes. The limits provided in the SANS 241:2015 are separated into the following risks:

- Acute health: Parameter that poses immediate unacceptable health risk if consumed with water at concentration values exceeding the specified limit;
- Aesthetic: Parameter that taints water with respect to taste, odour and colour, and that does not pose an unacceptable health risk if present at concentration values exceeding the specified limit;
- Chronic health: Parameter that poses an unacceptable health risk if ingested over an extended period if present at concentration values exceeding the specified limit; and
- Operational: Parameter that is essential for assessing the efficient operation of treatment systems and risks to infrastructure.

Results exceeding the SANS 241:2015 limits are highlighted in orange in Table 3-4 to Table 3-8.

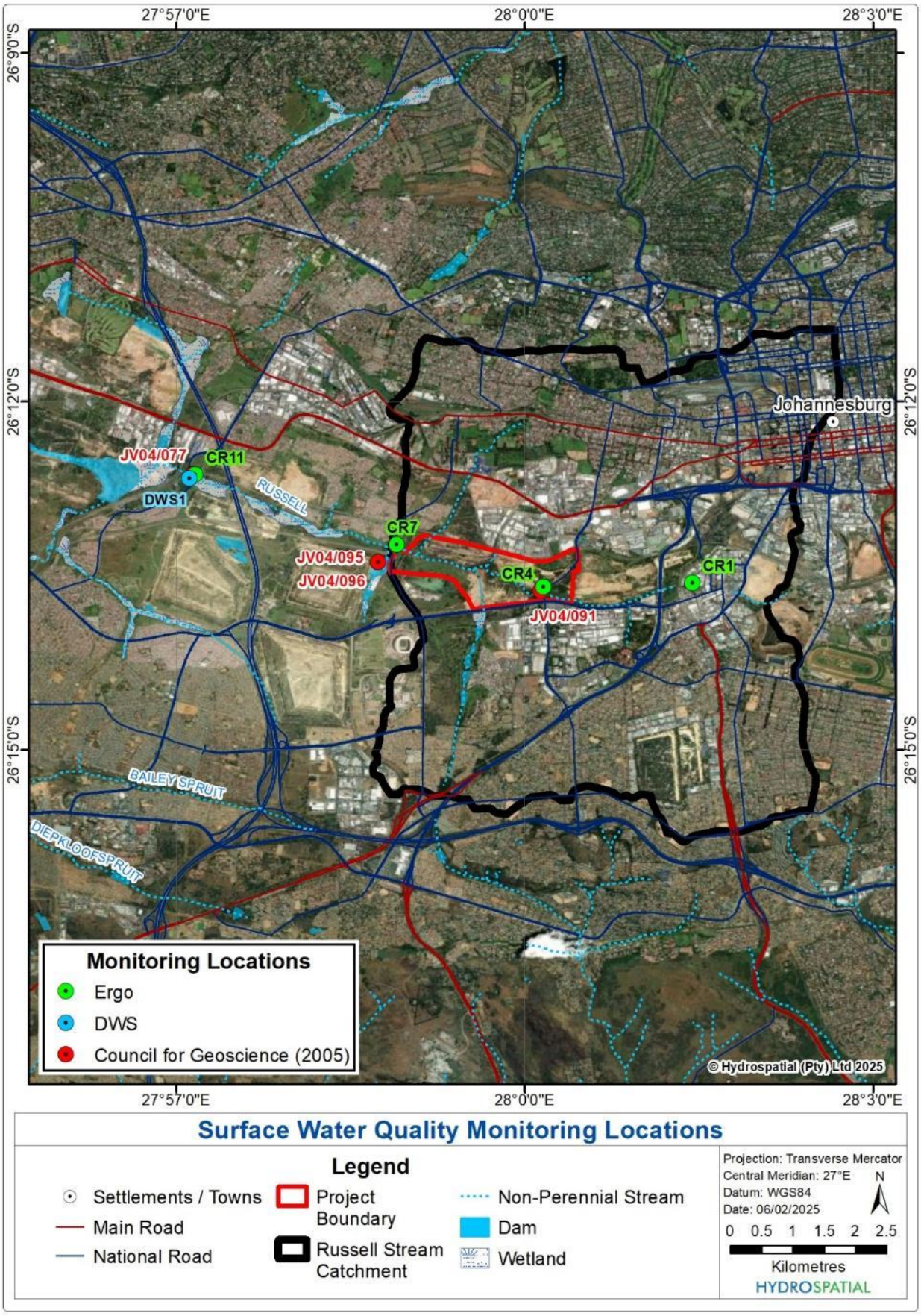


Figure 3-4: Surface water quality monitoring locations

3.4.4 Water Quality Status

3.4.4.1 Ergo and DWS Water Quality Monitoring

The Ergo water quality monitoring results are presented in Table 3-4 to Table 3-8, with trends in selected parameters shown in Figure 3-5, whilst the DWS water quality monitoring results are presented in Table 3-9, with trends shown in Figure 3-6. The following provides a summary of the water quality:

- pH was within limits at all monitoring locations except in December 2022 at CR1, CR4 and CR11, and at DWS1 in May 2014 and February 2019. This, however, was before the mining of silt began at Sector 1 in May 2023;
- Electrical Conductivity (EC) and Total Dissolved Solids (TDS), which provides an indication of the dissolved salts in water, were within acceptable limits at all monitoring locations;
- Nutrients (Ammonia, Nitrate and Phosphate), *E.coli* and Chemical Oxygen Demand (COD), were regularly elevated at DWS1, indicating sewage contamination of the Russell Stream;
- Elevated levels of heavy metal concentrations for Iron, Manganese, Aluminium, Nickel and Arsenic were recorded at most of the monitoring locations. This has been occurring since before the current mining operation at Sector 1 commenced in May 2023;
- Uranium was within limits at all of the Ergo monitoring locations; and
- Suspended Solids (SS) was regularly elevated above unacceptable limits at all monitoring locations. A comparison between the upstream (CR1 and CR4) and downstream (CR7) monitoring locations showed no significant increase in SS as a result of the current mining operation.

3.4.4.2 Council for Geoscience (2005) Report

As part of the Council for Geoscience (2005) study, water samples were taken along the Russell Stream at JV04/077 and JV04/091 in September and October 2004 respectively. Results were similar to the more recent results discussed above, with Iron, Manganese and Nickel elevated above limits. Uranium was found to be within limits, however, Sulphate exceeded unacceptable limits at both sampling locations. Samples were also taken from the Pollution Control Dams (PCDs) along the north-eastern side of the Mooifontein TSF at JV04/095 and JV04/096. Results indicated low pH levels, high levels of dissolved salts and metals, as well as Uranium levels that exceeded the SANS 241:2015 drinking water quality limits.

No sediment samples were taken from the Russell Stream as part of the Council for Geoscience (2005) study, however, results from sediment samples taken from other wetlands in the Witwatersrand, were used to obtain an understanding of the potential mobility of contaminants in the silt at the proposed project. Batch leach tests were performed to assess the leachable potential of Copper, Nickel, Cobalt, Arsenic and Uranium, from the sediment samples using clean water (neutral). The leachability was found to be low, with Nickel slightly more mobile than the other elements, indicating that the contaminants are well bound to

sediment. This was understood to be as a result of the samples originating from sub-aqueous environments (wetlands), being in contact with water for most of the year. Any easily mobilised metals will therefore be mobilised, while the more strongly bound fraction will require a more aggressive leachate than clean water to remobilise them. As long as the current conditions are maintained in these wetlands, i.e. continuous discharge of water to the wetlands and the maintenance of reducing conditions, it is unlikely that the metals will be mobilised (Council for Geoscience, 2005). Furthermore, metal speciation and mobility of elements in sediments were assessed in their report as part of other studies conducted in the Wonderfonteinspruit. It was found that under acidic (e.g. AMD or acid rain) and oxidising (e.g. drying out of sediment due to drought, extraction due to mining or fire) conditions, the remobilisation of metals from wetlands is possible.

3.4.4.3 Conclusion

It can be concluded that the water quality of the Russell Stream has a neutral pH of approximately 7.2, dissolved salts within the ideal range of the Klip River catchment guideline limits, high nutrient and *E.coli* levels, elevated Suspended Solids, as well as at times elevated metals in terms of Iron, Manganese, Aluminium, Nickel and Arsenic. Uranium was found to be within limits.

Based on the current water quality available, it appears that the current mining operation at Sector 1 is not having a significant impact on the water quality of the Russell Stream. This is likely due to current measures that are implemented onsite, such as berms that contain runoff from dirty areas, as well as silt traps that settle out silt.

Table 3-4: Ergo water quality results – June 2021 to June 2022

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits		June 2021				September 2021				December 2021				March 2022				June 2022			
		Tolerable	Unacceptable	Risk	Limit	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7	7.50	6.70	6.50	7.10	7.30	6.20	7.30	6.20	7.40	6.70	7.30	7.10	7.10	7.00	7.20	7.00	6.00	6.50	6.90	6.80
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170	25.10	56.20	95.20	81.30	38.50	50.70	61.30	114.00	46.90	97.40	64.10	66.70	41.70	77.60	79.90	87.20	88.20	102.00	83.50	76.20
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200	150.00	318.00	610.00	364.00	220.00	320.00	360.00	358.00	246.00	636.00	408.00	444.00	248.00	446.00	468.00	562.00	514.00	640.00	478.00	448.00
Total Acidity as CaCO3	mg/ℓ	---	---	---	---	<5	<5	<5	<5	16.00	36.00	20.00	70.00	<5	<5	<5	<5	<5	<5	<5	<5	28.00	28.00	28.00	24.00
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300	15.00	37.00	44.00	49.00	31.00	36.00	37.00	45.00	35.00	48.00	36.00	35.00	26.00	55.00	45.00	40.00	75.00	63.00	49.00	40.00
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500	30.00	98.00	326.00	186.00	32.00	45.00	86.00	7.00	27.00	188.00	84.00	58.00	47.00	100.00	138.00	213.00	165.00	301.00	176.00	198.00
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.50	0.30	0.20	0.20	0.20	0.30	0.30	0.40	0.40	0.20	0.30	0.30	0.20
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11	1.10	0.20	0.30	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.80	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.30	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	0.07
Bromide as Br	mg/ℓ	---	---	---	---	<0.1	<0.1	<0.1	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho Phosphate as P	mg/ℓ	---	---	---	---	<0.1	<0.1	<0.1	<0.1	0.60	<0.1	0.10	12.00	1.20	<0.1	<0.1	0.10	0.80	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Cyanide as CN	mg/ℓ	---	---	---	---	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---	0.10	7.00	13.00	15.00	4.70	5.50	11.00	119.00	8.10	13.00	5.80	9.40	5.20	11.00	12.00	9.10	16.00	14.00	16.00	12.00
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200	12.00	30.00	44.00	44.00	21.00	38.00	33.00	39.00	28.00	46.00	27.00	33.00	20.00	42.00	39.00	37.00	52.00	54.00	49.00	36.00
Potassium as K	mg/ℓ	---	---	---	---	4.10	10.30	12.30	12.60	5.10	8.90	8.80	14.30	8.50	12.50	8.00	8.60	4.60	14.50	10.70	10.00	19.60	18.20	11.40	9.60
Calcium as Ca	mg/ℓ	---	---	---	---	23.00	33.00	72.00	47.00	26.00	31.00	35.00	37.00	26.00	80.00	43.00	42.00	33.00	47.00	49.00	61.00	50.00	72.00	45.00	50.00
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---	7.00	13.00	25.00	20.00	11.00	13.00	17.00	16.00	11.00	21.00	18.00	18.00	12.00	18.00	20.00	24.00	22.00	26.00	20.00	24.00
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.10	<0.100	<0.100	<0.100
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02	0.00	<0.001	<0.001	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	<0.001	0.001	<0.001	<0.001	0.001	0.003	0.002	0.009	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	0.017	0.015	0.015	0.013
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7	0.10	0.11	0.11	0.10	0.14	0.14	0.14	0.06	0.06	0.05	0.04	0.05	0.05	0.04	0.05	0.04	0.06	0.05	0.04	0.04
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4	<0.025	0.06	0.06	0.05	0.11	<0.025	0.04	0.04	<0.025	0.06	0.05	0.03	<0.025	0.06	0.06	0.06	<0.025	<0.025	<0.025	0.03
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05	0.01	0.01	<0.010	<0.010	<0.010	0.02	0.01	<0.010	<0.010	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---	<0.025	0.04	0.30	0.16	<0.025	<0.025	<0.025	<0.025	<0.025	0.15	<0.025	0.10	<0.025	<0.025	<0.025	0.25	0.09	0.18	0.19	0.22
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2	0.01	<0.010	<0.010	<0.010	0.03	0.03	0.03	0.01	0.01	0.01	<0.010	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2	0.03	4.46	20.00	8.13	0.26	2.61	1.75	0.62	0.21	<0.025	<0.025	0.20	0.21	0.62	2.84	0.99	4.36	8.52	3.51	0.10
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---	0.03	0.46	0.62	0.53	<0.025	0.24	0.20	0.43	0.12	<0.025	<0.025	0.11	0.04	<0.025	0.32	<0.025	4.42	8.69	3.79	0.09
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---	<0.025	4.00	19.00	7.60	0.27	2.37	1.55	0.20	0.09	<0.025	<0.025	0.09	0.17	0.62	2.52	0.99	<0.025	<0.025	<0.025	<0.025
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	<0.001	<0.001	<0.001	<0.001	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4	<0.025	1.07	5.08	3.23	0.04	0.95	2.43	1.73	0.07	3.34	0.77	2.63	0.11	1.38	3.40	4.32	1.81	4.13	3.44	3.97
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07	<0.025	0.04	0.31	0.15	<0.025	<0.025	<0.025	<0.025	<0.025	0.17	0.13	0.16	<0.025	<0.025	0.03	0.33	0.09	0.23	0.22	0.28
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---	<0.025	0.39	0.05	0.15	0.88	0.42	0.65	17.00	1.78	0.20	0.15	0.15	0.80	0.35	0.10	0.03	3.20	3.15	3.60	3.11
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	<0.001	<0.001	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	0.00	<0.001	<0.001
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---	5.80	6.20	6.30	6.60	9.20	8.70	8.00	16.00	6.50	5.70	5.60	6.10	7.10	6.60	6.20	5.60	6.60	6.50	7.70	6.50
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---	0.10	0.12	0.20	0.15	0.14	0.14	0.15	0.18	0.11	0.18	0.16	0.15	0.16	0.18	0.19	0.21	0.20	0.21	0.17	0.17
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	0.00	<0.001	<0.001	<0.001	<0.001	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	0.00	<0.001	<0.001	<0.001
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03	0.001	0.001	0.005	0.007	<0.001	0.001	0.006	<0.001	<0.001	0.002	0.005	0.006	<0.001	0.003	0.010	0.010	0.002	0.006	0.006	0.007
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5	<0.025	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.04	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	0.03	0.15	0.04	0.08
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Suspended Solids	mg/ℓ	30 - 55	> 55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Turbidity	NTU	---	---	Aesthetic	≤ 5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table 3-5: Ergo water quality results – September 2022 to July 2023

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits		September 2022				December 2022				March 2023				June 2023				July 2023			
		Tolerable	Unacceptable	Risk	Limit	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7	6.80	6.70	7.50	7.40	8.60	10.40	9.80	9.60	7.60	7.00	6.80	6.60	7.20	6.50	7.20	7.10	---	7.40	7.20	---
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170	78.20	61.10	79.80	71.80	86.90	43.70	53.00	55.90	55.60	63.60	65.30	65.70	92.50	62.60	81.80	79.80	---	56.40	69.10	---
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200	480.00	390.00	396.00	428.00	562.00	268.00	354.00	352.00	266.00	376.00	398.00	390.00	538.00	362.00	444.00	468.00	---	306.00	410.00	---
Total Acidity as CaCO3	mg/ℓ	---	---	---	---	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	---	<5	<5	---
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300	61.00	48.00	53.00	52.00	107.00	39.00	52.00	45.00	36.00	35.00	31.00	28.00	78.00	45.00	53.00	48.00	---	36.00	46.00	---
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500	144.00	76.00	96.00	125.00	160.00	89.00	124.00	131.00	44.00	111.00	138.00	189.00	100.00	70.00	110.00	141.00	---	63.00	100.00	---
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5	0.30	0.30	0.30	0.20	0.20	0.20	0.20	0.30	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.30	---	0.30	0.30	---
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11	0.10	0.20	0.10	0.10	2.40	0.10	<0.1	2.30	<0.1	<0.1	<0.1	0.20	0.10	<0.1	<0.1	<0.1	---	<0.1	<0.1	---
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9	<0.05	<0.05	<0.05	<0.05	3.60	<0.05	<0.05	1.80	<0.05	<0.05	<0.05	0.10	<0.05	<0.05	<0.05	<0.05	---	<0.05	<0.05	---
Bromide as Br	mg/ℓ	---	---	---	---	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---
Ortho Phosphate as P	mg/ℓ	---	---	---	---	<0.1	<0.1	1.20	0.10	<0.1	0.10	<0.1	0.20	0.50	<0.1	<0.1	<0.1	1.60	0.30	0.50	0.10	---	0.40	0.20	---
Total Cyanide as CN	mg/ℓ	---	---	---	---	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	---	<0.07	<0.07	---
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---	12.00	6.80	22.00	11.00	0.80	2.50	5.20	5.40	15.00	8.60	8.30	7.40	29.00	13.00	26.00	17.00	---	15.00	18.00	---
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200	42.00	33.00	39.00	42.00	78.00	32.00	49.00	40.00	26.00	29.00	31.00	22.00	68.00	36.00	52.00	47.00	---	32.00	47.00	---
Potassium as K	mg/ℓ	---	---	---	---	15.40	11.00	13.20	12.00	27.00	10.00	11.40	10.40	7.40	9.20	7.10	6.00	21.00	13.00	14.80	12.70	---	10.00	11.40	---
Calcium as Ca	mg/ℓ	---	---	---	---	47.00	42.00	41.00	41.00	43.00	31.00	34.00	37.00	34.00	47.00	44.00	53.00	33.00	42.00	47.00	47.00	---	33.00	33.00	---
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---	18.00	14.00	18.00	17.00	21.00	4.00	5.00	10.00	13.00	16.00	18.00	21.00	16.00	17.00	23.00	22.00	---	13.00	15.00	---
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.13	<0.100	<0.100	<0.100	---	<0.100	<0.100	---
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02	<0.001	0.00	<0.001	<0.001	0.00	0.00	<0.001	<0.001	0.00	<0.001	0.00	0.00	<0.001	0.00	0.00	0.00	---	<0.001	<0.001	---
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	0.001	0.006	0.003	0.003	0.004	0.002	0.003	0.001	0.001	0.003	0.001	0.002	0.001	0.003	0.001	0.002	---	0.002	0.002	---
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7	0.06	0.06	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.05	0.05	0.04	0.04	0.05	0.03	0.03	---	<0.025	<0.025	---
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---	<0.025	0.03	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.13	0.14	0.14	0.13	---	<0.025	<0.025	---
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4	0.06	0.05	0.06	0.06	0.25	0.04	0.05	0.06	0.04	0.06	0.12	0.07	0.07	0.05	0.07	0.06	---	0.04	0.05	---
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05	<0.010	<0.010	<0.010	<0.010	0.02	<0.010	<0.010	<0.010	0.02	<0.010	<0.010	<0.010	<0.010	0.01	<0.010	<0.010	---	<0.010	<0.010	---
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	0.03	<0.025	0.03	0.03	<0.025	0.04	0.11	0.21	0.04	<0.025	0.06	0.11	---	<0.025	0.09	---
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2	0.04	0.04	0.04	0.03	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.02	0.01	0.01	0.02	---	<0.010	<0.010	---
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2	1.19	3.95	0.74	1.50	<0.025	<0.025	<0.025	<0.025	0.27	2.50	0.76	0.46	1.23	1.88	1.23	6.54	---	0.88	1.15	---
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---	<0.025	0.69	0.04	<0.025	<0.025	<0.025	<0.025	0.03	<0.025	0.20	0.16	<0.025	1.12	0.44	<0.025	0.56	---	0.45	0.61	---
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---	1.19	3.25	0.70	1.49	<0.025	<0.025	<0.025	<0.025	0.27	2.30	0.60	0.46	0.10	1.44	1.21	5.98	---	0.43	0.54	---
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4	2.24	1.55	3.14	2.73	0.46	<0.025	<0.025	<0.025	0.09	1.52	2.72	3.51	1.31	1.03	2.24	2.95	---	0.83	2.08	---
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006	0.002	0.001	0.002	0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.001	0.001	---	<0.001	<0.001	---
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07	<0.025	<0.025	0.03	0.05	0.04	<0.025	0.04	<0.025	<0.025	0.09	0.16	0.35	0.05	0.05	0.11	0.18	---	<0.025	0.09	---
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---	<0.025	0.03	1.46	0.15	0.20	<0.001	0.06	<0.001	1.74	0.18	0.04	0.02	2.56	0.14	0.23	0.17	---	0.74	0.51	---
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04	<0.001	<0.001	<0.001	<0.001	0.00	<0.001	<0.001	0.01	<0.001	<0.001	<0.001	<0.001	0.01	0.00	0.01	0.00	---	<0.001	<0.001	---
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---	6.00	6.40	6.80	7.00	4.00	0.50	1.10	1.80	9.20	7.20	5.50	4.70	8.10	9.60	10.10	9.10	---	7.50	8.00	---
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---	0.16	0.14	0.16	0.15	0.20	0.14	0.14	0.15	0.17	0.13	0.15	0.16	0.14	0.16	0.17	0.17	---	0.13	0.13	---
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	0.01	0.00	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03	0.001	0.001	0.004	0.004	0.003	<0.001	0.001	0.001	<0.001	0.006	0.004	0.002	0.001	0.001	0.004	0.008	---	0.002	0.003	---
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---	0.03	0.03	0.03	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.13	0.05	0.04	0.04	0.05	---	<0.025	<0.025	---
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Suspended Solids	mg/ℓ	30 - 55	> 55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Turbidity	NTU	---	---	Aesthetic	≤ 5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table 3-6: Ergo water quality results – August 2023 to December 2023

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits		August 2023				September 2023				October 2023				November 2023				December 2023			
		Tolerable	Unacceptable	Risk	Limit	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7	---	6.30	7.20	---	7.30	7.40	7.30	7.30	---	7.20	7.30	---	---	7.80	7.60	---	6.80	7.10	7.10	7.60
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170	---	52.60	66.60	---	62.50	53.90	67.40	67.80	---	48.50	70.00	---	---	64.40	65.30	---	64.00	56.30	57.10	78.30
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200	---	278.00	328.00	---	282.00	270.00	340.00	348.00	---	272.00	364.00	---	---	400.00	444.00	---	476.00	280.00	332.00	406.00
Total Acidity as CaCO3	mg/ℓ	---	---	---	---	---	16.00	<5	---	<5	<5	<5	<5	---	<5	<5	---	---	<5	<5	---	12.00	8.00	12.00	<5
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300	---	36.00	44.00	---	39.00	32.00	41.00	43.00	---	31.00	53.00	---	---	44.00	42.00	---	74.00	38.00	38.00	61.00
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500	---	51.00	84.00	---	56.00	67.00	112.00	115.00	---	79.00	119.00	---	---	50.00	116.00	---	<2	49.00	109.00	<2
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5	---	0.20	0.20	---	0.20	0.20	0.20	0.20	---	<0.2	0.20	---	---	0.20	0.20	---	0.20	<0.2	<0.2	0.20
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	0.10	---	0.10	0.10	---	---	0.10	0.20	---	<0.1	<0.1	<0.1	<0.1
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9	---	0.06	0.07	---	<0.05	<0.05	<0.05	0.05	---	<0.05	<0.05	---	---	<0.05	<0.05	---	<0.05	<0.05	<0.05	<0.05
Bromide as Br	mg/ℓ	---	---	---	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1
Ortho Phosphate as P	mg/ℓ	---	---	---	---	---	0.10	0.30	---	1.90	0.90	0.50	0.40	---	0.20	0.20	---	---	0.20	<0.1	---	0.70	1.10	0.20	1.00
Total Cyanide as CN	mg/ℓ	---	---	---	---	---	<0.07	<0.07	---	<0.07	<0.07	<0.07	<0.07	---	---	---	---	---	<0.07	<0.07	---	<0.07	<0.07	<0.07	<0.07
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---	---	10.00	19.00	---	23.00	13.00	17.00	17.00	---	11.00	24.00	---	---	12.00	10.00	---	7.20	18.00	12.00	22.00
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200	---	30.00	41.00	---	43.00	33.00	47.00	42.00	---	28.00	42.00	---	---	55.00	43.00	---	89.00	40.00	44.00	59.00
Potassium as K	mg/ℓ	---	---	---	---	---	7.50	11.00	---	11.90	8.10	10.70	10.50	---	9.00	13.10	---	---	10.40	10.60	---	14.90	11.20	10.50	15.70
Calcium as Ca	mg/ℓ	---	---	---	---	---	34.00	33.00	---	29.00	31.00	34.00	39.00	---	33.00	36.00	---	---	33.00	37.00	---	35.00	38.00	46.00	56.00
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---	---	12.00	15.00	---	13.00	12.00	16.00	17.00	---	13.00	16.00	---	---	11.00	14.00	---	18.00	14.00	18.00	21.00
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3	---	<0.100	<0.100	---	<0.100	<0.100	<0.100	<0.100	---	<0.100	<0.100	---	---	<0.100	<0.100	---	<0.100	<0.100	<0.100	0.11
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02	---	<0.001	<0.001	---	0.00	<0.001	0.00	0.00	---	0.00	0.00	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	0.00
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	---	0.005	0.002	---	<0.001	0.003	0.003	0.004	---	0.006	0.006	---	---	0.008	0.002	---	0.001	0.002	0.002	0.006
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7	---	0.05	0.04	---	0.04	0.04	0.04	0.03	---	0.04	0.03	---	---	0.04	0.04	---	0.07	0.04	0.04	0.04
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	0.20	0.17	0.17	0.14	---	0.07	0.07	---	---	0.22	0.18	---	0.14	0.04	0.07	0.07
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4	---	0.03	0.04	---	<0.025	<0.025	0.03	0.03	---	0.03	0.05	---	---	<0.025	<0.025	---	0.04	0.05	0.04	0.06
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05	---	0.01	<0.010	---	<0.010	<0.010	<0.010	<0.010	---	<0.010	<0.010	---	---	0.02	0.01	---	0.01	<0.010	<0.010	<0.010
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	0.05	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	0.05	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2	---	<0.010	<0.010	---	<0.010	<0.010	<0.010	<0.010	---	<0.010	<0.010	---	---	<0.010	<0.010	---	0.02	0.02	0.02	0.02
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2	---	<0.025	<0.025	---	0.38	0.76	0.44	0.42	---	0.86	1.85	---	---	0.38	0.37	---	0.14	0.11	0.68	0.04
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	0.05	0.04	0.03	0.03	---	0.12	0.34	---	---	0.18	0.14	---	0.06	0.03	<0.025	<0.025
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	0.34	0.72	0.40	0.39	---	0.74	1.52	---	---	0.20	0.23	---	0.08	0.08	0.65	0.03
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	---	0.00	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	0.00	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4	---	0.70	1.96	---	0.12	0.52	1.31	1.48	---	0.88	1.76	---	---	0.89	2.10	---	1.81	0.67	2.21	2.61
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006	---	<0.001	0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07	---	<0.025	0.05	---	<0.025	<0.025	0.03	0.03	---	<0.025	0.06	---	---	<0.025	0.03	---	<0.025	<0.025	0.04	<0.025
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---	---	0.36	0.89	---	3.82	1.85	1.43	0.55	---	0.61	1.58	---	---	0.73	0.18	---	0.98	1.34	0.35	1.17
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04	---	<0.001	<0.001	---	<0.001	<0.001	0.00	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	0.00	<0.001
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---	---	8.40	8.40	---	10.50	8.50	9.60	8.80	---	8.90	8.70	---	---	8.10	8.50	---	9.30	7.60	8.30	9.00
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---	---	0.14	0.14	---	0.13	0.12	0.13	0.13	---	0.15	0.15	---	---	0.12	0.14	---	0.16	0.16	0.18	0.18
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	0.00	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	0.01	0.01	0.02	0.02
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03	---	0.001	0.002	---	<0.001	0.001	0.003	0.004	---	0.002	0.004	---	---	0.001	0.002	---	<0.001	0.001	0.001	0.003
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5	---	<0.025	<0.025	---	0.04	0.03	0.03	0.03	---	0.04	0.03	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Suspended Solids	mg/ℓ	30 - 55	> 55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	456	---	---	---	37	---	---
Turbidity	NTU	---	---	Aesthetic	≤ 5	---	---	---	---	---	---	---	---	---	---	---	---	---	139	---	---	---	14	---	---

Table 3-7: Ergo water quality results – January 2024 to August 2024

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits		January 2024				February 2024				March 2024				June 2024				August 2024			
		Tolerable	Unacceptable	Risk	Limit	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7	---	6.80	7.00	---	---	7.30	7.20	---	7.10	6.90	7.10	7.10	6.80	7.00	7.20	7.10	---	7.10	7.00	---
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170	---	57.30	66.90	---	---	52.00	62.20	---	116.00	64.30	68.10	79.20	59.20	59.80	77.30	76.70	---	48.20	79.10	---
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200	---	420.00	474.00	---	---	264.00	322.00	---	578.00	344.00	410.00	410.00	302.00	318.00	394.00	424.00	---	274.00	388.00	---
Total Acidity as CaCO3	mg/ℓ	---	---	---	---	---	28.00	20.00	---	---	<5	<5	---	<5	<5	<5	<5	12.00	<5	<5	<5	---	24.00	173.00	---
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300	---	35.00	37.00	---	---	29.00	34.00	---	121.00	42.00	45.00	53.00	47.00	35.00	46.00	44.00	---	30.00	47.00	---
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500	---	113.00	158.00	---	---	58.00	92.00	---	40.00	42.00	61.00	79.00	50.00	57.00	79.00	102.00	---	45.00	48.00	---
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5	---	0.30	0.30	---	---	0.30	0.30	---	0.40	0.30	0.30	0.30	0.40	0.20	0.20	0.30	---	<0.2	<0.2	---
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11	---	<0.1	<0.1	---	---	<0.1	0.20	---	0.70	0.30	0.30	0.30	<0.1	2.10	2.00	2.00	---	<0.1	<0.1	---
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9	---	<0.05	<0.05	---	---	0.10	<0.05	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	---	0.05	<0.05	---
Bromide as Br	mg/ℓ	---	---	---	---	---	<0.1	<0.1	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---
Ortho Phosphate as P	mg/ℓ	---	---	---	---	---	<0.1	<0.1	---	---	0.40	0.40	---	0.80	0.40	0.40	0.60	<0.1	0.40	0.50	0.50	---	0.40	1.20	---
Total Cyanide as CN	mg/ℓ	---	---	---	---	---	<0.07	<0.07	---	---	<0.07	<0.07	---	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	---	<0.07	<0.07	---
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---	---	4.80	9.90	---	---	14.00	15.00	---	35.00	15.00	14.00	20.00	6.50	11.00	19.00	14.00	---	8.70	25.00	---
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200	---	34.00	38.00	---	---	26.00	38.00	---	95.00	38.00	48.00	58.00	35.00	36.00	47.00	51.00	---	27.00	54.00	---
Potassium as K	mg/ℓ	---	---	---	---	---	9.10	9.30	---	---	7.50	9.20	---	50.00	12.30	15.70	21.00	12.30	9.40	11.60	11.50	---	9.20	15.60	---
Calcium as Ca	mg/ℓ	---	---	---	---	---	46.00	50.00	---	---	31.00	34.00	---	35.00	28.00	35.00	41.00	37.00	35.00	37.00	40.00	---	34.00	41.00	---
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---	---	15.00	18.00	---	---	16.00	19.00	---	14.00	10.00	13.00	16.00	15.00	14.00	18.00	19.00	---	12.00	16.00	---
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3	---	<0.100	<0.100	---	---	<0.100	<0.100	---	0.13	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	---	<0.100	<0.100	---
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02	---	<0.001	<0.001	---	---	0.00	0.00	---	<0.001	<0.001	<0.001	<0.001	0.00	0.00	0.00	<0.001	---	0.00	0.00	---
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	---	0.001	0.001	---	---	0.002	0.003	---	0.004	0.005	0.002	0.005	0.002	0.003	0.003	0.003	---	0.006	0.005	---
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7	---	0.06	0.04	---	---	<0.025	<0.025	---	0.04	0.04	0.04	0.03	0.06	0.04	0.03	<0.025	---	0.03	0.04	---
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	0.03	0.03	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	0.04	---
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4	---	0.06	0.06	---	---	0.03	0.04	---	0.10	<0.025	<0.025	0.03	0.05	<0.025	0.03	0.04	---	<0.025	<0.025	---
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05	---	<0.010	<0.010	---	---	<0.010	0.02	---	<0.010	<0.010	<0.010	<0.010	0.01	0.01	0.02	0.02	---	<0.010	0.03	---
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---	---	0.04	0.07	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.03	---	<0.025	<0.025	---
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2	---	<0.010	<0.010	---	---	<0.010	<0.010	---	0.01	<0.010	<0.010	<0.010	<0.010	0.02	0.02	0.02	---	<0.010	<0.010	---
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2	---	0.37	<0.025	---	---	0.03	0.24	---	0.38	0.26	0.28	0.35	0.56	0.33	0.23	0.32	---	0.56	0.49	---
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	0.06	0.07	0.07		0.09	0.13	0.07	---	0.09	0.18	---
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---	---	0.37	<0.025	---	---	0.03	0.24	---	0.38	0.20	0.21	0.28		0.24	0.10	0.24	---	0.47	0.31	---
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4	---	1.70	3.91	---	---	<0.025	1.51	---	0.70	0.67	1.49	1.80	0.77	0.48	2.36	2.50	---	0.12	1.76	---
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	0.04	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07	---	0.05	0.11	---	---	<0.025	0.03	---	0.03	<0.025	0.03	0.03	<0.025	<0.025	0.04	0.03	---	<0.025	0.03	---
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---	---	0.01	0.02	---	---	0.05	0.07	---	1.07	1.07	0.77	1.15	0.42	0.22	0.39	0.14	---	8.41	2.51	---
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---	---	5.30	5.30	---	---	5.50	6.00	---	6.10	5.80	6.00	6.20	4.80	5.90	5.60	5.80	---	5.00	5.40	---
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---	---	0.16	0.16	---	---	0.14	0.14	---	0.17	0.13	0.16	0.17	0.18	0.15	0.15	0.15	---	0.15	0.17	---
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	0.00	<0.001	<0.001	<0.001	---	0.00	0.00	---
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03	---	0.003	0.005	---	---	0.004	0.005	---	0.002	<0.001	0.001	0.002	0.001	<0.001	0.001	0.001	---	0.001	0.001	---
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5	---	<0.025	<0.025	---	---	<0.025	<0.025	---	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Suspended Solids	mg/ℓ	30 - 55	> 55	---	---	---	33	---	---	---	31	---	---	---	71	---	---	---	---	---	---	---	95	125	---
Turbidity	NTU	---	---	Aesthetic	≤ 5	---	43	---	---	---	20	---	---	---	24	---	---	---	---	---	---	---	58	28	---

Table 3-8: Ergo water quality results – September 2024 to January 2025

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits		September 2024				October 2024				November 2024				December 2024				January 2025			
		Tolerable	Unacceptable	Risk	Limit	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7	7.30	7.30	7.20	7.20	---	7.20	7.20	---	---	7.10	7.10	---	7.20	7.10	7.20	7.10	---	6.00	6.80	---
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170	70.20	65.50	70.50	74.40	---	50.40	78.80	---	---	64.10	84.50	---	68.70	50.60	78.90	72.80	---	119.00	104.00	---
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200	328.00	439.00	472.00	499.00	---	272.00	354.00	---	---	294.00	358.00	---	284.00	284.00	412.00	378.00	---	802.00	646.00	---
Total Acidity as CaCO3	mg/ℓ	---	---	---	---	8.00	8.00	396.00	8.00	---	20.00	207.00	---	---	12.00	166.00	---	20.00	24.00	259.00	56.00	---	24.00	47.00	---
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300	50.00	33.00	46.00	44.00	---	31.00	55.00	---	---	40.00	53.00	---	40.00	35.00	52.00	47.00	---	42.00	40.00	---
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500	47.00	43.00	69.00	73.00	---	44.00	47.00	---	---	44.00	50.00	---	27.00	40.00	53.00	41.00	---	473.00	333.00	---
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5	0.20	0.40	0.30	0.20	---	0.20	0.20	---	---	0.20	0.30	---	<0.2	<0.2	<0.2	<0.2	---	<0.2	<0.2	---
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11	1.40	1.00	1.50	1.10	---	0.80	0.80	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1	---	0.10	<0.1	---
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9	<0.05	0.10	0.20	0.20	---	<0.05	<0.05	---	---	<0.05	<0.05	---	<0.05	<0.05	<0.05	<0.05	---	<0.05	<0.05	---
Bromide as Br	mg/ℓ	---	---	---	---	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---
Ortho Phosphate as P	mg/ℓ	---	---	---	---	2.20	2.00	1.30	2.70	---	0.60	2.10	---	---	0.70	1.80	---	2.20	0.20	1.00	3.20	---	<0.1	<0.1	---
Total Cyanide as CN	mg/ℓ	---	---	---	---	<0.35	<0.35	<0.35	<0.35	---	<0.07	<0.07	---	---	<0.07	<0.07	---	0.12	<0.07	<0.07	<0.07	---	0.27	0.10	---
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---	22.00	26.00	19.00	24.00	---	9.30	27.00	---	---	13.00	26.00	---	30.00	9.40	27.00	18.00	---	16.00	17.00	---
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200	48.00	37.00	52.00	45.00	---	31.00	54.00	---	---	37.00	50.00	---	35.00	28.00	48.00	54.00	---	51.00	46.00	---
Potassium as K	mg/ℓ	---	---	---	---	12.20	11.10	11.70	11.50	---	10.10	17.10	---	---	10.50	13.30	---	10.30	9.00	13.60	12.70	---	11.00	10.10	---
Calcium as Ca	mg/ℓ	---	---	---	---	34.00	31.00	33.00	33.00	---	34.00	35.00	---	---	35.00	31.00	---	33.00	34.00	36.00	35.00	---	126.00	97.00	---
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---	13.00	12.00	14.00	15.00	---	13.00	14.00	---	---	12.00	13.00	---	12.00	12.00	14.00	14.00	---	31.00	28.00	---
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3	<0.100	<0.100	<0.100	<0.100	---	0.49	0.74	---	---	<0.100	<0.100	---	0.19	<0.100	<0.100	<0.100	---	<0.100	<0.100	---
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02	0.00	0.00	0.00	<0.001	---	<0.001	<0.001	---	---	0.00	<0.001	---	0.00	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	0.021	0.010	0.016	0.005	---	0.007	0.007	---	---	0.017	0.007	---	0.012	0.003	0.009	0.018	---	0.002	0.001	---
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7	0.04	0.03	0.03	<0.025	---	0.06	0.06	---	---	0.03	0.03	---	0.04	0.04	0.03	<0.025	---	<0.025	<0.025	---
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---	0.03	0.04	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4	0.24	0.15	0.09	0.09	---	<0.025	<0.025	---	---	<0.025	0.04	---	0.43	0.17	<0.025	0.05	---	0.10	0.09	---
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05	0.02	0.01	0.02	0.01	---	<0.010	<0.010	---	---	<0.010	0.02	---	0.02	0.01	0.02	0.02	---	<0.010	<0.010	---
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	0.31	0.25	---
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2	<0.010	<0.010	<0.010	<0.010	---	<0.010	0.02	---	---	<0.010	<0.010	---	<0.010	<0.010	<0.010	<0.010	---	0.01	<0.010	---
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2	0.53	0.56	0.57	0.52	---	2.13	3.12	---	---	0.23	0.21	---	1.34	0.69	0.57	0.35	---	0.94	0.03	---
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---	0.27	0.05	0.10	<0.025	---	<0.025	0.12	---	---	0.05	0.10	---	<0.025	0.03	0.03	<0.025	---	<0.025	<0.025	---
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---	0.27	0.51	0.47	0.52	---	2.12	3.00	---	---	0.18	0.11	---	1.33	0.65	0.54	0.33	---	0.94	0.03	---
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	0.02	0.01	0.00	<0.001	---	0.07	0.03	---	---	<0.001	<0.001	---	0.04	0.00	0.00	0.00	---	<0.001	<0.001	---
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4	0.28	0.35	0.97	1.27	---	0.44	1.07	---	---	0.41	0.92	---	0.33	0.50	1.64	1.34	---	6.33	5.56	---
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07	<0.025	<0.025	0.03	<0.025	---	<0.025	0.05	---	---	0.09	0.10	---	<0.025	<0.025	0.03	<0.025	---	0.41	0.33	---
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---	1.54	1.55	0.96	2.90	---	0.39	1.51	---	---	1.19	2.87	---	3.36	0.65	1.80	4.23	---	0.04	0.03	---
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04	<0.001	<0.001	<0.001	<0.001	---	0.00	0.00	---	---	<0.001	<0.001	---	<0.001	0.00	0.00	<0.001	---	<0.001	<0.001	---
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---	5.60	4.20	4.80	4.20	---	5.30	5.80	---	---	5.00	4.70	---	5.50	4.00	4.20	4.30	---	3.10	3.60	---
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---	0.16	0.14	0.14	0.13	---	0.15	0.13	---	---	0.15	0.13	---	0.15	0.14	0.14	0.12	---	0.26	0.22	---
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	0.04	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	0.00	<0.001	---	<0.001	<0.001	---
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03	0.002	0.002	0.003	0.001	---	0.002	0.002	---	---	0.002	0.001	---	0.001	0.001	0.002	0.002	---	0.002	0.003	---
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	0.03	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5	<0.025	<0.025	<0.025	<0.025	---	0.07	0.10	---	---	<0.025	<0.025	---	0.05	<0.025	<0.025	<0.025	---	0.25	<0.025	---
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Suspended Solids	mg/ℓ	30 - 55	> 55	---	---	172	113	136	136	---	385	92	---	---	717	56	---	1373	74	46	548	---	41	28	---
Turbidity	NTU	---	---	Aesthetic	≤ 5	104	48	8	53	---	70	20	---	---	55	16	---	160	12	16	54	---	127	24	---

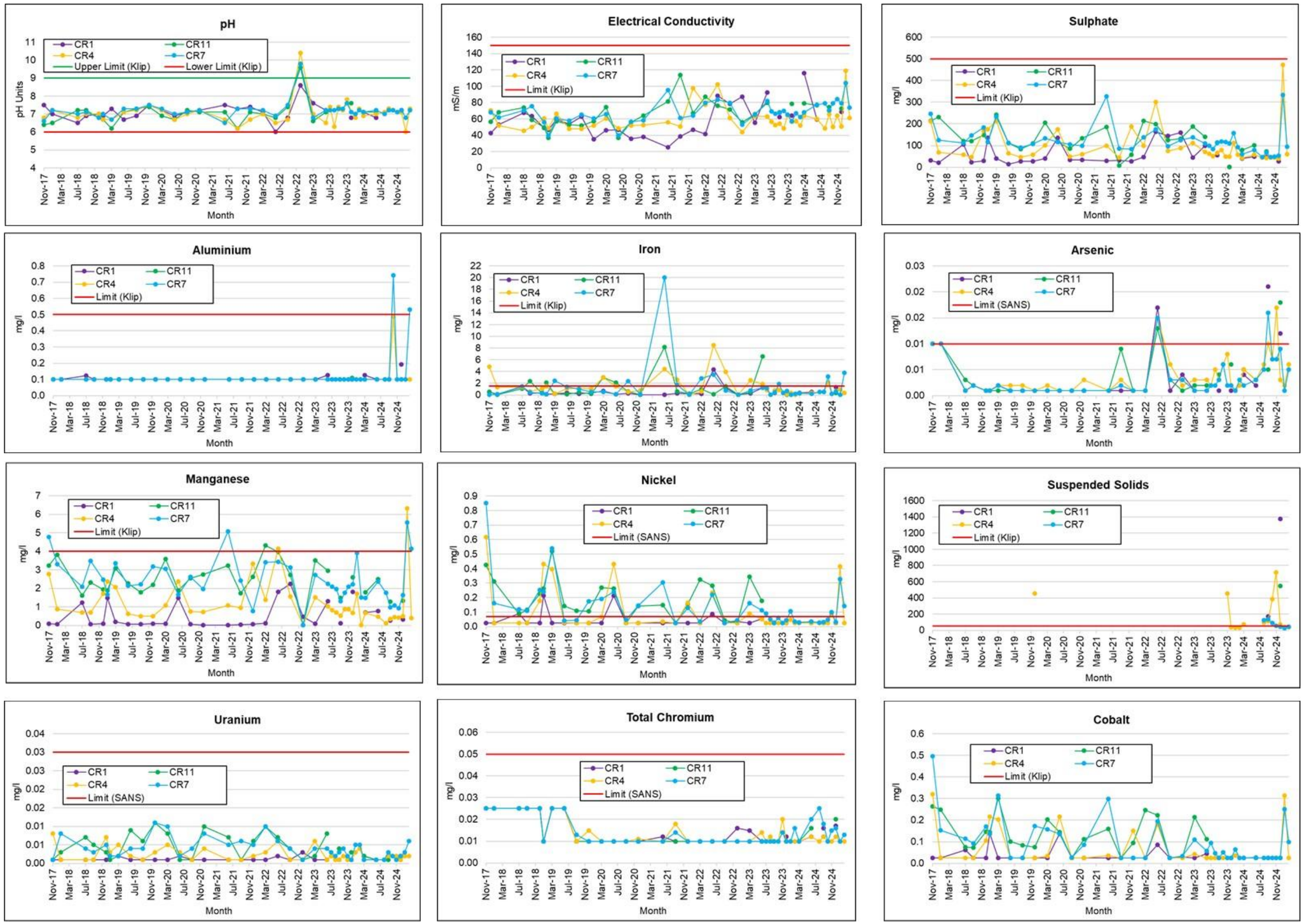
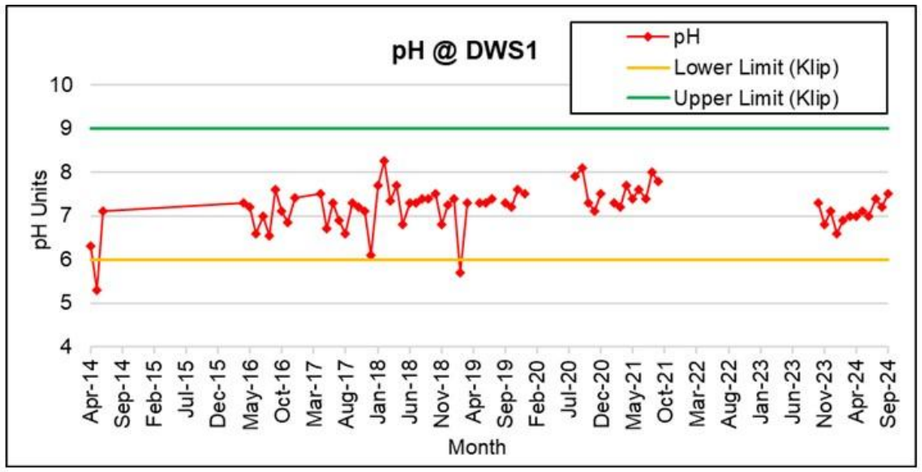


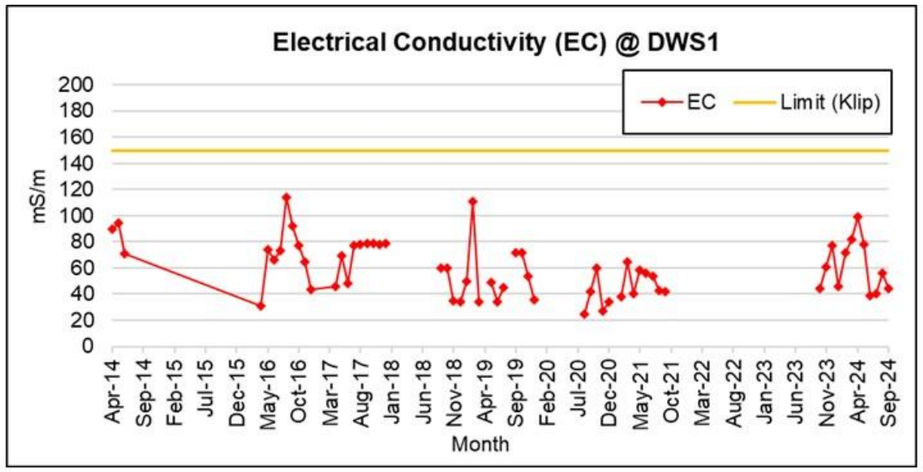
Figure 3-5: Trends in the Ergo water quality results for selected parameters

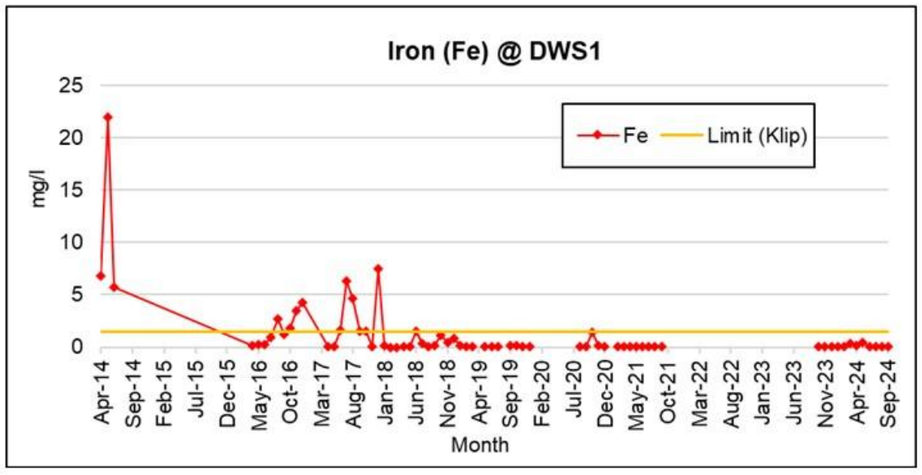
Table 3-9: DWS water quality results for monitoring location DWS1

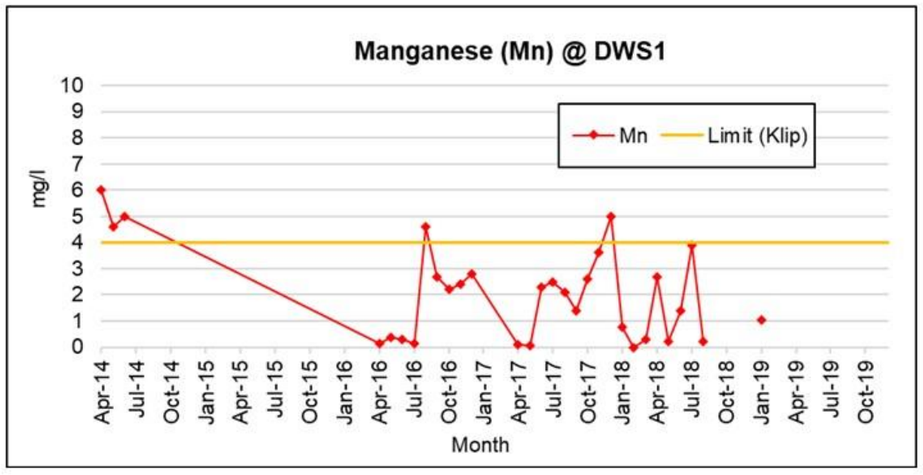
Parameter	Aluminium	Ammonia	Chemical Oxygen Demand	Chloride	Electrical Conductivity	*E. coli*	Iron	Magnesium	Manganese	Nitrate	pH	Phosphate	Sodium	Sulphate	Suspended Solids
Units	mg/ℓ	mg/ℓ	mg/ℓ	mg/ℓ	mS/m	counts/100ml	mg/ℓ	mg/ℓ	mg/ℓ	mg/ℓ	pH units	mg/ℓ	mg/ℓ	mg/ℓ	mg/ℓ
Klip River Catchment Tolerable Limits	0.3 - 0.5	1.5 - 4.0	30 - 40	75 - 100	100 - 150	200 - 400	1.0 - 1.5	30 - 70	2 - 4	4 - 7	-	0.5 - 1.0	80 - 100	350 - 500	30 - 55
Klip River Catchment Unacceptable Limits	> 0.5	> 4.0	> 40	> 100	> 150	> 400	> 1.5	> 70	> 4	> 7	< 6.0; > 9.0	> 1.0	> 100	> 500	> 55
Apr-14	2.9	2.3	53	28	90	14	6.8	---	6	---	6.3	0.2	31	353	48
May-14	0.03	8.7	36	36	94.7	6000	22	---	4.6	---	5.3	0.8	30	391	88
Jun-14	0.03	7.6	22	40	71.2	33600	5.7	---	5	---	7.11	0.74	40	215	71
Apr-16	0.01	0.1	20	25	31	1,200	0.1	---	0.13	0.2	7.3	0.2	19	169	3
May-16	0.035	19	29	42	74	40,000	0.24	---	0.39	0.21	7.2	0.2	40	230	48
Jun-16	0.015	18	23	38	66	11,400	0.21	---	0.29	0.2	6.6	0.2	35	245	52
Jul-16	0.01	15	86	38	73	290,500	0.89	---	0.15	0.25	7	0.2	43	308	58
Aug-16	0	21	188	57	114	700	2.7	---	4.6	0.2	6.55	0.2	67	702	65
Sep-16	0.01	15	99	33	92.3	82,000.00	1.2	---	2.7	0.2	7.59	0.2	37	234	40
Oct-16	0.05		125	33	77	1,450,000	1.8	---	2.2	0.28	7.1	1.6	43	186	43
Nov-16	0.01	8.7	67	25	64.3	352500	3.5	---	2.4	0.53	6.86	0.9	28	237	46
Dec-16	0.69	4.4	24	13	43.4	2,240.00	4.3	---	2.8	0.65	7.42	0.2	15	147	29
Apr-17	0.02	4.2	16	41	46	28,000	0.08	---	0.09	3.3	7.5	0.63	38	69	3
May-17	0.01	18	96	45	69.3	390000	0.06	---	0.04	0.2	6.7	0.2	53	326	10
Jun-17	0.04	14	93	33	48.1	26,100.00	1.6	---	2.3	0.2	7.3	0.2	33	121	46
Jul-17	0.02	23	195	54	77	690,000	6.3	---	2.5	0.2	6.9	0.35	68	223	51
Aug-17	0.01	28	105	51	78	510,000	4.7	---	2.1	0.2	6.6	4.2	59	138	40
Sep-17	0.03	28	---	53	79	2,330,000	1.5	---	1.4	0.2	7.3	4.1	51	99	56
Oct-17	0.02	2.3	97	44	79	440,000	1.5	---	2.6	0.2	7.2	0.2	46	10	58
Nov-17	0.04	1.2	37	35	78	39,600	0.04	---	3.61	0.2	7.1	0.2	38	188	104
Dec-17	1.85	1.1	10	53	79	1,400	7.47	---	4.98	0.41	6.1	0.2	36	337	8
Jan-18	0	13	70	37	---	207,000	0.1	---	0.76	2	7.7	1	35	35	46
Feb-18	0	0.1	16	20	---	10,500	0	---	0	0.2	8.25	0.2	20	75	17
Mar-18	0	0.1	11	22	---	700	0	---	0.29	0.88	7.35	0.2	20	90	44
Apr-18	0.04	1.4	72	38	---	1,700	0.02	---	2.7	3.4	7.7	0.2	45	74	50
May-18	0.01	2.3	10	39	---	1,530	0.02	---	0.21	3.5	6.8	0.31	46	71	3
Jun-18	0.03	28	55	53	---	7,000	1.5	---	1.4	0.2	7.3	0.2	51	99	56
Jul-18	0.02	19	10	79	---	3,300	0.37	---	3.9	6.6	7.3	2.3	67	70	35
Aug-18	0.01	21	31	72	---	1,040	0.02	---	0.21	1.2	7.4	2.3	70	60	52
Sep-18	0.06	30	10	76	60	10,000	0.17	10	---	0.2	7.4	1.4	71	54	96
Oct-18	0.006	30	10	76	60	10,000	1.17	10	---	0.2	7.5	1.4	71	54	96
Nov-18	0.026	18	85	36	35.2	216,000	0.43	14	---	0.2	6.8	0.61	39	37	68
Dec-18	0.04	31	10	47	34.2	108,000,000	0.83	10	---	0.29	7.25	0.94	46	39	104
Jan-19	0.008	6.2	32	42	50	670,000	0.1	---	1.02	0.28	7.4	0.2	37	62	30
Feb-19	0.085	17	22	47	111	248,000	0.01	27	---	0.2	5.7	0.2	49	446	52
Mar-19	0.009	9.2	29	34	34	315,000	0.05	21	---	0.2	7.3	0.2	29	164	29
May-19	0.05	16	22	36	49	55,000	0.06	11	---	0.13	7.3	0.65	41	44	20
Jun-19	0.009	9.2	29	34	34	315,000	0.05	21	---	0.2	7.3	0.2	29	164	29
Jul-19	0.05	5.3	20	34	45	1,080	0.08	12	---	1.61	7.4	0.02	35	60	20
Sep-19	0.05	32.3	369	49	72	6,000,000	0.19	14	---	0.01	7.3	2.45	58	48	111
Oct-19	0.050	32.30	369	49	72	6,000,000	0.19	14	---	0.13	7.2	7.53	58	48	111
Nov-19	0.050	11.00	60	43	54	25,000	0.05	12	---	12.10	7.6	3.30	52	52	48
Dec-19	0.050	5.07	36	23	36	270,000	0.05	10	---	0.38	7.5	0.74	31	39	20
Aug-20	0.05	0	20	24	25	3,400	0.05	12	---	1.5	7.9	0.01	25	62	20
Sep-20	0.05	0	20	33	42	16,000	0.05	13	---	0.02	8.1	0.01	31	60	20
Oct-20	0.05	18.8	107	40	60	170,000	1.46	12	---	0.13	7.3	0.1	51	39	31
Nov-20	0.05	1.6	37	16	27	13,000	0.13	7	---	0.4	7.1	0.2	15	46	53
Dec-20	0.05	0	6	21	34	13,800	0.05	5	---	0.63	7.5	0.08	23	56	20
Feb-21	0.06	0.2	11	22	38	320,000	0.05	12	---	0.09	7.3	0.06	23	71	20
Mar-21	0.05	15.3	39	41	65	250,000	0.05	22	---	0.13	7.2	0.01	35	142	30
Apr-21	0.05	0.9	24	25	40	400,000	0.05	12	---	1.26	7.7	0.07	25	62	39
May-21	0.05	10	59	43	58	15,000	0.05	14	---	1.42	7.4	0.72	44	57	20

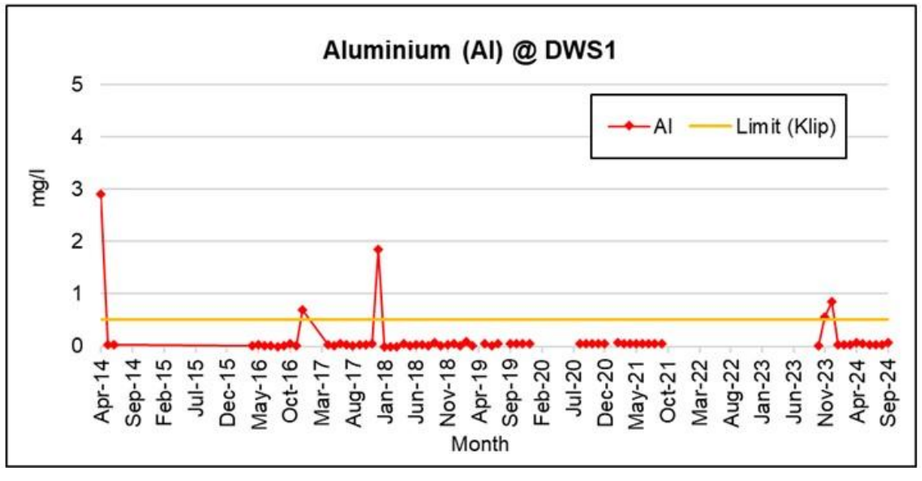
Parameter	Aluminium	Ammonia	Chemical Oxygen Demand	Chloride	Electrical Conductivity	*E. coli*	Iron	Magnesium	Manganese	Nitrate	pH	Phosphate	Sodium	Sulphate	Suspended Solids
Jun-21	0.05	9.3	53	39	56	12,700	0.05	14	---	1.63	7.6	0.73	45	57	20
Jul-21	0.05		54	36	54	96 000	0.07	15	---	1.28	7.4	0.05	47	56	20
Aug-21	0.05	0.3	13	31	43	14 000	0.05	12	---	1.48	8	0.07	30	55	20
Sep-21	0.05	0.1	14	30	42	38 000	0.05	12	---	0.2	7.8	0.06	31	41	20
Oct-23	0.01	6	47	33	44	108000	0.01	11	---	3.54	7.3	0.1	39	18	18
Nov-23	0.55	14	133	46	61	650000	0.02	12	---	0.25	6.8	1.07	47	53	92
Dec-23	0.85	8.1	32	27	77	111990	0.02	16	---	0.13	7.1	0.1	22	306	66
Jan-24	0.03	1.5	25	21	46	12033	0.02	11	---	2.8	6.6	0.19	20	117	< 18
Feb-24	0.03	9.8	59	36	72	2359000	0.05	17	---	1.07	6.9	<0.1	35	72	54
Mar-24	0.03	18	111	56	82	12997000	0.39	19	---	1.03	7	0.1	54	108	< 18
Apr-24	0.07	19	133	78	99	2014000	0.18	---	---	<0.25	7	0.27	59	158	66
May-24	0.05	17	129	54	78	6488000	0.44	---	---	0.44	7.1	<0.1	57	120	78
Jun-24	0.02	2.9	83	29	39	393000	0.03	---	---	2.84	7	0.16	12	45	< 18
Jul-24	0.02	<1.5	51	36	40	19890	0.04	---	---	5.67	7.4	<0.1	37	59	86
Aug-24	0.03	6.8	47	41	56	222400	0.09	---	---	0.64	7.2	0.46	49	83	58
Sep-24	0.06	3.8	<25	38	44	65100	0.02	---	---	6.15	7.5	0.33	59	22	< 18











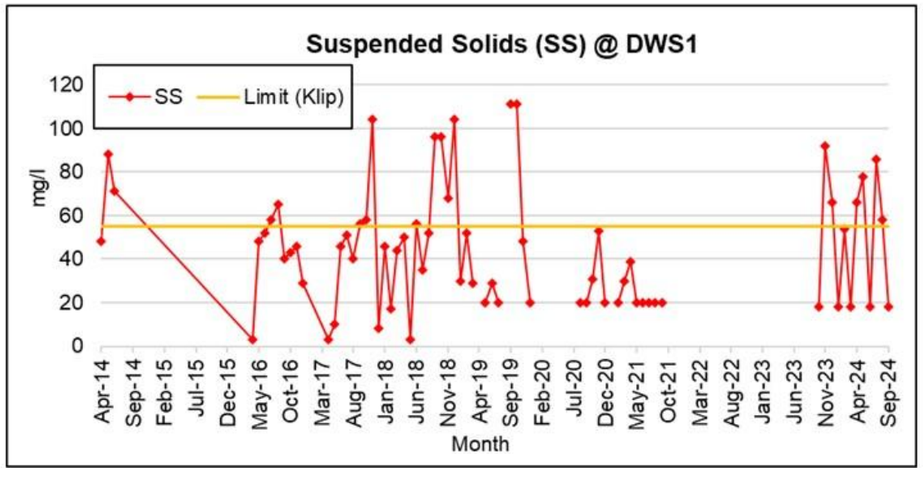


Figure 3-6: Trends in the DWS water quality results for selected parameters

4 FLOODLINE DETERMINATION

4.1 Purpose and Legal Requirements

According to Regulation 4 of GN R704, no person in control of a mine or activity may –

(a) Locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked; and
(b) Carry on any underground or opencast mining or prospecting or any other operation or activity under or within the 1:50 year floodline or within a horizontal distance of 100 m from any watercourse or estuary, whichever is the greatest.

The purpose of this section was to determine the 1:50 and 1:100 year floodlines for the Russell Stream as well as for a tributary flowing through mining block N19.

4.2 Methodology and Data Sources

The methodology and data sources used to determine the floodlines are discussed below.

4.2.1 Contributing Catchments

The contributing catchments for which the peak flows were calculated are shown on Figure 4-1.

4.2.2 Survey Data

Survey data in the form of 1 m contour intervals (dated: 28 November 2024) that covered the Project area between Crownwood road in the east to mining blocks N18 and N19 in the west, was provided by Ergo. The survey data did not cover mining blocks N20 and N22. To extend the survey data to these areas, 0.25 m contours were sourced from the City of Johannesburg Metropolitan Municipality. The two contour datasets were combined to generate a 1 m spatial resolution Digital Terrain Model (DTM). The DTM was used in the hydraulic modelling of the floodlines.

4.2.3 Land Cover/Use

Land cover/use form an important component of the hydrological assessment that was undertaken to calculate the peak flows. The South African National Land-Cover 2018 dataset (GeoTerraImage, 2019), was used to assess the land cover and use of the contributing catchments.

4.2.4 Hydraulic Structures

The bridges over the Russell stream at Crownwood and Nasrec Roads were included in the hydraulic model, and are shown on Figure 4-2 and Figure 4-3, respectively. The railway bridge to the east of Nasrec Road was not included in the model, as it is a very high bridge (24 m above the Russell Stream), with widely spaced piers (32 m apart), that would not have any significant impact on the floodlines.

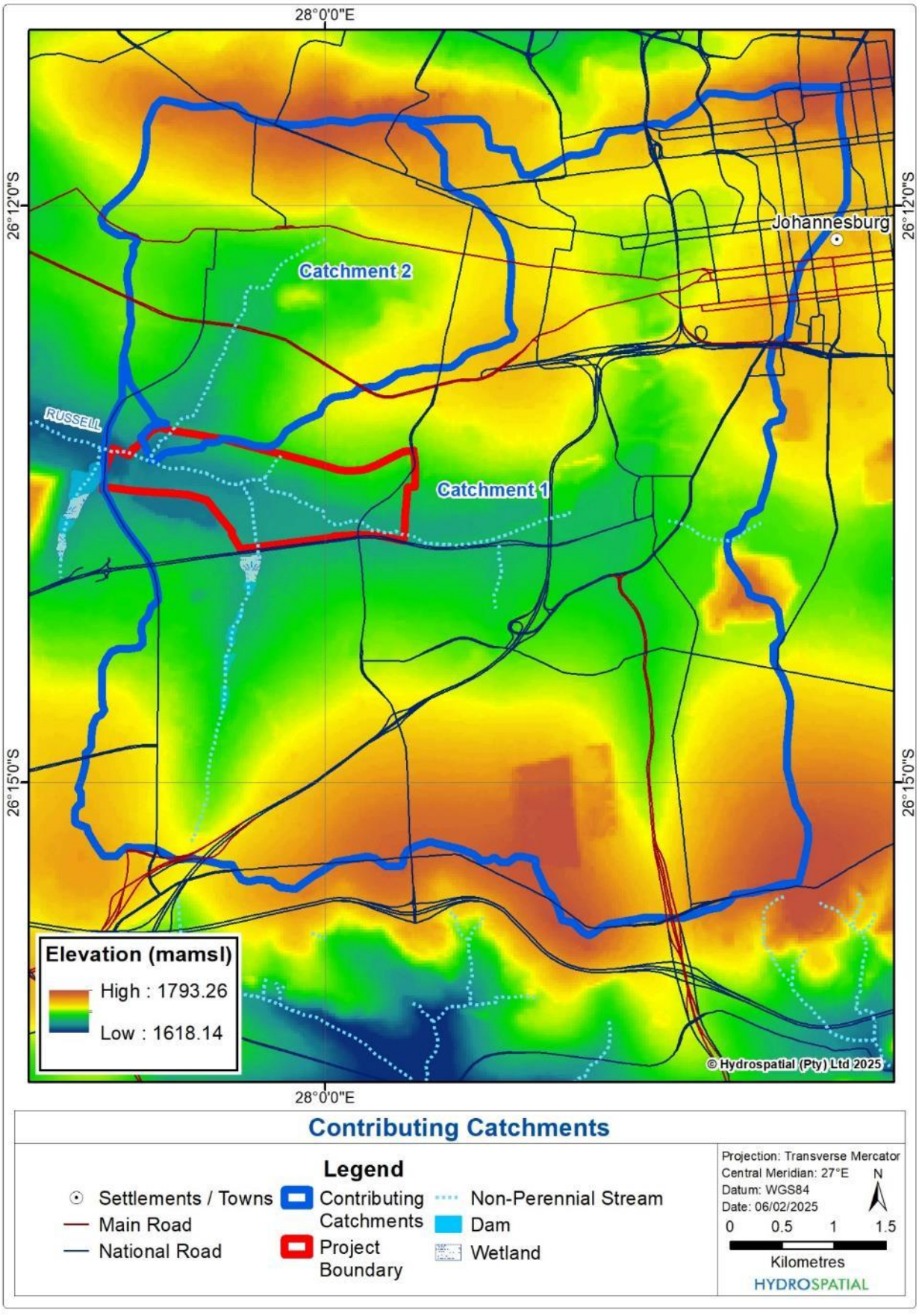


Figure 4-1: Contributing catchments



Figure 4-2: Bridge over the Russell Stream at Crownwood Road



Figure 4-3: Bridge over the Russell Stream at Nasrec Road

4.2.5 Manning's Roughness Coefficients

The Manning's roughness coefficients are values that represent the channel and adjacent floodplains resistance to flow. The Mannings roughness was assessed during the site investigation. A Mannings roughness coefficient of 0.1 was used to represent the channel and floodplains, as these areas were dominated by fairly dense vegetation in the form of reeds, bushes, tall grass and trees (Figure 4-4).



Figure 4-4: Russell Stream and adjacent area consisting of reeds, grass and trees

4.2.6 Peak Flow Calculations

The 1:50 and 1:100 year peak flows were calculated using the Soil Conservation Service (SCS) method. The SCS method is based on the triangular unit hydrograph concept. This unit hydrograph represents the temporal distribution of stormflow for an incremental unit depth of stormflow, ΔQ, occurring in a unit duration of time, ΔD.

Peak discharge for an increment of time ΔD is defined by the equation:

$$\Delta q_p = \frac{0.2083\mathrm{A}\Delta Q}{\frac{\Delta D}{2} + L}$$

Where:

Δq_p = Peak discharge of incremental unit hydrograph (m³/s)

A = Catchment area (km²)

ΔQ = Incremental stormflow depth (mm)

ΔD = Unit duration of time (h), used with the distribution of daily rainfall to account for rainfall intensity variations

L = Catchment lag (h), an index of the catchment's response time to the peak discharge

To determine the hydrograph response to a given rainfall total, incremental hydrographs are superimposed according to the distribution of stormflow over time, as determined from the time distribution of rainfall intensity and the stormflow response characteristics of the catchment. More details on the SCS method are provided in Schmidt and Schulze (1987).

4.2.7 Software Choice

The following software's were used:

- The DTM and catchment boundary were generated using Global Mapper software;
- QGIS was used to analyse the catchment slope, land cover and soils;

- The Visual SCS-SA software programme (Schulze et al., 2004) was used to calculate the peak flows; and
- The hydraulic modelling of the floodlines was undertaken using HEC-RAS (Brunner, 2016). HEC-RAS is a hydraulic software programme used to perform one and two dimensional hydraulic calculations for a range of applications, from a single watercourse to a full network of natural or constructed channels.

4.2.8 Hydraulic Model Setup

A one dimensional model was setup in HEC-RAS as follows:

- The DTM generated from the survey data was imported into HEC-RAS Mapper;
- Geometric data such as cross-sections, stream centre line and flow paths, were digitised in HEC-RAS Mapper;
- Hydraulic structures were setup in HEC-RAS;
- Parameters such as the peak flows, Mannings roughness coefficients and upstream and downstream boundary conditions for normal depth were entered into HEC-RAS; and
- A steady, mixed flow (combination of subcritical, supercritical, hydraulic jumps and drawdowns) model was run within HEC-RAS to calculate the 1:50 and 1:100 year flood water elevations.

4.3 Assumptions and Limitations

The following are assumptions and limitations:

- The floodlines are indicative for the purposes of the WULA and environmental authorisation processes. They should not be used for design purposes.

4.4 Results

4.4.1 Peak Flows

The catchment parameters and calculated peak flows are summarised in Table 4-1.

Table 4-1: Catchment parameters and calculated peak flows

Parameter	Catchment 1	Catchment 2
Catchment Area (km²)	42.42	8.58
MAP (mm)	748	756
Curve Number	86	85
Average Catchment Slope (%)	4.5	4.7
Lag Time (hr)	2.54	1.40
1:50 Year Peak Flow (m^3/s)	256	85
1:100 Year Peak Flow (m^3/s)	308	101

4.4.2 Floodline

The floodlines and 100 m stream buffer are shown on Figure 4-5. Appendix A provides the floodline results at cross-sections. The following proposed infrastructure is impacted by either the floodlines or 100 m stream buffer:

- Mining blocks N1 – N22;
- Drying stockpiles to the north, south and west of the current mining area as well as to the north of mining block N22;
- All river crossings;
- Sump;
- Overflow channel;
- Channel and two silt traps; and
- Paddocks to the north and south of mining blocks N1-N18.

The following is recommended:

- Berms should be placed along the downslope side of the mining blocks and drying stockpiles to prevent flooding. The berms should be constructed to withstand a 1:100 year flood at a height above the floodline; and
- It is recommended that exemption from GN R704 is applied for, for the infrastructure listed above, which are located within the floodlines and 100 m watercourse buffer.

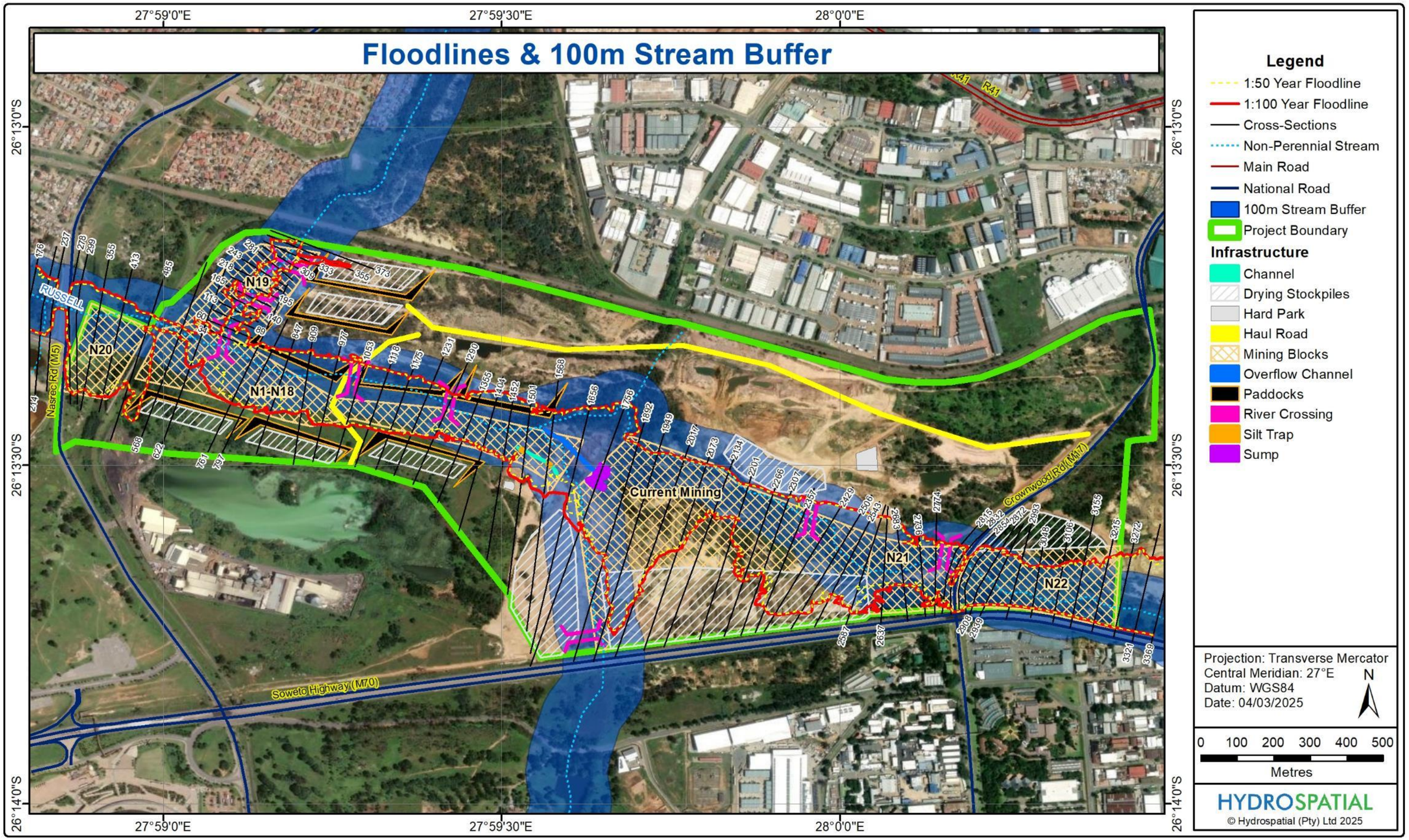


Figure 4-5: Floodlines and 100 m stream buffer

5 CONCEPTUAL STORMWATER MANAGEMENT PLAN

The purpose of the conceptual SWMP is to ensure that clean (areas unimpacted by the proposed mining activities) and dirty areas (impacted areas) are adequately separated, by diverting runoff from clean areas away from dirty areas towards the Russell Stream and ensuring that dirty runoff from the operational areas is captured, contained and managed appropriately.

5.1 Terminology

The following definitions are relevant to the SWMP. These are provided here for clarity, as they are commonly referred to in this section of the report:

- **Activity:** Any mining related process on the mine including the operation of washing plants, mineral processing facilities, mineral refineries and extraction plants; the operation and the use of mineral loading and off-loading zones, transport facilities and mineral storage yards, whether situated at the mine or not; in which any substance is stockpiled, stored, accumulated, dumped, disposed of or transported;
- **Clean area:** This refers to any area at or near a mine or activity, which produces clean runoff;
- **Clean water system:** This includes any dam, other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of clean unpolluted water;
- **Dam:** This includes any return water dam, settling dam, tailings dam, evaporation dam, catchment or barrier dam and any other form of impoundment used for the storage of unpolluted water or water containing waste (i.e. contain polluted water);
- **Dirty area:** This refers to any area at a mine or activity which causes, has caused or is likely to cause pollution of a water resource (i.e. generates polluted runoff);
- **Dirty water system:** This includes any dam, other form of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste; and
- **Watercourse:** This is defined in the NWA as -
    - A river or spring;
    - A natural channel in which water flows regularly or intermittently;
    - A wetland, 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, and a reference to a watercourse includes, where relevant, its bed and banks.

5.2 Design Philosophy

The following design philosophy was adopted to guide the development of the SWMP, and is based on GN R704 and the DWS Best Practice Guideline (BPG) G1: Storm Water Management:

- Divert any unpolluted runoff to a clean water system, away from dirty areas;
- Runoff from dirty areas must be captured, contained and managed appropriately;
- Clean and dirty water systems must be designed and constructed to prevent cross contamination;
- Clean and dirty water systems must convey/contain runoff from the 50 year storm event; and
- Appropriate maintenance and management of stormwater related infrastructure should be ensured at all times.

5.3 Potential Contaminants

The excavation of silt is likely to result in increased Suspended Solids (SS) and turbidity. Heavy metals are likely to have accumulated in the silt, with the lower lying silt layers containing higher concentrations of metals (Ndasi, 2007). The previous Groundwater Report prepared for the Sector 1 application (Groundwater Abstract, 2019), stated that in the deeper silt pockets, the pH is likely to be much lower and element concentrations higher, but due to current stable conditions that include saturation, low permeability and low oxygen levels, metal and salt leaching does not happen readily. However, the excavation of silt from the reclamation area, may trigger oxidation reactions that could result in acidic conditions and leaching of salts and metals (Groundwater Abstract, 2019). Similar conditions are expected at the stockpiling area, with the drying of the silt.

5.4 Clean and Dirty Areas

5.4.1 Dirty Areas

Dirty areas include the following:

- Mining blocks – mining of the silt has the potential to contaminate the Russell Stream with heavy metals, salts, acidic water and elevated SS. Water within the mining blocks will need to be contained and managed;
- Drying stockpiles – moisture seeping from the stockpiled silt is expected to have similar water quality to that described above and will need to be contained and managed; and
- Hard park areas – the two hard park areas will be used to park heavy machinery that have the potential to leak hydrocarbons. Drip mats or trays should be placed beneath parked machinery.

5.4.2 Clean areas

All areas surrounding the above-mentioned dirty areas should be treated as clean areas, and should be diverted away from flowing into dirty areas.

5.5 Assumptions and Limitations

The following are assumptions and limitations for the SWMP:

- The SWMP is based on the project description provided. Should the project description or infrastructure layout change, then the SWMP will need to be revised; and
- The SWMP is conceptual. A detailed SWMP should be designed based on the concept design prior to the commencement of construction activities.

5.6 Proposed Stormwater Measures

The proposed conceptual SWMP is indicated on Figure 5-1 and is discussed below.

5.6.1 Mining Blocks

5.6.1.1 Dirty Water Management

It is proposed that berms are constructed around the mining blocks to contain dirty water runoff. Dirty water within the mining blocks can be allowed to evaporate and can be used for dust suppression on the haul roads. Should there be a large accumulation of stormwater within the bermed off mining areas, then the excess stormwater will need to be released gradually to silt traps, that will settle out silt before entering the Russell Stream. This is currently done at the existing mining operation. The proposed heights of the berms are provided under section 5.6.4.

5.6.1.2 Clean Water management

Upslope runoff will be diverted around the mining blocks by berms towards the Russell Stream.

5.6.2 Drying Stockpiles

5.6.2.1 Dirty Water Management

Runoff and seepage from the stockpiles will be captured and contained in paddocks and bermed off areas. Dirty water within the paddocks will be allowed to evaporate. The proposed heights of the berms and paddocks are provided under section 5.6.4.

5.6.2.2 Clean Water management

Upslope runoff will be diverted around the stockpile areas by berms towards the Russell Stream.

5.6.3 Flood Protection

The berms at the bottom of the mining blocks as well as the paddocks running along the Russell Stream, will prevent flooding of the mining and stockpile areas. The proposed heights of the berms and paddocks are provided under section 5.6.4.

5.6.4 Berm Sizings

The berms and paddocks were sized to contain or divert the 1:50 year flood event as required by GN R704 and are provided in Table 5-1

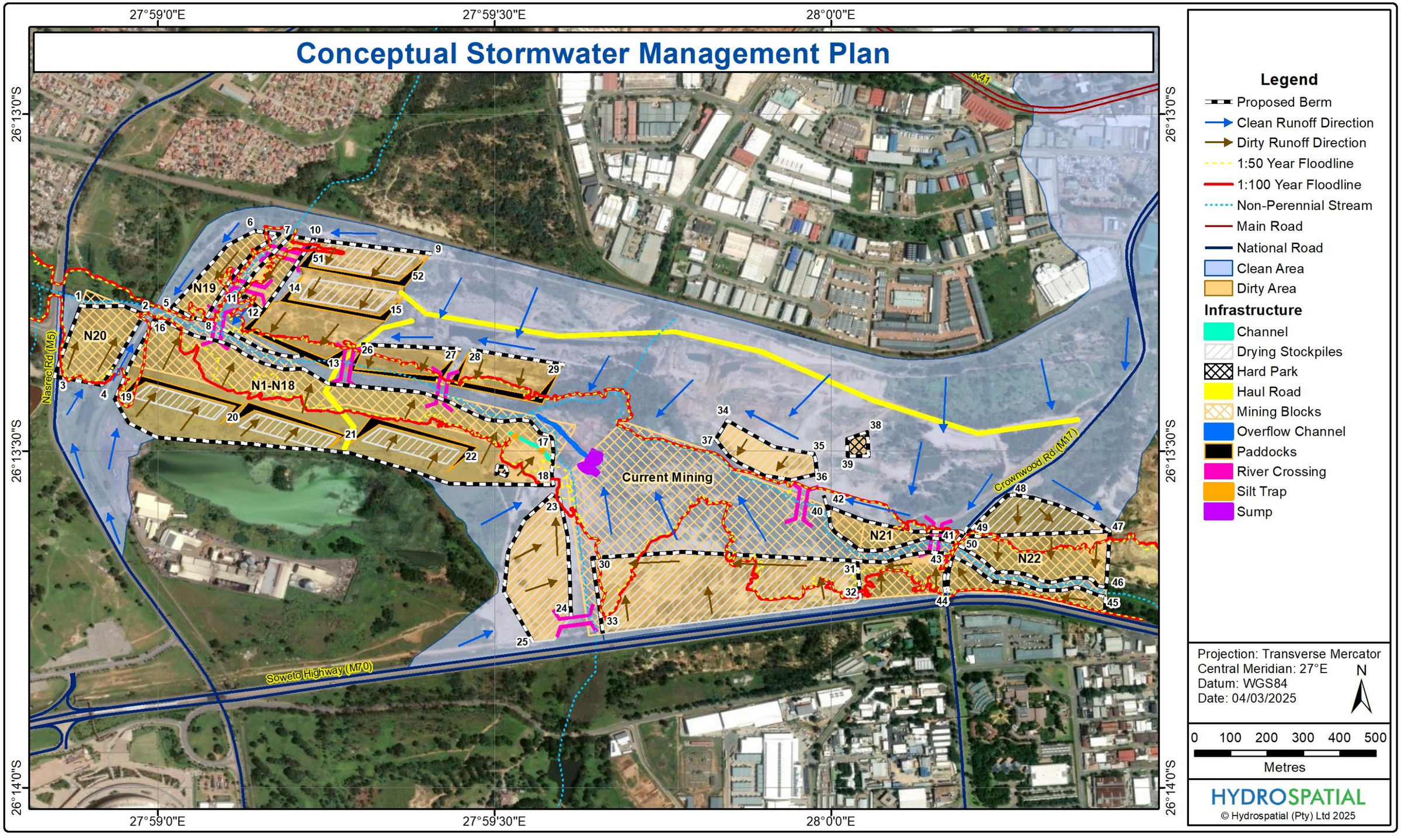


Figure 5-1: Proposed conceptual stormwater management plan

Table 5-1: Proposed berm and paddock heights

Berm/Paddock Section*	Berm Height (m)	Berm/Paddock Section*	Berm Height (m)
1 - 2	4	21 - 22	2
1 - 3	3	23 - 24	1.5
2 - 4	1.5	23 - 25	1.5
3 - 4	1.5	26 - 27	3
5 - 6	1.5	28 - 29	2
6 - 7	1.5	30 - 31	4
7 - 8	2.5	31 - 32	1.5
5 - 8	2.5	30 - 33	2
9 - 10	1.5	34 - 35	1.5
7 - 10	1.5	35 - 36	1.5
7 - 11	3.5	36 - 37	1.5
11 - 12	2	34 - 37	1.5
10 - 12	1.5	38 - 39	1.5
12 - 13	4	40 - 41	5
14 - 15	2	41 - 42	2
51 - 52	2	43 - 44	2
16 - 17	4	43 - 45	5.5
17 - 18	3	46 - 47	5
18 - 19	1.5	47 - 48	2
16 - 19	1.5	48 - 49	2
19 - 20	2	46 - 50	5.5
20 - 21	2		

*See Figure 5-1

6 SURFACE WATER IMPACT ASSESSMENT

6.1 Project Activities Assessed

The following key activities are likely to occur during the different phases of the project, and are assessed in the impact assessment:

6.1.1 Construction Phase

- Site clearance and the construction of minor infrastructure.

6.1.2 Operational Phase

- Mechanical excavation of silt and the stockpiling of silt.

6.1.3 Closure and Rehabilitation Phase

- Rehabilitation activities.

6.2 Methodology

The impact significance rating process serves to highlight the critical impacts requiring consideration in the management and approval process.

The impact significance rating system is presented in Table 6-1, Table 6-2 and Table 6-3, and involves three parts:

- **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/population and duration;
- **Part B**: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and
- **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from **Part B**) and the probability of occurrence.

These are discussed in further detail below.

6.2.1 Part A: Defining Consequence in Terms of Magnitude, Duration and Spatial Scale

Table 6-1 is used to determine the impact consequence characteristics for magnitude, spatial scale/population and duration.

Table 6-1: Consequence rating definitions

IMPACT CHARACTERISTICS	DEFINITION	CRITERIA
Magnitude	Major -	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate -	Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor -	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded
	Minor +	Minor improvement; change not measurable; or threshold never exceeded
	Moderate +	Moderate improvement; within or better than the threshold; or no observed reaction
	Major +	Substantial improvement; within or better than the threshold; or favourable publicity
Spatial scale or population	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral, catchment, topographic
	National/ International	Nationally or beyond

IMPACT CHARACTERISTICS	DEFINITION	CRITERIA
Duration	Short term	Up to 18 months.
	Medium term	18 months to 5 years
	Long term	Longer than 5 years

6.2.2 Part B: Determining the Consequence Rating

Once the impact consequence characteristics have been determined from Table 6-1, they are applied to Table 6-2 to obtain the consequence rating.

Table 6-2: Consequence rating

			SPATIAL SCALE/ POPULATION		
			Site or Local	**Regional**	**National/ international**
MAGNITUDE					
Minor	**DURATION**	**Long term**	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	**DURATION**	**Long term**	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium
Major	**DURATION**	**Long term**	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

6.2.3 Part C: Determining Significance Rating

The probability of the impact occurring is assessed as either being definite, possible or unlikely, and is selected in Table 6-3. The consequence rating determined from Table 6-2, is then used to obtain the significance of the impact in Table 6-3.

Table 6-3: Significance rating

		CONSEQUENCE		
		Low	**Medium**	**High**
PROBABILITY (of exposure to impacts)	**Definite**	Medium	Medium	High
	Possible	Low	Medium	High
	Unlikely	Low	Low	Medium

The significance rating of the impact is determined prior to mitigation (without mitigation), as well as after mitigation measures have been implemented.

6.3 Impact Assessment and Mitigation

6.3.1 Construction Phase

During the construction phase, vegetation will be cleared and temporary infrastructure will be erected. The construction phase will be less than a year. The activities and impacts that are likely to occur during the construction phase are summarised in Table 6-4.

Table 6-4: Summary of activities and impacts for the construction phase

Activity	Impact Description
Removal of vegetation and alteration to the topography.	Erosion of silt and consequent deterioration of water quality in the Russell Stream.

The ratings and proposed mitigation measures for the construction phase are provided in Table 6-5.

Table 6-5: Significance rating for the construction phase

NATURE OF IMPACT: The removal of vegetation will expose soils to water erosion that may lead to a deterioration in water quality of the Russell Stream		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Short term (construction phase period)	Short term (construction phase period)
Magnitude *(Major, Moderate, Minor)*	Moderate	Minor
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts • None foreseen		
Mitigation measures • Clearance of vegetation must be limited as far as possible; • The SWMP must be implemented as a first step during the construction phase; and		

NATURE OF IMPACT: The removal of vegetation will expose soils to water erosion that may lead to a deterioration in water quality of the Russell Stream
• Water quality sampling must continue upstream and downstream of construction areas. Should there be a deterioration in water quality from upstream to downstream, then immediate action should be undertaken to identify and address the issue.

6.3.2 Operational Phase

During the operational phase, the silt will be mechanical excavated and will be transported to the stockpiling areas. From the stockpiling areas, the silt will be transported off site. The operational phase will be approximately three years.

The excavation of silt may potentially result in an increase in SS within the mining area. Heavy metals are likely to have accumulated in the silt, with the lower lying silt layers containing higher concentrations of metals (Ndasi, 2007). The previous Groundwater Report for Sector 1 states that in the deeper silt pockets, the pH is likely to be much lower and element concentrations higher, but due to current stable conditions that include saturation, low permeability and low oxygen levels, metal and salt leaching does not happen readily. However, the excavation of silt may potentially trigger oxidation reactions that could result in acidic conditions and leaching of salts and metals (Groundwater Abstract, 2019). Moisture seeping from the stockpiled drying silt is expected to have similar water quality to that described above. It should be noted that based on the current water quality, the mining operation at Sector 1 is not having a significant impact on the Russell Stream, which is likely due to the implementation measures such as berms, paddocks and silt traps to contain and settle out SS.

Excavation of silt to levels below the Russell Stream riverbed, could result in water seeping from the Russell Stream into the mining voids, resulting in a loss of water quantity in the river.

Uncontrolled dirty water runoff from the mining and stockpiling areas, as well as poor maintenance of stormwater infrastructure, has the potential to impact on the downstream water quality. It is therefore recommended that the proposed SWMP is implemented, and that monitoring and maintenance of stormwater measures is undertaken as proposed under section 7.2.

Lastly, some of the mining and stockpiling areas are located within the floodlines of the Russell Stream, and are therefore at risk of flooding. Flooding of the operation can be prevented through the implementation of the SWMP.

The activities and impacts that could potentially occur during the operational phase are summarised in Table 6-6.

Table 6-6: Summary of activities and impacts for the operational phase

Activity	Impact Description
Excavation of the silt with impacts on water quality.	**Impact 1:** The excavation of the silt has the potential to increase oxygen levels within the silt, with subsequent oxidization reactions that could result in potential acidic conditions and leaching of salts and metals, which may impact on downstream water quality. The current water quality does not show any significant impacts as a result of this from the current mining operation at Sector 1, however, there is a potential for this to occur should mitigation measures not be implemented.
Excavation of the silt with impacts on water quantity.	**Impact 2:** Excavation of silt to levels below the riverbed of the Russell Stream, could result in water seeping from the Russell Stream into the mining voids, resulting in a loss of water quantity in the river.
Stockpiling of the silt.	**Impact 3:** Runoff and moisture from the stockpiled drying silt may potentially have poor water quality similar to that described under impact 1.
Uncontrolled dirty water runoff from the mining and stockpiling areas.	**Impact 4:** Runoff into the downslope Russell Stream impacting on water quality and sedimentation.
Poor maintenance of stormwater infrastructure.	**Impact 5:** Silted paddocks and eroded berms, can lead to spills into the downslope Russell Streams impacting on water quality and sedimentation.
Flooding of the mining and stockpiling areas.	**Impact 6:** Mechanical mining will take place within the Russell Stream floodplain. The stockpiling of silt is in close proximity to the floodplain. High rainfall such as a 1:50 year storm event can potentially result in flooding and consequent downstream water quality issues.

The ratings and proposed mitigation measures for the operational phase are indicated in Table 6-7 to Table 6-12.

Table 6-7: Significance rating of operational impact 1

NATURE OF IMPACT 1: Excavation of the silt resulting in potential acidic conditions and leaching of salts and metals, impacting on downstream water quality		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Medium term	Medium term
Magnitude *(Major, Moderate, Minor)*	Major	Minor
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts • None foreseen.		
Mitigation measures • Berms, paddocks and silt traps as per the proposed SWMP should be constructed around the mining and stockpiling areas to contain and evaporate dirty water.		

Table 6-8: Significance rating of operational impact 2

NATURE OF IMPACT 2: Excavation of silt to levels below the riverbed, could result in water seeping from the Russell Stream into the mining voids, resulting in a loss of water quantity in the river		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Medium term	Medium term
Magnitude *(Major, Moderate, Minor)*	Moderate	Minor
Probability *(Definite, Possible, Unlikely)*	Possible	Possible

NATURE OF IMPACT 2: Excavation of silt to levels below the riverbed, could result in water seeping from the Russell Stream into the mining voids, resulting in a loss of water quantity in the river		
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts • None foreseen.		
Mitigation measures • There is no feasible mitigation to prevent water seeping from the river into the voids, however, berms placed between the mining areas and the Russell Stream would assist to reduce inflow into the mining areas.		

Table 6-9: Significance rating of operational impact 3

NATURE OF IMPACT 3: Runoff and moisture from the stockpiled drying silt may potentially have poor water quality which may impact the water quality of the Russell Stream		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Medium term	Medium term
Magnitude *(Major, Moderate, Minor)*	Major	Minor
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	

NATURE OF IMPACT 3: Runoff and moisture from the stockpiled drying silt may potentially have poor water quality which may impact the water quality of the Russell Stream
Residual impacts • None foreseen.
Mitigation measures • Paddocks must be implemented downslope of the stockpiling area to capture, contain and evaporate runoff and seepage from the stockpiles; and • Once the operational phase is complete, any remnants of the stockpiles must be removed.

Table 6-10: Significance rating of operational impact 4

NATURE OF IMPACT 4: Uncontrolled dirty water runoff from the mining and stockpiling areas running off into the downslope Russell Stream impacting on water quality and sedimentation		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Medium term	Medium term
Magnitude *(Major, Moderate, Minor)*	Major	Minor
Probability *(Definite, Possible, Unlikely)*	Definite	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts • None foreseen.		
Mitigation measures • Implementation of the proposed SWMP. It must be ensured that stormwater measures are designed, constructed and operated to ensure that stormwater does not spill more than once in 50 years, to be compliant with GN R704 regulations; and • Water quality sampling must continue upstream and downstream of the mining and stockpiling areas. Should there be a deterioration in water quality from upstream to downstream, then immediate action should be undertaken to identify and address the issue.		

Table 6-11: Significance rating of operational impact 5

NATURE OF IMPACT 5: Poor maintenance of stormwater infrastructure resulting in silted paddocks and eroded berms, leading to spills into the downslope Russell Stream impacting on water quality and sedimentation		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Medium term	Medium term
Magnitude *(Major, Moderate, Minor)*	Major	Minor
Probability *(Definite, Possible, Unlikely)*	Possible	Unlikely
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts • None foreseen.		
Mitigation measures • Implementation of the stormwater monitoring plan detailed in section 7 of this report.		

Table 6-12: Significance rating of operational impact 6

NATURE OF IMPACT 6: Flooding of the mining and stockpiling areas which are located within the floodlines		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Medium term	Medium term
Magnitude *(Major, Moderate, Minor)*	Major	Minor

NATURE OF IMPACT 6: Flooding of the mining and stockpiling areas which are located within the floodlines		
Probability *(Definite, Possible, Unlikely)*	Possible	Unlikely
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts • None foreseen.		
Mitigation measures • Implementation of the proposed SWMP. It must be ensured that stormwater measures are designed, constructed and operated, to ensure that they can convey/deflect the 50 year runoff, to be compliant with GN R704 regulations.		

6.3.3 Closure and Rehabilitation Phase

Once mining is complete, all infrastructure will be removed from the site. The mined-out areas will be rehabilitated by shaping the areas where silt was removed and stockpiling took place, to a free draining surface. Thereafter, appropriate plant species will be planted to stabilise the soil. The Russel Stream will be allowed to re-establish its original course. Successful rehabilitation is expected to provide long-term benefits in terms of water quality improvement as well as lower flood levels in the area.

The activities and impacts that are likely to occur during the closure and rehabilitation phase are summarised in Table 6-13.

Table 6-13: Summary of activities and impacts for the closure phase

Activity	Impact Description
Exposure of soil during the closure and rehabilitation phase activities, once all silt has been removed.	**Impact 1:** Erosion and consequent deterioration of water quality in the Russell Stream.

The ratings and proposed mitigation measures for the closure and rehabilitation phase are indicated in Table 6-14.

Table 6-14: Significance rating of closure impact 1

NATURE OF IMPACT 1: The exposure of soil once all silt has been removed, has the potential to be washed into the downslope Russell Stream, impacting on water quality and sedimentation		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Short term	Short term
Magnitude *(Major, Moderate, Minor)*	Moderate	Minor
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating (Low, Medium, High)	**Medium**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts • None foreseen.		
Mitigation measures • Stormwater management measures (e.g. berms) should remain in place while rehabilitation is taking place, to prevent runoff from bare areas from flowing into the Russell Stream; • Revegetation of exposed areas should take place as soon as possible after shaping the area to a free draining surface; and • Water quality monitoring must continue upstream and downstream until the site has been fully rehabilitated.		

6.3.4 Post Closure Phase

Should rehabilitation be successfully implemented, then it is unlikely that any negative impacts will occur during the post closure phase. The removal of silt is likely to result in a long-term positive impact on the Russell Stream, provided that rehabilitation is successfully implemented.

6.4 Cumulative Impacts

Cumulative impacts are impacts that result from the incremental impact of the proposed activities on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective

impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

The Project is located in a catchment that is highly impacted by sewage, mining, urban and industrial activities. The implementation of a sound SWMP is crucial to contain dirty runoff from the operational area. The monitoring and maintenance of the implemented SWMP is of utmost importance, to ensure that spillages into the downslope watercourses do not occur. Furthermore, the implementation of a rehabilitation plan that ensures that the area is free draining and appropriately vegetated, could enhance the catchment water quality. Should the above not be done, then in the long term, the proposed project has the potential to cumulatively add to the already deteriorated water quality within the Russell Stream catchment.

The cumulative impact of the proposed project on the surface water quality of the catchment is rated in Table 6-15.

Table 6-15: Cumulative impact rating for surface water quality

NATURE OF IMPACT: Should dirty water runoff not be contained and an appropriate rehabilitation plan for the Russell Stream valley not be undertaken, then the proposed Project has the potential to add cumulatively to the already deteriorated surface water quality of the catchment		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Extent *(Local, Regional, International)*	Regional	Local
Duration *(Short term, Medium term, Long term)*	Long term (in excess of the Project life)	Long term (in excess of the Project life)
Magnitude *(Major, Moderate, Minor)*	Major	Minor
Probability *(Definite, Possible, Unlikely)*	Possible	Unlikely
Calculated Significance Rating (Low, Medium, High)	**High**	**Low**
Impact Status: (positive or negative)	Negative	Negative
Reversibility: (Reversible or Irreversible)	Irreversible	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts • None foreseen.		
Mitigation measures • Effective stormwater management as proposed under section 5, and in accordance with GN R704 Regulations; • Successful rehabilitation of the Valley Silts mining areas to a free draining and vegetated area; and		

NATURE OF IMPACT: Should dirty water runoff not be contained and an appropriate rehabilitation plan for the Russell Stream valley not be undertaken, then the proposed Project has the potential to add cumulatively to the already deteriorated surface water quality of the catchment
• Water quality monitoring upstream and downstream of the proposed project.

6.5 Impact Summary Table

The impacts and mitigation measures are summarised in Table 6-16.

Table 6-16: Summary of the impacts and mitigation measures

Impact No.	Activity	Impact Description	BEFORE MITIGATION					Mitigation measures / Recommendations	AFTER MITIGATION				
			Magnitude	Duration	Spatial Scale	Probability	SIGNIFICANCE		Magnitude	Duration	Spatial Scale	Probability	SIGNIFICANCE
Construction Phase													
1	Removal of vegetation and alteration to the topography.	Erosion of silt and consequent deterioration of water quality in the Russell Stream.	*Moderate -*	*Short Term < 18 months*	*Regional*	*Possible*	Medium	• Clearance of vegetation must be limited as far as possible; • The SWMP must be implemented as a first step during the construction phase; and • Water quality sampling must be implemented upstream and downstream of construction sites. Should there be a deterioration in water quality from upstream to downstream, then immediate action should be undertaken to identify and address the issue.	*Minor -*	*Short Term < 18 months*	*Site or Local*	*Possible*	Low
Operational Phase													
1	Excavation of the silt with impacts on water quality.	The excavation of the silt has the potential to increase oxygen levels within the silt, with subsequent oxidization reactions that could result in potential acidic conditions and leaching of salts and metals, which may impact on downstream water quality. The current water quality does not show any significant impacts as a result of this from the current mining operation at Sector 1, however, there is a potential for this to occur should mitigation measures not be implemented.	*Major -*	*Medium Term > 18 months < 5 years*	*Regional*	*Possible*	Medium	• Berms, paddocks and silt traps as per the proposed SWMP should be constructed around the mining and stockpiling areas to contain and evaporate dirty water.	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	*Possible*	Low

Impact No.	Activity	Impact Description	BEFORE MITIGATION					Mitigation measures / Recommendations	AFTER MITIGATION				
			Magnitude	Duration	Spatial Scale	Probability	SIGNIFICANCE		Magnitude	Duration	Spatial Scale	Probability	SIGNIFICANCE
2	Excavation of the silt with impacts on water quantity.	Excavation of silt to levels below the Russell Stream riverbed, could result in water seeping from the Russell Stream into the mining voids, resulting in a loss of water quantity in the river. This is not expected to be a significant impact, as the mining areas are small, and mining will only take place for a period of 3 years, after which, the area will be rehabilitated. Furthermore, much of the flow in the Russell Stream is from artificial sources (e.g. wastewater) and not from natural runoff.	*Moderate -*	*Medium Term > 18 months < 5 years*	*Regional*	*Possible*	Medium	• There is no feasible mitigation to prevent water seeping from the river into the voids, however, berms placed between the mining areas and the Russell Stream would assist to reduce inflow into the mining areas.	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	*Possible*	Low
3	Stockpiling of the silt	Runoff and moisture from the stockpiled drying silt may potentially have poor water quality which may impact the water quality of the Russell Stream. The current water quality does not show any significant impacts as a result of this from the current mining operation at Sector 1, however, there is a potential for this to occur should mitigation measures not be implemented.	*Major -*	*Medium Term > 18 months < 5 years*	*Regional*	*Possible*	Medium	• Suitably sized paddocks must be implemented downslope of the stockpiling area to capture, contain and evaporate runoff and seepage from the stockpiles; and • Once the operational phase is complete, any remnants of the stockpiles must be removed.	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	*Possible*	Low

Impact No.	Activity	Impact Description	BEFORE MITIGATION					Mitigation measures / Recommendations	AFTER MITIGATION				
			Magnitude	Duration	Spatial Scale	Probability	SIGNIFICANCE		Magnitude	Duration	Spatial Scale	Probability	SIGNIFICANCE
4	Uncontrolled dirty water runoff from the mining and stockpiling areas.	Runoff into the downslope Russell Stream impacting on water quality and sedimentation.	*Major -*	*Medium Term > 18 months < 5 years*	*Regional*	*Definite*	Medium	• Implementation of the proposed SWMP. It must be ensured that stormwater measures are designed, constructed and operated, to ensure that it does not spill more than once in 50 years, to be compliant with GN R704 regulations; and • Water quality sampling must be implemented upstream and downstream of the mining and stockpiling areas. Should there be a deterioration in water quality from upstream to downstream, then immediate action should be undertaken to identify and address the issue.	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	*Possible*	Low
5	Poor maintenance of stormwater infrastructure.	Poor maintenance of stormwater infrastructure resulting in silted paddocks and channels as well as eroded berms, leading to spills into the downslope Russell Stream impacting on water quality and sedimentation.	*Major -*	*Medium Term > 18 months < 5 years*	*Regional*	*Possible*	Medium	• Implementation of the stormwater monitoring plan detailed in section 7 of this report.	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	*Unlikely*	Low
6	Flooding of the mining and stockpiling area.	Some of the mining and stockpiling areas are located within the 1:50 and 1:100 year floodline.	*Major -*	*Medium Term > 18 months < 5 years*	*Regional*	*Possible*	Medium	• Implementation of the proposed SWMP. It must be ensured that stormwater measures are designed, constructed and operated, to ensure that they can convey/deflect the 50 year runoff, to be compliant with GN R704 regulations.	*Minor -*	*Medium Term > 18 months < 5 years*	*Site or Local*	*Unlikely*	Low
Closure & Rehabilitation Phase													

Impact No.	Activity	Impact Description	BEFORE MITIGATION					Mitigation measures / Recommendations	AFTER MITIGATION				
			Magnitude	Duration	Spatial Scale	Probability	SIGNIFICANCE		Magnitude	Duration	Spatial Scale	Probability	SIGNIFICANCE
1	Exposure of soil during the closure and rehabilitation phase activities, once all silt has been removed.	Erosion and consequent deterioration of water quality in the Russell Stream.	*Moderate -*	*Short Term < 18 months*	*Regional*	*Possible*	Medium	• Stormwater measures (e.g. berms) should remain in place while rehabilitation is taking place, to prevent runoff from bare areas from flowing into the Russell Stream; • Revegetation of exposed areas should take place as soon as possible after shaping the area to a free draining surface; and • Water quality monitoring must continue upstream and downstream until the site has been fully rehabilitated.	*Minor -*	*Short Term < 18 months*	*Site or Local*	*Possible*	Low
Cumulative Impacts													
1	Unsuccessful containment of dirty water runoff from the operation as well as unsuccessful rehabilitation	The proposed project has the potential to cumulatively impact on the already deteriorated surface water quality of the catchment	*Major -*	*Long Term > 5 years*	*Regional*	*Possible*	High	• Effective stormwater management as proposed under section 5, and in accordance with GN R704 Regulations; • Successful rehabilitation of the Valley Silts mining area to a free draining and vegetated area; and • Water quality monitoring upstream and downstream of the proposed project.	*Minor +*	*Long Term > 5 years*	*Site or Local*	*Unlikely*	Low

7 MONITORING PLANS

7.1 Surface Water Quality

A surface water quality monitoring programme is essential as a management tool to detect negative water quality impacts as they arise and to ensure that the necessary mitigation measures are implemented. It is recommended that Ergo continues to monitor the upstream, middle and downstream sections of the Russell Stream.

Water quality sampling should be done in accordance with the DWS Best Practice Guideline G3: Water Monitoring Systems. Samples must be kept cool (+-4°C), out of direct sunlight, and transported immediately to an accredited laboratory for water quality analysis within 24 hours of sampling. The impacts on water quality should be determined by comparing the monitoring results against the Klip River Catchment guideline limits and SANS 241:2015, and importantly against previous results, to determine any deviations in trends over time. If the trend analysis indicates any deviations to the baseline monitoring, in terms of deteriorating water quality, then an immediate investigation must be undertaken to determine whether the mine may be responsible. If responsible, urgent action must be undertaken to implement mitigation measures to prevent further contamination.

Reporting should continue to be done on a monthly / quarterly basis (or as recommended by the DWS). It is recommended that monitoring reports include trend analyses. It is further recommended that the water quality from upstream monitoring points is compared to downstream monitoring points.

7.2 Stormwater Infrastructure

Water infrastructure (channels, berms and paddocks) should be monitored on a monthly basis during the dry season, and on a weekly basis during the wet season. They should further be monitored immediately after any large storm events. Should blockages, silted up structures or breaches occur, immediate action should be undertaken to remove debris and repair breaches. Monitoring should be undertaken by the onsite Environmental Control Officer (ECO) or maintenance manager. Inspections must be recorded and should include the following:

- Date of inspection;
- Rainfall amount received;
- Photographs of blockages, silted up structures or breaches witnessed;
- What action was undertaken to fix issues, and the amount of time taken to address them; and
- Photographs post action taken.

Inspection reports should be kept ready and supplied to the DWS when requested, or as part of the WUL conditions.

8 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the most important aspect to prevent negative impacts from a surface water perspective, is to ensure that a sound stormwater management plan is implemented prior to the commencement of mining activities, in accordance with the conditions stipulated in GN R704. Maintenance of stormwater measures is of utmost importance and should be conducted as outlined in section 7. Furthermore, water quality monitoring must continue upstream and downstream of the proposed mining and stockpiling areas. The removal of the silt is expected to have a positive impact in the long-term on the water quality and flood levels of the Russell Stream, provided that rehabilitation is successfully implemented.

The following provides a summary of the key recommendations:

- The SWMP detailed under section 5 is implemented, and that all conditions specified in GN R704 are strictly adhered to;
- It is recommended that exemption from GN R704 is applied for, for the mining and stockpiling areas, which are located within the floodlines and 100 m stream buffer;
- The recommendations and mitigation measures provided under section 6 are implemented; and
- The monitoring plans provided under section 7 are implemented.

9 REFERENCES

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APPENDIX A: FLOODLINE RESULTS

Stream	Cross-Section	Profile	Peak Flow (m^3/s)	Flood Elevation (mamsl)	Flow Velocity (m/s)	Flood Width (m)	Froude Number
Russell Reach 1	3369	1:50 Year	256	1676.73	0.59	198.4	0.13
Russell Reach 1	3369	1:100 Year	308	1676.99	0.63	201.11	0.13
Russell Reach 1	3321	1:50 Year	256	1676.65	0.66	198.55	0.15
Russell Reach 1	3321	1:100 Year	308	1676.91	0.7	206.05	0.15
Russell Reach 1	3272	1:50 Year	256	1676.56	0.65	196.56	0.15
Russell Reach 1	3272	1:100 Year	308	1676.82	0.69	202.52	0.15
Russell Reach 1	3215	1:50 Year	256	1676.43	0.78	175.8	0.18
Russell Reach 1	3215	1:100 Year	308	1676.7	0.82	180.37	0.18
Russell Reach 1	3155	1:50 Year	256	1676.32	0.72	142.69	0.14
Russell Reach 1	3155	1:100 Year	308	1676.58	0.78	147.06	0.15
Russell Reach 1	3106	1:50 Year	256	1676.24	0.74	128.09	0.14
Russell Reach 1	3106	1:100 Year	308	1676.49	0.81	133.68	0.15
Russell Reach 1	3048	1:50 Year	256	1676.16	0.75	116.38	0.14
Russell Reach 1	3048	1:100 Year	308	1676.4	0.84	117.87	0.15
Russell Reach 1	2993	1:50 Year	256	1676.08	0.76	121.13	0.14
Russell Reach 1	2993	1:100 Year	308	1676.31	0.84	125.74	0.16
Russell Reach 1	2939	1:50 Year	256	1676.02	0.63	146.44	0.12
Russell Reach 1	2939	1:100 Year	308	1676.24	0.71	147.42	0.13
Russell Reach 1	2908	1:50 Year	256	1676	0.55	169.52	0.11
Russell Reach 1	2908	1:100 Year	308	1676.21	0.61	171.57	0.11
Russell Reach 1	2872	1:50 Year	256	1675.93	0.83	175.12	0.2
Russell Reach 1	2872	1:100 Year	308	1676.13	0.89	179.87	0.21
Russell Reach 1	2854	1:50 Year	256	1675.83	1.02	170.42	0.27
Russell Reach 1	2854	1:100 Year	308	1676.03	1.07	181.88	0.27
Russell Reach 1	2844		Bridge				
Russell Reach 1	2832	1:50 Year	256	1675.24	1.65	119.57	0.46
Russell Reach 1	2832	1:100 Year	308	1675.42	1.74	122.84	0.46
Russell Reach 1	2815	1:50 Year	256	1675.03	1.26	160.1	0.36
Russell Reach 1	2815	1:100 Year	308	1675.22	1.31	166.59	0.35
Russell Reach 1	2774	1:50 Year	256	1674.47	1.44	133.83	0.4
Russell Reach 1	2774	1:100 Year	308	1674.73	1.45	138.34	0.37

Stream	Cross-Section	Profile	Peak Flow (m^3/s)	Flood Elevation (mamsl)	Flow Velocity (m/s)	Flood Width (m)	Froude Number
Russell Reach 1	2736	1:50 Year	256	1673.86	1.62	111.31	0.43
Russell Reach 1	2736	1:100 Year	308	1674.1	1.61	169.43	0.48
Russell Reach 1	2683	1:50 Year	256	1673.12	1.27	171.71	0.38
Russell Reach 1	2683	1:100 Year	308	1673.3	1.32	173.01	0.36
Russell Reach 1	2637	1:50 Year	256	1672.91	0.77	189.82	0.19
Russell Reach 1	2637	1:100 Year	308	1673.09	0.84	202.14	0.2
Russell Reach 1	2587	1:50 Year	256	1672.82	0.56	260.22	0.14
Russell Reach 1	2587	1:100 Year	308	1672.99	0.62	266.05	0.14
Russell Reach 1	2543	1:50 Year	256	1672.72	0.71	234.11	0.18
Russell Reach 1	2543	1:100 Year	308	1672.87	0.77	241.51	0.19
Russell Reach 1	2506	1:50 Year	256	1672.67	0.48	304.06	0.12
Russell Reach 1	2506	1:100 Year	308	1672.82	0.53	311	0.12
Russell Reach 1	2429	1:50 Year	256	1672.52	0.66	333.63	0.2
Russell Reach 1	2429	1:100 Year	308	1672.65	0.71	337.38	0.2
Russell Reach 1	2357	1:50 Year	256	1672.08	0.93	314.02	0.32
Russell Reach 1	2357	1:100 Year	308	1672.24	0.96	316.1	0.3
Russell Reach 1	2307	1:50 Year	256	1671.78	0.82	210.6	0.22
Russell Reach 1	2307	1:100 Year	308	1671.93	0.9	219.5	0.23
Russell Reach 1	2266	1:50 Year	256	1671.57	0.88	249.55	0.26
Russell Reach 1	2266	1:100 Year	308	1671.71	0.94	251.83	0.27
Russell Reach 1	2201	1:50 Year	256	1670.14	2.61	145.14	1.02
Russell Reach 1	2201	1:100 Year	308	1670.24	2.75	149.94	1.02
Russell Reach 1	2134	1:50 Year	256	1663.88	0.87	75.33	0.14
Russell Reach 1	2134	1:100 Year	308	1664.2	0.97	76.76	0.15
Russell Reach 1	2073	1:50 Year	256	1663.87	0.36	177.64	0.06
Russell Reach 1	2073	1:100 Year	308	1664.2	0.4	190.88	0.06
Russell Reach 1	2017	1:50 Year	256	1663.86	0.32	308.93	0.06
Russell Reach 1	2017	1:100 Year	308	1664.18	0.34	341.82	0.07
Russell Reach 1	1949	1:50 Year	256	1663.86	0.13	394.11	0.02
Russell Reach 1	1949	1:100 Year	308	1664.18	0.15	396.44	0.02
Russell Reach 1	1892	1:50 Year	256	1663.86	0.15	285.89	0.02
Russell Reach 1	1892	1:100 Year	308	1664.18	0.17	290.95	0.02

Stream	Cross-Section	Profile	Peak Flow (m^3/s)	Flood Elevation (mamsl)	Flow Velocity (m/s)	Flood Width (m)	Froude Number
Russell Reach 1	1756	1:50 Year	256	1663.85	0.27	276.23	0.05
Russell Reach 1	1756	1:100 Year	308	1664.17	0.29	297.14	0.05
Russell Reach 1	1656	1:50 Year	256	1663.8	0.65	146.19	0.13
Russell Reach 1	1656	1:100 Year	308	1664.11	0.69	217.25	0.15
Russell Reach 1	1568	1:50 Year	256	1663.76	0.54	192.29	0.11
Russell Reach 1	1568	1:100 Year	308	1664.05	0.58	238.55	0.12
Russell Reach 1	1501	1:50 Year	256	1663.67	0.64	209.16	0.15
Russell Reach 1	1501	1:100 Year	308	1663.95	0.66	219.39	0.15
Russell Reach 1	1452	1:50 Year	256	1663.54	0.83	162.99	0.19
Russell Reach 1	1452	1:100 Year	308	1663.83	0.86	173.61	0.19
Russell Reach 1	1404	1:50 Year	256	1663.34	1	150.79	0.24
Russell Reach 1	1404	1:100 Year	308	1663.64	1.01	160.57	0.24
Russell Reach 1	1355	1:50 Year	256	1663.13	0.97	128.31	0.22
Russell Reach 1	1355	1:100 Year	308	1663.44	1.01	135.83	0.21
Russell Reach 1	1290	1:50 Year	256	1662.85	1.13	94.23	0.23
Russell Reach 1	1290	1:100 Year	308	1663.13	1.2	119.9	0.26
Russell Reach 1	1231	1:50 Year	256	1662.66	0.88	145.62	0.2
Russell Reach 1	1231	1:100 Year	308	1662.92	0.93	150.68	0.2
Russell Reach 1	1175	1:50 Year	256	1662.49	0.87	148.93	0.2
Russell Reach 1	1175	1:100 Year	308	1662.74	0.93	161.27	0.21
Russell Reach 1	1118	1:50 Year	256	1662.3	0.86	158.66	0.2
Russell Reach 1	1118	1:100 Year	308	1662.55	0.91	163.74	0.2
Russell Reach 1	1053	1:50 Year	256	1662.17	0.67	170.81	0.14
Russell Reach 1	1053	1:100 Year	308	1662.41	0.73	175.68	0.15
Russell Reach 1	977	1:50 Year	256	1661.94	0.96	177.79	0.25
Russell Reach 1	977	1:100 Year	308	1662.18	0.99	188.26	0.25
Russell Reach 1	909	1:50 Year	256	1661.44	1.15	163.06	0.32
Russell Reach 1	909	1:100 Year	308	1661.77	1.12	166.25	0.28
Russell Reach 1	847	1:50 Year	256	1660.88	1.37	96.42	0.31
Russell Reach 1	847	1:100 Year	308	1661.19	1.33	177.75	0.37
Russell Reach 1	797	1:50 Year	256	1660.6	0.95	170.68	0.24

Stream	Cross-Section	Profile	Peak Flow (m^3/s)	Flood Elevation (mamsl)	Flow Velocity (m/s)	Flood Width (m)	Froude Number
Russell Reach 1	797	1:100 Year	308	1660.87	0.97	176.51	0.23
Russell Reach 1	761	1:50 Year	256	1660.27	1.32	154.13	0.38
Russell Reach 1	761	1:100 Year	308	1660.6	1.24	176.29	0.33
Russell Reach 2	622	1:50 Year	256	1659.43	1.03	108.99	0.22
Russell Reach 2	622	1:100 Year	308	1659.84	1.03	128.55	0.22
Russell Reach 2	568	1:50 Year	256	1658.76	2.6	26.46	0.43
Russell Reach 2	568	1:100 Year	308	1659.08	2.87	27.15	0.46
Russell Reach 2	485	1:50 Year	256	1656.21	2.47	176.17	1.03
Russell Reach 2	485	1:100 Year	308	1656.28	2.65	180.19	1.05
Russell Reach 2	413	1:50 Year	256	1655.78	0.53	259.3	0.12
Russell Reach 2	413	1:100 Year	308	1656.12	0.54	266.82	0.12
Russell Reach 2	355	1:50 Year	256	1655.74	0.39	271.24	0.08
Russell Reach 2	355	1:100 Year	308	1656.08	0.41	276.89	0.08
Russell Reach 2	299	1:50 Year	256	1655.71	0.37	294.46	0.08
Russell Reach 2	299	1:100 Year	308	1656.06	0.38	300.27	0.08
Russell Reach 2	278	1:50 Year	256	1655.68	0.65	265.01	0.17
Russell Reach 2	278	1:100 Year	308	1656.03	0.62	294.07	0.15
Russell Reach 2	261		Bridge				
Russell Reach 2	237	1:50 Year	256	1654.05	1.65	130.38	0.48
Russell Reach 2	237	1:100 Year	308	1654.24	1.7	145.14	0.48
Russell Reach 2	214	1:50 Year	256	1653.85	1.11	148.78	0.28
Russell Reach 2	214	1:100 Year	308	1654.04	1.19	152.97	0.29
Russell Reach 2	176	1:50 Year	256	1653.61	1.01	169.94	0.26
Russell Reach 2	176	1:100 Year	308	1653.8	1.08	172.46	0.27
Tributary	373	1:50 Year	85	1662.7	2.93	16.23	0.7
Tributary	373	1:100 Year	101	1662.66	3.57	16.13	0.86
Tributary	355	1:50 Year	85	1662.05	1.75	69.34	0.67
Tributary	355	1:100 Year	101	1662.34	1.43	81.25	0.49
Tributary	333	1:50 Year	85	1661.86	0.92	66.72	0.25
Tributary	333	1:100 Year	101	1662.11	0.88	111.82	0.28
Tributary	309	1:50 Year	85	1661.67	1.17	48.99	0.31

Stream	Cross-Section	Profile	Peak Flow (m^3/s)	Flood Elevation (mamsl)	Flow Velocity (m/s)	Flood Width (m)	Froude Number
Tributary	309	1:100 Year	101	1661.89	1.21	50.88	0.3
Tributary	281	1:50 Year	85	1661.46	1.26	30.55	0.27
Tributary	281	1:100 Year	101	1661.66	1.37	31.24	0.28
Tributary	243	1:50 Year	85	1661.16	1.35	39.03	0.34
Tributary	243	1:100 Year	101	1661.36	1.42	39.69	0.34
Tributary	218	1:50 Year	85	1660.68	1.85	36.87	0.53
Tributary	218	1:100 Year	101	1660.93	1.82	41.22	0.5
Tributary	195	1:50 Year	85	1660.44	1.1	60.03	0.31
Tributary	195	1:100 Year	101	1660.76	1.04	61.6	0.26
Tributary	165	1:50 Year	85	1660.22	1.12	41.67	0.27
Tributary	165	1:100 Year	101	1660.6	1.1	44.59	0.24
Tributary	140	1:50 Year	85	1660.14	0.79	62.6	0.19
Tributary	140	1:100 Year	101	1660.54	0.76	65.79	0.17
Tributary	113	1:50 Year	85	1659.94	1.31	39.98	0.33
Tributary	113	1:100 Year	101	1660.39	1.2	45.09	0.28
Tributary	89	1:50 Year	85	1659.85	0.97	34.88	0.2
Tributary	89	1:100 Year	101	1660.31	0.97	36.97	0.18
Tributary	60	1:50 Year	85	1659.8	0.68	62.25	0.15
Tributary	60	1:100 Year	101	1660.27	0.65	70.29	0.14
Tributary	34	1:50 Year	85	1659.75	0.72	42.92	0.14
Tributary	34	1:100 Year	101	1660.22	0.68	92.95	0.17

APPENDIX B: CURRICULUM VITAE

HYDROSPATIAL

Hydrospatial (Pty) Ltd (2018/059188/07)
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Curriculum Vitae – Andy Pirie – Hydrologist

Details

Name and Surname:	Andy Pirie
Occupation:	Senior Hydrologist
Company:	Hydrospatial (Pty) Ltd
Address:	17 Sonop Place, Randpark, Johannesburg, 2194
Nationality:	South African
First Language:	English
Email Address:	andy@hydrospatial.co.za
Tel:	+27 84 441 9539

Andy Pirie is a senior hydrologist at Hydrospatial (Pty) Ltd. Andy graduated with a Master of Science (M.Sc.) in Water Resource Management (cum laude). He is registered as a Professional Natural Scientist (Pr.Sci.Nat.) in Water Resources Science with the South African Council for Natural Scientific Professions (SACNASP). He has worked on projects in South Africa, Cameroon, Senegal, Mali, Democratic Republic of the Congo (DRC), Botswana, Zambia and Namibia, for clients such as Assmang, Anglo American, Randgold Resources (now Barrick Gold), Sibanye-Stillwater, Birimian, Exxaro, Sasol, Eskom, Assore and SAFCOL. He has more than 9 years' experience in hydrological assessments and Geographical Information Systems (GIS). His expertise include the following:

- Floodline determinations;
- Mine water and salt balance modelling;
- Stormwater management plans;
- Surface water quality monitoring and assessment;
- Rainfall - runoff modelling;
- Catchment yield assessments;
- Sizing of dams and channels;
- Crop water requirement calculations;
- Environmental flow requirement calculations;
- Surface water impact assessments; and
- GN704 Regulation audits.

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Education

- 2013: M.Sc. Water Resource Management, cum laude (University of Pretoria).

Membership in Professional Associations

- Registered as a Professional Natural Scientist (Pr.Sci.Nat.) in Water Resources Science with the South African Council for Natural Scientific Professions (SACNASP). Registration number: 114988.

Employment

- March 2018 – Present: Senior Hydrologist at Hydrospatial (Pty) Ltd.
- June 2012 – February 2018: Hydrologist and GIS specialist at Digby Wells Environmental.

Selected Project Experience

Company	Position	Project Location	Client	Project	Responsibilities
Hydrospatial (Pty) Ltd	Senior Hydrologist	Gauteng	Sibanye Gold	Hydrological Study for the Sibanye Driefontein Operations EMP and WULA Update	• Baseline hydrological assessment. • Water quality assessment. • Stormwater management plan update. • Water and salt balance update. • GN704 and GN509 exemption assessment.
Hydrospatial (Pty) Ltd	Senior Hydrologist	Mpumalanga South Africa	SAFCOL	Streamflow Reduction Modelling of the Genus Exchange Ratio of Eucalyptus for Pine at the SAFCOL Berlin Plantations	• Setup of the WRSM/Pitman model. • Calculation of the allowable genus exchange area using the Gush Tables. • Reporting. • Presentation of study and hand over of reports.

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Company	Position	Project Location	Client	Project	Responsibilities
Hydrospatial (Pty) Ltd	Senior Hydrologist	Mpumalanga South Africa	Transvaal Gold Mining Estates	Hydrological Study for the Proposed Theta Mine Project	• Calculation of the water use freed up through the proposed removal of pine, eucalyptus and wattle in the Blyde River catchment for an offset strategy for the mine. • Baseline hydrological study. • Surface water impact assessment. • Water quality sampling and analysis. • Setup of a water monitoring network and programme. • Stormwater structure placement and sizings of structures. • Development of a water balance model. • Terrain modelling and catchment delineation using ArcGIS software. • Land use and soil assessment. • Determination of Peak flows for the 1:50 and 1:100 year storm event. • Hydraulic modelling to determine the 1:50 and 1:100 year floodlines. • Reporting.
Hydrospatial (Pty) Ltd	Senior Hydrologist	Limpopo, South Africa	Lunsklip Farming	Hydrological Study for the Lunsklip Irrigation Dam	• Catchment runoff modelling using the WRSM/Pitman model which included afforested areas. • Calculation of the farm irrigation requirements. • Quantification of the irrigation dam water balance.

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Company	Position	Project Location	Client	Project	Responsibilities
Hydrospatial (Pty) Ltd	Senior Hydrologist	Mpumalanga South Africa	Anglo American	Surface Water Assessment for the Proposed Leslie 1 Coal Mine	• Baseline hydrological study. • Surface water impact assessment. • Water quality sampling and analysis. • Setup of a water monitoring network and programme. • Stormwater structure placement and sizings of structures. • Development of a water balance model. • Terrain modelling and catchment delineation using ArcGIS software. • Land use and soil assessment. • Determination of Peak flows for the 1:50 and 1:100 year storm event. • Hydraulic modelling to determine the 1:50 and 1:100 year floodlines. • Reporting.
Hydrospatial (Pty) Ltd	Senior Hydrologist	Limpopo South Africa	Assmang	GN704 Legal Compliance Audit of the Dwarsrivier Chrome Mine	• Site audit of the mine to GN704 regulations. • Reporting on findings and recommendations for improvement to comply with GN704 regulations.
Hydrospatial (Pty) Ltd	Senior Hydrologist	Limpopo South Africa	Assmang	Floodline Determination for the Resource and Reserve Drilling Project at the Dwarsrivier Chrome Mine	• Catchment delineation. • Hydrological assessment to calculate the 1:50 and 1:100 year peak flows. • Hydraulic modelling of 18 river reaches to determine the 1:50 and 1:100 year flood water elevations.

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Company	Position	Project Location	Client	Project	Responsibilities
Hydrospatial (Pty) Ltd	Senior Hydrologist	Limpopo South Africa	Assore	GN704 Legal Compliance Audit of the Rustenburg Minerals Development Company Chrome Mine	• Site audit of the mine to GN704 regulations. • Reporting on findings and recommendations for improvement to comply with GN704 regulations.
Hydrospatial (Pty) Ltd	Senior Hydrologist	Gauteng South Africa	Fry's Metals	Stormwater Management Plan for the Fry's Metal Factory	• Audit of site stormwater infrastructure. • Calculation of peak flows and stormwater volumes. • Calculation of stormwater channel capacities to assess whether capacities comply with regulatory requirements.
Hydrospatial (Pty) Ltd	Senior Hydrologist	North West South Africa	Assore	Hydrological Study for the Wonderstone Mine	• Baseline hydrological study. • Surface water impact assessment. • Water quality Assessment. • Development of a stormwater. management plan. • River diversion assessment.
Hydrospatial (Pty) Ltd	Senior Hydrologist	KwaZulu-Natal, South Africa	The Biodiversity Company	Water Quality Monitoring and Assessment for the Edendale Bulwer Housing Development	• Setup of a water monitoring network. • Surface water sampling. • Assessment of water quality results.
Hydrospatial (Pty) Ltd	Senior Hydrologist	Gauteng South Africa	Eskom	Hydrological Assessment of a Tributary of the Braamfonteins pruit near Sandton, Johannesburg	• Site assessment. • Peak flow calculations. • Storm event assessment. • Hydraulic structure assessment. • Assessment of gabion retaining wall failure.

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Company	Position	Project Location	Client	Project	Responsibilities
					• Hydraulic modelling of watercourse.
Hydrospatial (Pty) Ltd	Senior Hydrologist	Limpopo South Africa	Assore	GN704 Legal Compliance Audit of the Zeerust Chrome Mine	• Site audit of the mine to GN704 regulations. • Reporting on findings and recommendations for improvement to comply with GN704 regulations.
Digby Wells Environmental	Hydrologist	Mali	Birimian	Hydrological Study for the Environmental and Social Impact Assessment for the Goulamina Lithium Project	• Baseline hydrological study. • Development of a water and salt balance. • Modelling of catchment flood hydrology. • Calculation of storm rainfall depths. • Stormwater management plan. • Surface water impact assessment.
Digby Wells Environmental	Hydrologist	Senegal	Randgold Resources	Hydrological Study for the Randgold Massawa Gold Project ESIA	• Baseline hydrological study. • Floodline determination. • Development of a water and salt balance. • Modelling of catchment hydrology. • Environmental flow requirement calculations. • Stormwater management plan. • Surface water impact assessment.
Digby Wells Environmental	Hydrologist	Cameroon	Caminex SA	Hydrological Study for the Environmental	• Baseline hydrological study. • Surface water impact

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Company	Position	Project Location	Client	Project	Responsibilities
				and Social Impact Assessment for the Ntem Iron Ore Project	assessment.
Digby Wells Environmental	Hydrologist	Gauteng South Africa	Sibanye-Stillwater	Sibanye Gold Millsite TSF Reclamation Project EIA	• Audit of existing stormwater management controls. • Development of a stormwater management plan to satisfy GN704 Regulation requirements. • Development of a stormwater control monitoring programme. • Water conservation and water demand management plan
Digby Wells Environmental	Hydrologist	Gauteng South Africa	Sibanye-Stillwater	Sibanye Gold Kloof Floodline Determination	• Site visit to assess channel and floodplains and to measure hydraulic structures. • DEM creation from lidar dataset. • Catchment delineation. • Catchment assessment of soils, vegetation, slope and land cover to obtain suitable runoff coefficients. • Calculation of peak flows using Rational and SDF methods. • Hydraulic modelling in HEC-RAS for approximately 25 river reaches to determine the 1:50 and 1:100 year surface water elevations.
Digby Wells Environmental	Hydrologist	Free State South Africa	Bothma and Son Transport	Stormwater management plan for the Bothma Sand	• Audit of existing stormwater management structures.

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Company	Position	Project Location	Client	Project	Responsibilities
				Mine	• Rainfall assessment. • Sizing of channels. • Development of a stormwater management plan to satisfy GN704 conditions. • Development of a stormwater structure monitoring programme. • Development of a PCD rehabilitation action plan. • Reporting.
Digby Wells Environmental	Hydrologist	Free State South Africa	Sasol Mining	Sasol Defunct Mines Surface Flow Analysis	• Project manager. • Creation of detailed DEMs from Lidar data for 4 of Sasol's defunct subsided collieries. • Modelling of surface water flow directions and accumulations to determine areas that are not free draining.
Digby Wells Environmental	Hydrologist	Gauteng South Africa	DRD Gold	DRD Gold Stormwater Management Plans for the Ergo Elsburg & Van Dyk Tailings Dams	• Project manager. • Site visit audit of stormwater management structures. • Flood peak calculations. • Stormwater structure sizing. • Management measures to ensure that stormwater structures are maintained. • Reporting.
Digby Wells Environmental	Hydrologist	Mpumalanga South Africa	Exxaro	Exxaro Surface Water Study for the Environmental Authorisation for the Proposed Schoonoord	• Baseline hydrological study. • Surface water impact assessment. • Water quality sampling and analysis of results.

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Company	Position	Project Location	Client	Project	Responsibilities
				Underground Mine, Arnot Coal, Mpumalanga	• Setup of a water monitoring network and programme. • Stormwater structure placement and sizings of structures. • Terrain modelling and catchment delineation using ArcGIS software. • Land use and soil assessment. • Determination of Peak flows for the 1:50 and 1:100 year storm event. • Hydraulic modelling using the HEC-RAS model to determine the 1:50 and 1:100 year floodlines. • Reporting.
Digby Wells Environmental	Hydrologist	Limpopo South Africa	Exxaro	Exxaro Floodline Determination for the Closure Environmental Management Plan for the Tshikondeni Coal Mine	• Catchment assessment of rainfall, topography, soils and land cover. • Determination of the 1:50 and 1:100 year peak flows. • Hydraulic modelling using HEC-RAS to determine the 1:50 and 1:100 year floodlines. • Reporting on catchment characteristics, methods and results obtained.
Digby Wells Environmental	Hydrologist	Botswana, Zambia and Namibia	Botswana Government	Kazungula Bridge Project Surface Water Quality Monitoring	• Setup of a water quality monitoring network and programme. • Monthly water sampling from the Zambezi and Chobe Rivers over a 6 year period to determine whether the construction and operation of

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Company	Position	Project Location	Client	Project	Responsibilities
					the Kazungula Bridge is impacting on the water quality. • Analysis of water quality results. • Monthly monitoring reports describing the water quality for the month and identifying possible sources of pollution as well as providing mitigation measures.
Digby Wells Environmental	Hydrologist	Free State South Africa	Sibanye-Stillwater	Sibanye Beatrix ESIA	• Baseline hydrological study. • Surface water impact assessment. • Water quality and trend analysis.
Digby Wells Environmental	Hydrologist	Mpumalanga South Africa	Anker Coal	Anker Coal Elandsfontein Colliery Stormwater Management Plan	• Site visit audit of stormwater structures. • Review of existing stormwater management plan. • Recommendations for the improvement of existing stormwater management plan
Digby Wells Environmental	Hydrologist & GN704 Auditor	Northern Cape, South Africa	Assmang	GN704 Legal Compliance Audit for the Khumani Iron Ore Mine	• Project manager. • Preparation of an audit checklist. • Audit of the mine to GN704 regulations. • Reporting on findings and recommendations for improvement to comply with GN704 regulations.
Digby Wells Environmental	Hydrologist	Okavango, Botswana	Botswana Government	Mohembo Bridge Surface Water Baseline and Monitoring Programme	• Setup of a surface water quality monitoring network and programme. • Surface water quality sampling and analysis of results. • Analysis of streamflows from the Mohembo

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Company	Position	Project Location	Client	Project	Responsibilities
					discharge gauging station. • Climate assessment.
Digby Wells Environmental	Hydrologist	Mpumalanga South Africa	Sasol Mining	Sasol Surface Water Study for the Environmental Authorisation for the Imvula Coal Mining Project	• Baseline hydrological study. • Surface water impact assessment. • Terrain modelling and catchment delineation using ArcGIS software. • Land cover and soil hydrological assessment. • Surface water report writing and compilation.
Digby Wells Environmental	Hydrologist	North-west South Africa	Sun International	Sun City Drinking Water Quality Analysis	• Sampling of drinking water at Sun City. • Interpretation of water quality results. • Reporting.
Digby Wells Environmental	Hydrologist	Limpopo South Africa	De Groote Boom Minerals	Surface Water Study for the Mining Permit Application for the De Groote Boom Project	• Baseline hydrological study. • Surface water impact assessment. • Water quality sampling and assessment of water quality results. • Setup of a water quality monitoring programme. • Reporting.
Digby Wells Environmental	Hydrologist	South Africa	Fountain Capital	Floodline Determination for Proposed Development of an Open Pit Coal Mine and Associated Infrastructure near Bronkhorstspruit, Gauteng	• Catchment assessment of rainfall, topography, soils and land cover. • Determination of the 1:50 and 1:100 year peak flows. • Hydraulic modelling using HEC-RAS to determine the 1:50 and 1:100 year floodlines. • Reporting on catchment

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Company	Position	Project Location	Client	Project	Responsibilities
					characteristics, methods and results obtained.
Digby Wells Environmental	Hydrologist	Limpopo South Africa	Pamish Investments No. 39	Floodline Determination for the Proposed Open Pit Magnetite Mine and Concentrator Plant, Mokopane, Limpopo Province	• Catchment assessment of rainfall, topography, soils and land cover. • Determination of the 1:50 and 1:100 year peak flows. • Hydraulic modelling using HEC-RAS to determine the 1:50 and 1:100 year floodlines. • Reporting on catchment characteristics, methods and results obtained.
Digby Wells Environmental	Hydrologist	Mpumalanga South Africa	Eskom	Eskom Surface Water Study for the Mashala Resourses 22kV Power Line	• Baseline hydrological study • Surface water impact assessment. • Hydraulic modelling using HEC-RAS to determine the 1:50 and 1:100 year floodlines. • Reporting.

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Company	Position	Project Location	Client	Project	Responsibilities
Digby Wells Environmental	Hydrologist	Mpumalanga South Africa	Msobo Coal	Msobo Coal Surface Water Study for the Sara Buffels A and B: IWULA and IWWMP for Opencast and Underground Mining Activities	• Surface water impact assessment. • Terrain modelling and catchment delineation using ArcGIS software. • Land use and soil assessment. • Determination of Peak flows for the 1:50 and 1:100 year storm event. • Hydraulic modelling using the HEC-RAS model to determine the 1:50 and 1:100 year floodlines. • Reporting.
Digby Wells Environmental	Hydrologist	Mali	Randgold Resources	Randgold Surface Water Study for the Morila Gold Mine Agri-Assessment Project	• Review of reports, mine layout plan and water quality data. • Classification of clean and dirty water areas based on the above. • Recommendations on water sources and areas for agri-business post mine closure.

APPENDIX D:

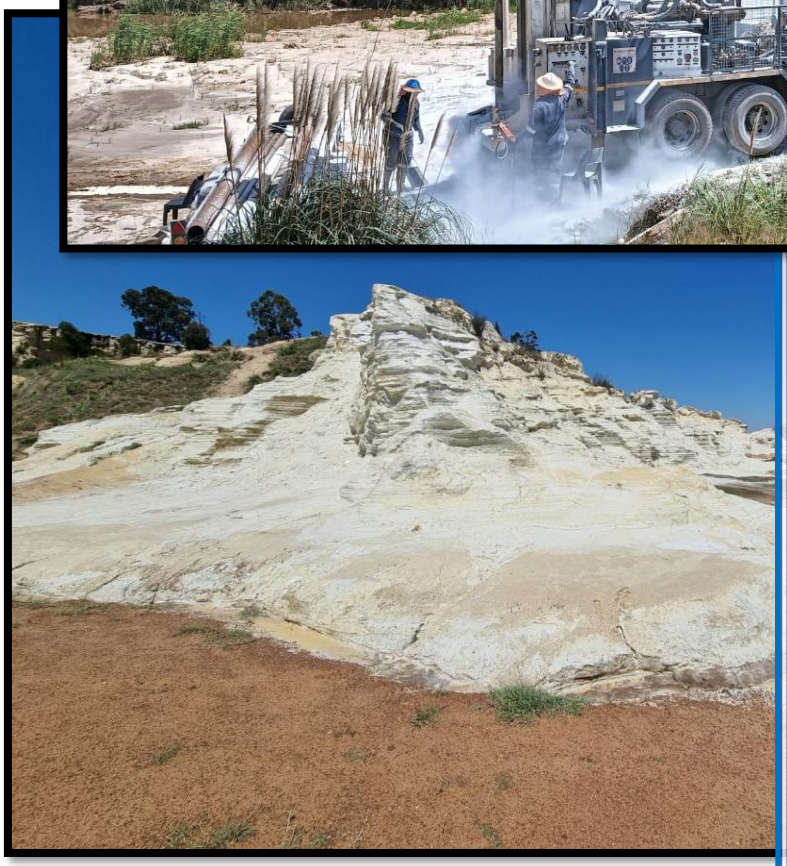
Specialist Studies

- ❖ Appendix D6 - Groundwater

2025

Valley Silts Expansion Project. Groundwater Report





5 April 2025

Groundwater Abstract (Pty) Ltd

Enterprise Number: 2017/489367/07

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VALLEY SILTS EXPANSION PROJECT. GROUNDWATER REPORT

Ergo Mining (Pty) Ltd

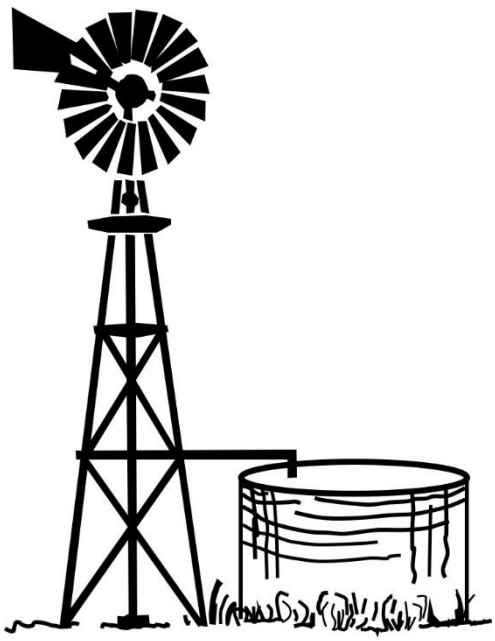
Report compiled by:

Groundwater Abstract Pty Ltd

Lucas Smith and Irene Lea

Principal Hydrogeologists –

M.Sc. and Pr. Sci. Nat.



On behalf of:

Kongiwe Environmental (Pty) Ltd

Declaration of Independence

We, Lucas Smith and Irene Lea, declare that –

General declaration:

- *I act as the independent Hydrogeology 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 hydrogeological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;*
- *I will comply with the Act, Regulations and all other applicable legislation;*
- *I have no, and will not engage in, conflicting interests in the undertaking of the activity;*
- *I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;*
- *I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;*
- *I will 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 hydrogeological 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.*

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SIGNATURES:





_____ _____

LA Smith I Lea

Executive Summary

Ergo Mining (Pty) Ltd (Ergo) obtained Environmental Authorisation and an Integrated Water Use Licence for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of NASREC near Booysens Reserve in Johannesburg – Valley Silts Project. The mining authorisation for the removal of silts falls within Mining Right GP 184 MR. Ergo intends to expand its Valley Silts reclamation operation – the Valley Silts Expansion Project.

The removal of silts within the already authorised Valley Silts Project area has been ongoing since May 2023. The construction and site establishment began in October 2022 and as such, it is now necessary to prepare for the Valley Eastern Expansion, Southern Expansion, and Valley Expansion Northwest to allow for continuous reclamation operation, as well as a sustainable feed source to the process plant.

The anticipated life span of the Valley Silts Expansion Project is approximately 5 years maximum. The silt removal is planned for 3 years and rehabilitation 2 years.

Water Management:

This project will not require any additional process water for the mechanical excavation of gold bearing silts from the Russell Stream. Potable drinking water will be sourced from the municipality.

The clean stormwater runoff from the area to the south of the drying sites will be diverted using a stormwater diversion drain (or berm) around the area to the west. Stormwater from the north will flow via properly constructed inlets into the Russell Stream. Temporary berms will be constructed along the banks of the channel.

Environmental Setting:

The Valley Silts Project is located on the Central Rand Group, of the Witwatersrand Supergroup. The Witwatersrand Supergroup is a sequence of conglomerate, shale and quartzite. The Lower Witwatersrand is composed mainly of argillaceous clays and shale, with occasional banded ironstone, tillite and intercalated lava flow, while the Upper Witwatersrand consists almost entirely of quartzite and conglomerate.

The Valley Silts Project is in the Klip River catchment, in the C22C quaternary catchment, forming part of the Vaal Water Management Area. The main drainage in the project area is the Russell Stream, that discharges into the Klip River.

Fieldwork Program:

Hydrocensus:

A hydrocensus was conducted across the study area during February 2025. The survey included the Valley Silts Project area, plus accessible properties within a 2 km radius, and concentrated on identifying existing boreholes to enhance the knowledge of the groundwater systems and current groundwater use. Six boreholes and two old mine shafts were identified, all on neighbouring properties.

It was concluded that groundwater is not used in the area and all properties make use of municipal supply. Two private boreholes were identified (VAL4 and VAL5) with only VAL4 in use for garden irrigation and swimming pool top-up. No boreholes were identified along the eastern portion of the project area.

Groundwater level measurements were possible from the six boreholes. The groundwater level below surface varied between 0.10 metres (m) bgl (borehole VAL2) and 30.85 m bgl for borehole VAL5 (in the Industria West area). Borehole VAL5 presents a groundwater level (30.85 m bgl) that is much deeper compared to the other five boreholes. This potentially relates to differences in the geological units. The rest groundwater levels in the other five boreholes are on average 2.08 m below surface.

Borehole Drilling:

Two groundwater characterisation and monitoring boreholes were drilled at each of the two target areas – the one borehole was drilled to a depth of 80 m below surface, with the aim of characterising and monitoring the deeper fractured aquifer. The second borehole was drilled 30 m deep, with the aim of monitoring potential groundwater flow, quality and possible connection between the deeper fractured aquifer and the shallow weathered aquifer in the area.

Not one of the four new percussion boreholes produced a measurable blow yield, but a groundwater level could be measurable in all four boreholes shortly after completion. In general, borehole yields throughout the area are low. The weathered – solid formation contact yielded little water – only seepage water. A fractured zone in the quartzite in borehole VS-BH2d, plus the quartzite-lava and the quartzite-conglomerate contacts also yielded little water. The depth of weathering varies between 8 and 12 m below ground level.

Aquifer Testing:

Following completion of the drilling program, an aquifer test program was initiated to determine the hydrogeological characteristics of the local aquifers.

For this project full drawdown and recovery pump tests were conducted on two of the four new boreholes (VS-BH1s and VS-BH1d) and a slug test was also completed on borehole VS-BH1s. Boreholes VS-BH2s and VS-BH2d were not tested due to the low volume of water inside the boreholes.

The recovery data (for the tested boreholes) indicate that the recovery is slow and that full recovery (100%) was not achieved within the predetermined testing timeframe. The low borehole yields, fast water level drawdown and slow recovery observed during the aquifer testing indicate low transmissivity aquifers, with low recharge. The average T-values calculated from the pumping tests range between 0.005 and 0.048 m^2/d.

Current Groundwater Quality:

The groundwater in the project area represents a Calcium/ Magnesium-Sulphate water, indicating contaminated water. Only borehole VAL4 (Abraham Kriel Bambanani borehole approx. 1.6 km north of the Russell Stream) presents a Calcium/ Magnesium-Bicarbonate water, indicating recent recharge water.

The following were concluded from the 2025 groundwater quality results:

- Health impact:
    - Iron – An elevated iron concentration was measured for all 7 boreholes (hydrocensus and newly drilled) sampled during the 2025 fieldwork program, with Iron concentrations varying between 4.59 mg/L (borehole VAL4) and 441 mg/L (borehole VS-BH1s), versus the maximum allowable concentration of 2 mg/L. The concentration of dissolved Iron in the 4 newly drilled boreholes, adjacent to the Russell Stream vary

between 72.7 mg/L and 441 mg/L, with lower concentrations measured for the two downgradient boreholes (VS-BH2s and d).

- Manganese – Six of the 7 boreholes sampled during the 2025 study measured a Manganese concentration that exceeds the health impact limit. The measured Mangansee concentration for borehole VAL4 (Abraham Kriel Bambanani borehole) exceeds the Aesthetic Limit of 0.1 mg/L, but is below the Health Impact limit of 0.4 mg/L.

  Manganese concentrations vary between 5.45 mg/L (borehole VAL1) and 74.3 mg/L (borehole VS-BH2d), versus the maximum allowable concentration of 0.4 mg/L. The concentrations of dissolved Manganese in the 4 newly drilled boreholes, adjacent to the Russell Stream vary between 34.7 mg/L and 74.3 mg/L, with lower concentrations measured for the 2 upstream boreholes (VS-BH1s and d).

- Cadmium – The 4 newly drilled boreholes measured a Cadmium concentration that could result in chronic health effects (0.008 to 0.117 mg/L). The health impact limit is set at 0.003mg/L. Elevated Cadmium concentrations were not measured for the 3 hydrocensus boreholes.

- Nickel – An elevated dissolved Nickel concentration was measured at the 4 newly drilled boreholes, plus hydrocensus borehole VAL2.

- Sulphate – Sulphate concentrations were elevated in 6 of the 7 boreholes sampled during the 2025 study. It was only borehole VAL4 where the measured Sulphate concentration was within acceptable health and aesthetic limits.

  The elevated Sulphate concentrations vary between 1125 mg/L (borehole VAL1) and 3126 mg/L (borehole VS-BH1d), versus the maximum allowable concentration of 500 mg/L. The concentration of Sulphate in the 4 newly drilled boreholes, adjacent to the Russell Stream vary between 2011 mg/L and 3126 mg/L, with lower concentrations measured for the two downstream boreholes (VS-BH2s and d).

- Lead – An elevated Lead concentration was measured for borehole VS-BH2d (0.012mg/L) and borehole VAL2 (0.012 mg/L), with the health limit defined as 0.01mg/L. The Lead concentration in all other boreholes were below the detection limit.
- Total Organic Carbon – High TOC values (between 11.2 and 19.1 mg/L) were measured for boreholes VAL1, VAL2, VS-BH2s and VS-BH2d.
- E. coli – borehole VAL4 produced a measurable E. coli count – 7 counts per 100 ml; the count must be zero. Borehole VAL4 is in an old residential and industrial area, and it has been assumed that leaking sewer lines are possibly contaminating the groundwater around this borehole.

- Aesthetic effects:

  - Aluminium – The aluminium concentration for boreholes VS-BH1s and VS-BH1d (25.1mg/L and 2.07 mg/L respectively) exceed the SANS241:2015 guideline value of 0.3 mg/L. The sampled groundwater from the BH1 cluster set was very muddy during the sampling process and this could have contributed to the elevated Aluminium concentrations.

- Zinc – The Zinc concentration for borehole VS-BH1s (7.99 mg/L) exceeds the SANS241:2015 guideline value of 5 mg/L. The measured Zinc concentrations for the other 3 newly drilled boreholes were below the aesthetic impact limit.
- Ammonium – The Ammonium concentration for borehole VAL1 exceeds the aesthetic limit for drinking water (14.6mg/L). The aesthetic limit set at 1.5 mg/L. The ammonia concentrations in the other boreholes vary between 0.19 and 0.88 mg/L.
- Sodium – The measured Sodium concentration for borehole VS-BH1d (210 mg/L) exceeds the aesthetic limits for drinking water (200mg/L).
- Turbidity – Turbidity was high in all boreholes with units varying between 42.5 NTUs and 730 NTUs.
- Calcium – The measured Calcium concentration was elevated for all sampled boreholes, with concentrations varying between 37.5 mg/L and 493 mg/L.
- Magnesium – High Magnesium concentrations were measured in 5 of the 7 boreholes and were in acceptable limits for boreholes VAL1 and VAL4.
- Total Hardness – The Total hardness value was elevated for all boreholes except borehole VAL4, indicating very hard water.
- Total Coliform – The total coliform count was elevated for borehole VAL4 (40 counts per 100 ml) and for borehole VS-BH1d (20 counts per 100 ml). The operational limit is set at 10 counts per 100 millilitres (ml).
- pH – the pH value for the two newly drilled upstream boreholes (VS-BH1s and VS-BH1d) (4.87 and 4.52 respectively) is below the SANS guideline limit of 5.
- The SANS 241 guideline limits for Electrical Conductivity (EC) and Total Dissolved Salts (TDS) were exceeded for all sampled sites, except for borehole VAL4. EC level varied between 222 and 403 mS/m. TDS varied between 1756 and 4134 mg/L.

The chemicals of concern for the Valley Silts project area are pH, Iron, Manganese, Sulphate, Cadmium, Lead, Nickel and Total Organic Carbon. Parameters exceeding aesthetic limits include Ammonium, Aluminium, Chloride, Calcium, Magnesium, Sodium, Zinc, Total Hardness and Turbidity. Most of these are elevated in the four newly drilled boreholes.

Geochemistry:

The 2005 Council for Geosciences study identified Co, Ni, Cu, As and U as the principal elements of concern. The Council for Geosciences found – "The leachable fractions determined from the compliance batch leach tests are uniformly low, with nickel slightly more mobile than the other elements.

The silts were all deposited in a sub-aqueous environment and are in contact with water for most of the year. Any easily mobilised metals will therefore be mobilised, while the more strongly bound fraction will require a more aggressive leachate than clean water to remobilise them. If the current conditions are maintained in these wetlands, i.e. continuous discharge of water to the wetlands and the maintenance of reducing conditions, it is unlikely that the metals will be mobilised."

The proposed Valley Silts Expansion Project will remove the silts, and then temporarily stockpile and dry the silt in stockpile areas directly north and south of Blocks N1 to N18. Silts will have up to 40% moisture content when hauled and are not expected to be fully dried out. The dried tailings/silts will be loaded onto tipper trucks and transported to the City Deep Plant for pre-processing.

The excavation of the silt from the water course will trigger oxidation reactions that will result in acidic conditions and leaching of salts and metals. Negative surface and groundwater quality impacts are expected in the excavated areas and the stockpile areas.

In the deeper silt pockets the pH will be much lower and element concentrations higher, but due to current stable conditions that include saturation, low permeability and low oxygen levels, metal and salt leaching does not happen readily. This will change when the silt excavation process introduces oxygen and disturbs the stable conditions.

Modelling:

The available information was used to construct a conceptual model of the aquifers present in the project area. The conceptual model forms the basis of the numerical groundwater model. To assess the potential impacts of the proposed silt excavation from section of the Russell Stream, a groundwater model was constructed for the project area.

The following scenarios were evaluated as part of the assessment:

- **Best case scenario**: Low seepage infiltration from the project to the underlying aquifers, equivalent to dry conditions.
- **Likely case scenario**: Moderate seepage infiltration rates to the underlying aquifers, equivalent to average conditions.
- **No Project scenario**: This is considered the worst case and assumes that the silts will remain in the Russell Stream floodplain.

Outcome of Simulations Completed:

The overall outcome of the simulations is summarised as follows:

- The cumulative impact of all historical TSFs located around the project area was included during simulations. These areas are included based on monitoring data from hydrocensus boreholes downgradient of two of these TSFs. Since these are likely dry as they are dormant, long-term impacts on groundwater quality associated with these could reduce. It is further noted that these TSFs are downgradient of the Valley Silts Expansion Project and are therefore not expected to impact directly on long-term water quality associated with the project.
- Also included is silt material present in the Russell Stream further downgradient and west of the Valley Silts Expansion Project. The extent of this material is inferred from information made available as part of the 2019 assessment. As this material will remain in the stream for now, it impacts on groundwater quality in this area will continue in future. This area is downgradient of the Valley Silts Project and will therefore not impact on long-term groundwater quality associated with the project.
- Only two of the boreholes and shafts identified during the 2025 hydrocensus are downgradient of the project, namely CRGB15 and VAL1. Borehole CRGB15 is downgradient of a historical TSF. For this reason, impacts on this borehole cannot be attributed to the Valley Silts Project. Borehole VAL1 is located approximately 2 km west of the Valley Silts Project, further along the flow of the Russell Stream. This borehole is located near the area where silts are likely to remain in the stream in future and is also downgradient of a historical TSF. Based on this it is concluded that groundwater is not currently used in the zone of impact associated with the Valley Silts Project.

- The project footprint is located on outcrops of Turffontein quartzite, Johannesburg quartzite and Booysens shale. Fieldwork completed during 2025 confirms that the aquifers associated with the shale and the Johannesburg quartzite have low permeabilities and recharge rates. As such, the sulphate and iron plumes associated with the project migrate very slowly in the aquifers. The advantage of this outcome is that contamination associated with the project is not likely to move more than a few hundred meters from the reclamation areas in the long-term.
- The disadvantage of the poorly developed aquifer conditions identified is that historical contamination will not be flushed in the long-term but will remain within the footprint area to a large extent. Removal of the silt material as part of the project is therefore likely to reduce the concentrations of contaminants but will not significantly do so. In addition to a reduction in concentration, the extent of the zone of impact on groundwater quality will reduce in the long-term after removal of the silt material from the stream.
- Groundwater plumes are expected to move towards the Russell Stream on a local scale, but regionally in a westerly directly, but slowly.
- The volumes of contaminated groundwater that may reach the wetlands downgradient in the Russell Stream cannot be accurately assessed based on one dataset alone. It is however expected to be low, probably not exceeding 20 m^3/a.
- Most significant impacts on groundwater quality, as delineated by the simulated zones of unacceptable long-term impacts and zones of acceptable operational impacts are mainly restricted to the Valley Silts Project footprint areas. The zones of unacceptable impact are indicated by thick red lines (Figure 21 and Figure 22) at concentrations exceeding 1000 mg/L for sulphate and exceeding 10 mg/L for iron.
- The extent of the iron plume is larger compared to that of sulphate. This is because lower concentration standards are imposed on iron compared to sulphate.

Impact at the End of the Operational Phase:

The impact of silt reclamation from the stream at the end of the operational phase is presented for iron and sulphate (Figure 21 and Figure 22). The simulations indicate the following:

- Due to the short duration of the project, the outcome of the operational impact on groundwater quality is mainly due to the impact of historical tailings deposition in the stream.
- Based on the current dataset, it is expected that sulphate concentrations would exceed 2000mg/L and iron concentrations would exceed 200 mg/L over the project footprint area at the end of the operational phase. The groundwater is currently not fit for use.
- The zone of impact on groundwater quality is not expected to significantly exceed the project boundary at the end of the operational phase. It is possible that the plumes can migrate 100 m west along the flow of the Russell Stream.
- No private boreholes fall within the delineated zone of impact of the Valley Silts Expension Project.

Likely Long-term Scenario:

The likely outcome of the removal of silts from the Russell Stream in terms of groundwater quality is presented in Figure 23 and Figure 24. The following is concluded from the impact predictions completed:

- Sulphate concentrations are expected to reduce to below 1000 mg/L over large portions of the footprint. It is possible that pockets in the aquifer may have concentrations exceeding 1000 mg/L, but not significantly so. These zones where sulphate exceeds 1000 mg/L will remain inside the project footprint area in the long-term.
- In addition, the extent of the zone of impact is expected to reduce to within the project footprint.
- Iron concentrations are also expected to reduce significantly within the project area. It is anticipated that iron concentrations would reduce to below 100 mg/L over most of the project area, but as with sulphate, pockets may remain where concentrations exceed 100 mg/L, but not significantly so. While this will be a significant reduction in iron concentrations, long-term impacts over the project footprint will continue to pose a risk that could result in acute or chronic health impacts. The groundwater within the project area will therefore remain unfit for use. The positive outcome of the project is however a significant reduction in concentrations and a reduction in the extent of the zone of unacceptable impacts.

Scenario Analysis for Long-term Impacts:

The outcome of the assessment for both sulphate and iron is summarised as follows:

- Impacts associated with the best case and likely scenarios are expected to be very similar in terms of impacts on groundwater quality. These two cases relate to how water is managed on site during the operational phase and the extent to which infiltration of dirty water takes place. Since the aquifer permeability within the project area is low, water management options during the comparatively short operational period are not likely to result in significant long-term effects. Despite this, it is recommended that clean and dirty water management measures, as indicted in Kongiwe (2025) are strictly adhered to. All measures must be taken to divert clean runoff and contain dirty water inside the dedicated paddocks. Dirty water must be reused during reclamation to avoid ponding over extended periods of time.
- If the Valley Silts Expansion Project is not implemented, current impacts on groundwater quality are expected to continue in the long-term. This is expected to increase sulphate and iron concentrations within the unacceptable levels over the footprint area as well as downstream in the Russell Stream. The extent of the zone of impact on groundwater quality is therefore expected to increase with time. The outcome of this scenario will result in long-term negative impacts on groundwater quality and should therefore be avoided. Removal of the silt material from the streambed will reduce long-term impacts, as discussed above.

During the rehabilitation phase of the project, it was assumed that all tailings and silt will be removed, that the soil will be shaped to create a free-draining surface, and that all radiation will be removed. It is noted that this rehabilitation scenario will not reverse the cumulative impact of historical tailings deposition. For this reason, a residual impact will remain post-closure of the project in the long-term.

The rehabilitation will be completed down to a red earth footprint. The area will be shaped for correct storm water management. During this phase, all project infrastructure will be removed, and a final radiological survey will be undertaken. Thereafter the property will be handed over to the landowner.

Recommendations:

It is crucial to implement the groundwater monitoring program before the desilting activities start at the expansion project, to define the pre-excavation status. The database will help the client identify groundwater quality and level trends and will serve as reference to identify and quantify potential impacts on the groundwater environment.

The excavated silt and any water must be removed from open and exposed formation surfaces as soon as possible to avoid seepage of contaminated water into the shallow weathered and deeper fractured aquifers. The desilting will be a continuous process, and water will be in the silts. It must be assumed that the groundwater system will take a portion of this load and ways to manage, contain and minimise the mobilisation of loads must be adopted.

The risk of groundwater contamination during the desilting process will be higher compared to the existing impacts, as chemical reactions and leaching from the silt will increase, due to increased surface area exposed to oxygen and rainwater. Surface water management and containment guidelines must be followed carefully during the desilting process.

In addition to the above, it is important that the necessary cut-off trenches and berms are put in place between the Valley Silts project area and the historical TSFs to avoid future wash of silts and slimes into the excavated and rehabilitated areas, thus compounding the project again.

Ergo must ensure that an effective surface water collection and retention system is in place to ensure that all flow and collected water is directed towards the cut-off trenches and sumps and not allowed to freely drain away and back to the Russell Stream. Pooling of water must not be allowed on open surfaces, except if lined.

It is the opinion of the project hydrogeologists that the Valley Silts Expansion Project can proceed, if good surface water / storm water management is in place and maintained. The project must further commit to complete silt removal and not undertake selective silt reclamation. In the short term there could be water quality impacts (increase in salts and metals) if water on the surface is not managed effectively. A sound groundwater monitoring program must be implemented in the four existing boreholes, plus borehole VAL1. Should the results of the monitoring indicate adverse impacts on groundwater quality over and above those already evident from historical impacts, immediate measures must be taken to rectify non-compliances. Overall, the project will deliver a long-term positive impact on groundwater quality if the silts are removed, and footprint areas are rehabilitated.

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Abbreviations

Abbreviation	Description
ADT	Articulated Dump Truck
AMD	Acid Mine Drainage
Bh	Borehole
BPG	Best Practice Guideline
CBD	Central Business District
CoC	Chemicals of Concern
CoJMM	City of Johannesburg Metropolitan Municipality
CV	Curriculum Vitae
DTM	Digital Terrain Model
DWAF	Department of Water Affairs and Forestry (now the DWS)
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EC	Electrical Conductivity
EO	Environmental Officer
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
Ergo	Ergo Mining (Pty) Ltd
FDEM	Frequency Domain Electro-magnetics
GPS	Global Positioning System
IWUL	Integrated Water Use Licence
k	Hydraulic conductivity, measured in m/d
km	kilometre
L/s	Litre per second
L/hr	Litres per hour
m	metre
m/day	metre per day
MAE	Mean Annual Evaporation
m amsl	metres above mean sea level
MAP	Mean Annual Precipitation
m bgl	metres below ground level
meq/L	Milli equivalent per litre
mg/ℓ	milligrams per litre

ml	millilitre
mm	millimetre
mm/a	millimetre per annum
MR	Mining Right
mS/m	milli Siemens per metre
NGA	National Groundwater Archive
NWA	National Water Act, 1998
RWD	Return water dam
SANAS	South African National Accreditation System
SANS	South African National Standards
TDS	Total Dissolved Solids
T	Transmissivity, measured in m^2/d
TSF	tailings storage facility
Wits	Witwatersrand Supergroup
WMA	Water Management Area
WQO	Resource Water Quality Objectives
WRC	Water Research Commission

1 INTRODUCTION

Historically, some of the mines of the Witwatersrand have discharged contaminated water into the streams and rivers of the area. The additional water generated by mining and other human activities has led to the formation of wetlands which perform an important function in the purification of water. Concern has been expressed about the concentration of contaminants, particularly metals in these wetlands and their ability to cope with the pollutant loads flowing into them. Water analyses show that the wetlands do indeed reduce the metal loads in the water, although this hazard remains for several kilometres downstream of the pollution sources (Council for Geosciences, 2005). These silts contain high grade gold and are accordingly amenable to reprocessing.

Ergo Mining (Pty) Ltd (Ergo), a subsidiary of DRDGOLD Limited, holds various Mining Rights (MR) in respect of slimes dams and sand dumps, extending 65 kilometres (km) from western Johannesburg to east of Ekurhuleni, with most activities occurring on the central and eastern sections of the Witwatersrand mining belt.

Ergo obtained Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of NASREC near Booysens Reserve, in Johannesburg (Figure 1 and Figure 2). This is the Valley Silts Project. The mining authorisation for the removal of silts falls within Mining Right GP 184 MR. Ergo intends to expand its Valley Silts reclamation operation (the Valley Silts Expansion Project) (Kongiwe, 2025).

The removal of silts within the already authorised Valley Silts Project area has been ongoing since May 2023. The construction and site establishment began in October 2022 and as such, it is now necessary to prepare for the Valley Eastern Expansion, Southern Expansion, and Valley Expansion Northwest, to allow for continuous reclamation operation, as well as a sustainable feed source to the process plant.

In terms of locality, the Valley Silts Project is located within the Russell Stream valley and stretches from New Canada Road, following the valley southeast, past the Nasrec Road bridge and past Crownwood Road until the stream meets the M1 (Figure 1).

The Valley Silts resource has three primary sectors. The current approved mining area is Sector 1 and extends from the dam wall to the end of the stockpile area near Crownwood Road (Figure 2). The site is already established with fully fenced hard park facilities, solar powered security lights, well maintained haul roads and site offices. Access is controlled by security.

The Expansion Phase of the project will consist of Sector 2 and Sector 3. Refer to Figure 2 for the Valley Silts Expansion Project infrastructure plan.

Sector 2 will extend from the dam wall to Nasrec Road (N1 to N20), with the remaining blocks (Sector 3: N21 and N22) being located either side of Crownwood Road. Because mining exceeds the delivery rate, stockpile areas are required for temporary storage as shown in Figure 2. Stock is moved in a sequential manner due to the moisture content, the drying process, as well as oxidation. The detailed plans are based on a 1:1000 scale survey plan and all blocks are based on a delivery rate required by DRDGOLD. Individual blocks will be removed in sequence.

Exploration trenching will determine the depositional flank extents, and all material will be removed from the natural flow path as well as the flanks. Paddocks and stormwater controls are required to protect the river from extraneous ingress, and these will be installed as indicated on Figure 2. The current facilities in Sector 1 will be utilised for the remaining extensions. Hard park, cut off trenches

and sumps are pre-installed and are appropriate for further use. Existing silt traps will move as the mining blocks progress. The existing sump will discharge to the stream.

The new activities for the Expansion Project include:

- Mining blocks (N 1 to N22);
- Drying stockpiles (8 locations);
- Stormwater control berms/paddocks;
- River crossings (8); and
- Haul and site roads.

The Russell Stream is surrounded by industrial, commercial, residential and undeveloped land. The closest residential area to the proposed target area is Riverlea; the outskirts of the suburb are situated approximately 120 metres (m) from Russell Stream. The Valley Silts Expansion Project is situated within Ward 68 and Ward 124 of the City of Johannesburg Metropolitan Municipality (CoJMM).

This report presents the groundwater impact assessment. An understanding of the hydrogeological environment is essential to understand the impacts of the reclamation of silt from target areas in the water course on the receiving environment. The adjacent slimes dams and sand dumps are potential sources of contamination and together with the silt in the Russell Stream were taken into consideration during the groundwater assessment.

2 About the Valley Silts Expansion Project

2.1 Reclamation Method

The gold bearing silts will be mechanically excavated from the project area. Thirty-ton Articulated Dump Trucks (ADT) will be used to transport and stockpile the silts from the Russell Stream. The gold bearing silts will be temporarily stockpiled and dried in the stockpile areas directly north and south of Blocks N1 to N18. This is considered a “dirty” footprint. Silts will have up to 40% moisture content when hauled and are not expected to be fully dried out. The dried tailings/silts will be loaded onto tipper trucks and transported to the City Deep Plant for pre-processing. The trucks transporting the material will follow Crownwood Road until it reaches Main Reef Road and then joins the M2 East. The trucks will follow the M2 until they reach Heidelberg Road which is followed to the City Deep Plant where they will be offloaded.

2.2 Water Management

This project will not require any additional process water for the mechanical excavation of gold bearing silts from the Russell Stream. Potable drinking water will be sourced from the municipality.

The clean stormwater runoff from the area to the south of the drying sites will be diverted using a stormwater diversion drain (or berm) around the area to the west. Stormwater from the north will flow via properly constructed inlets into the Russell Stream. Temporary berms will be constructed along the banks of the channel. These banks will be raised in sections to retain flood flow and prevent flooding of any of the reclamation area during excessive rainfall. The raised riverbanks and berms will be able to contain a 1:50 year storm event.

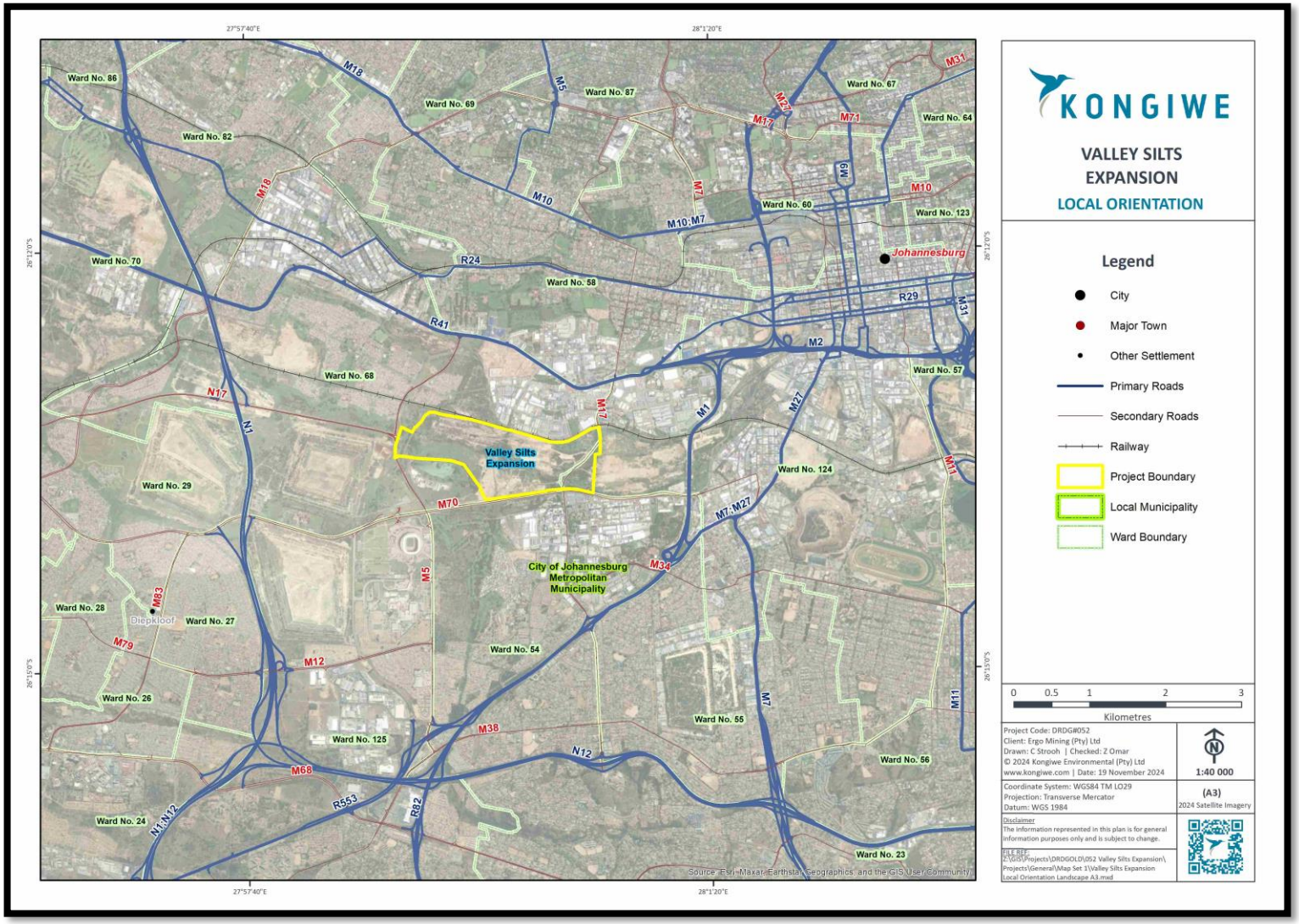


Figure 1. Valley Silts Project locality map

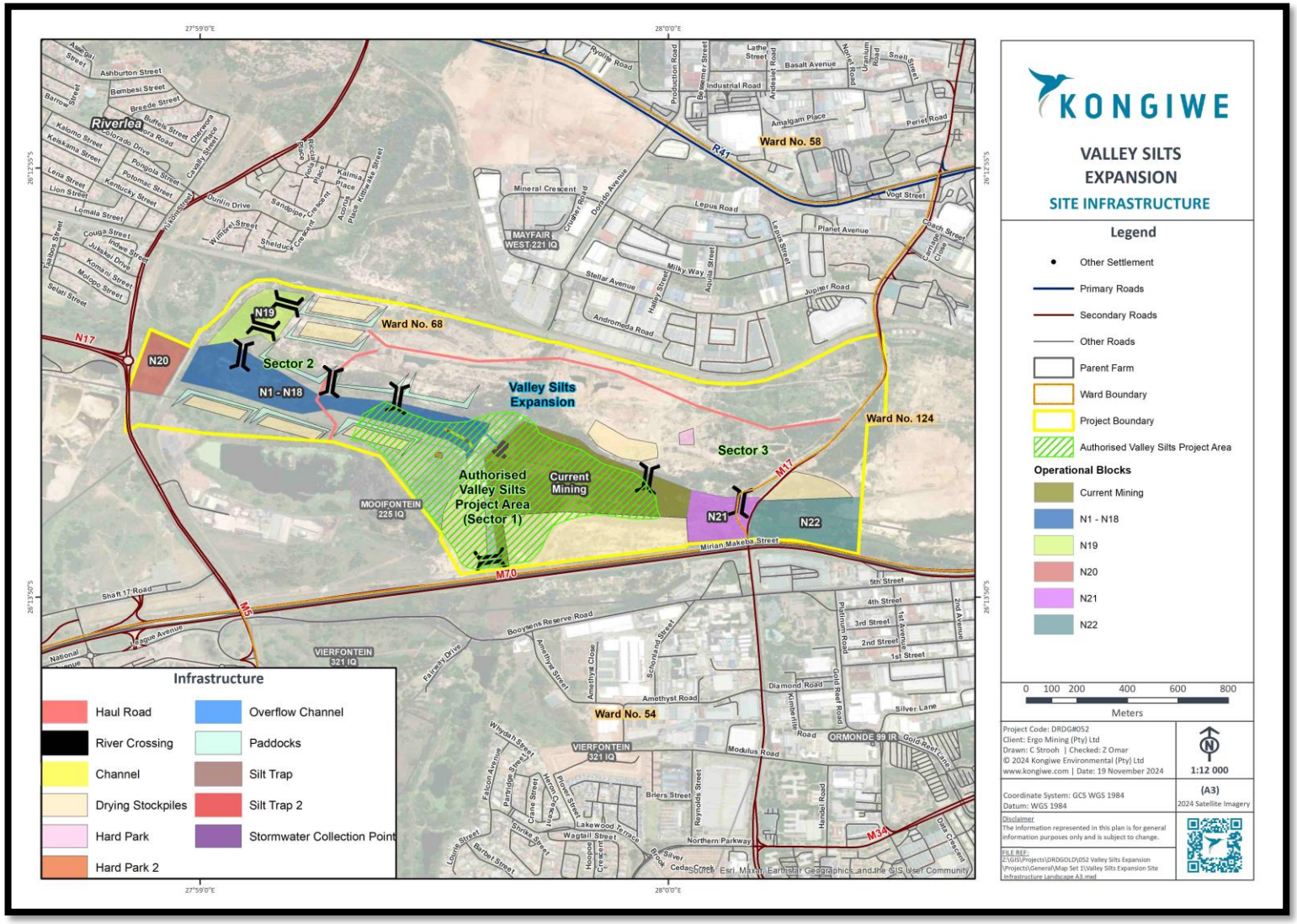


Figure 2. Valley Silts Expansion Project infrastructure plan

Dirty stormwater will be contained in existing paddocks on the drying sites. Should the paddocks reach capacity, the excess stormwater will need to be released into the Russell Stream.

Stormwater from the mined-out areas flows to a sump. Should the sump reach capacity it will overflow via a channel into the Russell Stream.

2.3 Life of the Operation

The anticipated life span of the project is approximately 5 years maximum. The silt removal is planned for 3 years and rehabilitation 2 years.

2.4 Infrastructure Proposed for the Project

The Valley Silts Project is well serviced by existing roads and infrastructure. Existing infrastructure to be utilised at stages during the project includes:

- Site offices;
- Hard Park areas;
- Existing site access roads; and
- Hauling road: access roads and main roads.

The additional infrastructure will include:

- Additional haul roads;
- Additional stockpile drying areas;
- Additional stream crossings; and
- Additional silt traps and stormwater control berms/ paddocks.

2.5 Rehabilitation

Once the silts have been removed from the targeted areas, decommissioning will commence with the removal of all associated vehicles and infrastructure from the site as well as the removal of berms, paddocks, diversion trenches, infrastructure, and anything else installed during construction and operations.

Rehabilitation will take place as excavation progresses to other target areas. Care will be taken to ensure that the material and excavated soil required for backfilling are free of contaminants and hydrocarbons. Ergo aims to rehabilitate the Valley Silts Project area by shaping the areas where silt was removed and make the area free draining. Thereafter, appropriate species will be planted to stabilise the soil.

Post-decommissioning activities will entail the assessment of rehabilitation and will address any further rehabilitation requirements. Monitoring must occur for at least five years after decommissioning and rehabilitation, or until satisfactory results are achieved.

Maintenance will specifically focus on the rehabilitated areas. Furthermore, groundwater and surface water monitoring will have to take place in the project area. It has been recommended that groundwater be monitored quarterly, for at least five years after closure. The monitoring process will be used to assess whether the rehabilitation process has been successful and to indicate if further deterioration on groundwater quality is expected. Water infrastructure (channels, berms and paddocks) must be monitored monthly during the dry season, and weekly during the wet season. They should further be monitored immediately after any large storm events. Should blockages, silted up structures or breaches occur, immediate action should be undertaken to remove debris and repair

breaches. Monitoring should be undertaken by the onsite Environmental Officer (EO) or maintenance manager.

Maintenance will specifically focus on the rehabilitated area in accordance with the approved EMPr. Continuous erosion monitoring of rehabilitated areas and slopes should be undertaken and zones with excessive erosion should be identified. The cause of the erosion should be identified, and rectified. Zones with erosion will need to be repaired with topsoil.

2.6 Consideration of Alternatives

The Valley Silts Project entails desilting of sections of the water course; geographically this project has no alternative. The Option of "the project not proceeding" would mean that the environmental and social status would remain the same as current. This implies that both negative and positive impacts would not take place. As such, the short-term negative impacts on the environment would not transpire; equally so, the long-term positive impacts such as environmental pollution removal, economic development, and the rehabilitation of the Russell Stream for both nature and human benefit – would not occur. The only alternative option to this project (the No-Go option) is to leave the polluting silts within the stream; there is no other potential use.

Geochemical modelling by Hatting RP, et al (2003) indicated that the major cation concentrations will remain at elevated levels for more than 50 years if no action is taken and nothing else is added to the system. A continuous flow of salts (SO_4^{2-}) continues for a period of at least 50 years. There are fluctuations in the production rate of salt, but the load remains at elevated levels over the 50-year period modelled.

The "No-Go" Option also assumes the continuation of the current land use, implying the absence of any rehabilitation activities and associated infrastructures. The means that the attraction of the gold reserves located within the stream could potentially enhance Illegal mining, and if left as is, population settlement on or around the stream could occur. In addition, without the removal of silts, the Russell Stream will continue to follow its current path – meaning that flooding risks to residents will remain.

3 Groundwater Assessment Framework

A thorough understanding of the hydrogeological environment is essential to understand the impact of the silt excavation on the receiving environment and to help design a groundwater management plan that reduces or removes the risk of groundwater quality and quantity impacts.

3.1 Groundwater Study Objectives

The groundwater impact assessment will focus on the following objectives:

- Define the current groundwater use in the Valley Silts Project area;
- Define the aquifers underlying the Valley Silts Project area, as well as current groundwater table depth, groundwater quality and flow characteristics;
- Define what impact the desilting activities might have on the groundwater environment; and
- Recommend an initial groundwater monitoring network that will monitor the groundwater quality and level changes during the desilting activities and post closure.

3.2 Compliance Framework

This report is compiled based on the requirements of GNR 267 of the National Water Act (1998) (NWA). The report format is also based on the requirements of the Department of Water and Sanitation (DWS) Best Practice Guideline (BPG) G4 (2008).

The water quality assessment will be based on South African National Standard (SANS) 241-1:2015, Drinking Water.

3.3 Groundwater Assessment Team

The following hydrogeologists are involved in the Valley Silts Expansion Project groundwater assessment:

- Lucas Smith (MSc Geohydrology) Pr.Sci.Nat:
  - Project hydrogeologist.
  - Field work, data analysis, interpretations, and reporting.
- Irene Lea (MSc Geohydrology) Pr.Sci.Nat:
  - Data analysis, interpretations, numerical model and reporting.

Curricula Vitae (CV) are appended to Appendix A.

3.4 Report Structure

The remainder of the report is structured as follow:

- Section 4 – Environmental Setting.
- Section 5 – Site Investigations.
- Section 6 – Conceptual Hydrogeological Model.
- Section 7 – Groundwater Modelling.
- Section 8 – Hydrogeological Impacts.
- Section 9 – Groundwater Impact Assessment.
- Section 10 – Cumulative Impacts.
- Section 11 – Groundwater Management Measures.
- Section 12 – Groundwater Monitoring.
- Section 13 – Reasoned Opinion.
- Section 14 – Conclusions.
- Section 15 – Recommendations.

Appendices:

- Appendix A: Curricula Vitae.
- Appendix B: Borehole Drill Logs.
- Appendix C: Pumping Test Information.
- Appendix D: Water Laboratory Certificates.
- Appendix E: Impact Assessment Ratings.

4 Environmental Setting

The proposed Valley Silts Expansion Project is in the Russell Stream valley, near Booysens Reserve. The project area stretches from New Canada Road, following the valley southeast, past the Nasrec Road bridge and past Crownwood Road until the stream meets the M1.

The Russell Stream (also referred to as the Klipspruit) is surrounded by industrial, commercial, residential and undeveloped land. The closest residential area to the project is Riverlea, the outskirt of the suburb is situated approximately 120 m from the Valley Silts project area. The FNB Stadium is approximately 1 km to the south, with the Johannesburg Central Business District (CBD) located approximately 4 km northeast.

The topography is typical of a river / stream where local drainage (surface topography) is towards the stream. The Russell Stream flows in a westerly direction, towards Soweto. The regional dip is in a southerly direction. The surface elevation in the project area varies from 1695 metres above mean sea level (m amsl) in the east, to 1653 m amsl in the west.

4.1 CATCHMENT

The Valley Silts Project is in the Klip River catchment, in the C22C quaternary catchment, forming part of the Vaal Water Management Area (WMA:5). The C22C quaternary catchment covers an area of approximately 465 km^2. The main drainage in the project area is the Russell Stream, that discharges into the Klip River. The Klip River is located approximately 15 km southwest of the Valley Silts Project.

4.2 CLIMATE AND RAINFALL

The Mean Annual Precipitation (MAP) for the C22C quaternary catchment is 697 mm/a, according to the information presented by Hydrospatial (Soweto Cluster, Surface Water Impact Assessment Report, October 2019) (Table 1). The Mean Annual Evaporation (MAE) for this C2B rainfall zone is 1625 millimetres (mm) (Zone 11A).

Table 1. Quaternary catchment information (Hydrospatial, 2019)

Quaternary catchment	C22C
Rainfall (mm/a)	697
Evaporation (mm/a)	1,625
Runoff (mm/a)	23.12

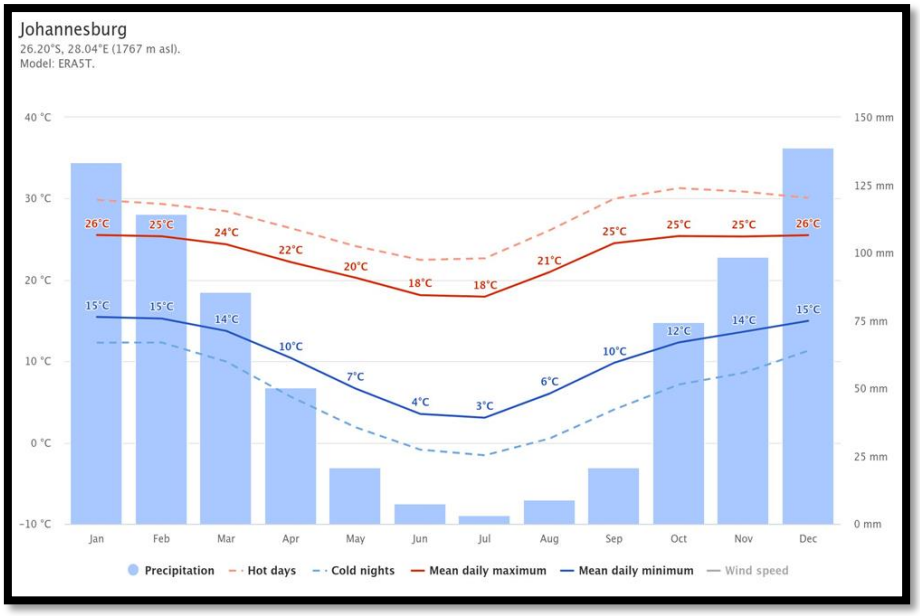


Figure 3. Average temperature in Johannesburg (www.meteoblue.com)

Precipitation occurs in the form of showers and thunderstorms, with the highest rainfall occurring from December to March (Figure 3). The winter months are dry with the combined rainfall between May and August making up only 6% of the MAP of 697 mm.

4.3 GEOLOGY

The Witwatersrand Basin lies on the Kaapvaal Craton and is one of the world's largest gold placer deposits. The basin stretches over an arc of roughly 400 km, traversing across the Free State, North West and Gauteng Provinces. The gold occurs in coarse-grained conglomerates, forming the upper portions of the Witwatersrand Supergroup. It is found in association with uranium, quartz, carbon seams, phyllo-silicates and pyrite. The mineralisation of the Witwatersrand reefs is extensive and approximately 70 ore minerals, including diamonds, have been documented from the Witwatersrand conglomerates (Minerals Council of SA, 2019).

Gold-bearing reefs within the Witwatersrand sediments have been mined from the Far West Rand to the East Rand, and certain of these operations yielded the mine dumps that contributed to the silt in the Russell Stream. Several of these dumps are currently being reclaimed by Ergo.

The Valley Silts Project is located on the Central Rand Group, of the Witwatersrand Supergroup (Figure 4). The Witwatersrand Supergroup is a sequence of conglomerate, shale and quartzite, ranging in age from 2.7 Ga for the Hospital Hill Subgroup to 2.4 Ga for the Turffontein Subgroup. The Lower Witwatersrand is composed mainly of argillaceous clays and shale, with occasional banded ironstone, tillite and intercalated lava flow, while the Upper Witwatersrand consists almost entirely of quartzite and conglomerate.

Sedimentation of the Central Rand Group occurred predominantly under alluvial braid-plain conditions with minor alluvial fan conditions or influence from marine environments. Structurally the Central Rand Group is relatively undisturbed in comparison to the other groups of the Witwatersrand Supergroup. However, mineralisation is generally associated with disconformities within the sequence.

The Russell Stream is underlain predominantly by the Booysens Subgroup (shale) of the Witwatersrand Supergroup. To the south is the younger Turffontein Subgroup (quartzite, conglomerate and shale) and to the north, conglomerate and quartzite of the older Johannesburg Subgroup (Figure 4 and Figure 12).

A characteristic of the Witwatersrand mining area is a series of cross-cutting faults and diabase dykes. The dykes are not 100% impermeable. Fault appearance varies from small localised fractured zones to large breccia filled zones. Faults are commonly filled with intrusive material. The composition ranges from diabase (or quartz diabase) to norite (Biccard Jeppe, 1946).

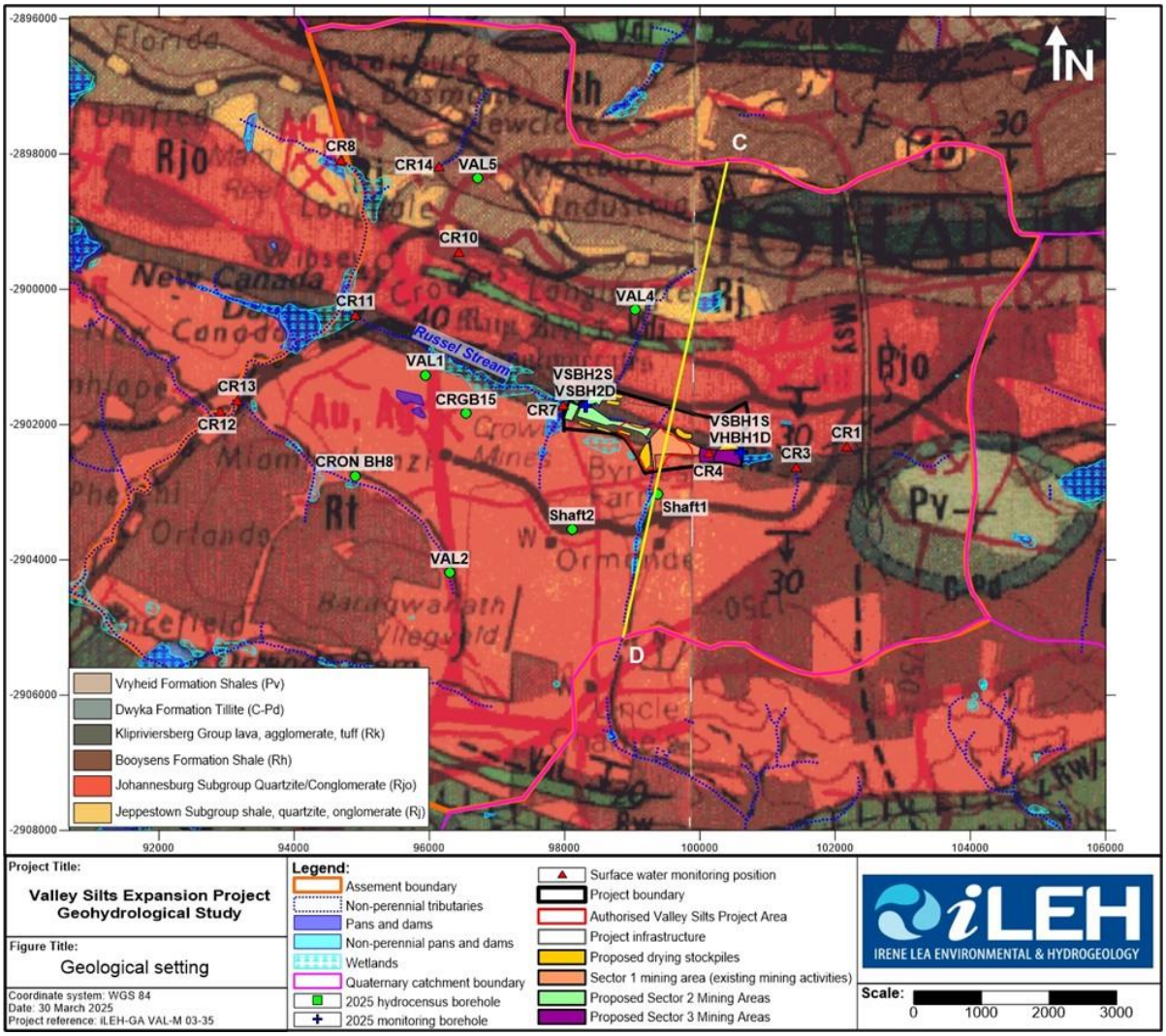


Figure 4. Valley Silts geology

5 Site Investigations

5.1 Hydrocensus

A hydrocensus was conducted across the study area during February 2025. The survey included the Valley Silts Project area, plus accessible properties within a 2 km radius, and concentrated on identifying existing boreholes to enhance the knowledge of the groundwater systems and current groundwater use. Six boreholes and two old mine shafts were identified, all on neighbouring properties (Table 2).

During the hydrocensus the following information was collected for each site:

- Borehole position (X, Y, Z-coordinates);
- Information relating to equipment installed;
- Borehole construction details;
- Borehole yield – if known by the land owner;
- Groundwater level, if possible; and
- Current use.

Only one of the six boreholes is in use (borehole VAL4), with the majority historically used for groundwater monitoring purposes (4 of the 6 boreholes). Two of the six boreholes are privately owned boreholes and include VAL4 and VAL5 (Figure 5).

Shaft 1 was accessible with a shallow water level visible just inside the shaft entrance. Shaft 2 is sealed and fenced off with no access possible (Figure 5). A summary of the hydrocensus information is available in Table 2. All coordinates were taken with a hand-held Garmin GPS (Global Positioning System) (WGS84).

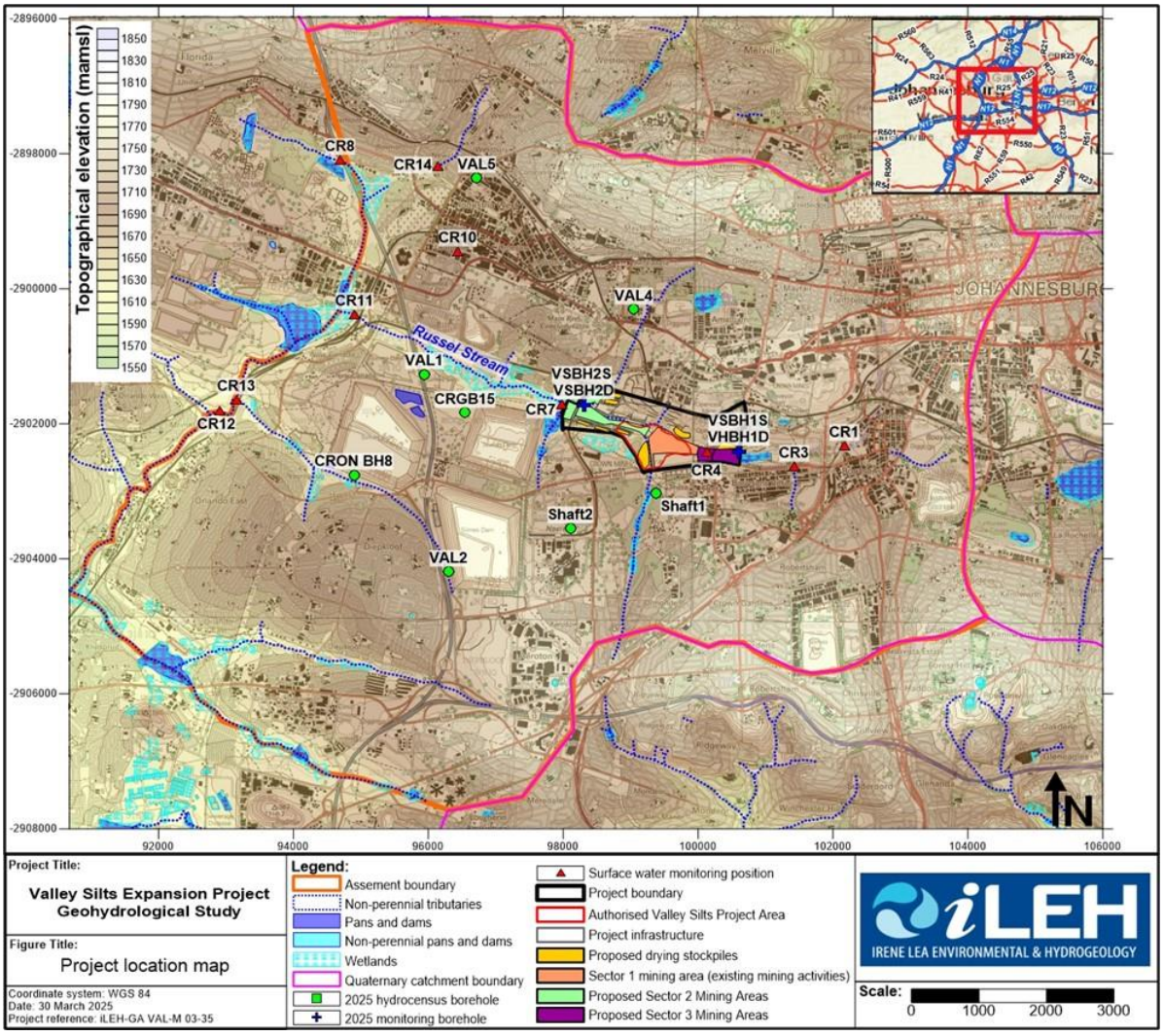


Figure 5. Borehole locality map

Water levels were measured by using a dip meter to measure the distance from the mouth of the borehole (borehole collar elevation) to the groundwater table depth in the borehole. The height of the borehole collar was subtracted from the measured water level to define a water level below surface (measured in m bgl).

Groundwater level measurements were possible from the six boreholes (Table 2). The groundwater level below surface varied between 0.10 m bgl (borehole VAL2) and 30.85 m bgl for borehole VAL5 (in the Industria West area) (Table 2). Borehole VAL5 presents a groundwater level (30.85 m bgl) that are much deeper compared to the other five boreholes. This potentially relates to differences in the

geological units. The rest groundwater levels in the other five boreholes are on average 2.08 m below surface.

If the groundwater levels are viewed as elevation above sea level, then the highest water elevation (1692.5 m amsl) is found at borehole VAL2. The lowest water table elevation is 1660.55 m amsl, at borehole VAL5. Second lowest levels are around 1662 mamsl, at boreholes VAL1 and CRON BH8 (downstream from the Valley Silts Project area). Locally surface drainage and possibly groundwater flow will be towards the Russell Stream, but the regional groundwater flow direction will be from east to west. If the information presented in Table 2 is contoured, it is shown that the groundwater flow direction is westerly, as shown in Figure 15.

The groundwater table governs water flow and in similar geological terrains a relationship exists between the groundwater table and the topography. This correlation is known as the Bayesian relationship. The borehole collar elevation is plotted against the measured groundwater elevation to test if this relationship is applicable. The correlation between topography and groundwater elevation is approximately 96.7%, as shown in Figure 6. This includes Shaft 1. This means that the depth to groundwater correlates well with the surface elevations (topography), indicating that on a local scale groundwater flow follows topography.

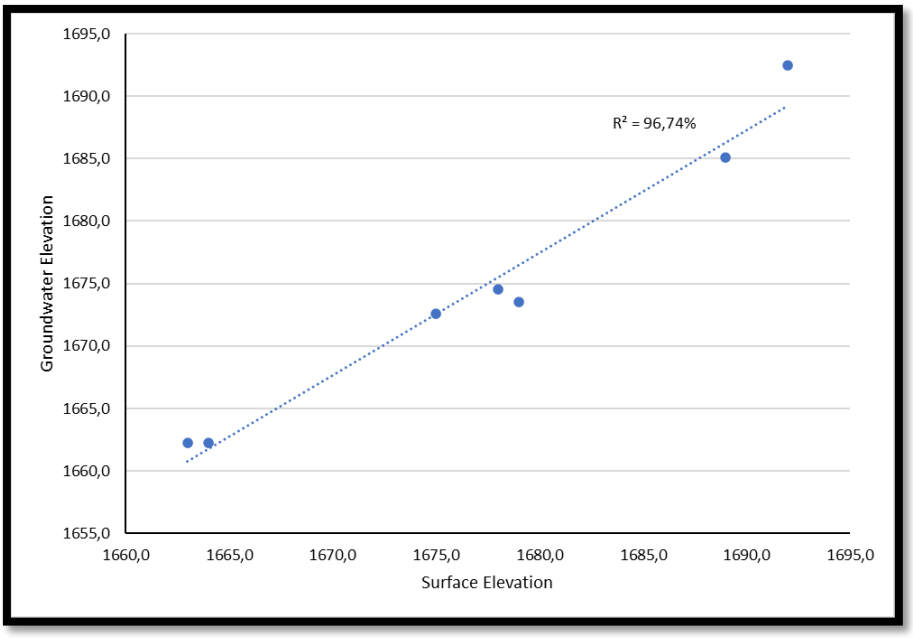


Figure 6. Correlation between surface and groundwater elevations in hydrocensus BHs

Groundwater samples were collected from three of the hydrocensus boreholes (see Section 5.5).

The extent of the study area, budget and time constraints, and land access limited the hydrocensus in terms of surveying every property in the area. The study aimed to cover the whole area to ensure a data set representative of the study area.

Detailed information in terms of borehole construction and yields, plus borehole depths and water strike depths, are not known for the identified hydrocensus sites. Time series groundwater level or quality data are also not available for the hydrocensus boreholes to determine seasonal groundwater changes for the area.

Table 2. 2025 Hydrocensus data

Site ID	Lat (WGS84)	Long	Elev (mamsl)	Locality	Water depth (mbgl)	Collar height (m)	Water elevation (mamsl)
Val 1	26°13'02.23"S	27°57'36.22"E	1664	N1 Riverlea offramp	2,32	0,55	1662,23
Val 2	26°14'37.38"S	27°57'49.80"E	1692	GMTS (3L8) TSF	0,10	0,60	1692,50
Val 4	26°12'32.08"S	27°59'28.09"E	1689	Abraham Kriel Bambanani	3,90	0,00	1685,10
Val 5	26°11'29.30"S	27°58'04.45"E	1691	Vitafoam Industrial West	30,85	0,40	1660,55
CRON BH8	26°13'50.98"S	27°56'58.88"E	1663	Homestead (3L5) TSF	1,20	0,44	1662,24
CRG B15	26°13'20.77"S	27°57'57.99"E	1675	Mooifontein (3L7) TSF	2,86	0,42	1672,56
Shaft 1	26°13'59.23"S	27°59'39.80"E	1679	iProp office	5,50	0,00	1673,50
Shaft 2	26°14'16.10"S	27°58'54.41"E	1712	FNB Stadium	no access	--	--

Site ID	BH depth (m)	Yield (L/hr)	Casing diameter (mm)	Sampled	Pump type	Use	Note
Val 1	30	80,00	100	yes	none	monitoring	On the offramp to Riverlea from the N1 highway
Val 2	--	--	110	yes	none	monitoring	Artesian. Casing damaged. No lid
Val 4	40	good	165	yes	submersible	swimming pool	Inside brick building. Very old BH
Val 5	--	--	165	no	none	not in use	Inside deep manhole at office
CRON BH8	80	--	110	no	none	monitoring	Casing damaged. No lid
CRG B15	50	--	110	no	none	monitoring	sealed. Can't sample
Shaft 1	--	--	--	no	submersible	gardens	Old decline shaft next to big lake
Shaft 2	--	--	--	no	none	not in use	Old vertical shaft. Sealed. No access

5.2 Geophysical Survey

A ground geophysical investigation was conducted to identify linear geological structures in the project area which could act as preferential groundwater flow paths. The geophysical survey has been used in conjunction with the available remote sensing images and geological maps to identify suitable drilling positions for upstream and downstream groundwater characterisation and monitoring boreholes.

The geophysical survey was conducted in February 2025 and included Magnetics and Electromagnetic (EM34-3) surveying only. The survey included two survey lines, and the line and station coordinates were marked in the field using a handheld Garmin GPS.

5.2.1 The Magnetic Method

Many geological formations by virtue of their content of magnetic minerals will behave like buried magnets and have associated with them a magnetic field. This very local magnetic field will be superimposed on the normal magnetic field of the earth. Measurements of the magnetic field taken in the locality of such geological formations will show departures from the undisturbed earth's magnetic field in the vicinity of these formations. These changes, or anomalies as they are called, could be larger or smaller and could be either an increase or a decrease of the earth's field and will depend on the depth of burial, degree and direction of magnetisation, and the attitude of formation in relation to the direction of the earth's field at that locality.

The Magnetic survey was run in support of the EM survey, at 5 m reading intervals.

5.2.2 The Electromagnetic Method

Frequency Domain Electromagnetics (FDEM) techniques use a primary time-varying magnetic field produced in a transmitter coil to induce the flow of electrical current in subsurface conductors via electromagnetic induction. By measuring the secondary magnetic fields or response of these currents, electrical and magnetic properties of the subsurface or causative body can be deduced.

FDEM is effective at mapping major lateral changes in shallow subsurface electrical conductivity due to variations in water conductivity (salinity), water saturation, porosity, presence of clays, conductive minerals (graphite and massive sulphides) and man-made metallic objects. FDEM relies on a contrast in physical properties of materials.

The EM34 data was recorded every 10 metres, with a coil separation of 20 m used on each survey line.

The geophysical data is presented in Figure 7 and Figure 8.

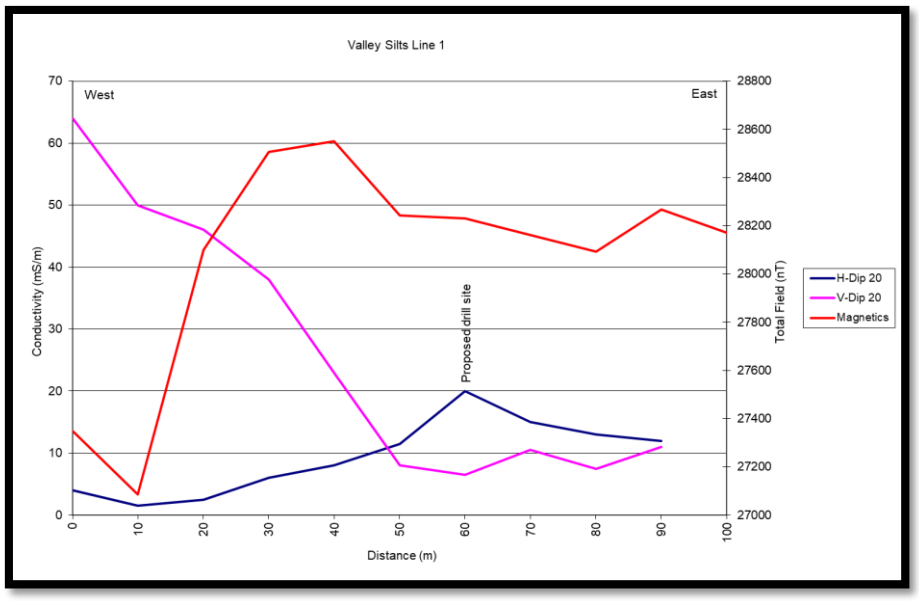


Figure 7. Geophysical survey – Line 1

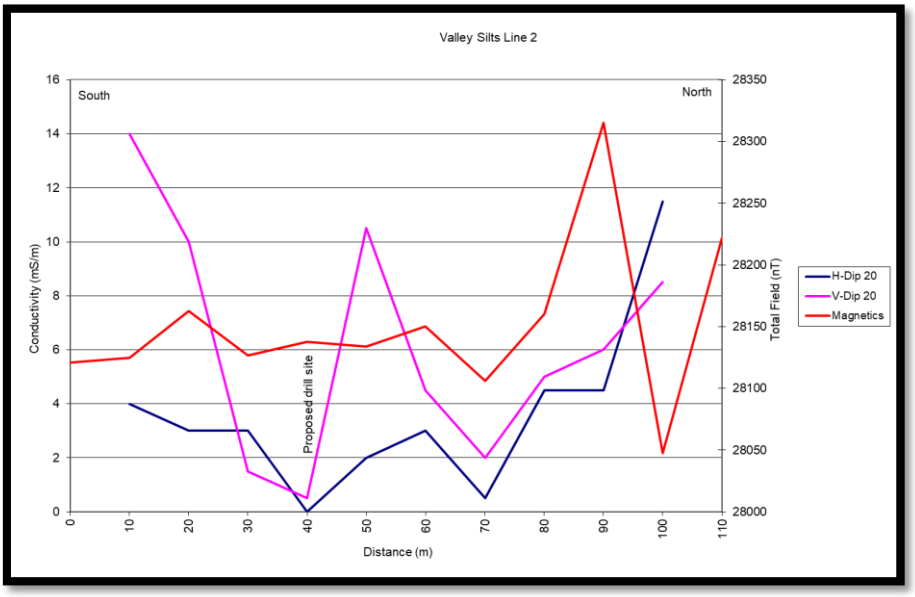


Figure 8. Geophysical survey – Line 2

5.3 Drilling Program

Based on the geophysical survey, an upstream- and a downstream drilling position was identified along the boundary of the Valley Silts Project (Figure 9 and Figure 10). The percussion drilling programme was carried out during March 2025, by Georoc Drilling.

Two groundwater characterisation and monitoring boreholes were drilled at the two target areas – the one borehole was drilled to a depth of 80 m below surface, with the aim of characterising and monitoring the deeper fractured aquifer. The second borehole was drilled 30 m deep, with the aim of monitoring potential groundwater flow, quality and possible connection between the deeper fractured aquifer and the shallow weathered aquifer in the area.

Data collected include the recording of geological formations at 1 metre intervals, water strike depths, the cumulative final blow yield and final rest water level. A summary of the results is presented in Table 3.

The borehole construction details are as follows:

- Deep boreholes (80 m) – 177 mm diameter solid steel casing from surface to 30 m below surface. Beyond this depth the diameter of the borehole is 165 mm.
- Shallow boreholes (30 m) – drill diameter is 203 mm with 177 mm steel casing installed over the full depth of the borehole. The bottom 12 m was perforated.

The geological profiles intercepted by the percussion drilling program are presented in Appendix B.

Not one of the four new percussion boreholes produced a measurable blow yield, but a groundwater level could be measurable in all four boreholes shortly after completion (Table 3). In general, borehole yields throughout the area are low. After several days the groundwater level in boreholes VS-BH2s and VS-BH2d were still near the bottom of the borehole.

Table 3. Drilling summary March 2025

		Borehole ID	VS-BH 1s	VS-BH 1d	VS-BH 2s	VS-BH 2d
Borehole Location	WGS84	Latitude	26°13'39.64"S	26°13'39.59"S	26°13'17.35"S	26°13'17.31"S
		Longitude	28°00'23.73"E	28°00'23.73"E	27°59'01.50"E	27°59'01.48"E
		Elevation	1677 mamsl	1677 mamsl	1663 mamsl	1663 mamsl
Borehole Data	Borehole Depth (m)		30	80	30	80
	Blow Yield (L/hr)		dry	dry	dry	dry
	Water Strike depth (m)		--	--	--	--
	Main Strike Geology		--	--	--	--
	Borehole Geology		Quartzite	Quartzite and lava	Quartzite and conglomerate	Black clay, quartzite with pyrite
	Solid Steel Casing (170mm ID)		0 – 18m	0 - 30m	0 – 18m	0 - 30m
	Perforated Steel Casing (170mm ID)		18 – 30m	none	18 – 30m	none
	Static Water Level (mbgl)		3.43 m	57.48 m	8.15 m	41.07 m
	Depth of Weathering (m)		10	10	12	8

From Table 3 it can be concluded that the area where the characterisation / monitoring boreholes were drilled area primarily underlain by quartzite of the Witwatersrand Supergroup. The weathered – solid formation contact yielded little water – only seepage water. A fractured zone in the quartzite in borehole VS-BH2d, plus the quartzite-lava and the quartzite-conglomerate contacts also yielded little water. The depth of weathering varies between 8 and 12 m below ground level.



Figure 9. Upstream borehole drilling locality



Figure 10. Downstream borehole drilling locality

5.4 AQUIFER TESTING

Following completion of the drilling program, an aquifer test program was initiated to determine the hydrogeological characteristics of the local aquifers.

Geovation (Pty) Ltd was appointed to undertake the aquifer testing of the newly drilled boreholes. Two cluster sets were available for testing, each set consisting of one shallow (30 m) and one deep (80 m) borehole.

The aquifer test program includes defining:

- Borehole drawdown and recovery characteristics.
- Aquifer hydraulic parameters:
  - Transmissivity (T) defined as the product of the average hydraulic conductivity (K) and the saturated aquifer thickness. It is a measure of the rate of flow under a unit hydraulic gradient through a cross-section of unit width over the whole saturated thickness of the aquifer. The unit of measurement is m^2/day.
- Characterisation of aquifer flow boundaries such as low permeable, no-flow or recharge boundaries. No-flow or low permeable boundaries refer to a lower transmissive structure (e.g., fracture with a lower conductance or low permeable dyke) or aquifer boundary (limit of aquifer – no-flow boundary) that results in an increase in groundwater drawdown during borehole abstraction. Recharge boundaries relate often to leakage from surface water bodies.

Prior to the aquifer test, static groundwater levels are measured in all boreholes to enable drawdown calculations during test pumping. During the test, the abstraction rate is continuously monitored by means of electronic flow meters and calibrated by manually measuring the time it takes to fill a container of known volume, with a stopwatch and drum.

The testing data with interpreted results were received from Geovation, upon completion of the test program. The aquifer test data and drawdown graphs are presented in Appendix C.

For this project full drawdown and recovery pump tests were conducted on two of the four new boreholes (VS-BH1s and VS-BH1d) and a slug test was also completed on borehole VS-BH1s. Boreholes VS-BH2s and VS-BH2d were not tested due to the low volume of water inside the boreholes. The methods are discussed in more detail below.

A **slug test** is a controlled field experiment performed to estimate the hydraulic properties of aquifers and aquitards in which the water level in a control environment is caused to change suddenly (rise or fall) and the subsequent water-level response (displacement or change from static) is measured over time in the borehole. Slug tests are also referred to as rising-head or falling-head tests to describe the direction of water-level recovery in the borehole following test initiation (HydroSOLVE, Inc).

The goal of a slug test, as in any aquifer test, is to estimate hydraulic properties of an aquifer system such as hydraulic conductivity. Aquifer properties are estimated from a slug test by fitting mathematical models to displacement data using curve matching. Curve matching may involve fitting type curves or straight lines to the measured data (HydroSOLVE, Inc).

At the Valley Silts Expansion Project, one of the four boreholes was tested by introducing a large solid objet (slug) in the borehole and measuring the height of the water column inside the borehole after slug introduction and then measuring the rate of change in the water column height for at least three to four hours.

Table 4. Summary of the aquifer parameters based on the slug test – borehole VS-BH1s

BH ID	Slug In/Out	Aquifer properties (Slug Test) (hydraulic conductivity in m/day)	
		Bouwer-Rice	
		K-value	*Yo-value*
VS-BH1s	In	0.0144	0.09811

The **maximum drawdown and recovery test** is a method developed as a rapid means of assessing the recovery characteristics of boreholes. The results may also indicate whether it is feasible to perform other tests on the borehole. The test involves measuring the water level response in a borehole to the rapid abstraction of water until pump inlet is reached. The recovery test follows directly after pump shut down. The residual drawdown over time (water level recovery) is measured until approximately 90% recovery is reached. Aquifer parameters can be derived from the time drawdown and recovery data by application of a variety of analytical methods.

Although these short-term tests cannot be considered as the ideal way of evaluating the long-term sustainability of a groundwater resource, it does provide a quick and simple way of evaluating the short-term performance characteristics of a borehole. It must be emphasised that calculations done from test pumping data are only representative of the aquifer characteristics in the immediate surrounding of the borehole. Factors such as aquifer transmissivity as well as the length of a test, will determine the area of influence reached during testing (the longer the test, the greater the area of influence and more accurate the predictions).

The following software was used for test pumping data analysis:

- The Flow Characteristic Method or FC Method (Van Tonder et al, 2001). The FC method uses the first and second order derivatives interpreted from time drawdown data (during test pumping), available drawdown, boundary conditions and recharge to derive sustainable borehole yields. The method is suited for characterising fractured rock aquifers.

A summary of the test programme is given in Table 5. The pumping test data is used during the construction and calibration of the groundwater numerical model.

The recovery of the groundwater table after abstraction is a good indicator of the aquifer's transmissivity, recharge and the borehole's potential yield. The recovery data (for the tested boreholes) indicate that the recovery is slow, and that full recovery (100%) was not achieved within the predetermined testing timeframe (Table 5).

The low borehole yields, fast water level drawdown and slow recovery observed during the aquifer testing indicate low transmissivity aquifers, with low recharge. The average T-values calculated from the pumping tests range between 0.005 and 0.048 m^2/d.

Aquifer testing done on the same geological formations during 2023 and 2024, at other Ergo facilities in the Johannesburg and Germiston areas yielded similar results. In the City Deep area (Johannesburg) aquifer testing (September 2023) indicated that the average T-values range between 2 and 11 m^2/d. The higher T-value has been assumed to represent a shallow weathered and fractured zones near the

contact between the quartzite and the lava. The slug tests yielded hydraulic conductivity values of approximately 0.00008m/d to 0.12 m/d (Table 6 – Bouwer-Rice analysis).

Table 5. Summary of the 2025 borehole testing

Borehole ID	Borehole Depth (m)	Static Water Level (m bgl)	Test pump depth (m bgl)	Available drawdown (m)	Startup yield (L/hr)	Test duration (min)	Recovery	K value (m/d)	T value (m2/day)	Water Sample
VS-BH1s	30	3.43	28	24.5	1000	10	100% in 208 min	0.1455	0.005	yes
VS-BH1d	80	57.48	78	20.5	1000	10	100% in 270 min	--	0.048	yes
VS-BH2s	No testing possible due to limited volume of water inside the borehole									yes
VS-BH2d	No testing possible due to limited volume of water inside the borehole									yes

Table 6. City Deep slug testing results

BH ID	Aquifer properties (Slug Test)	
	Bouwer-Rice	KGS Model
	K-value (m/day)	
CDMB-1S	0.052	0.057
CDMB-2S	0.006	0.003
CDMB-3S	0.019	0.019
CDMB-4D	0.11	1.54
CDMB-5D	0.003	0.002
CDMB-5S	0.05	0.05
CDMB-6S	0.12	0.19
CDMB-7S	8.00E-05	-

In the 4L39 TSF area (Germiston) aquifer testing (September 2024) indicated that the recovery data (for the tested boreholes) is slow, and that full recovery (100%) was not achieved within the predetermined testing timeframe (Table 7). The low borehole yields, fast water level drawdown and slow recovery observed during the aquifer testing indicate low transmissivity aquifers, with low recharge. The average T-values calculated from the steps test and constant discharge test data range between 0.3 and 1.6 m^2/d. The highest T-value was observed at borehole GWA1d and it has been assumed to represent a weathered and fractured zone in the quartzite.

Groundwater samples were collected from the 4 new boreholes at the Valley Silts Expansion Project, during the 2025 aquifer test program. The results are presented in Section 5.5.

Table 7. Summary of the 4L39 (Germiston) aquifer testing results

Borehole ID	BH1s	BH1d	BH2s	BH2d	BH3s	BH3d
Borehole Depth (m)	30	80	30	80	30	80
Static Water Level (m bgl)	2.64	5.53	1.07	1.04	1.38	1.48
Recovery Time	50% in 1 hr	70% in 1 hr	30% in 1 hr	30% in 1 hr	60% in 1 hr	45% in 1 hr
T value (m^2/day)	0.4	1.6	0.4	0.3	0.4	0.3

5.5 GROUNDWATER QUALITY

No historical, long-term groundwater quality information could be sourced for the project area. Three groundwater samples were collected from the Valley Silts Extension project area during the hydrocensus, and four water samples were also collected from the newly drilled boreholes.

The water samples were submitted to Aquatico Laboratories for analysis. Aquatico is a SANAS accredited laboratory (South African National Accreditation System). The water samples were analysed for basic inorganic parameters (Table 9 and Table 10) and the results were compared against the SANS 241:2015 Drinking Water Standards.

The samples were taken using a single valve, decontaminated bailer. Sterilized 500 millilitre (ml) sample bottles were used and filled to the top. Samples were stored in a cooler box during the site survey.

The 2025 water quality data is presented by means of a Piper diagram (Figure 11).

Piper Diagram:

A Piper diagram uses the relationship of chemical parameters to classify water samples according to their dominant cations and anions, as well as allowing for the grouping of water according to hydrogeological facies. The Piper diagram uses concentrations calculated in meq/L to represent a percentage of the total cations or anions. The cations and anions of each sample are plotted on the respective triangular plot and the points are then projected onto the central diamond graph (Figure 11). Depending on where the sample point falls on the diamond graph, basic assumptions can be attributed to the sample, and for this reason the diamond graph is divided into quarters. Displaying numerous water qualities of the same sample on one plot gives an understanding of the changes occurring over time (if any), whilst displaying multiple samples together provides a basis for comparison.

The left quarter in a Piper Diagram represents freshly recharged water, dominated by calcium-magnesium-bicarbonate signature. The right quarter is associated with stagnant or slow-moving groundwater and is dominated by sodium and chloride. The bottom quarter is typical of dynamic groundwater flow and is dominated by sodium and bicarbonates; and the top quarter typically indicates contamination and is dominated by sulphate.

The water quality results for the Valley Silts project area are presented in Table 8 to Table 10. Table 8 presents the water quality data for the Valley Silts area during the 2019 groundwater study. Table 9 and Table 10 present the groundwater qualities during the 2025 hydrocensus and the 2025 aquifer testing programs respectively. The laboratory certificates are attached in Appendix D.

Based on Figure 11, the groundwater in the project area represents a Calcium/ Magnesium-Sulphate water, indicating contaminated water. Only borehole VAL4 (Abraham Kriel Bambanani borehole approx. 1.6 km north of the Russell Stream) presents a Calcium/ Magnesium-Bicarbonate water, indicating recent recharge water.

Based on the 2025 groundwater quality results (Table 9 and Table 10), the following conclusions were drawn:

- Health impact:
    - Iron – An elevated iron concentration was measured for all 7 boreholes (hydrocensus and newly drilled) sampled during the 2025 fieldwork program, with Iron concentrations varying between 4.59 mg/L (borehole VAL4) and 441 mg/L (borehole VS-BH1s), versus the maximum allowable concentration of 2 mg/L. The concentration of dissolved Iron in the 4 newly drilled boreholes, adjacent to the Russell Stream varies between 72.7 mg/L and 441 mg/L, with lower concentrations measured for the two downgradient boreholes (VS-BH2s and d).

      The concentration of dissolved Iron in water is dependent on the occurrence of other heavy metals, such as manganese, and the pH of the water.

    - Manganese – Manganese is a relatively abundant element, constituting approximately 0.1% of the earth's crust. Six of the 7 boreholes sampled during the 2025 study measured a Manganese concentration that exceeds the health impact limit. The measured Mangansee concentration for borehole VAL4 (Abraham Kriel Bambanani borehole) exceeds the Aesthetic Limit of 0.1 mg/L, but is below the Health Impact limit of 0.4 mg/L.

      Manganese concentrations vary between 5.45 mg/L (borehole VAL1) and 74.3 mg/L (borehole VS-BH2d), versus the maximum allowable concentration of 0.4 mg/L. The concentration of dissolved Manganese in the 4 newly drilled boreholes, adjacent to the Russell Stream varies between 34.7 mg/L and 74.3 mg/L, with lower concentrations measured for the 2 upstream boreholes (VS-BH1s and d).

      Manganese tends to precipitate out of solution to form a black hydrated oxide which is responsible for staining problems.

    - Cadmium – The 4 newly drilled boreholes measured a Cadmium concentration that could result in chronic health effects (0.008 to 0.117 mg/L). The health impact limit is set at 0.003mg/L. Elevated Cadmium concentrations were not measured for the 3 hydrocensus boreholes.

      Cadmium has a low solubility under conditions of neutral or alkaline pH and is highly soluble under acidic conditions, where toxic concentrations can easily arise from the dissolution of cadmium from cadmium-plated materials. Cadmium sulphide, carbonate and hydroxide salts are insoluble in water, whereas cadmium chloride, nitrate and sulphate salts are highly soluble in water. Cadmium is not usually found in water at concentrations greater than 0.001 mg/L, unless the water has been subject to pollution from cadmium containing industrial effluents. Cadmium is used in electroplating, in alloys, in certain solders and in nickel-cadmium batteries. Salts of cadmium are used in photography, pottery, the electronics industry and as pigments in many different applications (DWAF, 1996).

- Nickel – An elevated dissolved Nickel concentration was measured at the 4 newly drilled boreholes, plus hydrocensus borehole VAL2. Nickel may be present in groundwater because of dissolution from nickel ore-bearing rocks.
  There are many anthropogenic sources of these chemicals. Industrial uses include alloys, paints, pigments, electroplating, batteries, automotive parts, coatings and electrical wiring.
- Sulphate – Sulphate forms salts with various cations such as potassium, sodium, calcium, magnesium, barium, lead and ammonium (DWAF, 1996). Sulphate is a common constituent of water and arises from the dissolution of mineral sulphates in soil and rock. Since most sulphates are soluble in water it tends to accumulate to progressively increasing concentrations. Contamination by sulphate is to be expected in waters contaminated by Witwatersrand mining activities, due to the oxidation of sulphides in the ores and wastes.

  Sulphate concentrations were elevated in 6 of the 7 boreholes sampled during the 2025 study. It was only borehole VAL4 where the measured Sulphate concentration was within acceptable health and aesthetic limits.

  The elevated Sulphate concentrations vary between 1125 mg/L (borehole VAL1) and 3126 mg/L (borehole VS-BH1d), versus the maximum allowable concentration of 500 mg/L. The concentration of Sulphate in the 4 newly drilled boreholes, adjacent to the Russell Stream vary between 2011 mg/L and 3126 mg/L, with lower concentrations measured for the two downstream boreholes (VS-BH2s and d).
- Lead – An elevated Lead concentration was measured for borehole VS-BH2d (0.012mg/L) and borehole VAL2 (0.012 mg/L), with the health limit defined as 0.01mg/L. The Lead concentration in all other boreholes were below the detection limit.

  The occurrence of Lead in its elemental state is rare. Lead tends to accumulate in sediments and soils in the environment. Lead has many industrial applications which can give rise to sources of Lead contamination in water. Lead is used in batteries, in domestic water distribution pipes, in paints and as an organic lead compound, alkyl lead, in gasoline.
- Total Organic Carbon – High TOC values (between 11.2 and 19.1 mg/L) were measured for boreholes VAL1, VAL2, VS-BH2s and VS-BH2d. In groundwater, the main natural sources of organic matter include buried peat, kerogen and coal; soil and sediment organic matter; and organic matter present in water infiltrating into the subsurface from rivers or dams/ pans.
- E. coli – borehole VAL4 produced a measurable E. coli count – 7 counts per 100 ml; the count must be zero. E. coli is a type of faecal coliform bacteria commonly found in the intestines of animals and humans. Of the five general groups of bacteria that comprise the total coliforms, only E. coli is generally not found growing and reproducing in the environment. Consequently, E. coli is the species of coliform bacteria that is the best indicator of faecal pollution and the possible presence of pathogens.

Borehole VAL4 is in an old residential and industrial area, and it has been assumed that leaking sewer lines are possibly contaminating the groundwater around this borehole.

- Aesthetic effects:
    - Aluminium – The aluminium concentration for boreholes VS-BH1s and VS-BH1d (25.1mg/L and 2.07 mg/L respectively) exceed the SANS241:2015 guideline value of 0.3 mg/L. Aesthetic effects (discolouration) occur in the presence of iron or manganese. Aluminium is the most common metal in the earth's crust. Aluminium does not occur in the elemental form, but its minerals, particularly the silicates of aluminium (clay minerals), are widespread. The sampled groundwater from the BH1 cluster set was very muddy during the sampling process and this could have contributed to the elevated Aluminium concentrations.
    - Zinc – The Zinc concentration for borehole VS-BH1s (7.99 mg/L) exceeds the SANS241:2015 guideline value of 5 mg/L. The measured Zinc concentrations for the other 3 newly drilled boreholes were below the aesthetic impact limit.

      Zinc is an essential nutritional trace element for plants and animals. Humans have a high tolerance level to elevated Zinc concentrations, while fish are highly susceptible to poisoning.

      The most common mineral form of Zinc is the sulphide (sphalerite). Zinc is also found as a carbonate, oxide or silicate and may occur in association with many other metal ores such as Copper and Arsenic. The Chloride, Sulphate and Nitrate salts of Zinc are highly soluble in water, but at neutral and alkaline pH they hydrolyse to form relatively insoluble hydroxides which tend to be associated with sediments. On acidification of the water, the insoluble hydroxides are released back into solution. If the water is acidic, Zinc leaching caused by dissolution of the protective zinc hydroxide layer of galvanised piping can give rise to relatively high concentrations of Zinc in solution.

      Zinc and zinc salts are used in many industrial processes. Zinc itself is extensively used in galvanising processes and in alloys (DWAF, 1996).
    - Ammonium – The chemistry of ammonia is very complex, especially where transition metals are present in water, and while ammonia itself is of relatively low toxicity, this is not necessarily the case for some of its organometallic complexes. Taste and odour complaints are likely to occur if the ammonia concentration exceeds 1.5 mg/L. High concentrations of ammonia can also give rise to Nitrite. The Ammonium concentration for borehole VAL1 exceeds the aesthetic limit for drinking water (14.6mg/L). The aesthetic limit set at 1.5 mg/L. The ammonia concentrations in the other boreholes vary between 0.19 and 0.88 mg/L.
    - Sodium – Sodium is abundant in the environment and usually occurs as sodium chloride, but sometimes as sodium sulphate, bicarbonate or even nitrate (DWAF, 1996). Sodium is highly soluble in water and does not precipitate when water evaporates, unless saturation occurs. The measured Sodium concentration for borehole VS-BH1d (210 mg/L) exceeds the aesthetic limits for drinking water (200mg/L). With the re-use or recycling of water, the Sodium concentration will tend to increase with each cycle or addition of Sodium to the water. For this reason, Sodium concentrations are elevated in runoffs or leachates.

- Turbidity – Turbidity is indicative of the concentration of suspended matter in water and is also related to clarity, a measure of the transparency of water and settleable material. Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles, and organic matter. The latter can be both living matter such as micro-organisms and non-living matter such as dead algal cells. Turbidity was high in all boreholes with units varying between 42.5 NTUs and 730 NTUs.
- Calcium – The measured Calcium concentration was elevated for all sampled boreholes, with concentrations varying between 37.5 mg/L and 493 mg/L. Calcium is an alkaline earth metal and exists as the doubly positively charged ion, Ca(II) (DWAF, 1996). Calcium occurs naturally in varying concentrations in most waters and, together with magnesium, is one of the main components of water hardness. Soft waters contain low, while hard waters contain high concentrations of Calcium; see Total Hardness. Calcium is an essential element for all living organisms and is an important constituent of the bony skeleton of mammals, which consists of phosphates of calcium. Mineral deposits of calcium are common, usually as calcium carbonate, phosphate or sulphate (DWAF, 1996).
- Magnesium – Magnesium is an alkaline earth metal which reacts with oxygen and water to form magnesium oxide and magnesium hydroxide, respectively. Magnesium is a common constituent of water, and the solubility is governed by the carbonate/bicarbonate equilibrium and the pH. Magnesium, together with calcium, is responsible for the hardness of water. High Magnesium concentrations were measured in 5 of the 7 boreholes and were thus in acceptable limits for boreholes VAL1 and VAL4.
- Total Hardness – The Total hardness value was elevated for all boreholes except borehole VAL4, indicating very hard water. Water hardness is influenced by the presence of calcium and magnesium salts. Other metals such as strontium, iron, aluminium, zinc and manganese may occasionally contribute to the hardness of water, but the calcium and magnesium hardness usually predominates. Temporary hardness is due to the presence of bicarbonates of calcium and magnesium and can be removed by boiling, whereas permanent hardness is attributed to other salts such as sulphate and chloride salts, which cannot be removed by boiling. Excessive hardness of water can give rise to scaling in plumbing and household heating appliances.
- Total Coliform – Total coliform bacteria are common in the environment (soil or vegetation) and are generally harmless. The total coliform count was elevated for borehole VAL4 (40 counts per 100 ml) and for borehole VS-BH1d (20 counts per 100 ml). The operational limit is set at 10 counts per 100 millilitres (ml).

  Total coliform bacteria are frequently used to assess the general hygienic quality of water and to evaluate the efficiency of drinking water treatment and the integrity of the distribution system. They should not be detectable in treated water supplies. If found, they suggest inadequate treatment, post-treatment contamination and/or aftergrowth or an excessive concentration of nutrients. In some instances, they may indicate the presence of pathogens. Some bacteria classified as coliforms are not of faecal origin. Total coliforms include bacteria that are found in the soil, in water that has been influenced by surface water, and in human or animal waste.

- pH – the pH value for the two newly drilled upstream boreholes (VS-BH1s and VS-BH1d) (4.87 and 4.52 respectively) is below the SANS guideline limit of 5.

  The mobility of trace elements is dependent on several parameters, including pH. All the trace elements examined are most mobile when the pH <4.5, and least mobile when the pH > 6. The pH for the two downstream groundwater samples was 5.6 and 6.2.

- The SANS 241 guideline limits for Electrical Conductivity (EC) and Total Dissolved Salts (TDS) were exceeded for all sampled sites, except for borehole VAL4. EC level varied between 222 and 403 mS/m. TDS varied between 1756 and 4134 mg/L.

The chemicals of concern for the Valley Silts project area are pH, Iron, Manganese, Sulphate, Cadmium, Lead, Nickel and Total Organic Carbon (Table 9 and Table 10). Parameters exceeding aesthetic limits include Ammonium, Aluminium, Chloride, Calcium, Magnesium, Sodium, Zinc and Total Hardness and Turbidity. Most of these are elevated in the four newly drilled boreholes. Based on the SANS241 drinking water guidelines and on the sampled water results, the sampled water is not fit for human consumption (unless treated).

A groundwater study by Rösner et al, 1998 (WRC Report K5/797/0/1) concluded that groundwater near tailings dams is affected by salt loads. The groundwater quality improved with increasing distance down gradient from the pollution source, mainly because of dilution and solid speciation. Once contaminants have migrated through the unsaturated zone, into the groundwater zone, the rate of lateral movement increases by orders of magnitude. The implication of this is that although there is a dilution effect because of contact with groundwater, the potential impact on the environment is extended in a spatial and temporal sense.

The gold containing silt in Russell Stream and the adjacent TSF and sand dump facilities can potentially add sulphate, iron, chloride, calcium, magnesium, manganese and aluminium to the local groundwater system, if the management of contaminated water on site is not effective, but also through seepage from the adjacent dumps. This has been confirmed by the 2019 and the 2025 water sampling results (Table 8 to Table 10). Metals like cobalt, copper, nickel and zinc can also be elevated. In general, sulphate concentrations around the tailings complexes south and west of Johannesburg vary between 417 and 4700 mg/L.

The pyrite present in the silt and sand material is oxidised in the presence of oxygen and water to form ferrous sulphate and sulphuric acid. Both reactions result in an acidic pH, and high sulphate and metal concentrations, leading to Acid Mine Drainage (AMD); often measured in leachate from these dumps. Pirite was also noted in the drill samples from borehole VS-BH2d.

The rate at which pyrite oxidation takes place within the surrounding dumps varies and decreases with depth. The addition of lime during the gold recovery process raises the pH to neutral conditions when tailings are deposited on the facilities. Negative quality impacts are expected when the silts are excavated and exposed to oxygen and water.

The Valley Silts Project area is surrounded by residential and industrial areas. Many pollution sources (industrial discharge, mining activities and poor waste and sanitation management) do exist that can contribute to groundwater contamination. It will be difficult to define the contaminants and concentration at all point sources in the area.

Table 8. Hydrocensus groundwater quality – October 2019

Parameter	Unit	SANS241 Standard Limits		DHSWS Drinking Standards	B15	Storm 1	Val 1
Ammonium	mg N/ℓ	Aesthetic ≤1.5			0,451	0,202	3,61
Chloride	mg Cl/ℓ	Aesthetic ≤300			145	118	43,1
Aluminium	mg Al/ℓ	≤0.3			-0,002	19	-0,002
Cadmium	mg Cd/ℓ		Chronic health ≤0.003		-0,002	-0,002	-0,002
Calcium	mg Ca/ℓ			No health. Scaling intensifies from 32mg/L	330	577	76,4
Copper	mg Cu/ℓ		Chronic health ≤2		-0,002	-0,002	-0,002
Iron	mg Fe/ℓ	Aesthetic ≤0.3	Chronic health ≤2		-0,004	342	-0,004
Lead	mg Pb/ℓ		Chronic health ≤0.01		-0,004	-0,004	-0,004
Magnesium	mg Mg/ℓ			Diarrhoea and scaling issues from 70mg/L	249	93,6	37,7
Manganese	mg Mn/ℓ	Aesthetic ≤0.1	Chronic health ≤0.4		4,74	28,1	0,705
Nickel	mg Ni/ℓ		Chronic health ≤0.07		-0,002	-0,002	-0,002
Zinc	mg Zn/ℓ	Aesthetic ≤5			0,07	0,6	-0,002
Electrical Conductivity at 25°C	mS/m	Aesthetic ≤170			316	460	95,6
Fluoride	mg/ℓ		Chronic health ≤1.5		-0,263	0,615	-0,263
Nitrate	mg/ℓ		Acute health ≤11		0,303	-0,194	0,509
pH at 25°C		≥5 - ≤9.7			6,16	4,13	7,41
Potassium	mg K/ℓ			No aesthetic or health effects below 50mg/L	3,21	59,7	6,72
Sodium	mg Na/ℓ	Aesthetic ≤200			202	219	65,1
Sulphate	mg SO_4/ℓ	Aesthetic ≤250	Acute health ≤500		1843	3208	417
Total Alkalinity	mg $CaCO_3$/ℓ				55,4	13,1	39,2
Total Dissolved Solids	mg/ℓ	Aesthetic ≤1200			2807	4285	677
Total Hardness	mg $CaCO_3$/ℓ	60–120 mg/l, moderately hard	120–180 mg/l, hard	more than 180 mg/l, very hard	1848	1826	346
Orthophosphate (PO_4) as P	mg/ℓ				-0,005	-0,005	-0,005
Cobalt	mg/ℓ				0,208	0,945	0,041
Turbidity	NTU	Aesthetic ≤5			93	38,2	3,41
TOC			Chronic health ≤10		2,75	13,3	1,99

Table 9. Hydrocensus groundwater quality – February 2025

Parameter	Unit	SANS241 Standard Limits		DHSWS Drinking Standards	Val 1	Val 2	Val 4
Ammonium	mg N/ℓ	Aesthetic ≤1.5			14,6	0,887	0,229
Chloride	mg Cl/ℓ	Aesthetic ≤300			81,9	145	25,6
Aluminium	mg Al/ℓ	≤0.3			-0,002	-0,002	-0,002
Cadmium	mg Cd/ℓ		Chronic health ≤0.003		0,003	0,003	-0,002
Calcium	mg Ca/ℓ			No health. Scaling intensifies from 32mg/L	232	376	37,5
Copper	mg Cu/ℓ		Chronic health ≤2		0,015	0,016	-0,002
Iron	mg Fe/ℓ	Aesthetic ≤0.3	Chronic health ≤2		11,7	18,3	4,59
Lead	mg Pb/ℓ		Chronic health ≤0.01		-0,004	0,012	-0,004
Acid Soluble Chromium	mg Cr/ℓ		Chronic health ≤0.05		-0,003	-0,003	-0,003
Magnesium	mg Mg/ℓ			Diarrhoea and scaling issues from 70mg/L	66,9	82,1	16,8
Manganese	mg Mn/ℓ	Aesthetic ≤0.1	Chronic health ≤0.4		5,45	53	0,294
Nickel	mg Ni/ℓ		Chronic health ≤0.07		-0,002	0,123	-0,002
Zinc	mg Zn/ℓ	Aesthetic ≤5			-0,002	-0,002	-0,002
Electrical Conductivity at 25°C	mS/m	Aesthetic ≤170			222	271	31,9
Fluoride	mg/ℓ		Chronic health ≤1.5		-0,263	-0,263	-0,263
Nitrate	mg/ℓ		Acute health ≤11		0,269	-0,194	4,19
TON	mg/ℓ				0,269	-0,194	4,19
pH at 25°C		≥5 - ≤9.7			7,49	7,55	8,17
Potassium	mg K/ℓ			No aesthetic or health effects below 50mg/L	28,2	12,9	1,28
Sodium	mg Na/ℓ	Aesthetic ≤200			164	92,3	5,78
Sulphate	mg SO_4/ℓ	Aesthetic ≤250	Acute health ≤500		1125	1388	23,5
Total Alkalinity	mg $CaCO_3$/ℓ				62,8	48	97,7
Total Dissolved Solids	mg/ℓ	Aesthetic ≤1200			1756	2127	189
Total Hardness	mg $CaCO_3$/ℓ	60–120 mg/l, moderately hard	120–180 mg/l, hard	more than 180 mg/l, very hard	855	1278	163
E.coli	CFU/100ml		Not detected		-1	-1	7
Total Coliforms	CFU/100ml	≤ 10			5	-1	40
Turbidity	NTU	Aesthetic ≤5			302	317	42,5

TOC	mg/ℓ		Chronic health ≤10		18,9	11,2	2,18
Langelier Saturation Index	LSI	A negative Langelier index indicates a scale-dissolving tendency, with the possibility of corrosion			-0,39	-0,24	-0,21

Table 10. Aquifer testing groundwater quality – March 2025

Parameter	Unit	SANS241 Standard Limits		DHSWS Drinking Standards	VSBH-1d	VSBH-1s	VSBH-2s	VSBH-2d
Ammonium	mg N/ℓ	Aesthetic ≤1.5			0,263	0,758	0,328	0,196
Chloride	mg Cl/ℓ	Aesthetic ≤300			31.0	59.0	77,2	78,1
Aluminium	mg Al/ℓ	≤0.3			2,07	25,10	0,023	0,071
Cadmium	mg Cd/ℓ		Chronic health ≤0.003		0,063	0,117	0,012	0,008
Calcium	mg Ca/ℓ			No health. Scaling intensifies from 32mg/L	493	341	334	414
Copper	mg Cu/ℓ		Chronic health ≤2		0,043	0,077	0,019	0,022
Iron	mg Fe/ℓ	Aesthetic ≤0.3	Chronic health ≤2		296	441	83,5	72,7
Lead	mg Pb/ℓ		Chronic health ≤0.01		-0,004	-0,004	-0,004	0,012
Acid Soluble Chromium	mg Cr/ℓ		Chronic health ≤0.05		-0,003	-0,003	-0,003	0,017
Magnesium	mg Mg/ℓ			Diarrhoea and scaling issues from 70mg/L	246	96,6	168	149
Manganese	mg Mn/ℓ	Aesthetic ≤0.1	Chronic health ≤0.4		38,2	34,7	68,3	74,3
Nickel	mg Ni/ℓ		Chronic health ≤0.07		5,21	10,2	1,4	5,83
Zinc	mg Zn/ℓ	Aesthetic ≤5			2,19	7,99	0,036	0,391
Electrical Conductivity at 25°C	mS/m	Aesthetic ≤170			403	317	299	341
Fluoride	mg/ℓ		Chronic health ≤1.5		-0,263	-0,263	-0,263	-0,263
Nitrate	mg/ℓ		Acute health ≤11		1,49	1,01	-0,194	-0,194
TON	mg/ℓ				1,49	1,01	-0,194	-0,194
pH at 25°C		≥5 - ≤9.7			4,52	4,87	6,22	5,69
Potassium	mg K/ℓ			No aesthetic or health effects below 50mg/L	9,09	6,94	18,50	26,90
Sodium	mg Na/ℓ	Aesthetic ≤200			210	77,7	121	145
Sulphate	mg SO_4/ℓ	Aesthetic ≤250	Acute health ≤500		3126	2395	2011	2246
Total Alkalinity	mg $CaCO_3$/ℓ				21,3	14,5	43,5	41,4
Total Dissolved Solids	mg/ℓ	Aesthetic ≤1200			4134	2991	2757	3085
Total Hardness	mg $CaCO_3$/ℓ	60–120 mg/l, moderately hard	120–180 mg/l, hard	more than 180 mg/l, very hard	2243	1249	1525	1650
E.coli	CFU/100ml		Not detected		-1	-1	-1	-1
Total Coliforms	CFU/100ml	≤ 10			20	5	-1	-1
Turbidity	NTU	Aesthetic ≤5			626	730	566	133
TOC	mg/ℓ		Chronic health ≤10		4,18	5,42	19,1	12,3

Langelier Saturation Index	LSI	A negative Langelier index indicates a scale-dissolving tendency, with the possibility of corrosion	-3,51	-3,48	-1,69	-2,16

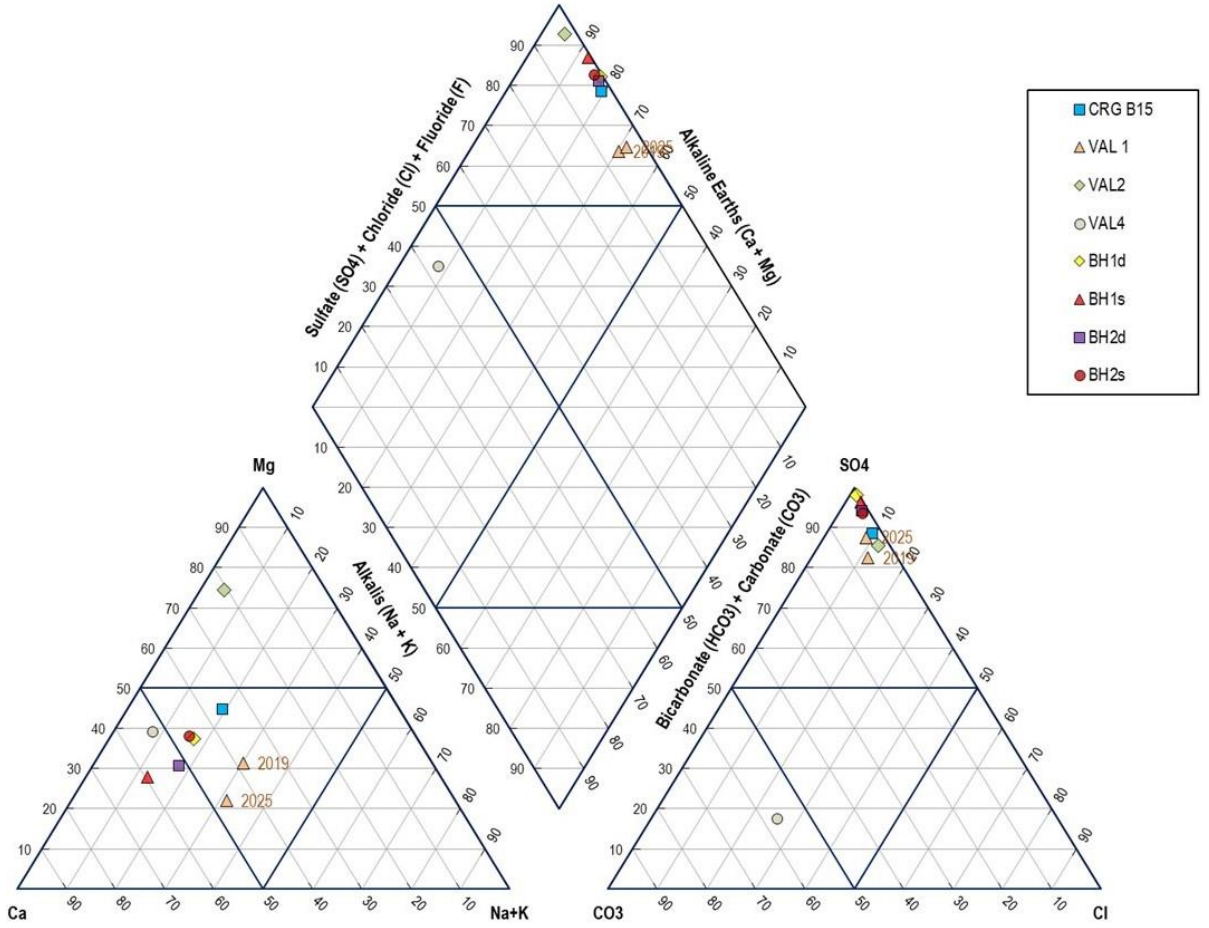


Figure 11. Piper diagram

5.6 Date and Season of the Field Surveys

The hydrocensus was completed during February 2025 during the rainy season in Gauteng. The 2025 fieldwork program was completed during February and March 2025, which represents wet season conditions.

6 Conceptual Hydrogeological Model

This section presents a general understanding of the site conditions in terms of geology, groundwater occurrence, groundwater level and water quality. According to Barnard (2000) various aquifer types are found in the area i.e. weathered and fractured aquifers. The Witwatersrand formations present aquifers that have a combination of loose unconsolidated/ weathered material overlaying hard rock formations, in which fractures, fissures or joints potentially hold water. Groundwater is often encountered in both the saturated weathered material below the regional groundwater rest level and in the transition zone between weathered and fresh formations.

The available information was used to construct a conceptual model of the aquifers present in the project area. The conceptual model forms the basis of the numerical groundwater model constructed and calibrated to complete the impact assessment for this project.

A schematic cross section through the project area is presented in Figure 12. The location of the cross section is indicated on Figure 4. Figure 12 demonstrates the locations and extent of the various geological formations that are present. It is shown that the Valley Silts Project footprint is underlain by formations of the Witwatersrand Supergroup, including Booysens shale and Turrfontein quartzite and conglomerate. The rest groundwater table is shallow in the weathered Wits formations, as indicated by information gathered during the 2025 hydrocensus. The shallow groundwater conditions suggest that groundwater discharges to the Russell Stream, which is substantiated by the groundwater flow contours generated.

6.1 Unsaturated Zone

Published geological maps and the recent drilling program confirmed that the project area is underlain by quartzite. The soils surrounding the project area are shallow sandy soils. Vertic, Melanic, Duplex, Plinthic, Oxidic, Gleyic, Cumulic and lithic soils all have a possibility of being present in the study area (Kongiwe 2025).

It is further noted that the newly drilled monitoring boreholes were largely dry. This doesn't necessarily mean the shallow weathered aquifer is dewatered, only that aquifer permeabilities are very low and that the groundwater table slowly recovers after drilling is completed. Regionally, the groundwater table is about 6.3 m below surface.

6.2 Saturated Zone

Various aquifer types are found in the area, including:

- Weathered aquifers: The project is underlain by shale Booysens Subgroups as well as quartzite of the Turffontein and Johannesburg Subgroups. Shallow aquifers typically form in the upper weathered zone of the geological succession due to the vertical retardation of infiltrated rainwater along the limit of weathering. The depth of weathering within the new monitoring boreholes varies between 8 and 12 m below surface. The depth of weathering is dependent on several factors, including the composition of the rock, the presence of shallow fractures or geological contact zones, climatic impacts like rainfall and the presence of water in soil, and

chemical processes like oxidation and acidification. Groundwater occurrence in this aquifer manifests as seepage. No groundwater strikes were recorded during the 2025 drilling program in the weathered zone. The recharge to the Witwatersrand outcrop and the weathered aquifers is considered low due to the limited presence of the outcrop in the urban setting. Higher recharge rates may be associated with streams flowing through the project area, like the Russell Stream.

- Fractured aquifers: The deeper Witwatersrand formations (Johannesburg, Booysens and Turffontein Subgroups) form rock aquifers where water is stored in and moves preferentially through fractures. No fault and only one large fracture were identified in the formations intersected in the deeper monitoring boreholes. In fact, most of the deep boreholes were dry or yielded only groundwater seepage. No groundwater strikes were recorded in the deeper boreholes during the 2025 drilling programme. The results of aquifer and slug tests completed on the boreholes indicate low permeabilities. This is supported by the very slow groundwater level recovery after drilling of some of the boreholes, which is discussed in more detail below.

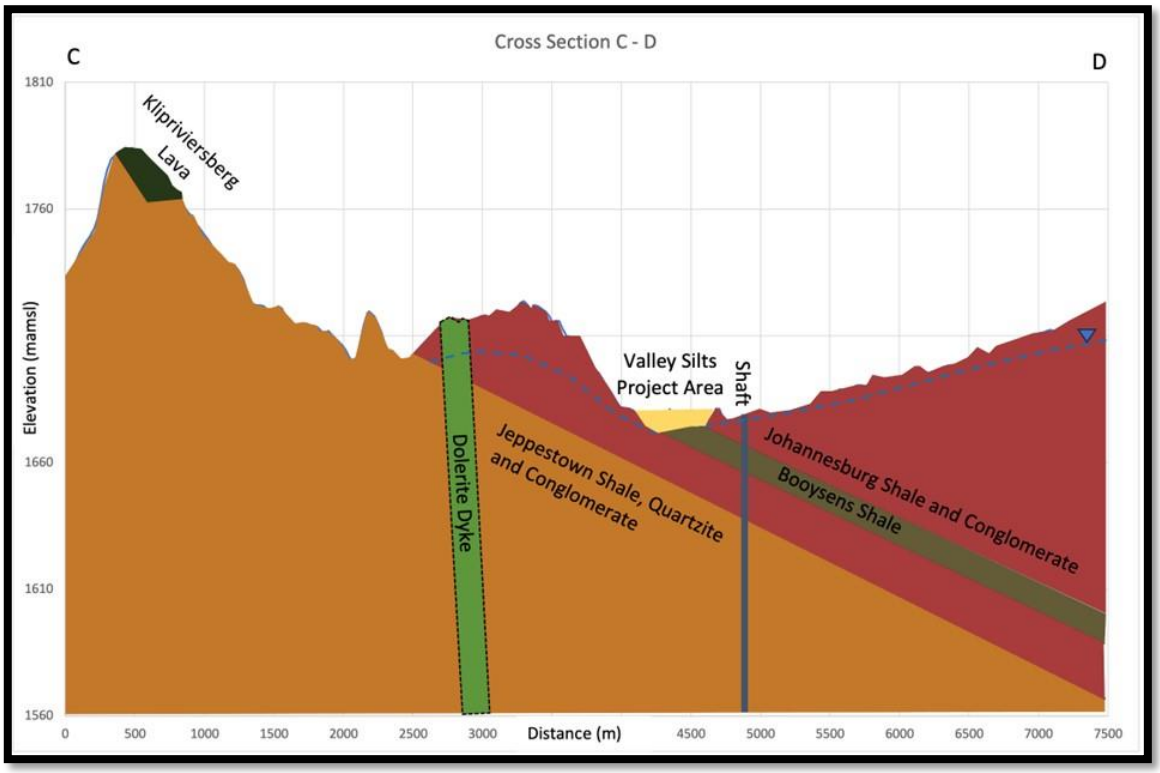


Figure 12. Schematic cross section through the project area

6.3 WITWATERSRAND FORMATION CHARACTERISTICS

The Witwatersrand formations (Central Rand Group) is composed of arenaceous and rudaceous rocks. When these formations decay, they generally produce sandy soils. The Central Rand Group lithologies produce borehole yields of 1 to 2.0 litres per second (L/s) (Barnard, 2000). Higher borehole yields are associated with faults and highly fractured systems – high permeability zones. The Valley Silts Project area is located on Witwatersrand formations, mainly the Turffontein quartzite/ conglomerate, and the Johannesburg quartzite/ conglomerate and Booysens shale. It is thought that the permeabilities of the shale would be low compared to that of the over- and underlaying quartzite and conglomerate. The formations strike east-west and dip between 30° and 60° in a southerly direction (Figure 4 and Figure 12). Many of the faults and diabase intrusions in the area have an east-west orientation.

The hydraulic parameters obtained during the recent aquifer testing at Valley Silts, plus previous aquifer tests in the City Deep and Germiston areas indicate characteristics of low permeability, where groundwater movement at depth is controlled by limited discontinuous fractures in the quartzite/conglomerate bedrock. Water bearing zones can be associated with:

- the tailings material and rock contact zone;
- the shale and quartz contact; and
- fractures / faults within the quartzite.

The shallow depth to bedrock is favourable for the development of perched water tables. These zones are areas of potential preferential horizontal flow. The presence of pearched water tables could not be confirmed for the Valley Silts Project area. On average, the depth to water table in the Witwatersrand Formations is between surface and 6 metres below surface.

6.4 Historical Monitoring Borehole Details

There were two boreholes included in Ergo's water quality monitoring programme for the Valley Silts Project area. These were boreholes CRBH1 and CRBH2. A review of the monitoring reports indicates that the boreholes have not been sampled / tested since November 2017, as they were destroyed (earliest datasource) (Ergo Quarterly Water Quality Monitoring Reports, 2017 to 2019).

A review of the National Groundwater Archive (NGA) dataset also yielded no boreholes in the project area.

6.5 Groundwater Availability Assessment

No information could be recorded during the hydrocensus on the volumes of groundwater regionally used. It is noted that groundwater is used for swimming pool top-up, gardening and monitoring. The only private / production boreholes that were identified during the 2025 hydrocensus are VAL4 and VAL5 (Figure 5). Only VAL4 is in use. VAL4 is approximately 1.6 km north of Russell Stream and borehole VAL5 is approximately 2.5 km north of Russell Stream.

The DWS' published 1:500 000 scale hydrogeological map borehole yield classification is summarised below. The map considers all available data, including blow yields. The general distribution of borehole yield on the published maps indicates the following:

- Witwatersrand quartzite, lava and shale form fractured aquifers with borehole yields varying between 0,5 and 2 L/s.

Information obtained from the aquifer tests completed on the new monitoring boreholes drilled upstream and downstream from the Valley Silts Project area indicate that borehole yields are low. The aquifer test information indicates that the weathered and fractured aquifers present underneath the Russell Stream do not have significant yields and are all considered minor aquifers with low permeabilities.

6.6 Groundwater Potential Contaminants

During the 2019 geohydrological study completed for the project (Groundwater Abstract, 2019), Sulphate and Iron were identified as the key indicators for the impacts on groundwater. This outcome was confirmed with data from the 2025 water sampling, as indicated in Table 11. Sulphate (SO_4) and Iron (Fe) concentrations are compared to pH conditions and TDS concentrations in the table. Elevated Sulphate and Iron concentrations are associated with the dissolution of sulphide minerals in the

tailings and silt material. Exposure of the sulphide minerals to oxygen and water often results in acid mine drainage of which sulphate is a by-product.

The information confirms that groundwater within the project area is acidic with elevated Sulphate and Iron concentrations. As discussed earlier, this is due to the impact of historical tailings deposition in the area. Sulphate concentrations in both the shallow and deep aquifers exceed 2000 mg/L and Iron concentrations are above 300 mg/L, on average. Human health risks associated with Sulphate concentrations measured on site include diarrhoea in all individuals and a very strong and bitter taste, as indicated in Table 12. At the Iron concentrations reported, the groundwater is likely to result in chronic and acute effects with acute toxicity at concentrations of 300 mg/L and above. Severe aesthetic impacts area also expected in terms of taste and impacts on plumbing.

Table 11. 2025 concentrations for indicator elements

Borehole	pH	TDS	SO_4	Fe
Val1	7,49	1756	1125	11,7
Val2	7,55	2127	1388	18,3
Val4	8,17	189	24	4,6
VSBH1D	4,52	4134	3126	296
VSBH1S	4,87	2991	2395	441
CR7	7,20	408	94	3,8

Table 12. Effects of sulphate and iron on human health

Sulphate range (mg/L)	Effects
Sulphate	
0 – 250	No adverse health effects
250 - 500	Tendency to develop diarrhoea in sensitive and some non-adapted individuals. Slight taste noticeable
500 - 600	Diarrhoea in most non-adapted individuals. Definite salty or bitter taste
600 - 1000	Diarrhoea in most individuals. User-adaptations do not occur. Pronounced salty or bitter taste
>1000	Diarrhoea in all individuals. User-adaption does not occur. It has a very strong salty and bitter taste
Iron	
0 – 0.3	No adverse health effects
0.3 - 1	Adverse aesthetic effects (taste). No health effects
1 - 10	Pronounced aesthetic effects (taste and plumbing). Slight health effects in young children and sensitive individuals
10 - 100	Severe aesthetic effects (taste and plumbing). Chronic health effects in young children and sensitive individuals, increasing with higher concentrations
100 - 3000	Chronic and acute health effects and acute toxicity may begin to appear at concentrations of around 300 mg/L. Severe aesthetic effects (taste and plumbing)

Disturbance of the silt material during the reclamation is likely to temporarily affect water quality associated with the project, as indicated for monitoring data for surface water sampling point CR7. This impact is however not expected to result in acidification or significantly elevated salts and metals.

Groundwater quality diagnostic maps were prepared for Sulphate and Iron concentrations and are presented in Figure 13 and Figure 14.

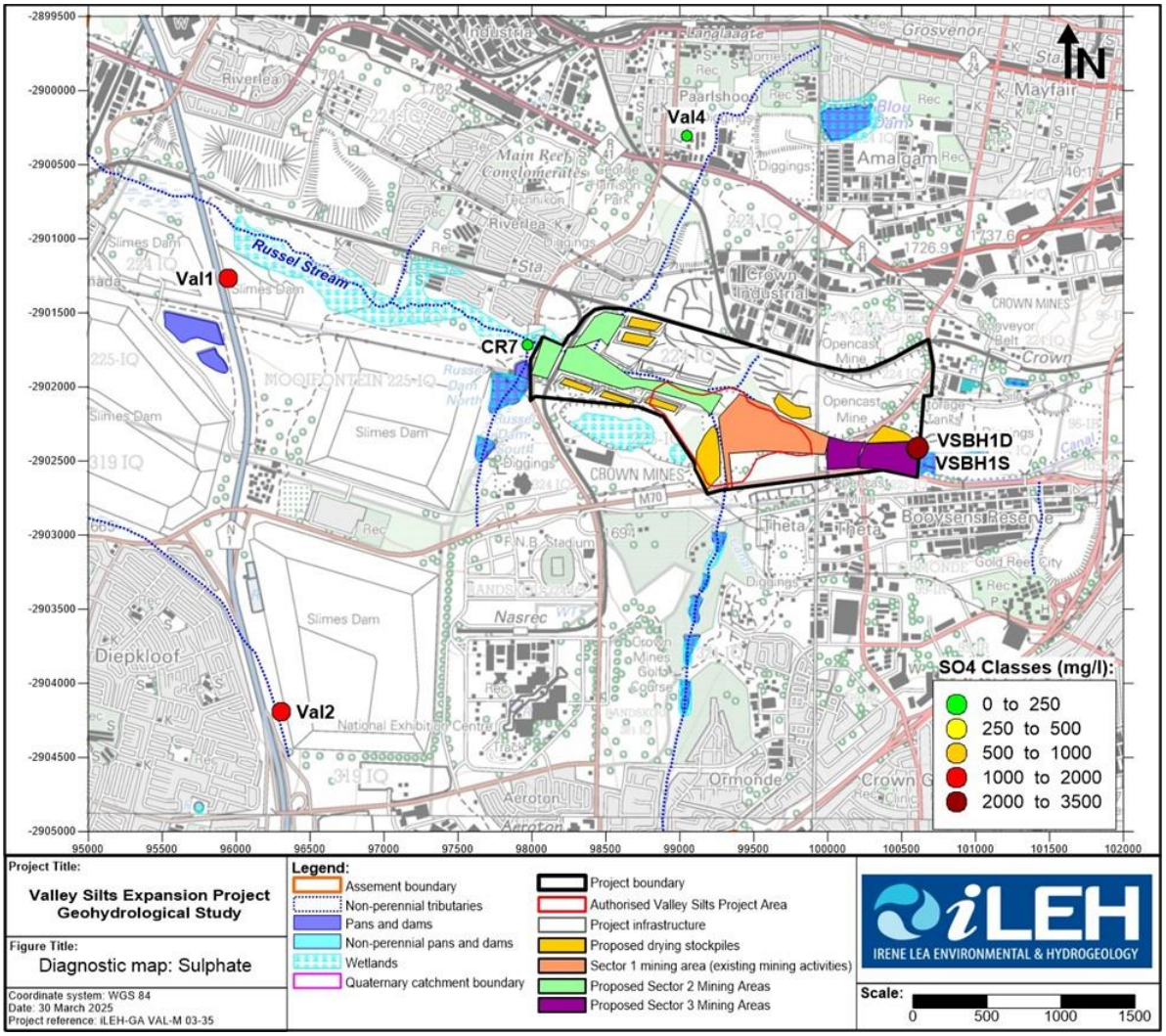


Figure 13. Groundwater quality diagnostic map for sulphate

It is shown that regionally groundwater quality is impacted by existing tailings storage facilities (TSF) located in the vicinity of the Valley Silts Project. For example, in boreholes VAL1 and VAL2, located down gradient of two TSFs not associated with the project, sulphate concentrations vary between 1000 and 2000 mg/L and iron concentrations between 10 and 30 mg/L, which is elevated above ambient conditions. These TSFs will continue to impact on groundwater quality after the Valley Silts Project is completed. This cumulative impact will be assessed during groundwater modelling, as discussed below.

On site, sulphate concentrations exceed 2000 mg/L and iron concentrations 300 mg/L, as discussed above. The removal of the silt material in the stream will improve groundwater quality in this area in the long-term, which is a positive outcome.

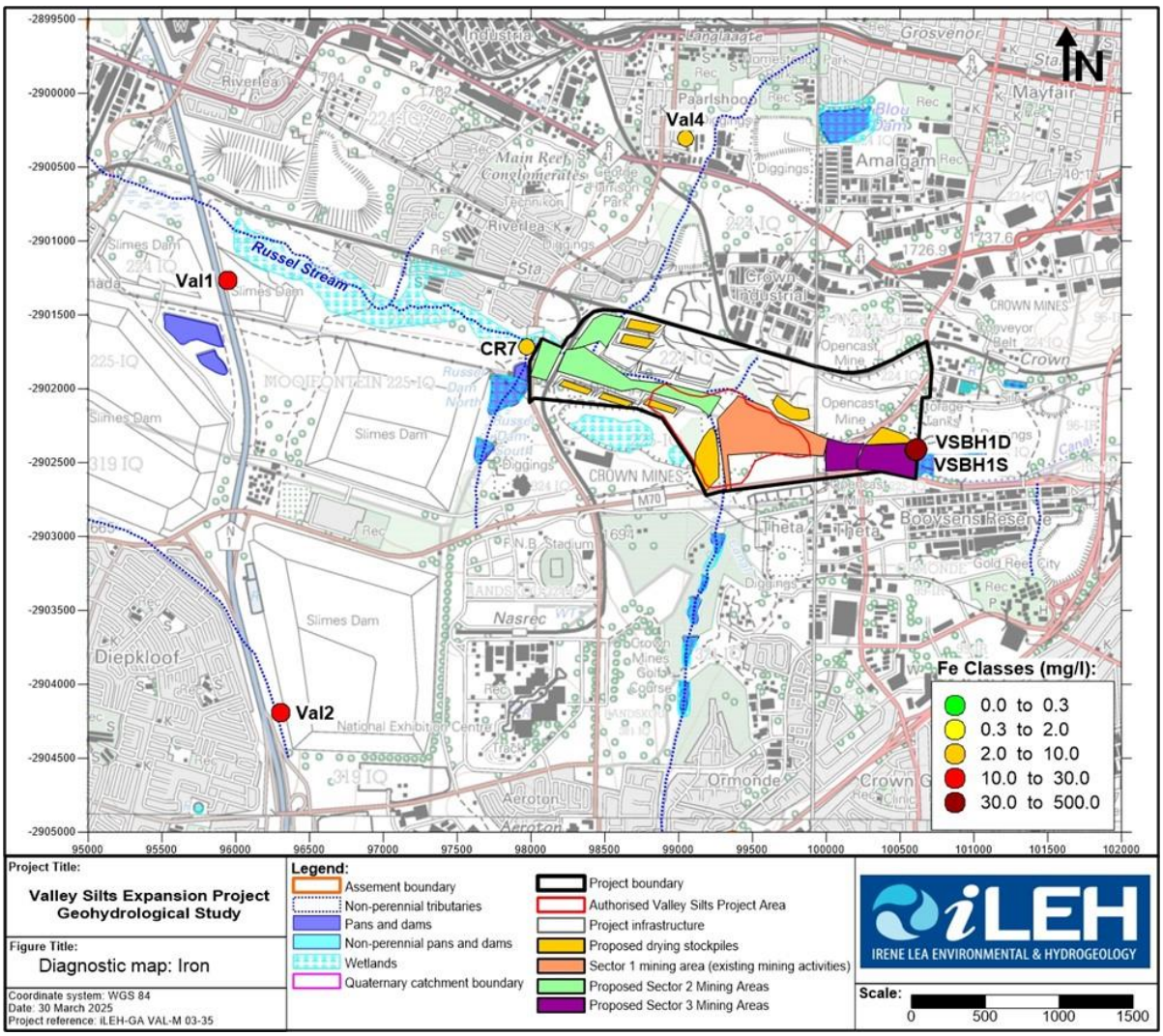


Figure 14. Groundwater quality diagnostic map for iron

The gold containing silt and the adjacent TSF and sand dump facilities can potentially add sulphate, iron, chloride, calcium, magnesium, manganese and aluminium to the local groundwater system, if the management of contaminated water on site is not effective, but also through seepage from the adjacent dumps. Metals like cobalt, copper, nickel and zinc can also be elevated. In general, sulphate concentrations around the tailings complexes south and west of Johannesburg vary between 417 and 4700 mg/L.

The pyrite present in the tailings and sand material is oxidised in the presence of oxygen and water to form ferrous sulphate and sulphuric acid. Both reactions result in an acidic pH, and high sulphate and metal concentrations, leading to Acid Mine Drainage. The rate at which pyrite oxidation takes place within the dump varies and decreases with depth. The addition of lime during the gold recovery process raises the pH to neutral conditions when tailings are deposited on these facilities. Negative quality impacts are expected when the silts are excavated and exposed to oxygen and water.

The Valley Silts Project area is surrounded by residential and industrial areas. Many pollution sources (industrial discharge, mining activities and poor waste and sanitation management) do exist that can contribute to groundwater contamination. It will be difficult to define the contaminants and concentration at all point sources in the area.

6.7 Groundwater Levels

Based on the information available (2025 hydrocensus), the depth to groundwater in the Valley Silts Project area varies between 0.1 m bgl around the TSFs and 5.5 m bgl at Shaft 1 approx 600 m to 700 m south of the Valley Silts Project area, with an average groundwater level depth of 2.65 m bgl.

Since groundwater level measurements in the new monitoring boreholes do not reflect static groundwater conditions, groundwater flow patterns were approximated from the topography and the aquifer conceptualisation discussed above. It is shown that rest groundwater levels vary regionally between 0.1 and 30.9 m below surface, with an average depth of 6.3 m. The deeper groundwater level of 30.9 m measured in boreholes VAL5 north of the project area is probably reflective of conditions in the Booysens shale aquifer.

The depth of groundwater in the new monitoring boreholes vary between 3.4 m and 77.7 m below surface. Within the project area, groundwater flow is in a westerly direction. Locally, groundwater flow is expected to be towards the Russell Stream, mimicking the topography. On a local scale groundwater movement might be in the opposite direction but adopt the regional trend / flow direction as the groundwater moves further away from the topographical feature.

For the Valley Silts Project area, the groundwater flow direction will be in a westerly to south-westerly direction, towards the Klip River (Figure 15).

6.8 Acid Generation Capacity

An assessment of the risk of acidification of process water associated with the project was completed using the Ergo surface water monitoring data immediately downgradient of the project, for sample site CR7. The location of this sample is indicated on Figure 5. This position will indicate impacts on water resources associated with the current silt reclamation activities.

The results of the monitoring programme are presented in Figure 16. The information indicates that the pH in surface water downgradient of the project is neutral with only occasional near-neutral results. The average pH over the period January 2018 to February 2025 is 7.2. The TDS concentrations at this position fluctuates seasonally between 250 and 650 mg/L, with an average concentration of 400 mg/L.

This information suggests that the surface water down gradient of the current activities has not acidified. This outcome will be assumed for the activities planned as part of the Valley Silts Expansion Project.

A comparison between pH and TDS in groundwater is provided in Figure 17. Also indicated are the February 2025 data for surface water sample CR7. It is shown that groundwater in hydrocensus boreholes have neutral to alkaline pH conditions. Groundwater down gradient of TSFs situated near the project area (boreholes VAL1 and VAL2) however have elevated TDS concentrations.

The groundwater samples from the new monitoring boreholes drilled as part of this project indicate acidic conditions with significantly elevated TDS concentrations. These conditions are reflective of the historical impact of tailings and silt deposition in the Russell Stream. This information suggests that removal of the silt material, which has historically contaminated groundwater in this position, will result in a positive long-term impact on groundwater quality.

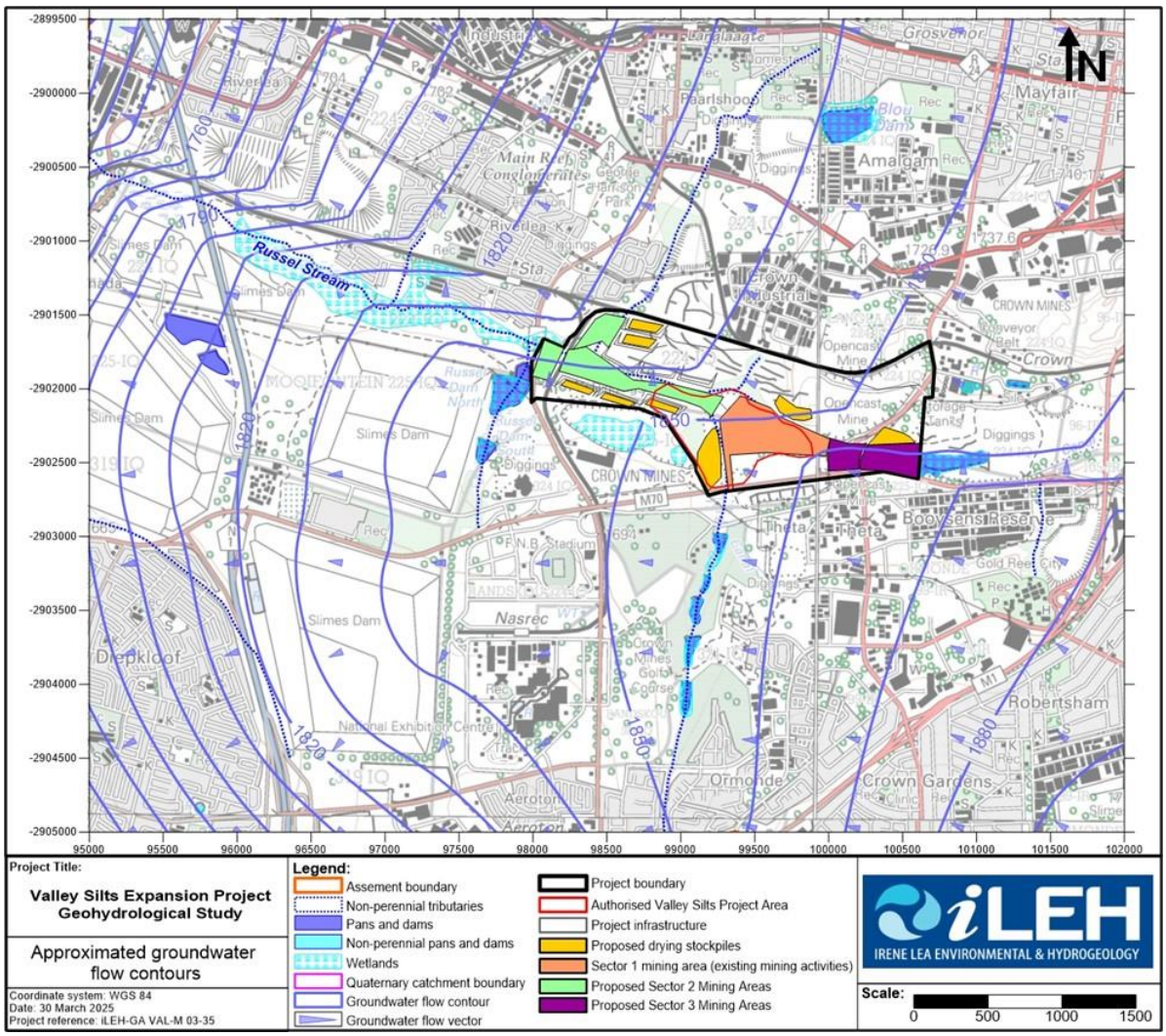


Figure 15. Estimated groundwater flow patterns

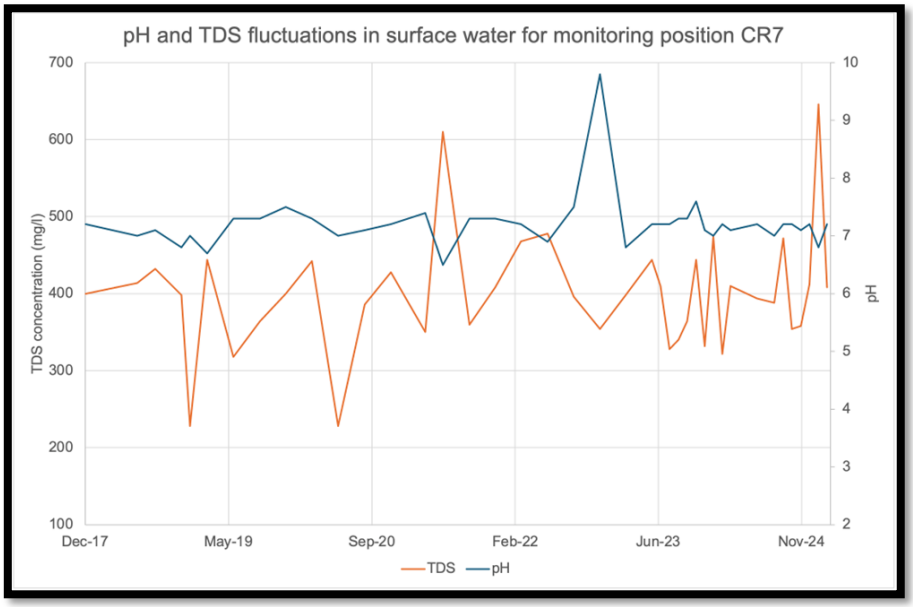


Figure 16. pH and TDS fluctuations in surface water downstream of the project

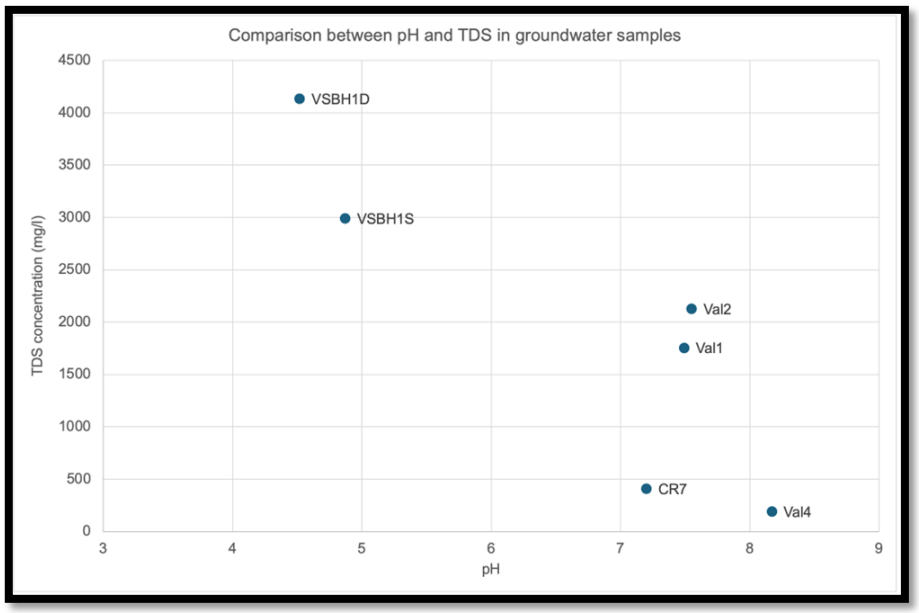


Figure 17. Comparison between pH and TDS in groundwater

6.9 Aquifer Characterisation and Vulnerability

Based on aquifer classification methodology and regions published in the Aquifer Classification Map Series of South Africa (DWS, 2012), the aquifers present in the project area are minor aquifers with low yields and variable quality. No known groundwater use for domestic supply takes place downstream of the project, based on the 2025 hydrocensus. Ambient groundwater quality associated with the Wits sediments are generally acceptable for potable use except where mining, industrial or sewage discharge activities have affected groundwater quality. The aquifers fall in a moderate vulnerable category, which means they are vulnerable to some pollutants in the long-term when these are continuously discharged or leached. Overall, the aquifers presented are ranked with a medium susceptibility to the impacts of pollutants.

Based on the information above, as well as the methodology described by Parsons (1995), the aquifer protection classification is rated as medium. This is because groundwater has been impacted by industrial, mining and sewage discharge activities.

7 Groundwater Modelling

To assess the potential impacts of the proposed silt excavation from section of the Russell Stream, a groundwater model was constructed for the project area. The information presented and discussed below should be considered as a first approximation of the impact of desilting, as the study is based on a limited dataset.

7.1 Key Assumptions, Literature-Based Data Inputs

The numerical modelling used to complete the impact prediction for the project is based on the following assumptions:

- The geometry of the aquifers present was inferred from published geological maps as well as inferred from natural groundwater barriers.

- Aquifer parameters or borehole construction details were not available for the hydrocensus boreholes. Aquifer characterisation was completed with data from the four monitoring boreholes drilled on site.
- The source term was inferred from the existing groundwater quality on site. As discussed earlier, this represents the impact of historical tailings deposition on groundwater quality.
- The volume of leachate available for infiltration during the operational phase is based on work completed for the project in 2019 as well as on experience with similar projects.
- There is currently no information available to characterise the timeline of the historical tailings deposition and management in the project areas. For this reason, assumptions had to be made on when these TSF were established and how long they were operational. This information is considered tentative and should be revised if more specific information becomes available.
- Only advective transport of contaminants was simulated. Assumptions made regarding advection, are discussed below. While it is acknowledged that attenuation will take place in the soils, there is currently insufficient information available to quantify the extent to which this takes place. As such, simulations are based on the precautionary principle and take the worst-case scenario into consideration.

7.1.1 Modelling Objectives

The objectives of the numerical modelling presented in this report are based on the requirements of the EIA process and the Water Use Licence Application requirements. The following objectives are therefore reported:

- Estimate the impact of the proposed Valley Silts Expansion Project during the construction and operational phases of the project on groundwater quality. No significant impacts on groundwater levels are expected.
- Predict the long-term impact of the project on groundwater quality post closure and rehabilitation.
- Evaluate the effect that silt removal and footprint rehabilitation would have on groundwater quality.
- Develop a groundwater monitoring program, based on the outcome of the impact prediction study.
- Develop a groundwater management program geared at reducing the impacts on groundwater quality identified.

7.1.2 Model Construction

The numerical modelling was undertaken according to accepted industry principles and standards, including the South African Department of Water and Sanitation's Best Practice Guideline for Impact Prediction (DWS BPG G4, 2008).

The numerical model for the project was constructed using MODFLOW and MT3DS. MODFLOW is a modular three-dimensional groundwater flow model and MT3DS a modular three-dimensional solute transport model published by the United States Geological Survey. MODFLOW and MT3DS use finite difference discretization and flow codes to solve the governing equations. MODFLOW and MT3DS are widely used simulation codes, which are well documented. MODFLOW is used to simulate

groundwater flow rate and direction. MT3DS is superimposed on the MODFLOW simulation results and is used to predict the rate and direction of contaminant movement in the aquifers.

To accommodate the large area over which simulations will be undertaken, the model area was refined into block cells of 50 m by 50 m (Figure 18).

The positions where rivers and streams exit the model area were simulated as a constant head and general head boundaries. The northern, eastern and southern model boundaries were included as no-flow boundaries.

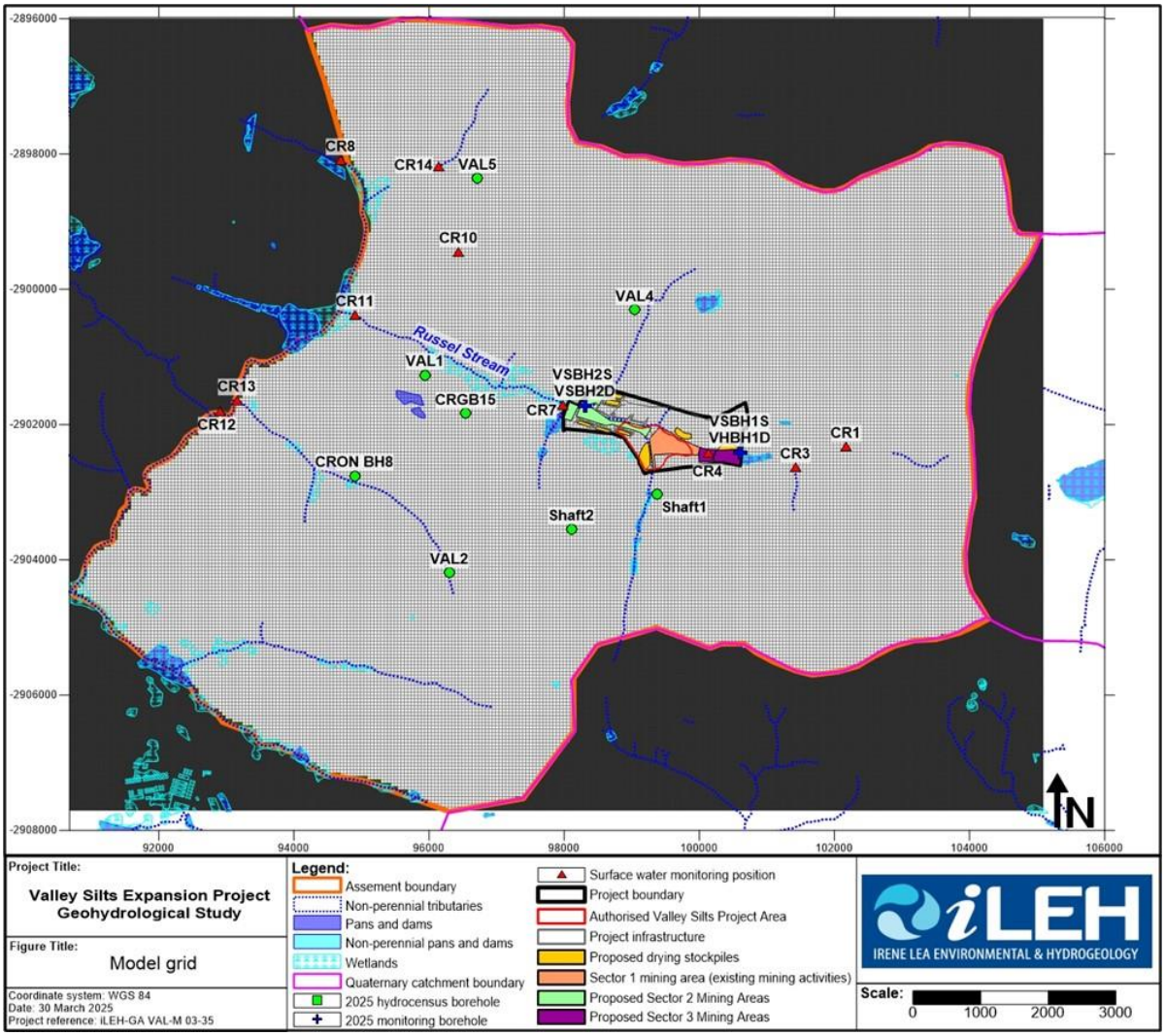


Figure 18. Model grid

Perennial rivers, streams and wetlands inside the model boundary were simulated with discrete cells.

Two layers were included in the model. The upper layer presents the upper weathered aquifer. This layer is included to facilitate a more accurate simulation of the wetlands, rivers and streams included in the model. The second layer represents the Witwatersrand formations, which are considered aquitards to a large extent. The upper layer was simulated as an unconfined aquifer. The second layer was allowed to vary between confined and unconfined conditions, depending on water level fluctuations.

All units used during simulations were presented in metres (length) and days (time).

7.1.3 Groundwater Elevation and Gradient

The 2025 measured groundwater water levels in hydrocensus boreholes were used to calibrate the model for this assessment. The groundwater elevations and gradient for this dataset were discussed in Section 6.7.

It is noted that some of the groundwater level measurements in the dataset do not reflect rest groundwater levels, especially the levels for the four new boreholes. These groundwater levels are rather a reflection of the slow recovery of groundwater levels post drilling due to low aquifer permeabilities.

7.2 Model Input Files and Integration

The conceptual model discussed in Chapter 6 was used to construct the numerical model for the project area. The conceptual aquifer parameters were gradually adjusted during calibration, as discussed below, to obtain the best fit for the dataset.

The geometry of the numerical model is based on the conceptualisation of the aquifers and on the regional geological. The geological formations are included as discrete zones in the model.

The topographical surface was interpolated from the Digital Terrain Model (DTM) (i.e. the surface topography) and incorporated into the model to ensure that the elevations of the drains used to simulate the streams reflect the topography.

The top of the upper layer of the model was simulated with the surface contours for the project, which was obtained from the DTM for the catchment.

The initial water levels in the model layers of the model were kriged from available information.

During contaminant transport modelling it was assumed that horizontal and vertical transverse dispersivity is 0.01. The effective molecular diffusion coefficient is 8,64E-5 m^2/d and that the longitudinal dispersivity is 90 m. The latter was calculated using the empirical equation developed by Neuman (1990) for an average travel distance of 1000 m.

No chemical reaction was taken into consideration during simulations.

The timelines considered during modelling are presented in Table 13. Detailed information is not available to accurately reflect historical tailings deposition and reclamation. Some of the dates are therefore assumptions.

Table 13. Assumed timeline used during simulations

Stress Period	Dates	Length (years)	Description of activities
1	1900 - 2021	121	Historical deposition of tailings and sediments in the stream
2	2022 - 2025	3	Sector 1 of reclamation currently underway
3	2026 - 2029	3	Sectors 2 and 3 of the Valley Silts Expansion Project
4	2030 - 2031	2	Rehabilitation period
5	2032 - 2132	100	Simulation period to evaluate long-term impacts

7.3 Source Term

7.3.1 Seepage Quality

The seepage quality associated with the project was inferred from groundwater quality measured on site during 2025. As discussed earlier, the groundwater quality reflects the impact of historical tailings deposition in the Russell Stream. Removal of the tailings and silt material is expected to improve groundwater quality in the long-term. The extent to which this will occur will be assessed as part of this project. Seepage qualities for the indicator elements are presented in Table 14.

Table 14. Source term: Leachate quality

	Sulphate concentration (mg/L)	Iron concentration (mg/L)
On-site range (VSBH1D and D data)	2400 - 3200	300 - 440
Surrounding historical TSF range (VAL1 and VAL2 data)	1200 - 1400	12 - 18

It is noted that in the 2019 assessment, the assumed source term included a sulphate concentration of 3500 mg/L and iron concentration of 350 mg/L for historical impacts, which is comparable to the 2025 measured data.

7.3.2 Operational Seepage Volume

The volume of leachate available for infiltration was calculated from experience with similar projects as well as the work completed in 2019 (Groundwater Abstract, 2019). The information is presented as a percentage of the mean annual precipitation.

Table 15. Source term: Leachate volume

Scenario	Estimated seepage volume (% of MAP)
Best case (dry conditions)	0,1%
Likely case (average conditions)	1%
Worst case (wet conditions)	2%

7.4 Potential Pathways and Receptors

Based on the available dataset, the following aquifer pathways are identified for the project:

- Vertical flow through the unsaturated soil horizon from the silt reclamation areas to the underlying weathered and fractured rock aquifers.
- Vertical and horizontal flow through the weathered aquifer over the silt reclamation areas.
- It is noted that the formations of the Witwatersrand Supergroup are considered to be poor aquifers or aquitards. Groundwater is expected to flow slowly though these formations.

The following receptors were identified:

- Boreholes identified during the hydrocensus. None of these boreholes are however located downstream of the project area.
- The Russell Stream. Groundwater is expected to contribute to stream baseflow, specifically during the wet season when groundwater levels are expected to rise above the base of the streams because of the recharge of rainwater.

- The wetlands associated with the Russell Stream. Shallow groundwater is expected to contribute to the maintenance of these wetlands, especially during the dry season, when river water levels may be lowered.

The potential pathways and receptors are summarised in Table 16.

Table 16. Pathways and receptors

Pathways	Receptors
Runoff	Boreholes identified during the hydrocensus
Seepage	Russell Stream
Fractures, faults, joints and bedding planes in the upper fractured rock aquifer	Wetlands associated with the Russell Stream

7.5 Calibration Results

Calibration of a numerical model refers to the demonstration that the model is capable of reproducing field-measured data, which are the calibration values. Calibration is achieved when a set of parameters, boundary conditions, source terms and stresses are found that produce simulated heads and concentrations that match field measured data within the calibration criteria set for the project. This is an important step in the modelling project, which ensures that model results are reliable.

Calibration was completed with groundwater level measurements in boreholes visited during the 2025 hydrocensus as well as rest groundwater levels from site measurements. The calibration criteria set for the project are presented in Table 17.

Table 17. Calibration criteria

Requirement	Acceptability criteria	Compliance
Model convergence	Maximum change in head of 0,001 m	Complied with (see discussion below)
Water balance	Difference between inflow and outflow <1%	Complied with (see discussion below)
Root Mean Square Error	<5 m for targets	Complied with (see discussion below)
Calibration error	80% of targets with <5 m error between simulated and measured head	Complied with (see discussion below)

The results of the calibration process are presented in Table 18 and Figure 19. It is shown that the calibration error (the difference between measured and simulated head) is less than 5 m for all but two data points.

The root mean square error, which provides an indication of the goodness of fit during calibration, is 3.97 m, which is within the acceptable criterial limit of 5 m. The sum of the residuals is 8.44 m, which means that the model doesn't over or under-estimate groundwater levels preferentially.

The water balance error calculated with the numerical model is -0.43%, which also complies with the acceptable calibration criteria set.

Factors that influence the calibration process and results include the following:

- Errors in the coordinates and elevations recorded for the boreholes. The coordinates used were recorded with a hand-held GPS.

- The absence of borehole logs with which to characterise the aquifer conditions that groundwater levels in hydrocensus boreholes represent.
- A lack of understanding the mechanisms that affect water levels in the shaft included.
- As mentioned earlier in this report, the modelling code assumes a continuous porous medium, which means that the aquifers are simulated using average parameters. This does not allow for local variations in permeability that affects groundwater levels in the aquifers. Discrete zones were however included to represent the mapped faults.

Model calibration can be improved once additional monitoring information becomes available from the proposed monitoring program. Model-recalibration and verification can be undertaken with this data. Groundwater monitoring requirements are discussed later in this report.

Table 18. Calibration results

BH ID	Simulated	Measured	Residual
VAL1	1660,746	1661,7	-0,954
CRGB15	1669,443	1672,1	-2,657
VAL2	1697,945	1691,9	6,045
CRONBH8	1665,491	1661,8	3,691
VAL4	1691,613	1685,1	6,513
SHAFT1	1670,653	1673,5	-2,847
VSHBH1	1673,247	1674,6	-1,353

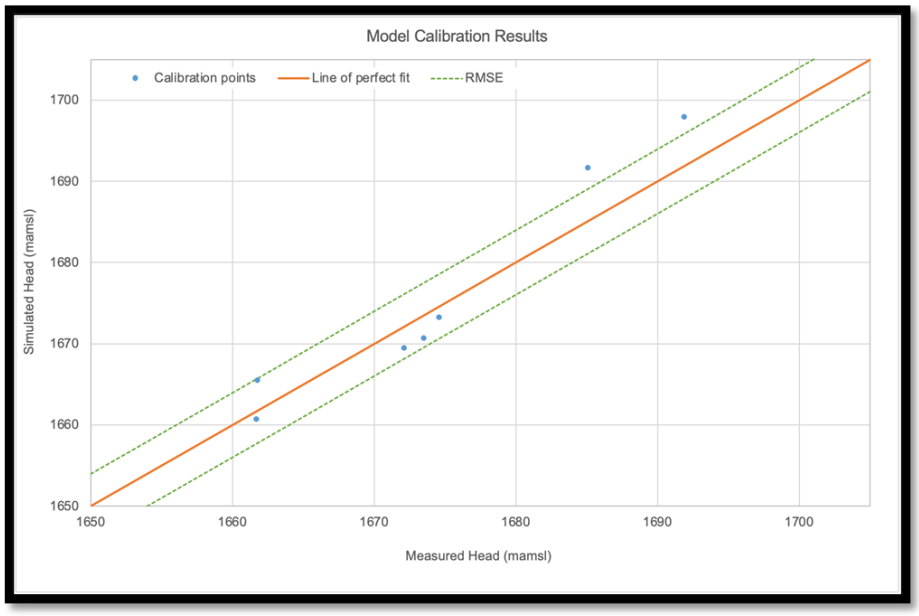


Figure 19. Calibration results

7.6 Model Sensitivity

A sensitivity analysis was completed on the model. The purpose of the sensitivity analysis is to quantify the uncertainty in the calibrated model caused by uncertainty in the estimates of aquifer parameters, stresses and boundary conditions. The level of heterogeneity of the aquifer material can never be accurately measured with field data. The uncertainty of the impact of heterogeneity on simulations is therefore assessed as part of the sensitivity analysis.

The results of a sensitivity analysis can be used to identify data gaps and to plan for additional fieldwork, including monitoring requirements, once the modelling has been completed.

The comparative sensitivity for the parameters included during calibration is presented in Figure 20. The comparative sensitivity provides an indication of how sensitive the model is to changes in each parameter, compared to the other parameters tested. A low value indicates a low sensitivity and a high value a high sensitivity. The results indicate the following:

- The model is sensitive to changes in the rate of recharge to the aquifers and the permeability of the weathered aquifer (Witswatersrand formations).

As discussed in the calibration section above, model sensitivity can be addressed through additional calibration with groundwater monitoring data that will become available from the operations once the monitoring programme is implemented.

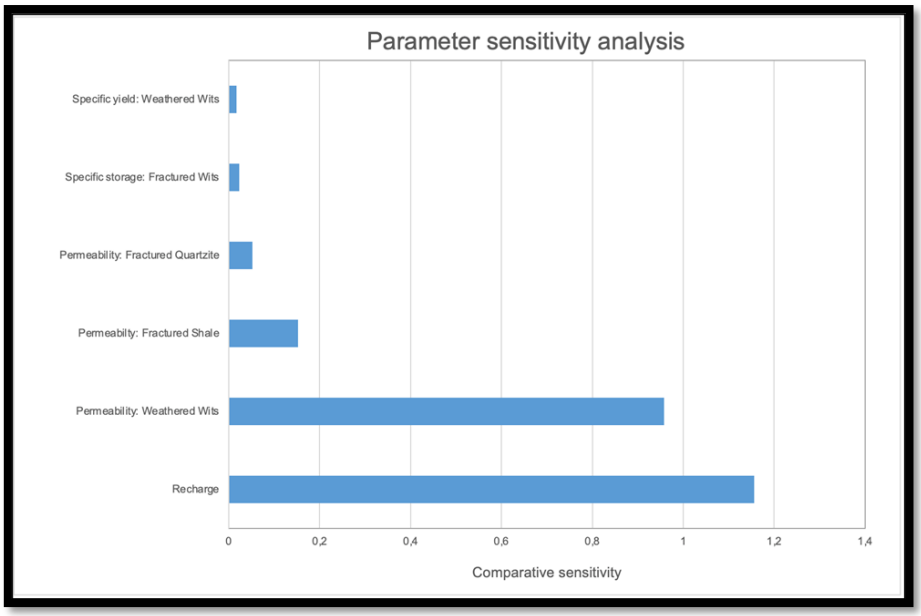


Figure 20. Sensitivity analysis

7.7 Assessment of Uncertainties

The accuracy of the modelling project depends on the quality of the input data and the available information. Even with an unchanging environment, impacts are difficult to predict with absolute certainty. Predictions were undertaken with the calibrated flow model, which is a simplified version of reality. The model represents a tool that can be used to assess the impact of the proposed silt reclamation activities on the aquifers and to identify data gaps. The calibration error is discussed above and is acceptable within the limitations of the study. The model should be updated and verified with site-specific monitoring information, when it becomes available. Calibration against hydrographs (groundwater level fluctuation with time) and on-site rainfall data will be of specific value in improving the current understanding of aquifer parameters. Uncertainties are approached conservatively, based on the precautionary principle, to ensure that the predictions and impact assessment in this report addresses the maximum potential impact of the proposed development. The uncertainties in the model include:

- Uncertainties regarding aquifer conditions within the project area: The field data that could be used during model calibration is limited to the four boreholes on site. Regional aquifer conditions were assumed based on previous studies completed in the area. This introduces uncertainty into the modelling results. To address this uncertainty, three scenarios were tested to evaluate the impact of a varying source term on predicted outcome.
- Uncertainties regarding borehole depth, construction and geology intersected: This information is not available for the hydrocensus boreholes. For this reason, it was assumed that all hydrocensus boreholes target the fractured rock aquifer.
- Uncertainties regarding the borehole elevations: The elevations used during simulations were inferred from hand-held GPS measurements and inaccuracies may occur. It is however thought that the error in elevation will not exceed the calibration error of 5 m.
- Mathematical modelling uncertainties: It is not possible with the available information to quantify the heterogeneity present in the aquifers simulated. For this reason, there are inherent uncertainties in the model. The level of confidence in the model can be improved with the incorporation of additional monitoring data.

The uncertainties listed above can be reduced or eliminated through the implementation of the groundwater monitoring program at the Valley Silts Project and surrounding areas. This information can be used to improve aquifer parameter estimation and model calibration.

8 HYDROGEOLOGICAL IMPACTS

8.1 PREAMBLE

There are positive and negative impacts reported for tailings reclamation. Lieferink (2012) provides the following positive impacts related to water resources, for this process:

- Removal will partially remove one of the sources of water pollution and ingress.
- Removal will expose the natural soil layer, allowing vegetation growth after rehabilitation.
- Significant long-term benefits, provided that the footprint is adequately rehabilitated and remediated.

Conversely, Lieferink (2012) reports that negative impacts will also manifest. From a water management perspective, the following is applicable:

- Not completing the reclamation of the project, thus leaving a portion of the source of contamination behind.
- Selective extraction of value from portions of a site and not rehabilitating the full extent of the footprint.
- Elevated levels of residual radioactivity in the soils, restricting reuse.
- Introduction of large volumes of water and oxygen into anaerobic tailings which exacerbates pollution. The process of reclamation therefore imposes a greater duty of care.

The Valley Silts Project is positioned on outcrops of quartzite and shale of the Witwatersrand Supergroup. Aquifers associated with these formations are generally considered aquitards which exhibit low permeabilities and are therefore a low-yielding aquifers.

The source term presented earlier in this report and the assumed project timeline presented in Table 13 and Table 15, were applied during simulations.

The extent of silt deposited in the Russell Stream was inferred from the work completed during the 2019 study. Some silt deposits will remain further west along the flow of the stream. These were included during simulations. Impacts are however not related to Valley Silts Project.

Similarly, the historical TSFs located around the project area were included during simulations, based on monitoring data from two hydrocensus boreholes immediately downgradient of these facilities (VAL1 and VAL2). It is assumed that these facilities are fairly dry as they have been dormant for an extensive period. Water balance calculations are not available for these TSFs.

The outcome of the simulations is presented as sulphate and iron concentration contour maps that delineate the anticipated plumes for three scenarios to be tested. These include:

- **Best case scenario**: Low seepage infiltration from the project to the underlying aquifers, equivalent to dry conditions.
- **Likely case scenario**: Moderate seepage infiltration rates to the underlying aquifers, equivalent to average conditions.
- **No Project scenario**: This is considered the worst case and assumes that the silts will remain in the Russell Stream floodplain.

The assessment was undertaken to evaluate impacts at the end of the operational phase as well as long-term impacts of a period 100 years after rehabilitation is completed.

The plumes presented below represent aquifer conditions in the upper 80 m of the geological succession. Most significant impacts on groundwater quality are however expected in the upper weathered aquifer. The extent of the plumes is based on the SAN241:2015 Drinking Water Qualities as detailed in Table 19.

Table 19. Applicable In-stream Water Quality Guidelines for the project

Sulphate range (mg/L)	Effects
Sulphate	
500	Used to delineate the zone of impact on groundwater quality
1000	Used to delineate the zone of unacceptable impact on groundwater quality
Iron	
1	Used to delineate the zone of impact on groundwater quality
10	Used to delineate the lower limit of the unacceptable impact on groundwater quality
100	Used to delineate the zone of unacceptable impact on groundwater quality

8.2 Rehabilitation Measures Considered

During the rehabilitation phase of the project, it was assumed that all tailings and silt will be removed, that the soil will be shaped to create a free-draining surface, and that all radiation will be removed. It is noted that this rehabilitation scenario will not reverse the cumulative impact of historical tailings deposition. For this reason, a residual impact will remain post-closure of the project in the long-term.

The rehabilitation will be completed down to a red earth footprint. As mentioned above, the area will be shaped for correct storm water management. During this phase, all project infrastructure will be removed, and a final radiological survey will be undertaken. Thereafter the property will be handed over to the landowner.

8.3 General Outcome for All Scenarios

The overall outcome of the simulations is summarised as follows:

- The cumulative impact of all historical TSFs located around the project area was included during simulations. These areas are included based on monitoring data from hydrocensus boreholes downgradient of two of these TSFs. Since these are likely dry as they are dormant, long-term impacts on groundwater quality associated with these could reduce. It is further noted that these TSFs are downgradient of the Valley Silts Expansion Project and are therefore not expected to directly impact on long-term water quality associated with the project.
- Also included is silt material present in the Russell Stream further downgradient and west of the Valley Silts Expansion Project. The extent of this material is inferred from information made available as part of the 2019 assessment. As this material will remain in the stream for now, it impacts on groundwater quality in this area will continue in future. This area is downgradient of the Valley Silts Project and will therefore not impact on long-term groundwater quality associated with the project.
- Only two of the boreholes and shafts identified during the 2025 hydrocensus are downgradient of the project, namely CRGB15 and VAL1. Borehole CRGB15 is downgradient of a historical TSF. For this reason, impacts on this borehole cannot be attributed to the Valley Silts Project. Borehole VAL1 is located approximately 2 km west of the Valley Silts Project, further along the flow of the Russell Stream. This borehole is located near the area where silts are likely to remain in the stream in future and is also downgradient of a historical TSF. Based on this it is concluded that groundwater is not currently used in the zone of impact associated with the Valley Silts Project.
- The project footprint is located on outcrops of Turffontein quartzite, Johannesburg quartzite and Booysens shale. Fieldwork completed during 2025 confirms that the aquifers associated with the shale and the Johannesburg quartzite have low permeabilities and recharge rates. As such, the sulphate and iron plumes associated with the project migrate very slowly in the aquifers. The advantage of this outcome is that contamination associated with the project is not likely to move more than a few hundred meters from the reclamation areas in the long-term.
- The disadvantage of the poorly developed aquifer conditions identified is that historical contamination will not be flushed in the long-term but will remain within the footprint area to a large extent. Removal of the silt material as part of the project is therefore likely to reduce the concentrations of contaminants but will not significantly do so. In addition to a reduction in concentration, the extent of the zone of impact on groundwater quality will reduce in the long-term after removal of the silt material from the stream.
- Groundwater plumes are expected to move towards the Russell Stream on a local scale, but regionally in a westerly directly, but slowly.
- The volumes of contaminated groundwater that may reach the wetlands downgradient in the Russell Stream cannot be accurately assessed based on one dataset alone. It is however expected to be low, probably not exceeding 20 m^3/a.
- Most significant impacts on groundwater quality, as delineated by the simulated zones of unacceptable long-term impacts and zones of acceptable operational impacts are mainly restricted to the Valley Silts Project footprint areas. The zones of unacceptable impact are indicated by thick red lines at concentrations exceeding 1000 mg/L for sulphate and exceeding 10 mg/L for iron.

- The extent of the iron plume is larger compared to that of sulphate. This is because lower concentration standards are imposed on iron compared to sulphate.

8.4 Impact Prediction

8.4.1 Impact at the End of the Operational Phase

The impact of silt reclamation from the stream at the end of the operational phase is presented for iron and sulphate (Figure 21 and Figure 22). The simulations indicate the following:

- Due to the short duration of the project, the outcome of the operational impact on groundwater quality is mainly due to the impact of historical tailings deposition in the stream.
- Based on the current dataset, it is expected that sulphate concentrations would exceed 2000mg/L and iron concentrations would exceed 200 mg/L over the project footprint area at the end of the operational phase. The groundwater is currently not fit for use.
- The zone of impact on groundwater quality is not expected to significantly exceed the project boundary at the end of the operational phase. It is possible that the plumes can migrate a hundred meters west along the flow of the Russell Stream.
- No private boreholes fall within the delineated zone of impact of the Valley Silts Expension Project.

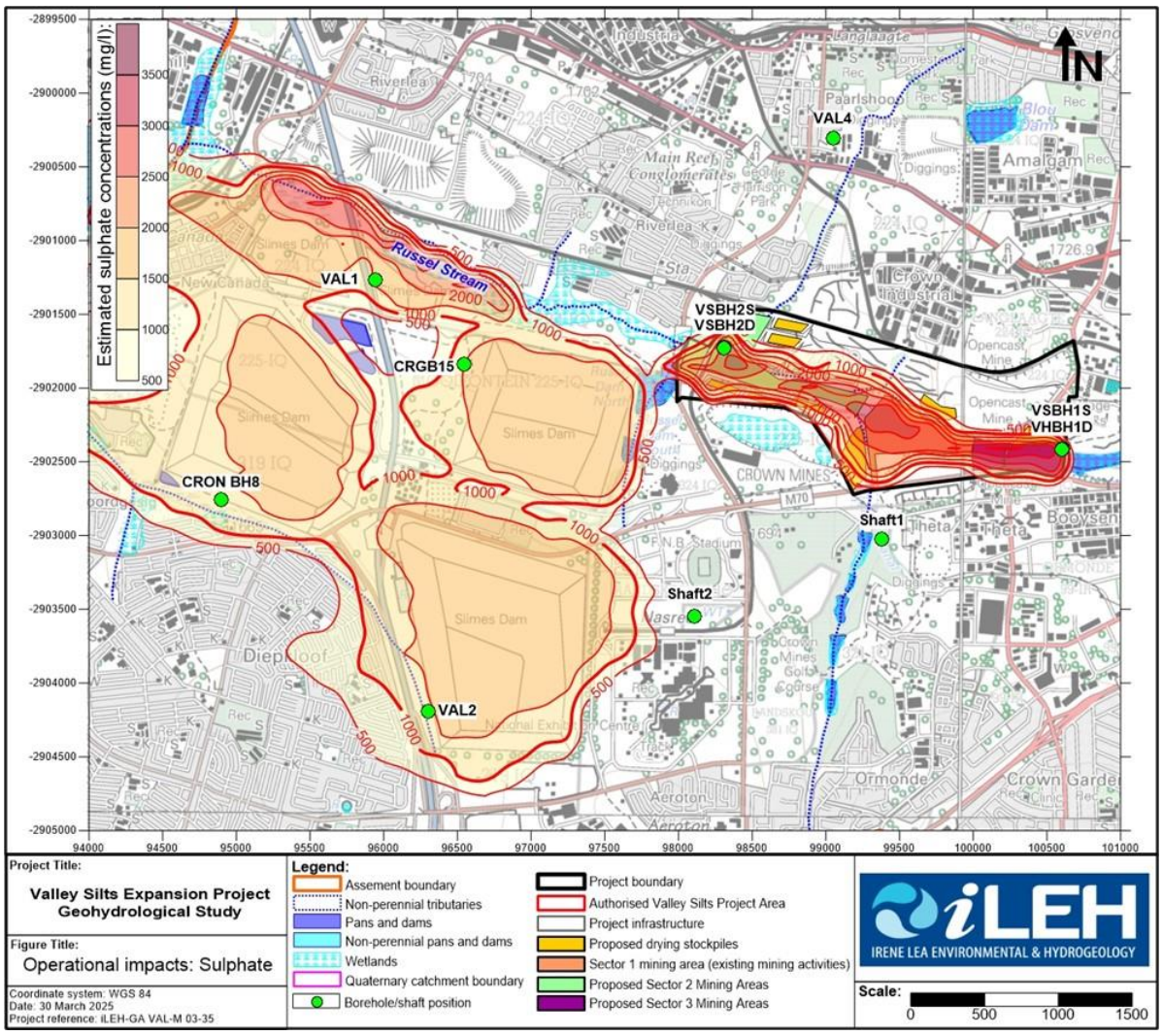


Figure 21. Likely zone of impact on groundwater quality for SO_4: operational phase

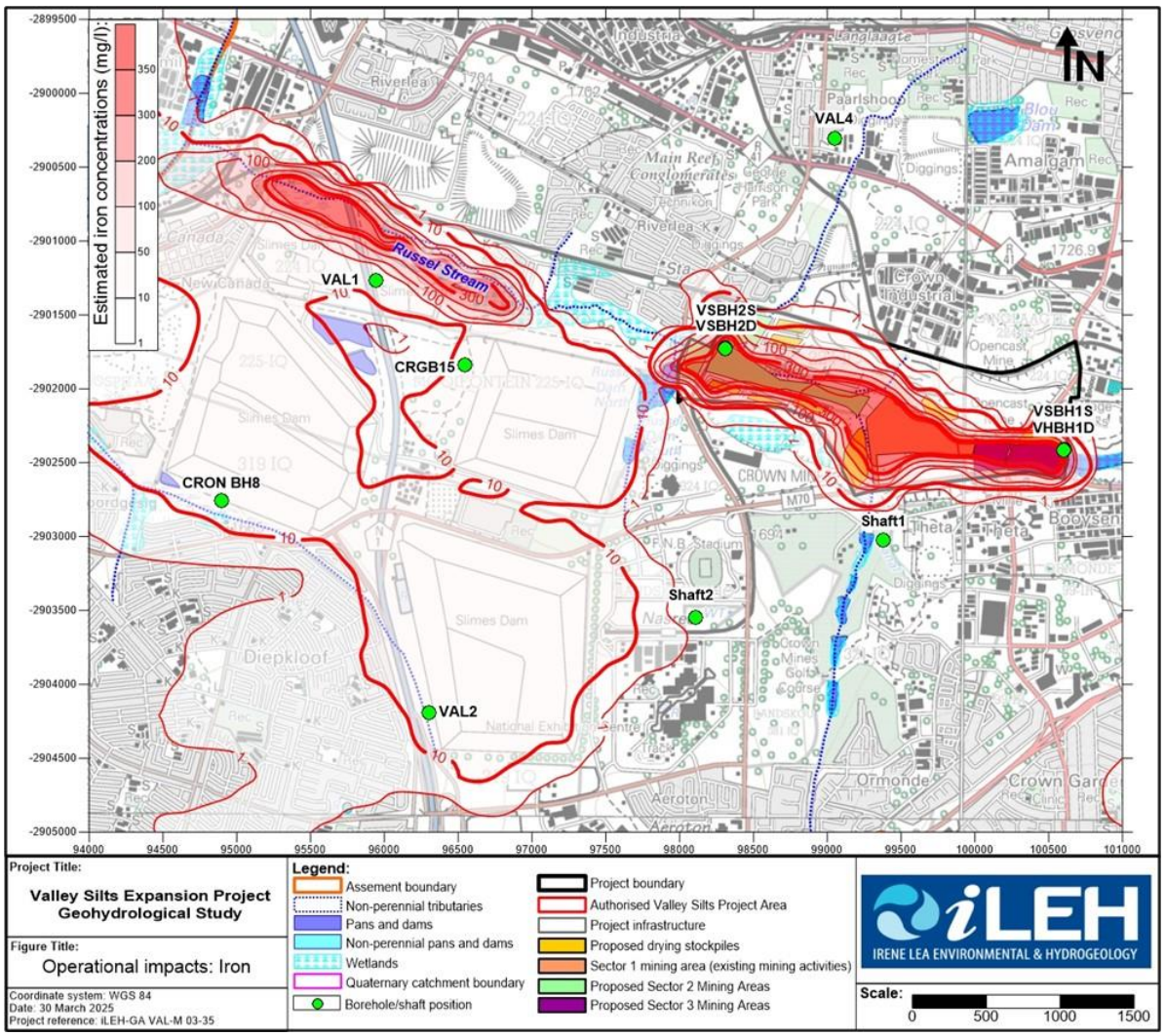


Figure 22. Likely zone of impact on groundwater quality for Fe: operational phase

8.4.2 LIKELY LONG-TERM SCENARIO

The likely outcome of the removal of silts from the Russell Stream in terms of groundwater quality is presented in Figure 23 and Figure 24. The following is concluded from the impact predictions completed:

- Sulphate concentrations are expected to reduce to below 1000 mg/L over large portions of the footprint. It is possible that pockets in the aquifer may have concentrations exceeding 1000 mg/L, but not significantly so. These zones where sulphate exceeds 1000 mg/L will remain inside the project footprint area in the long-term.
- In addition, the extent of the zone of impact is expected to reduce to within the project footprint.
- Iron concentrations are also expected to reduce significantly within the project area. It is anticipated that iron concentrations would reduce to below 100 mg/L over most of the project area, but as with sulphate, pockets may remain where concentrations exceed 100 mg/L, but not significantly so. While this will be a significant reduction in iron concentrations, long-term impacts over the project footprint will continue to pose a risk that could result in acute or

chronic health impacts. The groundwater within the project area will therefore remain unfit for use. The positive outcome of the project is however a significant reduction in concentrations and a reduction in the extent of the zone of unacceptable impacts.

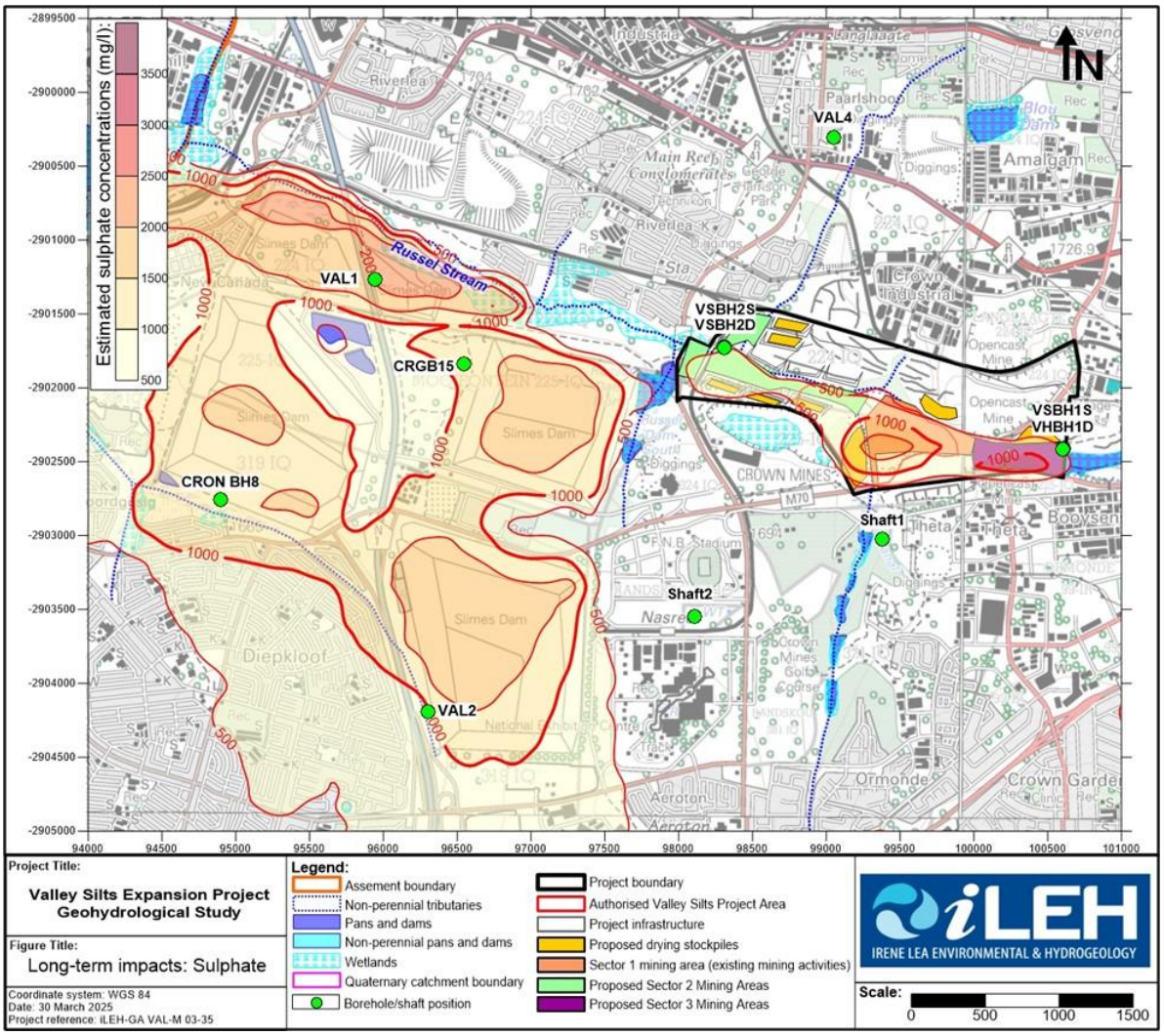


Figure 23. Likely long-term zone of impact on groundwater quality: SO_4

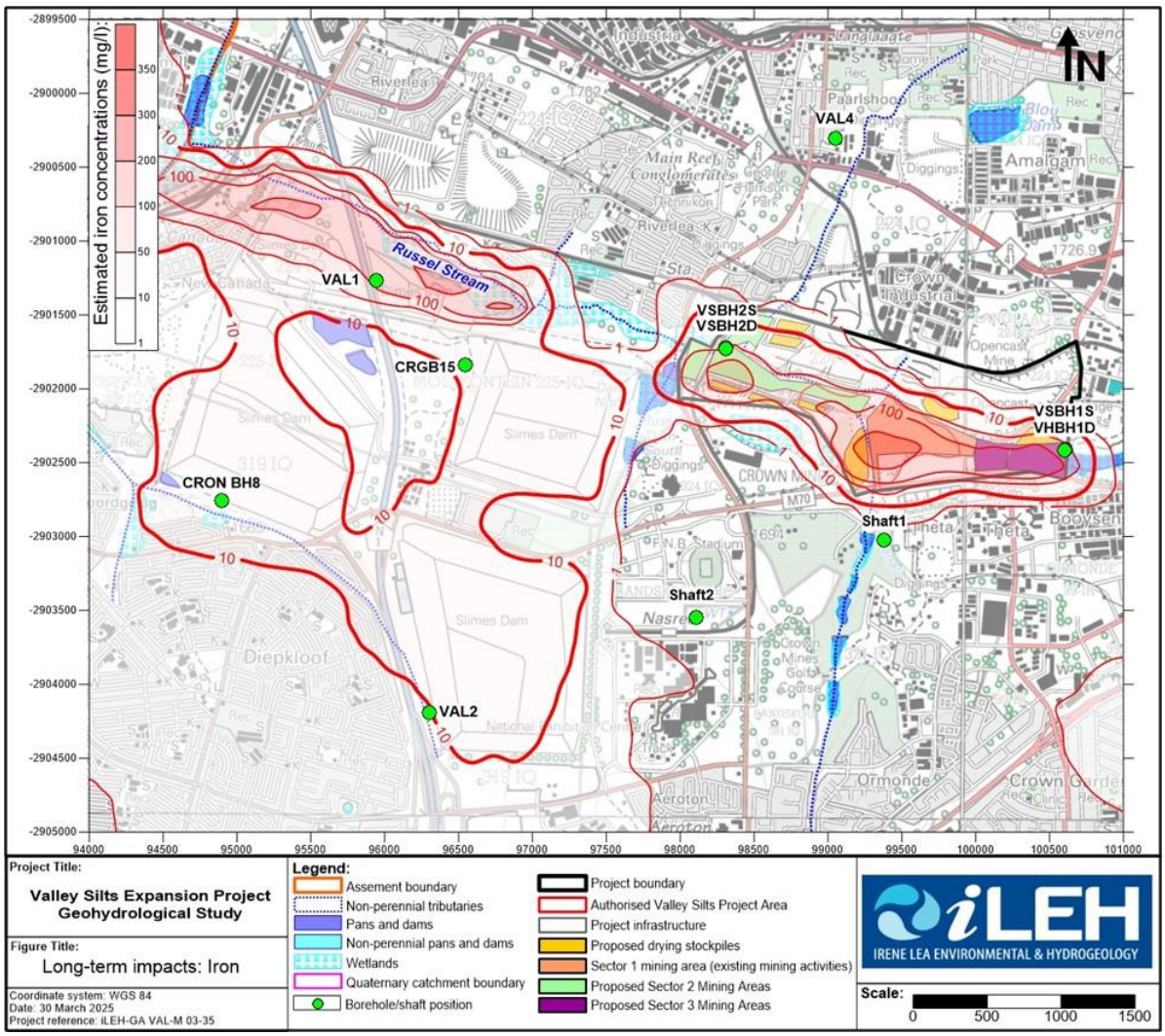


Figure 24. Likely long-term zone of impact on groundwater quality: Fe

8.5 Cumulative Impacts

The anticipated cumulative impact of regional tailings deposition is considered for all scenarios presented above. To achieve this, the assumptions discussed above were used to simulate the historical TSFs in the project sub-catchment and silt material that will remain in the Russell Stream. During long-term simulations, it was assumed that these facilities will remain in-situ.

It is noted that these areas are all downgradient of the project area and will therefore not impact on groundwater quality associated with the project.

8.6 Scenario Analysis for Long-term Impacts

To evaluate project alternatives, a scenario analysis was completed for long-term impacts on groundwater quality. The outcome of these is presented in Figure 25 and Figure 26.

The following scenarios were evaluated as part of the assessment, as mentioned earlier:

- **Best case scenario**: Low seepage infiltration from the project to the underlying aquifers, equivalent to dry conditions.

- **Likely case scenario**: Moderate seepage infiltration rates to the underlying aquifers, equivalent to average conditions.
- **No Project scenario**: This is considered the worst case and assumes that the silts will remain in the Russell Stream floodplain.

The outcome of the assessment for both sulphate and iron is summarised as follows:

- Impacts associated with the best case and likely scenarios are expected to be very similar in terms of impacts on groundwater quality. These two cases relate to how water is managed on site during the operational phase and the extent to which infiltration of dirty water takes place. Since the aquifer permeability within the project area is low, water management options during the comparatively short operational period are not likely to result in significant long-term effects. Despite this, it is recommended that clean and dirty water management measures, as indicted in Kongiwe (2025) are strictly adhered to. All measures must be taken to divert clean runoff and contain dirty water inside the dedicated paddocks. Dirty water must be reused during reclamation to avoid ponding over extended periods of time.
- If the Valley Silts Expansion Project is not implemented, current impacts on groundwater quality are expected to continue in the long-term. This is expected to increase sulphate and iron concentrations within the unacceptable levels over the footprint area as well as downstream in the Russell Stream. The extent of the zone of impact on groundwater quality is therefore expected to increase with time. The outcome of this scenario will result in long-term negative impacts on groundwater quality and should therefore be avoided. Removal of the silt material from the streambed will reduce long-term impacts, as discussed above.

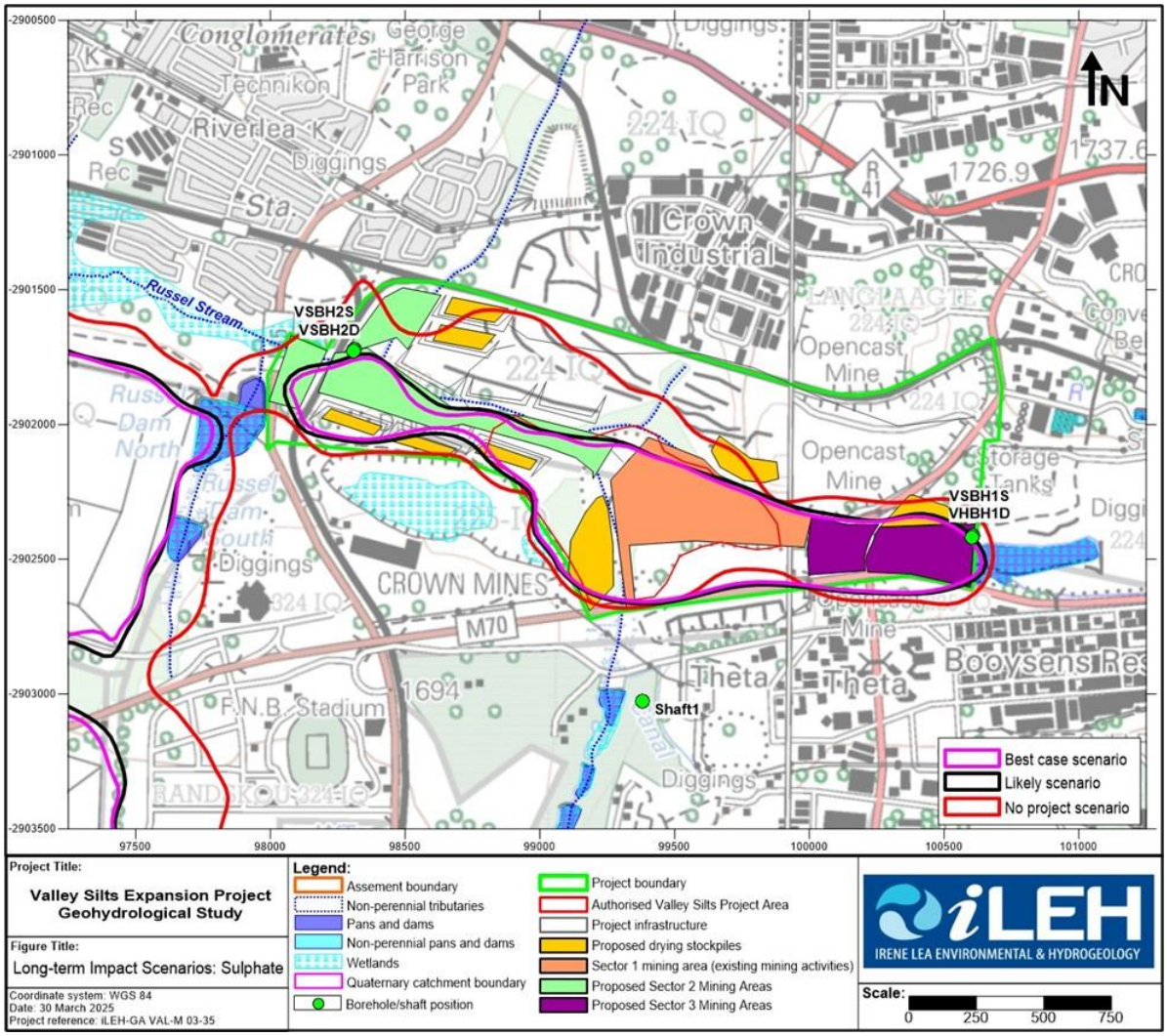


Figure 25. Scenario analysis for long-term impacts: SO_4

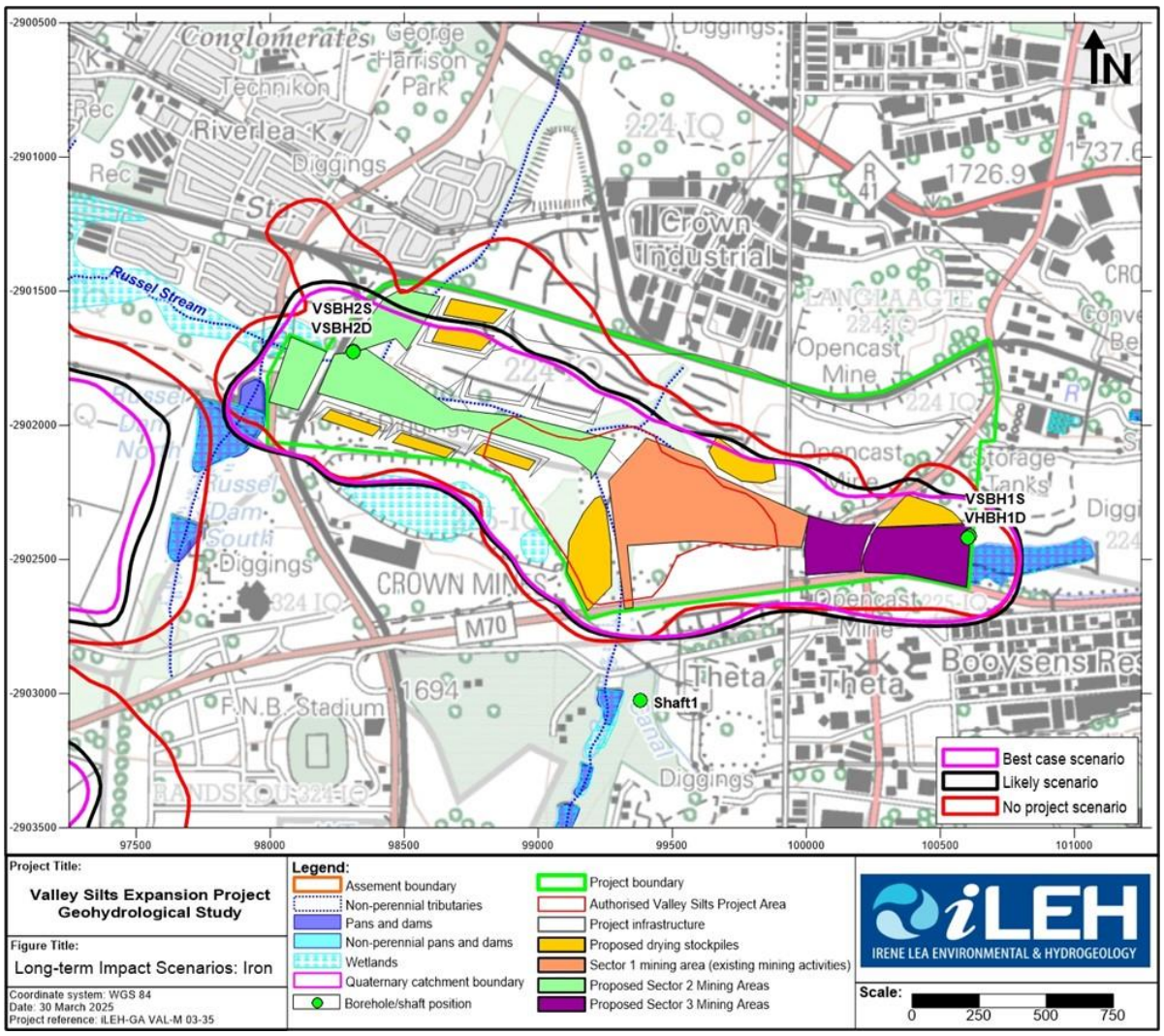


Figure 26. Scenario analysis for long-term impacts: Fe

8.7 Risk of Decant

No risk of decant was flagged for this project.

8.8 Post Closure Management

8.8.1 Remediation of Physical Activity

The preferred remediation strategy for the Valley Silts Expansion Project is to remove all silt material down to red soil. Once the footprint has been cleared, it must be rehabilitated and made free draining. Please refer to Section 8.2 for additional rehabilitation measures.

8.8.2 Remediation of Storage Facilities

Not applicable.

8.8.3 Remediation of Environmental Impacts

As discussed above.

8.8.4 Remediation of Water Resources Impacts

Not applicable.

8.8.5 Backfilling of Pits

Not applicable.

9 Groundwater Impact Assessment

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impact significance rating system is presented in Table 20, Table 21 and Table 22 and involves three parts:

1. **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/ population and duration.
2. **Part B**: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A.
3. **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from Part B) and the probability of occurrence.

9.1 Part A: Defining Consequence in Terms of Magnitude, Duration and Spatial Scale

The definitions in Table 20 are used to define the consequence in Part B.

Table 20. Consequence rating methodology

IMPACT CHARACTERISTICS	DEFINITION	CRITERIA
Magnitude	Major -	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate -	Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor -	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded
	Minor +	Minor improvement; change not measurable; or threshold never exceeded
	Moderate +	Moderate improvement; within or better than the threshold; or no observed reaction

IMPACT CHARACTERISTICS	DEFINITION	CRITERIA
	Major +	Substantial improvement; within or better than the threshold; or favourable publicity
Spatial scale or population	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral, catchment, topographic
	National/ International	Nationally or beyond
Duration	Short term	Up to 18 months
	Medium term	18 months to 5 years
	Long term	Longer than 5 years

9.2 Part B: Determining Consequence Rating

Rate consequence based on definition of magnitude, spatial extent and duration (Table 21).

Table 21. Consequence rating methodology

			SPATIAL SCALE/ POPULATION		
			Site or Local	**Regional**	**National/ international**
MAGNITUDE					
Minor	**DURATION**	**Long term**	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	**DURATION**	**Long term**	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium
Major	**DURATION**	**Long term**	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

9.3 Part C: Determining Significance Rating

Rate significance based on consequence and probability (Table 22).

Table 22. Significance rating methodology

Probability (of exposure to impacts)	Consequence Negative			Consequence Positive		
	Low	Medium	High	Low	Medium	High
Definite	Medium	Medium	High	Medium	Medium	High
Possible	Low	Medium	High	Low	Medium	High
Unlikely	Low	Low	Medium	Low	Low	Medium

The impact assessment is based on the Kongiwe assessment methodology as presented above. A detailed impact assessment table with mitigation measures is presented in Appendix E and groundwater management and mitigation options are presented in Chapter 11.

The lack of long-term groundwater monitoring data close to the Russell Stream and detailed geochemistry information for the area makes it difficult to quantify the impacts associated with the desilting activities as there are currently no users or monitoring sites to measure against. The sampled surface and groundwater indicate quality impacts, but due to dilution and precipitation the quality impacts seem to reduce further away from the slimes dams and sand dumps.

Based on the impact ratings the highest negative risks are associated with the operational phase, where salt and metal seepage from the stockpile and excavated areas could lead to groundwater quality impacts. This could increase the salt load and sulphate concentrations within the groundwater environment.

There is currently not enough groundwater data available for the Valley Silts Project area, especially along the Russell Stream to quantify the current impacts of the silt in the riverbed on the underlying groundwater environment. Excavation of the silts will trigger oxidation reactions, and the pH will drop, linked to leaching of salts and metals. In the long term, the excavation of the silt will have a positive impact on the groundwater environment, but only if surface and groundwater discharge from the slimes dams and sand dumps along the Russell Stream is effectively managed and kept out of the Russell Stream.

9.4 Construction Phase

During the construction phase, the sediments and silt in the area, earmarked for excavation, will be disturbed. The introduction of oxygen during this phase of the project is expected to result in a deterioration in groundwater quality. Due to the short duration of the construction phase, this impact is not expected to have an additional negative impact in terms of salt and heavy metal concentration increases, nor be laterally extensive.

No additional impact is expected on the groundwater quantity and quality during the construction phase. Construction will be conducted in a relatively short period compared to the operational and post-closure phases. Impacts on the groundwater environment are therefore rated as Low (Table 23).

Table 23. Construction Phase water quality impacts

NATURE OF IMPACT 1: **Impact on the local groundwater quality**		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Impact Status: (positive or negative)	Negative	Negative
Extent *(Local, Regional, International)*	Local	Local
Duration *(Short term, Medium term, Long term)*	Short term	Short term
Magnitude *(Major, Moderate, Minor)*	Minor -	Minor +
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating *(Low, Medium, High)*	**Low**	**Low**
Reversibility: (Reversible or Irreversible)	Reversable	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts ❖ The slimes dams and sand dumps along the Russell Stream are all potential sources of pollution and silt. In the current state of the stream (with silt) and after removal of the silt, these pollution sources next to the stream must be managed more effectively to ensure no contaminated silt, surface or groundwater enters the rehabilitated Russell Stream. Current water qualities indicate high salt and metal concentrations, with a low pH water found along the TSF footprint areas.		
Mitigation measures ❖ Implement a groundwater monitoring program before excavation starts. Use the dedicated groundwater monitoring boreholes along the Russell Stream to measure the groundwater status, impact of the activities on the groundwater environment and changes in groundwater qualities and levels post closure. Refer to Section 12.1. ❖ Develop sound surface runoff management plans to ensure that all dirty runoff from the stockpile areas, but also from the adjacent slimes dams and sand dumps are contained and diverted to the cut-off trenches and sumps. No pooling of water on surface allowed. ❖ Ensure that cut-off trenches and sumps are designed to contain all dirty water generated during the process, to prevent overflows and spillages.		

9.5 Operational Phase – Excavation / Desilting

The following impacts can be expected during the excavation process:

9.5.1 Groundwater Quality

Historically the sources of pollution associated with the Valley Silts Project area include:

- Contaminated storm water runoff from the slimes dams and sand dumps along the Russell Stream;
- Seepage water from the slimes dams and return water dams (RWD), possibly containing high sulphates and metals; and
- Recharge of contaminated water by means of seepage from the dumps and any unlined storm water channels.

Groundwater quality will be negatively affected with potential increase in salt loads, especially sulphate and iron concentrations during the excavation activities. The silt will potentially contain pyrite minerals and when exposed to oxygen and water during excavation it will result in the formation of acidic conditions. The risk of groundwater contamination during the excavation activities will be higher compared to the existing impacts, as chemical reactions and leaching from the silt will increase when exposed to oxygen and rainwater. Surface water management and containment guidelines must be followed carefully during the desilting process (Table 24).

The desilting activities will be driven by mechanical excavation. No water is used in the process, but water will be present along the stream channel.

The current understanding of the aquifers present and the potential sources to groundwater contamination suggests that the impact on groundwater quality during the operational phase will mainly be limited to the disturbed areas. Within the disturbed areas, both the simulated sulphate and iron concentrations are expected to exceed the Klip River catchment unacceptable water quality guidelines. This impact may extend several hundred metres from the excavations, depending on aquifer conditions.

The wetlands to the west of the Valley Silts Project may experience groundwater quality in terms of sulphate and iron concentrations that exceed tolerable interim target water qualities. In the long-term groundwater qualities are expected to improve to within acceptable management targets in this wetland. There is currently insufficient information available to estimate the salt load on this wetland because of contamination groundwater baseflow components.

Monitoring of groundwater quality and water levels must be implemented along and downgradient of the Russell Stream, with continuous review and updating of the monitoring network based on the monitoring results.

A cause for concern in reclaimed residue deposits is incomplete clean-up operations. Any remaining material, in particular sulphide minerals, poses an environmental hazard. It is important that a sound stormwater management plan is implemented during the operational phase to ensure that dirty footprints and runoff are contained.

In addition to the above, it is important that the necessary cut-off trenches and berms are put in place between the Valley Silts Project area and the historical TSF to avoid future wash of silts and slimes into the excavated and rehabilitated areas, thus compounding the project again.

Table 24. Operational Phase water quality impacts

NATURE OF IMPACT 2: **Impact on the local groundwater quality**		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Impact Status: (positive or negative)	Negative	Negative
Extent *(Local, Regional, International)*	Local	Local
Duration *(Short term, Medium term, Long term)*	Long term	Long term
Magnitude *(Major, Moderate, Minor)*	Major -	Moderate -
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating *(Low, Medium, High)*	**High**	**Medium**
Reversibility: (Reversible or Irreversible)	Reversable	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts ❖ Combined impact with other mining and industrial activities. Refer to Chapter 10.		
Mitigation measures ❖ Maintain sound surface runoff management to ensure that all dirty runoff is contained and diverted to the cut-off trenches and sumps. No pooling of water on surface allowed. ❖ Monitor groundwater quality in all boreholes listed in Section 12.1. The groundwater monitoring network efficiency must be assessed and new monitoring boreholes drilled, if required. ❖ Ensure that cut-off trenches with sumps can contain all dirty water generated during the desilting process to prevent overflows and spillages. ❖ Ensure that sufficient cutoff trenches and berms are implemented to avoid future wash of silt and slimes from the historical TSF situated adjacent to the Valley Silts project.		

9.5.2 GROUNDWATER QUANTITY

The Russell Stream desilting project will not have any significant impacts on the groundwater quantity (Table 25). The desilting activities will be driven by mechanical excavation. No water is used in the process. There is a possibility that water will seep into the underlaying formations, but the additional recharge should be negligible and should have no impact on the groundwater table elevation.

Table 25. Operational Phase water quantity impacts

NATURE OF IMPACT 3: **Reduction in aquifer yield**		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Impact Status: (positive or negative)	Positive	Positive
Extent *(Local, Regional, International)*	Local	Local
Duration *(Short term, Medium term, Long term)*	Long term	Long term
Magnitude *(Major, Moderate, Minor)*	Minor +	Minor +
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating *(Low, Medium, High)*	**Medium**	**Medium**
Reversibility: (Reversible or Irreversible)	Reversable	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts ❖ Combined impact with other mining and industrial activities. Refer to Chapter 10.		
Mitigation measures ❖ Monitor groundwater levels in all boreholes listed in Section 12.1.		

9.6 DECOMMISSIONING

9.6.1 GROUNDWATER QUALITY

Groundwater quality along the Russell Stream is expected to improve as the in-stream source of contamination will be removed (Table 26). Sulphate concentrations in the immediate vicinity of the stream may reduce to below 1000 mg/L because of silt removal. Iron concentrations are also expected to reduce significantly within the project area. It is anticipated that iron concentrations would reduce to below 100 mg/L over most of the project area. The zone of impact over which sulphate and iron concentrations would exceed unacceptable Klip River catchment water quality targets will reduce in the long-term. The contamination is however not expected to dissipate, but it is likely that sulphate and iron concentrations would reduce to within tolerable interim and even acceptable management water quality targets in the long-term. Historical groundwater contamination will most likely continue to move through the aquifers in a westerly direction towards the tributary of the Klip River. The removal of the silt and sediments in the Russell Stream is however expected to reduce the zone of impact in the long-term.

The impact because of the desilting is anticipated to be positive after the waste material and sand have been removed.

Table 26. Decommissioning Phase water quality impacts

NATURE OF IMPACT 4: **Water quality impacts when silt has been removed**		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Impact Status: (positive or negative)	Positive	Positive
Extent *(Local, Regional, International)*	Local	Local
Duration *(Short term, Medium term, Long term)*	Long term	Long term
Magnitude *(Major, Moderate, Minor)*	Minor +	Moderate +
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating *(Low, Medium, High)*	**Medium**	**Medium**
Reversibility: (Reversible or Irreversible)	Reversable	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts ❖ Combined impact with other mining and industrial activities. Refer to Chapter 10.		
Mitigation measures ❖ Monitor groundwater quality in all boreholes listed in Section 12.1. ❖ Maintain sound surface runoff management to ensure that all dirty runoff is contained and diverted away from the Russell Stream.		

9.6.2 GROUNDWATER QUANTITY

There will be no impacts on the groundwater quantity during decommissioning (Table 27). The desilting activities will have stopped and any form of seepage of contaminated water to the subsurface will reduce and ultimately stop, apart from precipitation.

Table 27. Decommissioning Phase water quality impacts

NATURE OF IMPACT 5: **Reduction in aquifer yield**		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Impact Status: (positive or negative)	Positive	Positive
Extent *(Local, Regional, International)*	Local	Local
Duration *(Short term, Medium term, Long term)*	Long term	Long term
Magnitude *(Major, Moderate, Minor)*	Minor +	Moderate +
Probability *(Definite, Possible, Unlikely)*	Definite	Definite
Calculated Significance Rating *(Low, Medium, High)*	**Medium**	**Medium**
Reversibility: (Reversible or Irreversible)	Reversable	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts ❖ Combined impact with other mining and industrial activities. Refer to Chapter 10.		
Mitigation measures ❖ Monitor groundwater levels in all boreholes listed in Section 12.1.		

9.7 Post Closure

The following impacts can be expected after closure:

9.7.1 Groundwater Quality

Overall, there should be an improvement in the groundwater qualities along the Russell Stream post closure as the source of in-stream contamination has been removed (Table 28).

Table 28. Post Closure Phase water quality impacts

NATURE OF IMPACT 6: **Groundwater quality impacts after silt is removed**		
	Impact Rating without Mitigation	**Impact Rating with Mitigation**
Impact Status: (positive or negative)	Positive	Positive
Extent *(Local, Regional, International)*	Local	Local
Duration *(Short term, Medium term, Long term)*	Long term	Long term
Magnitude *(Major, Moderate, Minor)*	Minor +	Moderate +
Probability *(Definite, Possible, Unlikely)*	Possible	Possible
Calculated Significance Rating *(Low, Medium, High)*	**Medium**	**Medium**
Reversibility: (Reversible or Irreversible)	Reversable	
Irreplaceable loss of resources: (Yes or No)	No	
Can impacts be enhanced: (Yes or No)	Yes	
Residual impacts ❖ Combined impact with other mining and industrial activities. Refer to Chapter 10.		
Mitigation measures ❖ Monitor groundwater quality in all boreholes listed in Section 12.1. ❖ Maintain sound surface runoff management.		

9.7.2 GROUNDWATER QUANTITY

No impact is expected on the water quantity post-desilting.

10 CUMULATIVE IMPACTS

Cumulative impacts result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of high salt or metal loads to a river that combine to cause a reduction in the use of the resource that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period and can include both direct and indirect impacts.

The Valley Silts Project is near other historical tailings depostion, mining activities, industrial activities and residential developments. Cumulatively all these activities contribute to the surface and groundwater quality impacts identified at the Valley Silts Project area and could also impact the groundwater resources, especially in terms of quality.

The outcome of the Valley Silts desilting groundwater assessment indicates that the desilting activities will have an overall positive impact on the receiving environment.

Establishing a monitoring system (Chapter 12) along the Russell Stream and downstream areas are required to assess the implications that stream desilting will have on the aquifers and to identify if poor quality groundwater will reach a sensitive receptor. The monitoring data recorded as desilting operations progress must be used to update the monitoring program.

Table 29. Cumulative impact rating

NATURE OF THE CUMULATIVE IMPACT:		
	OVERALL IMPACT OF THE PROJECT CONSIDERED IN ISOLATION	**CUMULATIVE IMPACT OF THE PROJECT AND OTHER PROJECTS IN THE AREA**
Impact Status: (positive or negative)	Negative	Negative
Extent *(Local, Regional, International)*	Local	Local
Duration *(Short term, Medium term, Long term)*	Long term	Long term
Magnitude *(Major, Moderate, Minor)*	Moderate	Major
Probability *(Definite, Possible, Unlikely)*	Definite	Definite
Calculated Significance Rating (Low, Medium, High)	Medium	Medium
Reversibility: (Reversible or Irreversible)	Reversable	Reversable
Irreplaceable loss of resources: (Yes or No)	No	No
Can impacts be enhanced: (Yes or No)	Yes	Yes
Mitigation measures ❖ Ensure that contaminated surface and groundwater from the adjacent mining and industrial activities are effectively managed and that polluted water is not allowed to enter the rehabilitated Russell Stream.		

11 GROUNDWATER MANAGEMENT MEASURES

Based on the outcome of the information presented in this report, several groundwater management measures are proposed for the project. These are detailed below.

11.1 GROUNDWATER OBJECTIVES AND TARGETS

The following objectives and targets are proposed for groundwater management at the operations:

- Implement a management plan aimed at reducing and/or eliminating adverse impacts on the receptors identified, including watercourses. The management plan must be earmarked at achieving conditions comparable to the best-case scenario presented in this report.
- Track and record the progress of implementation of all groundwater management measures.

- Implement sufficient monitoring procedures to measure the effectiveness of groundwater management measures.
- Analyse the information obtained from all monitoring programs against compliance targets to establish trends and to determine the need to trigger additional actions to reduce adverse impacts.
- Should the trends indicate adverse impacts on groundwater levels and/or quality, implement suitable measures within the shortest possible time to remediate and/or eliminate such adverse impacts identified.

11.2 Over-arching Groundwater Management Measures

Several broad over-arching groundwater management measures should be implemented by Ergo for the project to minimise impacts on groundwater, as detailed in Table 30.

Table 30. Over-arching groundwater management measures

Construction Phase
A dedicated groundwater monitoring network must be established including the four monitoring boreholes drilled as part of the project. The monitoring programme is discussed in Chapter 12.
Make financial provision for sufficient groundwater level and quality monitoring to implement the groundwater monitoring program, before the reclamation starts in the Extension area.
Implement stormwater runoff management measures to ensure that all dirty runoff is contained and reused in the project water balance. Avoid ponding of water over exposed areas.
Ensure that dirty water containment measures are designed to contain all dirty water generated during the project to prevent overflows and spillages.
Implement sound house-keeping measures to prevent and clean spills, address leaks and undertake regular inspections. Ensure that the record-keeping procedure is in place and that instructions given are carried out.
Measure rainfall on site.
Operational Phase
Complete regular inspections of dirty water containment structures, specifically noting incidences of overflow and leakage. If the latter is identified, measures must be taken to rectify immediately.
Maintain sound house-keeping measures to prevent spills and leaks.
Continue the groundwater monitoring programme.
Measure rainfall on site.
Record all groundwater-related complaints and deal with each complaint within the agreed timeframe.
Decommissioning and Closure Phase
Complete all rehabilitation to a satisfactory level, focussing specifically on the water drainage and collection system.
Ensure that all tailings and silt material is removed from the footprint.
Continue with the groundwater monitoring period for a minimum of two years after completion of the rehabilitation. The continued need for groundwater monitoring will depend on the outcome of the final closure assessment.

11.3 Specific Groundwater Management Measures

11.3.1 Measures to Reduce Impacts on Groundwater Availability

The project is not expected to have any impacts on groundwater availability in the region. The following specific measures are however recommended to minimise and/or eliminate the impacts on groundwater levels and availability:

- None of the private boreholes are located within the zones of unacceptable impacts delineated as part of this assessment. It is however recommended that borehole VAL1 is

included in the monitoring programme on an annual basis. Even though borehole CRGB15 is located closer to the project, it is downstream of a historical TSF and will not reflect impacts associated with the Valley Silts Project.

- Ensure that an effective surface water collection and retention system is in place to ensure that all flow and collected water is directed towards the cut-off trenches with sumps and not allowed to freely drain away from the various silt holding areas.

11.3.2 Measures to Reduce Impacts on Groundwater Quality

The following specific measures are recommended to reduce the risk of deterioration of groundwater quality and the volume of leachate available for infiltration to the aquifers:

- To minimise negative long-term impacts associated with the project, it is important that silt reclamation must be completed to soil level at the site. All silt must be removed.
- No ponding must be allowed on exposed areas. Process water that is allowed to pond uncontrolled will increase the risk of infiltration to the underlying aquifers.
- After rehabilitation, the footprint area must be made free draining to minimise infiltration of water to the aquifers.
- Ensure that clean and dirty water is separated at the reclamation and drying areas, and that dirty water is contained. Contain dirty water in adequately sized and lined sumps. Prevent dirty water runoff from leaving the area.
- All dirty water being pumped from the reclamation areas should reused in the water balance of pumped off site to prevent unnecessary discharge into the natural environment.
- Ergo must implement a water quality monitoring program during reclamation, focussed specifically on monitoring groundwater and process water quality. If the results of the monitoring indicate deterioration of quality to within the criteria specified for the likely case scenario in this assessment, Ergo must take measures to address and rectify non-compliances.
- A dedicated groundwater monitoring network must be established that includes borehole VAL1 as identified during the hydrocensus, on an annual basis.
- The impact and risk assessment presented in this report must be updated if any component of the project changes to what was used in this study or if additional information becomes available that deviates from that used.

12 Groundwater Monitoring

To monitor and prevent the spread of groundwater contamination, groundwater management procedures and practices must be implemented that are in line with accepted practices and in accordance with the requirements of the Environmental Management Plan (EMP). It is recommended to implement the groundwater monitoring program presented in this report. The key objectives of the groundwater monitoring program are to:

- Detect short and long-term trends;
- Recognise changes in groundwater quality and levels;
- Measure impacts and define mitigation measures; and
- Develop improved monitoring systems.

Groundwater monitoring will be undertaken to establish the extent of contamination in the shallow weathered and deeper fractured aquifers, during and after desilting.

12.1 MONITORING LOCATIONS

Monitoring must be undertaken in the four newly drilled boreholes as well as borehole VAL1. These boreholes are optimally located from a groundwater perspective. No additional monitoring boreholes are required, based on the outcome of this assessment.

If these boreholes are destroyed during reclamation, they must be replaced as soon as possible.

12.2 MONITORING REQUIREMENTS

The monitoring requirements are presented in Table 31.

Table 31. Groundwater monitoring requirements

Monitoring parameter	Element for analysis	Monitoring frequency	Monitoring trigger-response criteria
Depth to groundwater level in existing boreholes	Groundwater level	Quarterly	Variations by more than 3 m for 2 consecutive months should be investigated
Water quality analysis in all existing boreholes and process water	All elements included in the analyses completed as part of this assessment	Quarterly	Variations in concentrations of more than 15% for major cations and anions and more than 7% for metal concentrations for more than 2 consecutive months should be investigated. Any result that exceeds specified water quality objectives must be investigated when it occurs
Groundwater level and quality in borehole Val1 (hydrocensus BH)	Groundwater level as well as all elements included in analyses presented in this report	Quarterly	As above
Rainfall	Rain depth (mm)	Daily on site	None

The monitoring trigger-response criteria listed in Table 31 must be reviewed on an annual basis and updated, based on the outcome of the monitoring program results. All monitoring information must be entered into a spreadsheet for record keeping and analysis. Copies of the certificates of analyses must be kept on file for inspection. If significant exceedances are recorded during the monitoring program, the following actions should be taken:

- Log the exceedances in the incident reporting system within 24-hours of it occurring.
- Undertake an investigation to identify causes of the exceedances.
- Implement the necessary remedial actions according to the outcome of the investigation and consultation with the affected parties.
- Report significant exceedances to the Environmental and General Managers as well as to the regulatory authority and track the incident until completion.

The results of the monitoring program must be reported quarterly and on an annual basis for the purpose of internal Ergo water management. These reports must also be submitted to the authorities for review.

12.3 GROUNDWATER MONITORING REPORTS

Monitoring reports must contain the following information:

- Monitoring borehole location map;
- Geology map;
- All coordinates of the groundwater sampling sites;
- Certificates of analysis must be included for quality assurance. Monitoring results will be compared to South African National Standards (SANS241) and the Klip River catchment guideline limits;
- Time-series graphs for key indicator elements (e.g. pH, EC, TDS, Fe, Mn, Cd, Ni, Al, Pb and SO_4);
- Trilinear or other analytical groundwater plots;
- A discussion regarding observed trends and potential groundwater contamination; and
- Recommendations regarding possible amendments or additions to the groundwater monitoring program, based on trends and other information observed.

12.4 QUALITY ASSESSMENT AND QUALITY CONTROL

Quality assurance means:

- Developing a system of activities to ensure that measurements meet defined standards of quality with a stated level of confidence;
- Defining monitoring objectives, quality control procedures to be followed and quality assessment;
- To define data quality objectives, including accuracy, precision, completeness, representativeness and comparability; and
- Designing a network, selecting sampling sites, selecting instruments and designing the sampling system, as discussed above.

All monitoring equipment must be maintained as required, and calibration must be undertaken on a regular basis.

To ensure that the Groundwater Monitoring Strategy complies with the above, it is important that analytical laboratories used should be accredited for each type of analysis required, to ensure that accurate analytical methods are used.

While only one or two of the common major ions found in waters may be specified as key indicators, it is necessary to analyse for the full suite of common ions for quality control purposes and to detect discrete events and long-term trends in anion composition.

Special attention must be paid to sampling methods and to preservation and handling of samples prior to analysis. pH and conductivity must be measured in the field.

Close attention must be given to siting, logging and construction of monitoring boreholes and assessment of their condition must be made quarterly.

The following sampling protocol is proposed:

- Sterilised plastic bottles, with a plastic cap and no liner within the cap are required for the sampling. Sample bottles should be marked clearly with the borehole name, date of sampling, water level depth and the sampler's name;
- Water levels should be measured prior to taking the sample, using a dip meter (m bgl);
- Each borehole to be sampled should be purged (to ensure sampling of the aquifer and not stagnant water in the casing) using a submersible pump or a clean disposable polyethylene bailer. At least three borehole volumes of water should be removed through purging; or through continuous water quality monitoring, until the electrical conductivity value stabilizes;
- The following field measurements should be recorded on a field form for each sampling point: pH, EC and temperature;
- Samples should be kept cool in a cooler box in the field and kept cool prior to being submitted to the laboratory; and
- The pH and EC meter used for field measurements should be calibrated daily using standard solutions obtained from the instrument supplier.

13 Reasoned Opinion

It is the opinion of the project hydrogeologists that the Valley Silts Expansion Project can proceed, if good surface water / storm water management is in place and maintained. The project must further commit to complete silt removal and not undertake selective silt reclamation. In the short term there could be water quality impacts (increase in salts and metals) if water on the surface is not managed effectively. A sound groundwater monitoring program must be implemented in the four existing boreholes, plus borehole VAL1. Should the results of the monitoring indicate adverse impacts on groundwater quality over and above those already evident from historical impacts, immediate measures must be taken to rectify non-compliances. Overall, the project will deliver a long-term positive impact on groundwater quality if the silts are removed, and footprint areas are rehabilitated.

14 Conclusions

The Valley Silts Expansion Project entails desilting of the Russell Stream in specific areas; geographically this project has no alternative. The main aim of the project is to remove the contaminated silts from specific areas of the Russell Stream.

Ergo obtained Environmental Authorisation and an Integrated Water Use Licence for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of NASREC near Booysens Reserve in Johannesburg – Valley Silts Project. The mining authorisation for the removal of silts falls within Mining Right GP 184 MR. Ergo Mining (Pty) Ltd (Ergo) intends to expand its Valley Silts reclamation operation – the Valley Silts Expansion Project.

The removal of silts within the already authorised Valley Silts Project area has been ongoing since May 2023. The construction and site establishment began in October 2022 and as such, it is now necessary to prepare for the Valley Eastern Expansion, Southern Expansion, and Valley Expansion Northwest to provide for continuous reclamation operation, as well as a sustainable feed source to the process plant.

The anticipated life span of the Valley Silts Expansion Project is approximately 5 years maximum. The silt removal is planned for 3 years and rehabilitation 2 years.

Water Management:

This project will not require any additional process water for the mechanical excavation of gold bearing silts from the Russell Stream. Potable drinking water will be sourced from the municipality.

The clean stormwater runoff from the area to the south of the drying sites will be diverted using a stormwater diversion drain (or berm) around the area to the west. Stormwater from the north will flow via properly constructed inlets into the Russell Stream. Temporary berms will be constructed along the banks of the channel.

Environmental Setting:

The Valley Silts Project is located on the Central Rand Group, of the Witwatersrand Supergroup. The Witwatersrand Supergroup is a sequence of conglomerate, shale and quartzite. The Lower Witwatersrand is composed mainly of argillaceous clays and shale, with occasional banded ironstone, tillite and intercalated lava flow, while the Upper Witwatersrand consists almost entirely of quartzite and conglomerate.

The Valley Silts Project is in the Klip River catchment, in the C22C quaternary catchment, forming part of the Vaal Water Management Area. The main drainage in the project area is the Russell Stream, that discharges into the Klip River.

Fieldwork Program:

Hydrocensus:

A hydrocensus was conducted across the study area during February 2025. The survey included the Valley Silts Project area, plus accessible properties within a 2 km radius, and concentrated on identifying existing boreholes to enhance the knowledge of the groundwater systems and current groundwater use. Six boreholes and two old mine shafts were identified, all on neighbouring properties.

It was concluded that groundwater is not used in the area and all properties make use of municipal supply. Two private boreholes were identified (VAL4 and VAL5) with only VAL4 in use for garden irrigation and swimming pool top-up. No boreholes were identified along the eastern portion of the project area.

Groundwater level measurements were possible from the six boreholes. The groundwater level below surface varied between 0.10 m bgl (borehole VAL2) and 30.85 m bgl for borehole VAL5 (in the Industria West area). Borehole VAL5 presents a groundwater level (30.85 m bgl) that are much deeper compared to the other five boreholes. This potentially relates to differences in the geological units. The rest groundwater levels in the other five boreholes are on average 2.08 m below surface.

Borehole Drilling:

Two groundwater characterisation and monitoring boreholes were drilled at each of the two target areas – the one borehole was drilled to a depth of 80 m below surface, with the aim of characterising and monitoring the deeper fractured aquifer. The second borehole was drilled 30 m deep, with the aim of monitoring potential groundwater flow, quality and possible connection between the deeper fractured aquifer and the shallow weathered aquifer in the area.

Not one of the four new percussion boreholes produced a measurable blow yield, but a groundwater level could be measurable in all four boreholes shortly after completion. In general, borehole yields throughout the area are low. The weathered – solid formation contact yielded little water – only seepage water. A fractured zone in the quartzite in borehole VS-BH2d, plus the quartzite-lava and the quartzite-conglomerate contacts also yielded little water. The depth of weathering varies between 8 and 12 meters below ground level.

Aquifer Testing:

Following completion of the drilling program, an aquifer test program was initiated to determine the hydrogeological characteristics of the local aquifers.

For this project full drawdown and recovery pump tests were conducted on two of the four new boreholes (VS-BH1s and VS-BH1d) and a slug test was also completed on borehole VS-BH1s. Boreholes VS-BH2s and VS-BH2d were not tested due to the low volume of water inside the boreholes.

The recovery data (for the tested boreholes) indicate that the recovery is slow, and that full recovery (100%) was not achieved within the predetermined testing timeframe. The low borehole yields, fast water level drawdown and slow recovery observed during the aquifer testing indicate low transmissivity aquifers, with low recharge. The average T-values calculated from the pumping tests range between 0.005 and 0.048 m^2/d.

Current Groundwater Quality:

The groundwater in the project area represents a Calcium/ Magnesium-Sulphate water, indicating contaminated water. Only borehole VAL4 (Abraham Kriel Bambanani borehole approx. 1.6 km north of the Russell Stream) presents a Calcium/ Magnesium-Bicarbonate water, indicating recent recharge water.

The following were concluded from the 2025 groundwater quality results:

- Health impact:
    - Iron – An elevated iron concentration was measured for all 7 boreholes (hydrocensus and newly drilled) sampled during the 2025 fieldwork program, with Iron concentrations varying between 4.59 mg/L (borehole VAL4) and 441 mg/L (borehole VS-BH1s), versus the maximum allowable concentration of 2 mg/L. The concentration of dissolved Iron in the 4 newly drilled boreholes, adjacent to the Russell Stream vary between 72.7 mg/L and 441 mg/L, with lower concentrations measured for the two downgradient boreholes (VS-BH2s and d).
    - Manganese – Six of the 7 boreholes sampled during the 2025 study measured a Manganese concentration that exceeds the health impact limit. The measured Mangansee concentration for borehole VAL4 (Abraham Kriel Bambanani borehole) exceeds the Aesthetic Limit of 0.1 mg/L, but is below the Health Impact limit of 0.4 mg/L.

      Manganese concentrations vary between 5.45 mg/L (borehole VAL1) and 74.3 mg/L (borehole VS-BH2d), versus the maximum allowable concentration of 0.4 mg/L. The concentration of dissolved Manganese in the 4 newly drilled boreholes, adjacent to the Russel Stream vary between 34.7 mg/L and 74.3 mg/L, with lower concentrations measured for the 2 upstream boreholes (VS-BH1s and d).

- Cadmium – The 4 newly drilled boreholes measured a Cadmium concentration that could result in chronic health effects (0.008 to 0.117 mg/L). The health impact limit is set at 0.003mg/L. Elevated Cadmium concentrations were not measured for the 3 hydrocensus boreholes.
- Nickel – An elevated dissolved Nickel concentration was measured at the 4 newly drilled boreholes, plus hydrocensus borehole VAL2.
- Sulphate – Sulphate concentrations were elevated in 6 of the 7 boreholes sampled during the 2025 study. It was only borehole VAL4 where the measured Sulphate concentration was within acceptable health and aesthetic limits.

  The elevated Sulphate concentrations vary between 1125 mg/L (borehole VAL1) and 3126 mg/L (borehole VS-BH1d), versus the maximum allowable concentration of 500 mg/L. The concentration of Sulphate in the 4 newly drilled boreholes, adjacent to the Russel Stream vary between 2011 mg/L and 3126 mg/L, with lower concentrations measured for the two downstream boreholes (VS-BH2s and d).
- Lead – An elevated Lead concentration was measured for borehole VS-BH2d (0.012mg/L) and borehole VAL2 (0.012 mg/L), with the health limit defined as 0.01mg/L. The Lead concentration in all other boreholes were below the detection limit.
- Total Organic Carbon – High TOC values (between 11.2 and 19.1 mg/L) were measured for boreholes VAL1, VAL2, VS-BH2s and VS-BH2d.
- E. coli – borehole VAL4 produced a measurable E. coli count – 7 counts per 100 ml; the count must be zero. Borehole VAL4 is in an old residential and industrial area, and it has been assumed that leaking sewer lines are possibly contaminating the groundwater around this borehole.

- Aesthetic effects:
  - Aluminium – The aluminium concentration for boreholes VS-BH1s and VS-BH1d (25.1mg/L and 2.07 mg/L respectively) exceed the SANS241:2015 guideline value of 0.3 mg/L. The sampled groundwater from the BH1 cluster set was very muddy during the sampling process and this could have contributed to the elevated Aluminium concentrations.
  - Zinc – The Zinc concentration for borehole VS-BH1s (7.99 mg/L) exceeds the SANS241:2015 guideline value of 5 mg/L. The measured Zinc concentrations for the other 3 newly drilled boreholes were below the aesthetic impact limit.
  - Ammonium – The Ammonium concentration for borehole VAL1 exceeds the aesthetic limit for drinking water (14.6mg/L). The aesthetic limit set at 1.5 mg/L. The ammonia concentrations in the other boreholes vary between 0.19 and 0.88 mg/L.
  - Sodium – The measured Sodium concentration for borehole VS-BH1d (210 mg/L) exceeds the aesthetic limits for drinking water (200mg/L).
  - Turbidity – Turbidity was high in all boreholes with units varying between 42.5 NTUs and 730 NTUs.
  - Calcium – The measured Calcium concentration was elevated for all sampled boreholes, with concentrations varying between 37.5 mg/L and 493 mg/L.
  - Magnesium – High Magnesium concentrations were measured in 5 of the 7 boreholes and were thus in acceptable limits for boreholes VAL1 and VAL4.

- Total Hardness – The Total hardness value was elevated for all boreholes except borehole VAL4, indicating very hard water.
- Total Coliform – The total coliform count was elevated for borehole VAL4 (40 counts per 100 ml) and for borehole VS-BH1d (20 counts per 100 ml). The operational limit is set at 10 counts per 100 millilitres (ml).
- pH – the pH value for the two newly drilled upstream boreholes (VS-BH1s and VS-BH1d) (4.87 and 4.52 respectively) is below the SANS guideline limit of 5.
- The SANS 241 guideline limits for Electrical Conductivity (EC) and Total Dissolved Salts (TDS) were exceeded for all sampled sites, except for borehole VAL4. EC level varied between 222 and 403 mS/m. TDS varied between 1756 and 4134 mg/L.

The chemicals of concern for the Valley Silts project area are pH, Iron, Manganese, Sulphate, Cadmium, Lead, Nickel and Total Organic Carbon. Parameters exceeding aesthetic limits include Ammonium, Aluminium, Chloride, Calcium, Magnesium, Sodium, Zinc and Total Hardness and Turbidity. Most of these are elevated in the four newly drilled boreholes.

Geochemistry:

The 2005 Council for Geosciences study identified Co, Ni, Cu, As and U as the principal elements of concern. The Council for Geosciences found – "The leachable fractions determined from the compliance batch leach tests are uniformly low, with nickel slightly more mobile than the other elements.

The samples were all deposited in a sub-aqueous environment and are in contact with water for most of the year. Any easily mobilised metals will therefore be mobilised, while the more strongly bound fraction will require a more aggressive leachate than clean water to remobilise them. If the current conditions are maintained in these wetlands, i.e. continuous discharge of water to the wetlands and the maintenance of reducing conditions, it is unlikely that the metals will be mobilised."

The proposed Valley Silts Expansion Project will remove the silts, and then temporarily stockpile and dry the silt in stockpile areas directly north and south of Blocks N1 to N18. Silts will have up to 40% moisture content when hauled and are not expected to be fully dried out. The dried tailings/silts will be loaded onto tipper trucks and transported to the City Deep Plant for pre-processing.

The excavation of the silt from the water course will trigger oxidation reactions that will result in acidic conditions and leaching of salts and metals. Negative surface and groundwater quality impacts are expected in the excavated areas and the stockpile areas.

In the deeper silt pockets the pH will be much lower and element concentrations higher, but due to current stable conditions that include saturation, low permeability and low oxygen levels, metal and salt leaching does not happen readily. This will change when the silt excavation process introduces oxygen and disturbs the stable conditions.

Modelling:

The available information was used to construct a conceptual model of the aquifers present in the project area. The conceptual model forms the basis of the numerical groundwater model. To assess the potential impacts of the proposed silt excavation from section of the Russell Stream, a groundwater model was constructed for the project area.

The following scenarios were evaluated as part of the assessment:

- **Best case scenario**: Low seepage infiltration from the project to the underlying aquifers, equivalent to dry conditions.
- **Likely case scenario**: Moderate seepage infiltration rates to the underlying aquifers, equivalent to average conditions.
- **No Project scenario**: This is considered the worst case and assumes that the silts will remain in the Russel Stream floodplain.

Outcome of Simulations Completed:

The overall outcome of the simulations is summarised as follows:

- The cumulative impact of all historical TSFs located around the project area was included during simulations. These areas are included based on monitoring data from hydrocensus boreholes downgradient of two of these TSFs. Since these are likely dry as they are dormant, long-term impacts on groundwater quality associated with these could reduce. It is further noted that these TSFs are downgradient of the Valley Silts Expansion Project and are therefore not expected to directly impact on long-term water quality associated with the project.
- Also included is silt material present in the Russel Stream further downgradient and west of the Valley Silts Expansion Project. The extent of this material is inferred from information made available as part of the 2019 assessment. As this material will remain in the stream for now, it impacts on groundwater quality in this area will continue in future. This area is downgradient of the Valley Silts Project and will therefore not impact on long-term groundwater quality associated with the project.
- Only two of the boreholes and shafts identified during the 2025 hydrocensus are downgradient of the project, namely CRGB15 and VAL1. Borehole CRGB15 is downgradient of a historical TSF. For this reason, impacts on this borehole cannot be attributed to the Valley Silts Project. Borehole VAL1 is located approximately 2 km west of the Valley Silts Project, further along the flow of the Russel Stream. This borehole is located near the area where silts are likely to remain in the stream in future and is also downgradient of a historical TSF. Based on this it is concluded that groundwater is not currently used in the zone of impact associated with the Valley Silts Project.
- The project footprint is located on outcrops of Turffontein quartzite, Johannesburg quartzite and Booysens shale. Fieldwork completed during 2025 confirms that the aquifers associated with the shale and the Johannesburg quartzite have low permeabilities and recharge rates. As such, the sulphate and iron plumes associated with the project migrate very slowly in the aquifers. The advantage of this outcome is that contamination associated with the project is not likely to move more than a few hundred meters from the reclamation areas in the long-term.
- The disadvantage of the poorly developed aquifer conditions identified is that historical contamination will not be flushed in the long-term but will remain within the footprint area to a large extent. Removal of the silt material as part of the project is therefore likely to reduce the concentrations of contaminants but will not significantly do so. In addition to a reduction in concentration, the extent of the zone of impact on groundwater quality will reduce in the long-term after removal of the silt material from the stream.

- Groundwater plumes are expected to move towards the Russel Stream on a local scale, but regionally in a westerly directly, but slowly.
- The volumes of contaminated groundwater that may reach the wetlands downgradient in the Russel Stream cannot be accurately assessed based on one dataset alone. It is however expected to be low, probably not exceeding 20 m^3/a.
- Most significant impacts on groundwater quality, as delineated by the simulated zones of unacceptable long-term impacts and zones of acceptable operational impacts are mainly restricted to the Valley Silts Project footprint areas. The zones of unacceptable impact are indicated by thick red lines at concentrations exceeding 1000 mg/L for sulphate and exceeding 10 mg/L for iron.
- The extent of the iron plume is larger compared to that of sulphate. This is because lower concentration standards are imposed on iron compared to sulphate.

Impact at the End of the Operational Phase:

The impact of silt reclamation from the stream at the end of the operational phase is presented for iron and sulphate (Figure 21 and Figure 22). The simulations indicate the following:

- Due to the short duration of the project, the outcome of the operational impact on groundwater quality is mainly due to the impact of historical tailings deposition in the stream.
- Based on the current dataset, it is expected that sulphate concentrations would exceed 2000mg/L and iron concentrations would exceed 200 mg/L over the project footprint area at the end of the operational phase. The groundwater is currently not fit for use.
- The zone of impact on groundwater quality is not expected to significantly exceed the project boundary at the end of the operational phase. It is possible that the plumes can migrate a hundred meters west along the flow of the Russel Stream.
- No private boreholes fall within the delineated zone of impact of the Valley Silts Expension Project.

Likely Long-term Scenario:

The likely outcome of the removal of silts from the Russel Stream in terms of groundwater quality is presented in Figure 23 and Figure 24. The following is concluded from the impact predictions completed:

- Sulphate concentrations are expected to reduce to below 1000 mg/L over large portions of the footprint. It is possible that pockets in the aquifer may have concentrations exceeding 1000 mg/L, but not significantly so. These zones where sulphate exceeds 1000 mg/L will remain inside the project footprint area in the long-term.
- In addition, the extent of the zone of impact is expected to reduce to within the project footprint.
- Iron concentrations are also expected to reduce significantly within the project area. It is anticipated that iron concentrations would reduce to below 100 mg/L over most of the project area, but as with sulphate, pockets may remain where concentrations exceed 100 mg/L, but not significantly so. While this will be a significant reduction in iron concentrations, long-term impacts over the project footprint will continue to pose a risk that could result in acute or chronic health impacts. The groundwater within the project area will therefore remain unfit for use. The positive outcome of the project is however a significant reduction in concentrations and a reduction in the extent of the zone of unacceptable impacts.

Scenario Analysis for Long-term Impacts:

The outcome of the assessment for both sulphate and iron is summarised as follows:

- Impacts associated with the best case and likely scenarios are expected to be very similar in terms of impacts on groundwater quality. These two cases relate to how water is managed on site during the operational phase and the extent to which infiltration of dirty water takes place. Since the aquifer permeability within the project area is low, water management options during the comparatively short operational period are not likely to result in significant long-term effects. Despite this, it is recommended that clean and dirty water management measures, as indicted in Kongiwe (2025) are strictly adhered to. All measures must be taken to divert clean runoff and contain dirty water inside the dedicated paddocks. Dirty water must be reused during reclamation to avoid ponding over extended periods of time.
- If the Valley Silts Expansion Project is not implemented, current impacts on groundwater quality are expected to continue in the long-term. This is expected to increase sulphate and iron concentrations within the unacceptable levels over the footprint area as well as downstream in the Russel Stream. The extent of the zone of impact on groundwater quality is therefore expected to increase with time. The outcome of this scenario will result in long-term negative impacts on groundwater quality and should therefore be avoided. Removal of the silt material from the streambed will reduce long-term impacts, as discussed above.

During the rehabilitation phase of the project, it was assumed that all tailings and silt will be removed, that the soil will be shaped to create a free-draining surface, and that all radiation will be removed. It is noted that this rehabilitation scenario will not reverse the cumulative impact of historical tailings deposition. For this reason, a residual impact will remain post-closure of the project in the long-term.

The rehabilitation will be completed down to a red earth footprint. The area will be shaped for correct storm water management. During this phase, all project infrastructure will be removed, and a final radiological survey will be undertaken. Thereafter the property will be handed over to the landowner.

15 RECOMMENDATIONS

It is crucial to implement the groundwater monitoring program before the desilting activities start at the expansion project, to define the pre-excavation status. The database will help the client identify groundwater quality and level trends and will serve as reference to identify and quantify potential impacts on the groundwater environment.

The excavated silt and any water must be removed from open and exposed formation surfaces as soon as possible to avoid seepage of contaminated water into the shallow weathered and deeper fractured aquifers. The desilting will be a continuous process, and water will be in the silts. It must be assumed that the groundwater system will take a portion of this load and ways to manage, contain and minimise the mobilisation of loads must be adopted.

The risk of groundwater contamination during the desilting process will be higher compared to the existing impacts, as chemical reactions and leaching from the silt will increase, due to increased surface area exposed to oxygen and rainwater. Surface water management and containment guidelines must be followed carefully during the desilting process.

In addition to the above, it is important that the necessary cut-off trenches and berms are put in place between the Valley Silts project area and the historical TSFs to avoid future wash of silts and slimes into the excavated and rehabilitated areas, thus compounding the project again.

Ergo must ensure that an effective surface water collection and retention system is in place to ensure that all flow and collected water is directed towards the cut-off trenches and sumps and not allowed to freely drain away and back to the Russell Stream. Pooling of water must not be allowed on open surfaces, except if lined.

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Appendix A

CVs



Curriculum Vitae
Lucas Andries Smith (Pr. Sci.Nat)

Independent Hydrogeological Consultant

Principal Hydrogeologist

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Rietfontein
Tshwane

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QUALIFICATIONS

MSc Geohydrology, IGS (UFS) Bloemfontein, South Africa, 2003.

Baccalaureus Technology Geology, Technicon Pretoria, South Africa, 1997.

National Diploma Geotechnology, Technicon Pretoria, South Africa, 1992.

EMPLOYMENT HISTORY

Department of Water and Sanitation – 17 years.

ERM Consulting – 3.5 years.

Digby Wells Environmental – 5.5 years.

ASST Group – 12 months.

Current – Director, Groundwater Abstract Pty Ltd

FIELDS OF SPECIAL COMPETENCE

- Water use assessments (hydrocensus)
- Geophysical investigations
- Borehole drilling and rehabilitation studies
- Aquifer testing
- Community water supply and resource management
- Mine dewatering, water supply and management programmes
- Groundwater quality assessments
- Groundwater, catchment and impact assessments
- Design and management of water monitoring programmes
- Integrated Water and Waste Management Plans
- Water Use License Applications and compliance assessments
- Geochemistry assessments and waste classification
- Staff management
- Project management

SUMMARY OF COMPETENCIES

Lucas has 33 years of experience in the field of hydrogeology. Before moving to environmental consulting, he was a principal hydrogeologist at the Department of Water Affairs and Forestry (now Dept. Water and Sanitation) (South Africa) where he devoted 17 years to groundwater research and exploration programmes; rural water supply-, larger municipal water supply-, and government water supply schemes projects; artificial groundwater recharge projects; as well as borehole and aquifer development and remediation projects.

He executed and managed different hydrogeological projects, focussing on aspects such as community water supply programmes, geophysical investigations, characterisation of aquifers, pollution studies, in-stream flow requirements, hydraulic fracturing, dolomite and karst investigations and monitoring, chemical borehole rehabilitation (biofouling) and hydro-chemical analyses.

Over the past 16 years Lucas' environmental consulting experiences include the Southern African and Central- and West African mining sectors, as well as Energy sectors (Eskom and alternatives) where he manages groundwater and surface water resource evaluations and interaction, as well as conceptualising and quantification of groundwater flow/contaminant transport, ultimately for input to Environmental and Social Impact Assessments (ESIA), Environmental Management Programme reports (EMPr), Feasibility Studies and mine water management. Integrated water management is key to any business, mine, industry, or communities to ensure a sustainable resource for the environment and local communities to benefit from.

At Digby Wells Environmental Lucas was part of the EXCO committee; where he managed a team of 14 surface and groundwater specialists and several projects.

He served on the H&S Committee at ERM and Digby Wells where he also served as Chairperson for the H&S Committee for 1 year.

Lucas is a dedicated employee, husband and farther; and passionate about managing and protecting our natural resources and the environment.

RECENT RELEVANT PROJECT EXPERIENCE

During the 33 years in the Water Geosciences industry Lucas was involved in many projects where he served as team member on many field works and research programmes; he managed staff and various projects throughout Africa and even as far as Pakistan, and played a prominent role in being the overall Sponsor on projects, as well as acting as key client manager for clients like Sasol and Universal Coal.

A list of clients and projects over the last couple of years can be provided on request, but due to the extent of the experience it has been omitted from this CV.

SHORT CV Irene Lea

Personal Information

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Employment

Current Position:

Consulting Hydrogeologist

Sole Proprietor, Irene Lea Environmental and Hydrogeology cc (ILEH)

September 2009 – Present

Previous Employment:

Pamodzi Gold and its predecessors – Group Environmental Manager (Dec 2002 – July 2009)

Groundwater Consulting Services – Water Unit Manager (Jan 1996 – Nov 2002)

CSIR – Staff Hydrogeologist (January 1992 – December 1995)

Professional Registration

Professional Natural Scientist (SACNASP, Reg. No. 400278/06)

Education

B.Sc. Geology and Mathematics, University of Stellenbosch, 1988 - 1990

B.Sc. (Hons) Geology, University of Stellenbosch, 1992

M.Sc. Geohydrology, Institute for Groundwater Studies, University of the Free State, 1996 - 1997

Experience

The project will be completed by Irene Lea. She has 27 years experience in the geohydrological field. She has a M.Sc. in Geohydrology and is a registered Professional Natural Scientist (400278/06). Her focus includes numerical groundwater flow and contaminant transport modelling, water treatment, integrated water and waste management strategies, rehabilitation and closure projects, environmental management systems, risk assessments and auditing. A project that she managed was nominated and short listed for a Nedbank Green Mining Award in 2006.

Recent Projects

Groundwater flow and contaminant transport modelling:

- AECI Modderfontein Industrial Complex, Groundwater Impact Assessment (SRK, 2012)
- Exxaro Arnot Colliery – Groundwater Impact Assessment (Golder and Associates, 2012)
- Transalloys Industrial site – Groundwater Impact Assessment (Jones & Wagener, 2012)
- Tschudi Copper Mine – Dewatering and groundwater supply (Jones & Wagener, 2012)
- Harmony Kalgold – Optimisation of abstraction boreholes and TSF EIA (Jones & Wagener, 2013)
- Fry Metals – Contaminant Transport Model to evaluate rehabilitation options (Rison, 2013)
- Assmang Chrome - Machadodorp Works Contaminant Transport Model (ESS, 2014)
- Sebilo Resources – Perth Manganese Numerical Groundwater Model (Sebilo Resources, 2014)
- Rand Gold Mali Loulo Mine – Updated Groundwater Impact Assessment (Digby Wells Environmental, 2015)
- Vantage Goldfields – Groundwater Study for IWWMP: Lily and Barbrook Mines (Vantage Gold, 2015)
- South Deep – Numerical simulations for the closure of a Tailings Storage Facility (Rison, 2015)
- Dwarsrivier Mine – Groundwater flow and contaminant transport model (EnviroGistics, 2015)
- Braeside Colliery – Groundwater specialist study for the Scoping and EIA phases (EIMS, 2015)
- Oakleaf Colliery – Numerical groundwater model for mining right application (Digby Wells Environmental, 2015)
- Withok Tailings Storage Facility – Numerical simulations for re-commissioning of TSF (Ergo Mining, 2015)
- Dwarsrivier Mine WULA – Numerical groundwater model to assess impacts (Assmang Chrome, 2015)
- Fry Metals – Contaminant Transport Model update (Rison, 2015)
- De Wittekranz Project - Numerical groundwater model to assess impacts (EIMS, 2015)
- Tetra4 Virginia Gas Project – Groundwater specialist input and numerical modelling (EIMS, 2016)
- DRD Gold – Numerical groundwater model for Withok Tailings Storage facility (Beric Robinson Tailings, 2016)
- Tetra4 Virginia Gas Project – Follow-up numerical modelling (EIMS, 2017)
- City of Cape Town Kalbaskraal Waste Disposal Project – Numerical modelling (Cliffe Decker Hofmeyr, 2017)
- Lephalale Coal Mines – Geohydrological modelling (ASST, 2017)
- Dwarsrivier Mine – Follow-up numerical groundwater flow and contaminant transport model (Envirogistics, 2017)
- Prieska Copper Mine – Geohydrological impact assessment, including numerical modelling (ABS Africa, 2017)
- Umsimbithi eMakhazeni Project - Geohydrological impact assessment, including numerical modelling (Kongiwe, 2018)
- City of Cape Town Kalbaskraal Waste Disposal Project – Numerical modelling (Cliffe Decker Hofmeyr, 2018)
- Vardocube Mining – Geohydrological impact assessment, including numerical modelling (ABS Africa, 2018)
- Assmang Manganese Cato Ridge – Numerical groundwater flow and contaminant transport model (Assmang Manganese, 2018)
- eMakazeni Mining Project - Numerical groundwater flow and contaminant transport model (Kongiwe, 2018)
- Leslie 1 Project – Numerical groundwater flow and contaminant transport model (Kongiwe, 2018)
- City of Cape Town Kalbaskraal Waste Disposal Project – Numerical modelling (Cliffe Decker Hofmeyr, 2018)
- Dwarsrivier Mine –Numerical groundwater flow and contaminant transport model (Envirogistics, 2018)
- Assmang Chrome Machadodorp Works - Numerical groundwater flow and contaminant transport mod (Assmang, 2018)
- Assore – Numerical groundwater flow and contaminant transport model – RMDC operations (Assore, 2019)
- Assore – Numerical groundwater flow and contaminant transport model – ZCM operations (Assore, 2019)
- Kranspan Colliery – Numerical groundwater flow and contaminant transport model (ABS Africa, 2019)
- DRD Gold – Numerical groundwater flow and contaminant transport modeling: Soweto Cluster and Marievale Projects (Kongiwe, 2019)
- South32 – Wolvekrans Mega Project – Geohydrological specialist study (NTC Group, 2019)

Integrated Water and Waste Management:

- Nkomati Mine Salt and Water Balance (ERM, 2007)
- Total Coal Dorstfontein Mine Salt and Water Balance (Groundwater Consulting Services, 2010)
- Blue Ridge Platinum Salt and Water Balance (Groundwater Consulting Services, 2010)
- Sebilo Resources – Perth Manganese water use license application (Sebilo, 2014)
- Vantage Goldfields – Water Balance: Lily and Barboork Mines (Vantage Gold, 2015)
- Dwarsrivier Mine – Integrated Water Monitoring Programme (Assmang Chrome, 2015)
- RK Boerdery – Water balance for piggery (Batho Environmental, 2015)
- Sakura JV Indonesia – Groundwater study (Assmang Ltd, 2015)
- PMG Mining – Water balance of manganese mine (Globesight, 2016)
- Sebilo – Perth Manganese Mine – Water Use License Application (Sebilo, 2016)
- Transnet – Confidential technical report review (DMT Kai Batla, 2016)
- Tswane Metropolitan Municipality – Tswane Agri-Hub Baseline Hydrogeological Study (DMT Kai Batla, 2016)
- Afrisam South Africa – Ulco Cement Factory Hydrogeological Investigation (MojaTerre, 2016)
- City of Cape Town – Kalbaskraal Waste Disposal Facility Geohydrological Modelling (Cliffe Decker Hofmeyer, 2017)
- Sebilo Resources – Perth Mine Waste Classification (Sebilo Resources, 2017)
- Zeerust Chrome Mine – Tailings Waste Classification Study (AMTIT, 2017)
- Lephalale Coal and Power Project – Numerical groundwater flow and contaminant transport model (ASST, 2017)
- eMakhazeni Coal Project – Numerical groundwater flow and contaminant transport model (ASST, 2017)
- Beeshoek Iron Ore Mine – Water and Salt Balance (Envirogistics, 2017)
- Beeshoek Iron Ore Mine – Water Conservation and Demand Management Plan (Envirogistics, 2017)
- Machadorp Smelter – Water and Salt Balance (Assmang Ltd, 2017)
- Dwarsrivier Chrome Mine – Water Conservation and Demand Management Plan (Envirogistics, 2017)
- Dwarsivier Chrome Mine – Waste Classificaiton Study (DCM, 2017)
- New Kleinfontein Mine – Water and Salt Balance (NTC Group, 2017)
- Zeerust Chrome Mines – Basic Assessment Report -Groundwater (Envirogistics, 2018)
- Rustenburg Minerals Development Corporation – Basic Assessment Report – Groundwater (Envirogistics, 2018)
- Dwarsrivier Chrome Mine – Water Balance Study (Envirogistics, 2018)
- Beeshoek Mine -Water Balance Study (Envirogistics, 2018)
- Gold One New Kleinfontein Mine – Water Balance Study (NTC, 2018)
- Beeshoek Mine – Water and Salt Balance and Water Conservation and Demand Management Plan (Envirogistics, 2019)
- Dwarsrivier Mine – Water Conservation and Demand Management Plant (Envirogistics, 2019)
- ARM Alloys – Machadodorp Works Water and Salt Balance (ARM Alloys, 2019)

Environmental Management:

- Management of the construction of a river diversion (Pamodzi Gold, 2006)
- Minxcon Competent Person's Report (Bema Gold, 2006)
- Management of the construction and commissioning of a 10 ML/d mine water treatment plant (Pamodzi Gold, 2008/2009)
- Standard Bank Due Diligence (Pamodzi Gold, 2009)
- Environmental Baseline Assessment: Bien Venue Gold Prospect (Rock & Stock, 2010)
- Environmental Baseline Assessment: Perth Manganese Prospect (Sebilo Resources, 2010)
- Prospecting Right EMP: Aquarius Chieftans and Valhallah Prospect (SRK Consulting, 2011)
- NI43-101 Technical Report - Hydrogeology: Homeland Energy (SRK Consulting, 2011)
- Zeerust Chrome Mine EMP Amendment (Assore, 2011)
- Northam Platinum Due Diligence – Hydrogeology (SRK, 2011)
- Mogale Gold Technical Assessment – Water-related issues (MSA Geoservices, 2011)
- Rustenburg Mineral Corporation EMP Amendment (Assore, 2011)
- Mogale Gold – Lancaster Dam Baseline Assessment (Mintails SA Ltd, 2011)
- Mogale Gold – Review of Rehabilitation Quantum (Mintails SA Ltd, 2011)
- Sebilo Resources – Perth Mining Right Application EMP (2012)
- Isibaya – Performance Assessment Audit (Rock & Stock, 2012)
- Lebalelo Water Users Association – Olifants River Project (Anglo Platinum, 2012)
- Capricorn Iron Melkbosch Project – Performance Assessment Audit (Rock & Stock, 2012)
- Umlabu Colliery – Due Diligence (SRK, 2012)
- Isibaya Mining Resources – Performance Assessment Audit (Rock & Stock, 2013)
- Assore – PA Audits for RMDC, ZCM and Wonderstone Operations (Assore, 2013)
- Keegan Resources - Esaase Gold Project, Ghana – Gap Analysis and ESIA (Epoch Resources, 2013)
- Sebilo Resources – Quantum for Rehabilitation (Sebilo, 2014)
- Galabyte (Pty) Ltd – Middelvlei Mine Environmental Management Function (Galabyte, 2014)
- Pembani Group – Evaluation of the Carolina Operations water related liabilities (Pembani, 2014)
- Obarex – Van Roois Vley Environmental Management Programme (Rock & Stock, 2014)
- Glencore & Royal Bafokeng Holdings – Boschfontein Slag Dump Groundwater Risk Assessment (EIMS, 2014)
- Sebilo Resources – Performance Assessment Audit and Quantum for Rehabilitation – Perth Mine (Sebilo Resources, 2015)
- RK Boerdery – Baseline geohydrological study for piggery (Batho Environmental, 2015)
- Sungu Sungu Gas – Geohydrological study (EIMS, 2015)
- Gold mining industry – Groundwater component of a confidential Due Diligence (EBS, 2015)
- Sungu Sungu Gas – Groundwater specialist input – Scoping and EIA (EIMS, 2016)
- Kao Diamond Mine Lesotho – Groundwater specialist input – Scoping and EIA (EIMS, 2016)
- The Mineral Corporation – Mukulu Project Competent Persons Report Technical Review (TMC, 2016)
- HC Van Wyk Diamponds – Groundwater input to diamond prospecting (MojaTerre, 2016)
- Black Mountain Mine – Groundwater Basic Assessment Report (The MSA Group, 2016)
- Tetra4 – Virginia Gas Project Baseline Hydrogeological Study (Tetra4, 2016)
- DRD Gold – Tailings reprocessing offset evaluation (DRD Gold, 2016)
- Dwarsrivier Chrome Mine – Assessment of Quantum for Rehabilitation (Assore, 2016)
- Hlagisa – Wildfontein Section 102 application (ESS, 2017)
- African Mining Trust – Zeerust, Wonderstone and RMDC Quantum for Rehabilitation (2013 – 2017)
- Dwarsrivier Chrome Mine – Assessment of Quantum for Rehabilitation (Assore, 2018)
- AMT – Updated of Quantum for Rehabilitation for three operations (AMT, 2018)

Appendix B

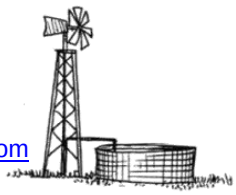
Borehole Drill Logs

Groundwater Abstract (Pty) Ltd

Lucas Smith

0825778439

Lucas@wellsafrica.com

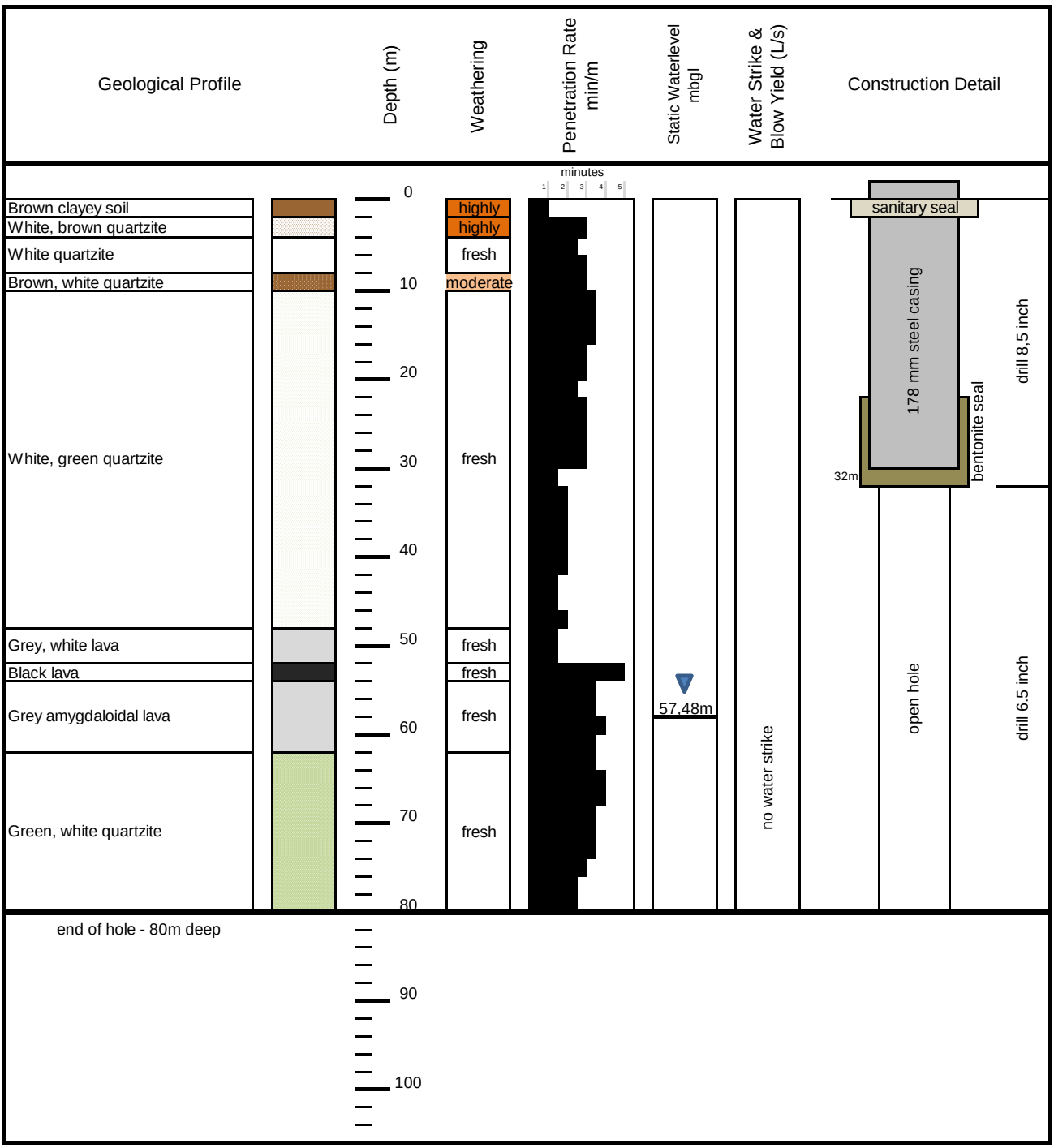


Percussion Drilling Borehole Log	Borehole No. VS_BH 1d

Client: Ergo Mining (Pty) Ltd

PROJECT:	Valley Silts Expansion
LOCATION:	Crown - Booysens area
DRILLER:	Georoc Drilling
DRILL DATE:	26/02/2025
LOGGED BY	Lucas Smith

COORDINATES	
Latitude	26°13'39.59"S
Longitude	28°00'23.73"E
Elevation	1678 mamsl
COORD SYSTEM	
	WGS84



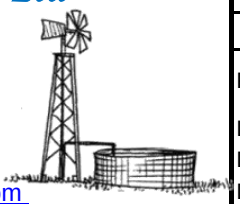
Casing Height:	58 cm	pH:	
		EC (ms/m):	
Concrete Height:	21 cm	TDS (mg/L):	sample not taken
		TDS (ppm):	
Development Time:	Blown clean	Salinity (ppm):	
		Temp °C:	

Groundwater Abstract (Pty) Ltd

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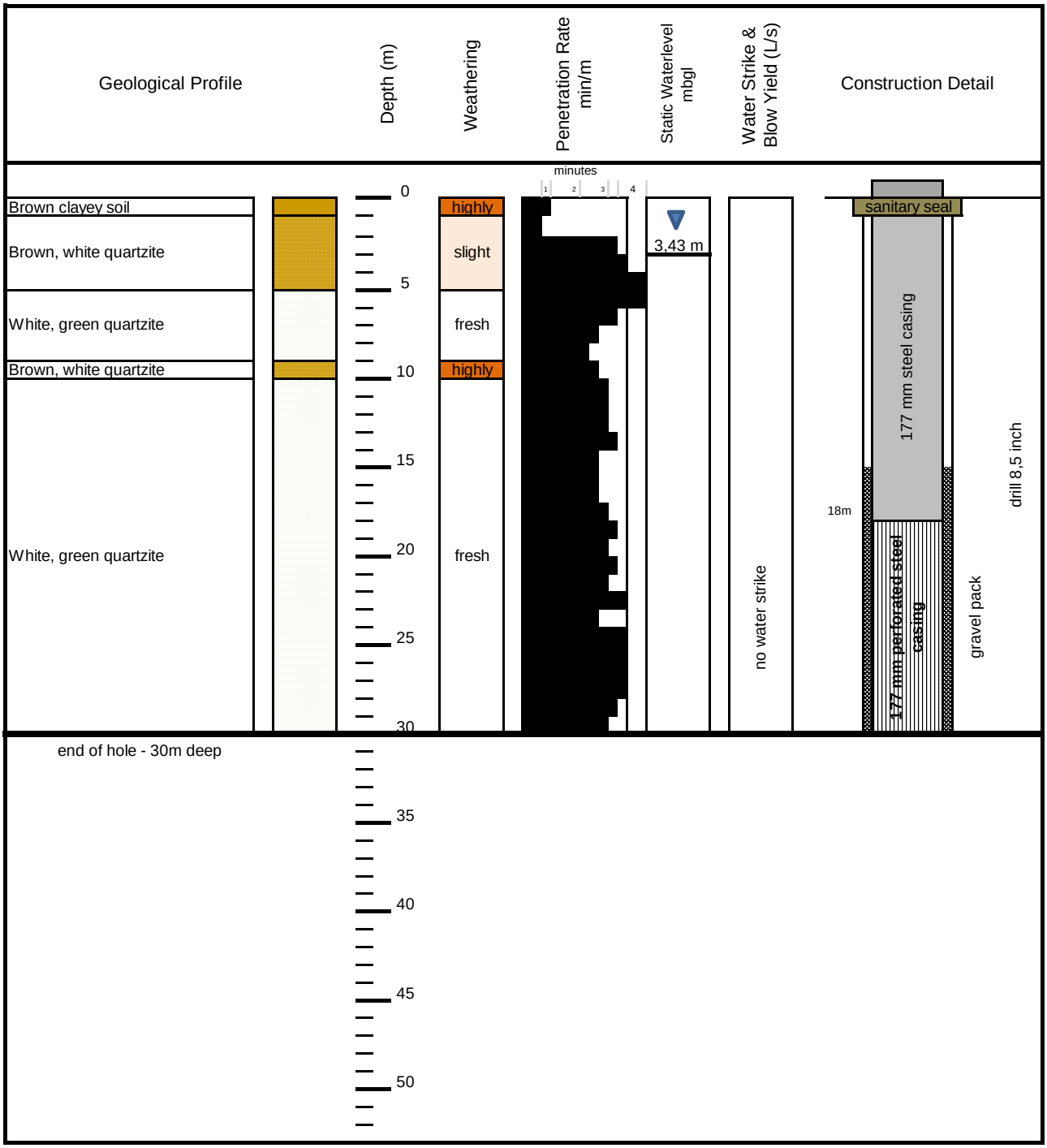
Percussion Drilling Borehole Log

Borehole No. VS_BH 1s

Client: Ergo Mining (Pty) Ltd

PROJECT:	Valley Silts Expansion
LOCATION:	Crown - Booysens area
DRILLER:	Georoc Drilling
DRILL DATE:	27/02/2025
LOGGED BY	Lucas Smith

COORDINATES	
Latitude	26°13'39.64"S
Longitude	28°00'23.73"E
Elevation	1678 mamsl
COORD SYSTEM	
	WGS84



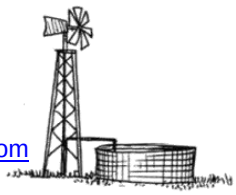
Casing Height:	55 cm	pH:	
		EC (ms/m):	
Concrete Height:	25,5 cm	TDS (mg/L):	sample not taken
		TDS (ppm):	
Development Time:	blown clean	Salinity (ppm):	
		Temp °C:	

Groundwater Abstract (Pty) Ltd

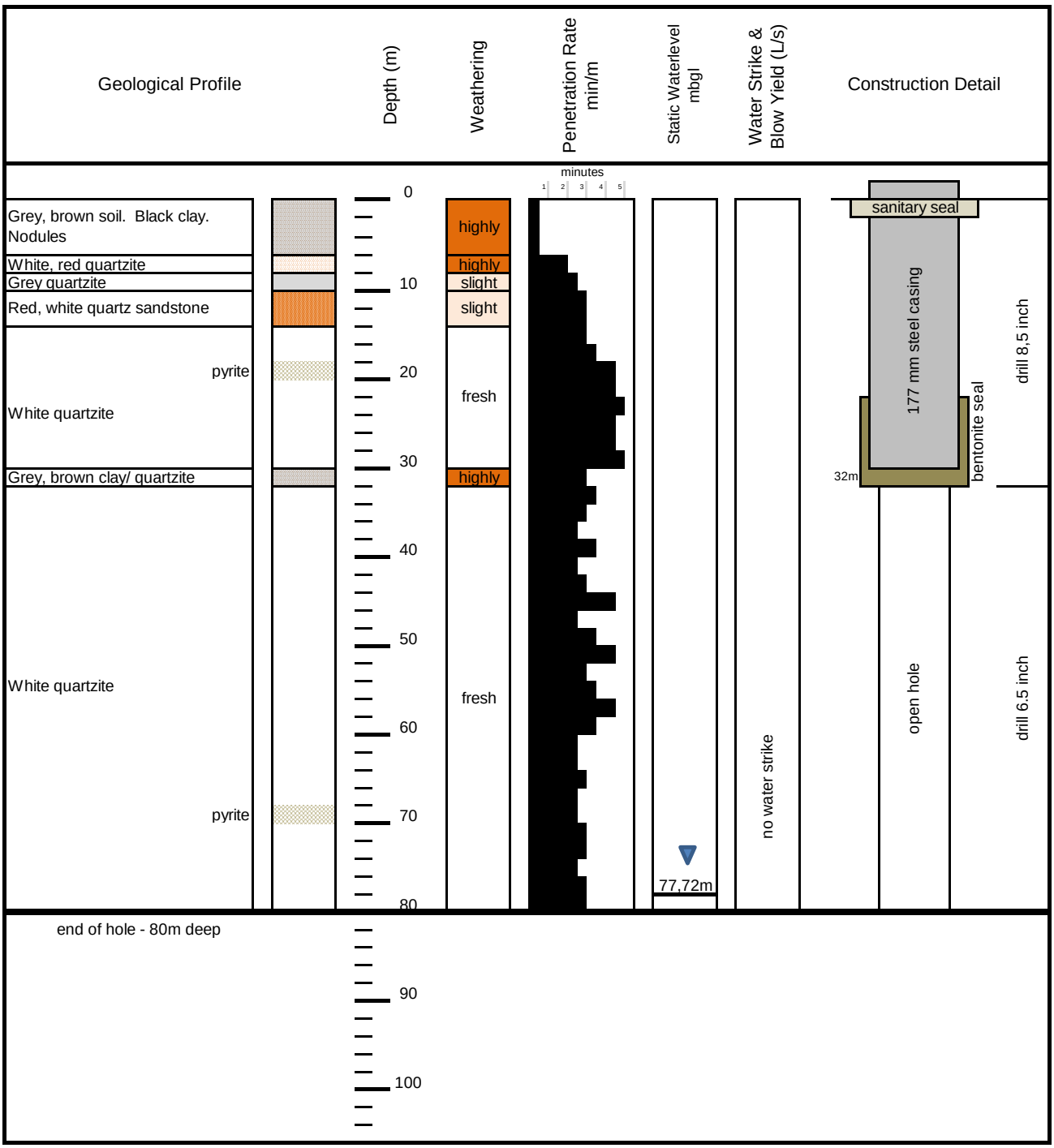
Lucas Smith

0825778439

Lucas@wellsafrica.com



Percussion Drilling Borehole Log	Borehole No. VS_BH 2d
Client:	**Ergo Mining (Pty) Ltd**
PROJECT: Valley Silts Expansion	COORDINATES
LOCATION: Crown - Booysens area	Latitude 26°13'17.31"S
DRILLER: Georoc Drilling	Longitude 27°59'01.48"E
DRILL DATE: 04/03/2025	Elevation 1663 mamsl
LOGGED BY Lucas Smith	COORD SYSTEM WGS84



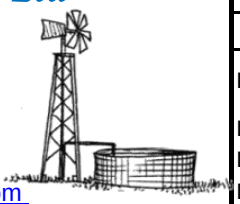
Casing Height:	26 cm	pH:	
		EC (ms/m):	
Concrete Height:	26 cm	TDS (mg/L):	sample not taken
		TDS (ppm):	
Development Time:	Blown clean	Salinity (ppm):	
		Temp °C:	

Groundwater Abstract (Pty) Ltd

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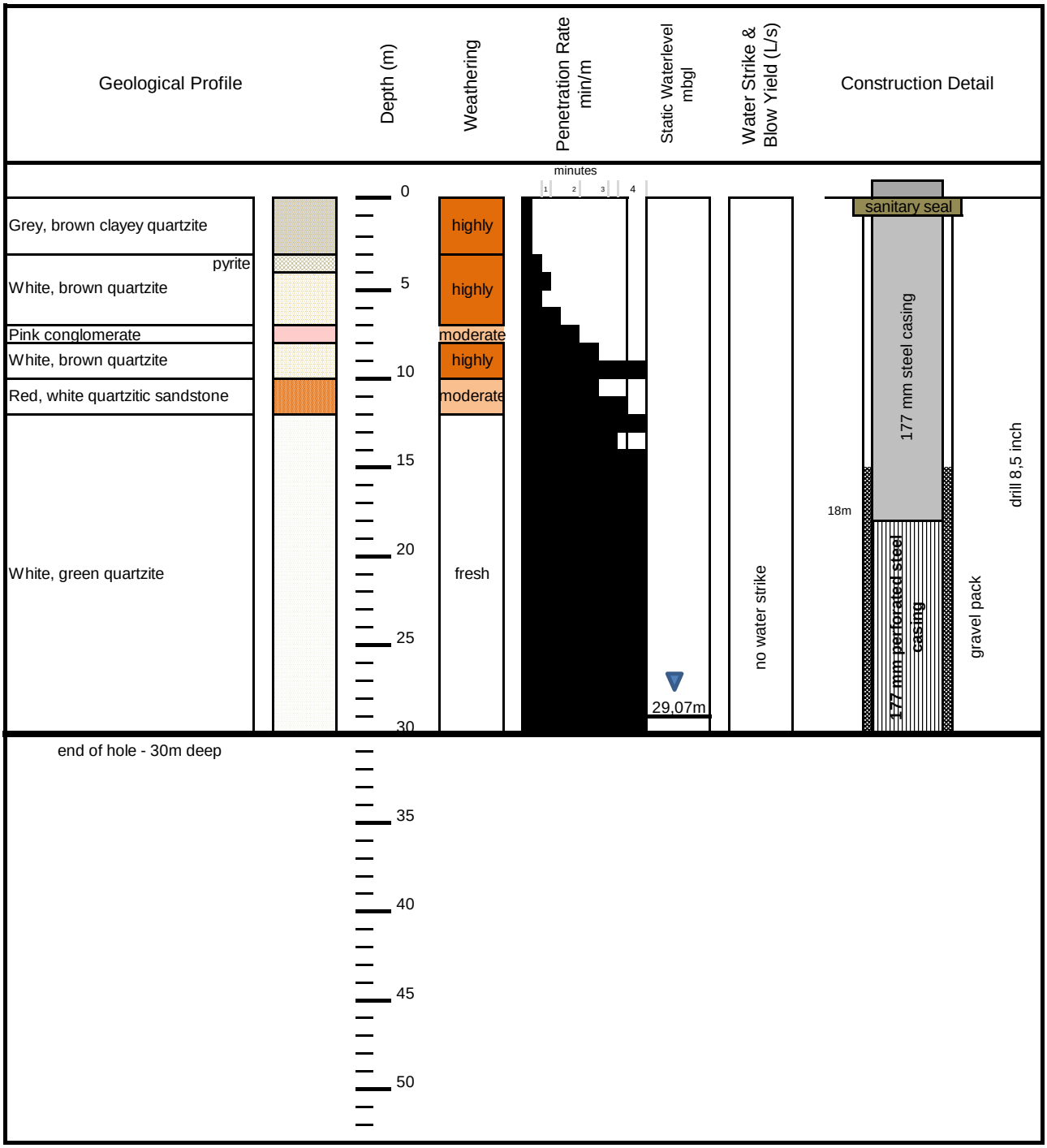
Percussion Drilling Borehole Log

Borehole No. VS_BH 2s

Client: Ergo Mining (Pty) Ltd

PROJECT:	Valley Silts Expansion
LOCATION:	Crown - Booysens area
DRILLER:	Georock Drilling
DRILL DATE:	05/03/2025
LOGGED BY	Lucas Smith

COORDINATES	
Latitude	26°13'17.35"S
Longitude	27°59'01.50"E
Elevation	1663 mamsl
COORD SYSTEM	
	WGS84

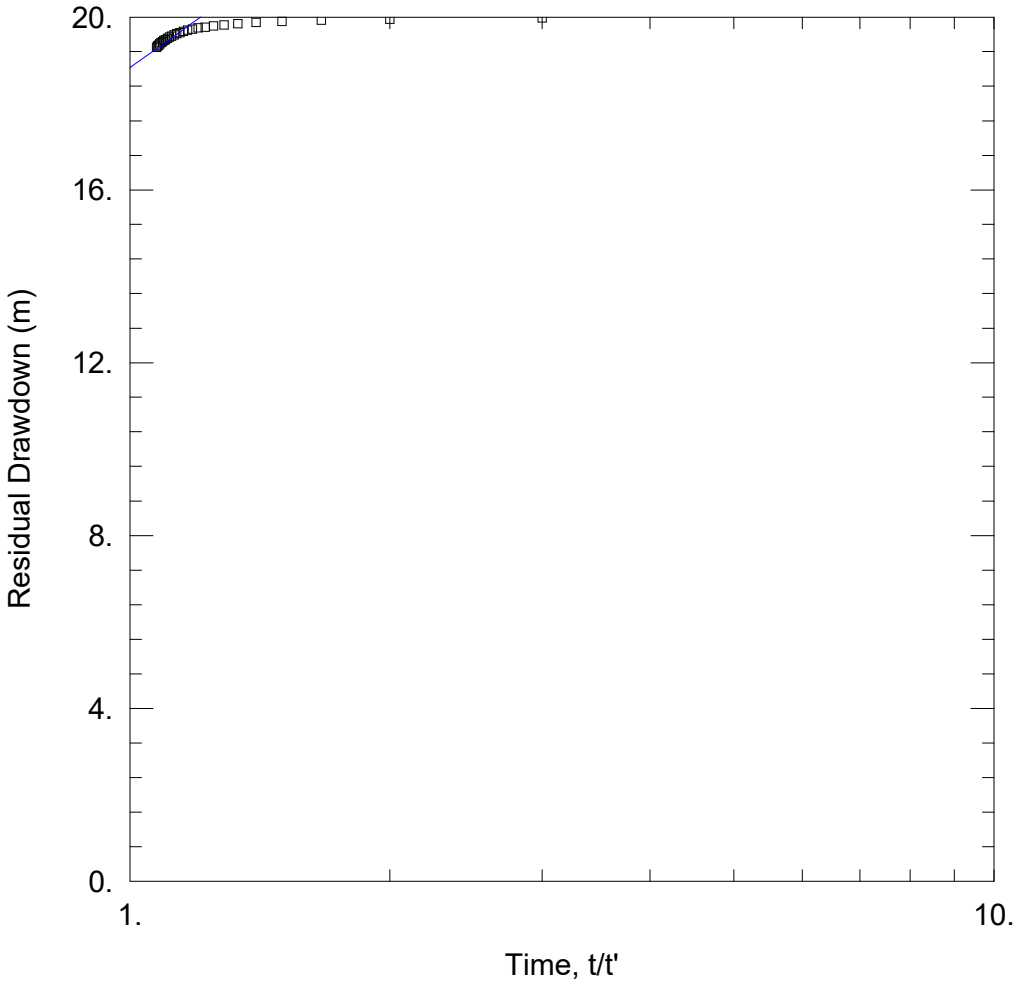


Casing Height:	26 cm	pH:	
		EC (ms/m):	
Concrete Height:	26 cm	TDS (mg/L):	sample not taken
		TDS (ppm):	
Development Time:	blown clean	Salinity (ppm):	
		Temp °C:	

Appendix C

Aquifer Test Data

(Geovation)



WELL TEST ANALYSIS

Data Set: D:\24-17 Valley Silt\VSBH1D_Pump out.aqt
Date: 03/10/25 Time: 15:17:08

PROJECT INFORMATION

Company: Groundwater Abstract
Client: DRD
Location: JHB
Test Well: VSBH1S
Test Date: 03/03/2025

AQUIFER DATA

Saturated Thickness: 20. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
VSBH1D	0	0

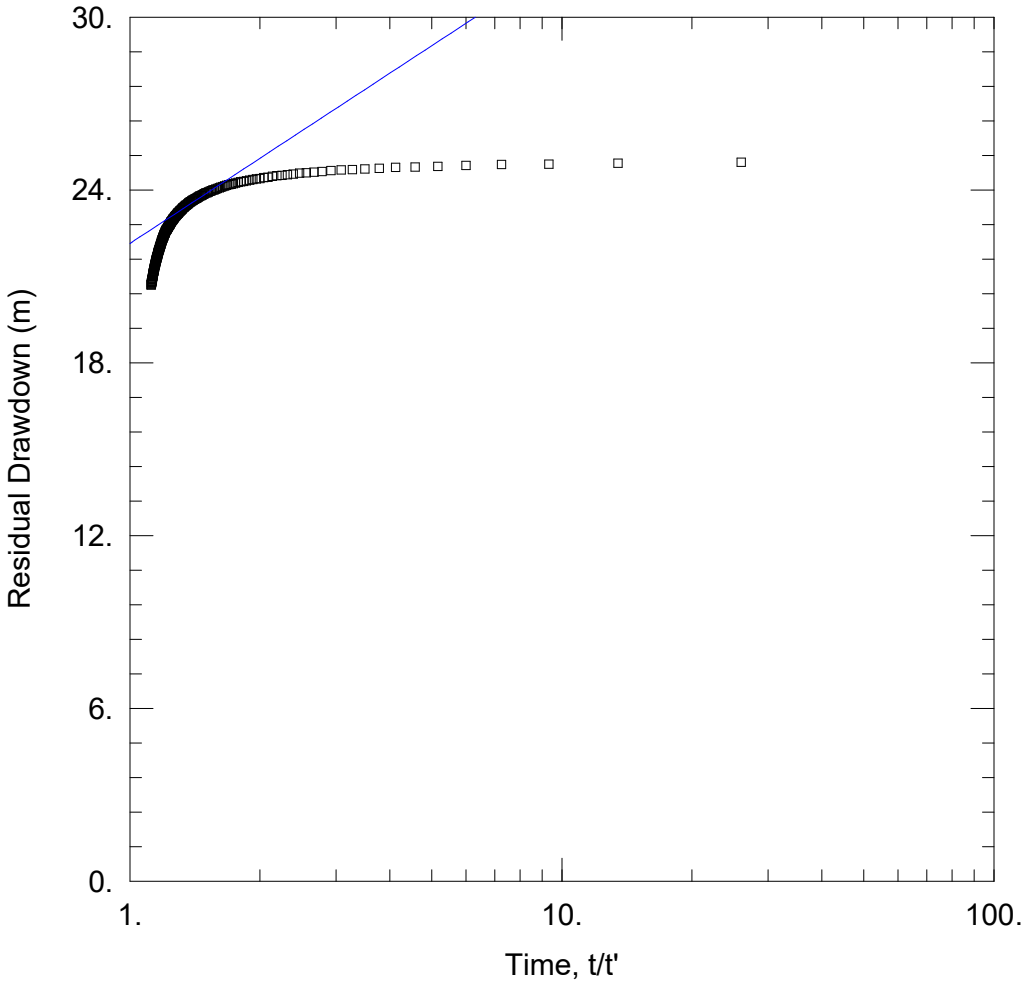
Observation Wells

Well Name	X (m)	Y (m)
▫ VSBH1D	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 1.104 m^2/day S/S' = 0.04865



WELL TEST ANALYSIS

Data Set: D:\24-17 Valley Silt\VSBH1S_Pump out.aqt
Date: 03/10/25 Time: 14:54:12

PROJECT INFORMATION

Company: Groundwater Abstract
Client: DRD
Location: JHB
Test Well: VSBH1S
Test Date: 03/03/2025

AQUIFER DATA

Saturated Thickness: 26. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
VSBH1S	0	0

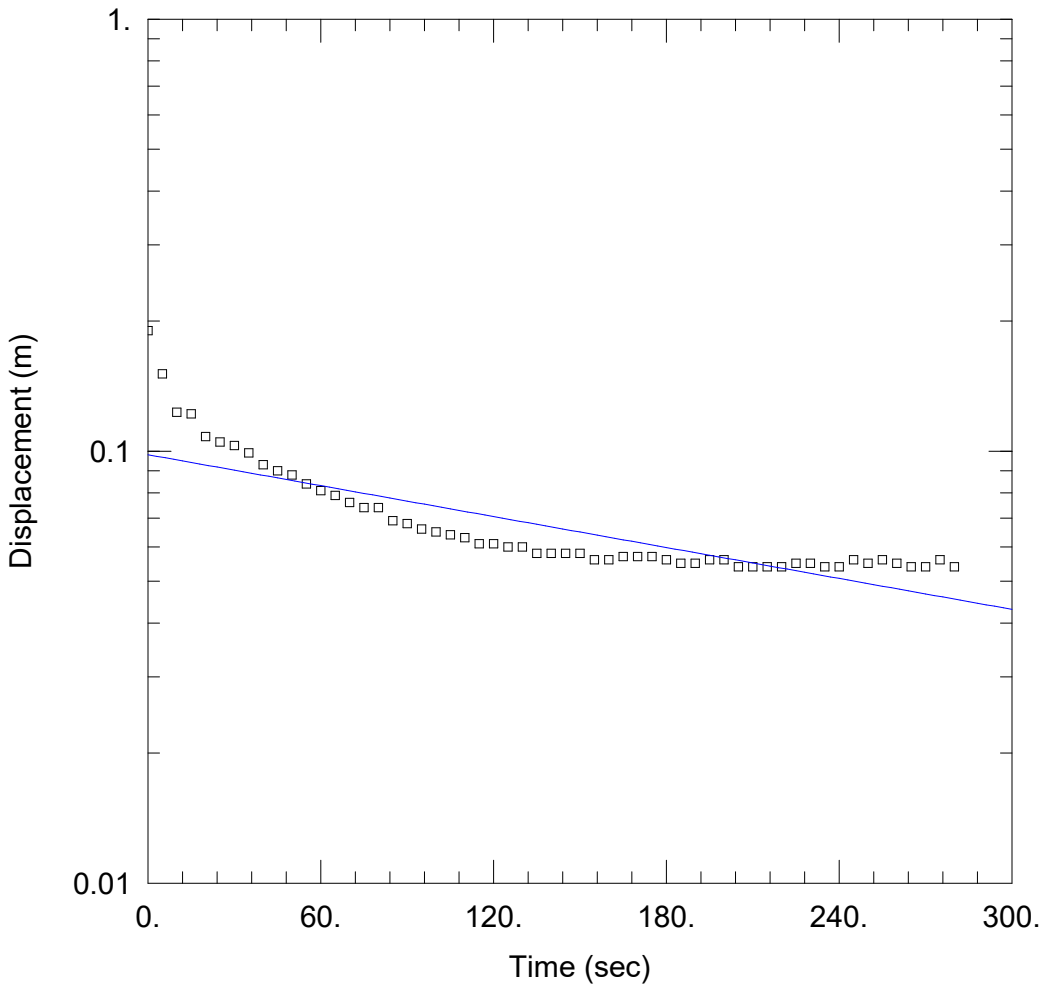
Observation Wells

Well Name	X (m)	Y (m)
▫ VSBH1S	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 1.611 m^2/day S/S' = 0.005588



WELL TEST ANALYSIS

Data Set: D:\24-17 Valley Silt\VSBH1S_Slug.aqt
Date: 03/10/25 Time: 13:23:43

PROJECT INFORMATION

Company: Groundwater Abstract
Client: DRD
Location: JHB
Test Well: VSBH1S
Test Date: 28/02/2025

AQUIFER DATA

Saturated Thickness: 26. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (VSBH1S)

Initial Displacement: 0.19 m
Total Well Penetration Depth: 27. m
Casing Radius: 0.08 m
Static Water Column Height: 26. m
Screen Length: 24. m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.1455 m/day
y0 = 0.09811 m

Appendix D

Water Laboratory Certificates

Test Report

Client: Groundwater Abstract Pty Ltd GWA
Address: 828 20th Avenue , Rietfontein, Pretoria, 0084
Report no: 213427
Project: Valley Silts

Date of report: 12 March 2025
Date accepted: 28 February 2025
Date completed: 12 March 2025
Date received: 28 February 2025

					212841	212842	212843
Lab no:							
Date sampled:					27-Feb-25	27-Feb-25	27-Feb-25
Aquatico sampled:					No	No	No
Sample type:					Water	Water	Water
Locality description:					Val1	Val2	Val4
		Analyses	**Unit**	**Method**			
A	AQL	pH @ 25°C	pH	ALM 20	7.49	7.55	8.17
A	AQL	Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	222	271	31.9
A	AQL	Total dissolved solids (TDS)	mg/l	ALM 26	1756	2127	189
A	AQL	Total Alkalinity	mg $CaCO_3$/l	ALM 01	62.8	48.0	97.7
A	AQL	Chloride (Cl)	mg/l	ALM 02	81.9	145	25.6
A	AQL	Sulphate (SO_4)	mg/l	ALM 03	1125	1388	23.5
A	AQL	Nitrate (NO_3) as N	mg/l	ALM 06	0.269	<0.194	4.19
A	AQL	Total oxidised nitrogen as N	mg/l	ALM 06	0.269	<0.194	4.19
A	AQL	Ammonium (NH_4) as N	mg/l	ALM 05	14.6	0.887	0.229
A	AQL	Fluoride (F)	mg/l	ALM 08	<0.263	<0.263	<0.263
A	AQL	Acid Soluble Calcium (Ca)	mg/l	ALMA 30	232	376	37.5
A	AQL	Acid Soluble Magnesium (Mg)	mg/l	ALMA 30	66.9	82.1	16.8
A	AQL	Acid Soluble Sodium (Na)	mg/l	ALMA 30	164	92.3	5.78
A	AQL	Acid Soluble Potassium (K)	mg/l	ALMA 30	28.2	12.9	1.28
A	AQL	Acid Soluble Aluminium (Al)	mg/l	ALMA 31	<0.002	<0.002	<0.002
A	AQL	Acid Soluble Iron (Fe)	mg/l	ALMA 31	11.7	18.3	4.59
A	AQL	Acid Soluble Manganese (Mn)	mg/l	ALMA 31	5.45	53.0	0.294
A	AQL	Acid Soluble Chromium (Cr)	mg/l	ALMA 31	<0.003	<0.003	<0.003
A	AQL	Acid Soluble Copper (Cu)	mg/l	ALMA 31	0.015	0.016	<0.002
A	AQL	Acid Soluble Nickel (Ni)	mg/l	ALMA 31	<0.002	0.123	<0.002
A	AQL	Acid Soluble Zinc (Zn)	mg/l	ALMA 31	<0.002	<0.002	<0.002
A	AQL	Acid Soluble Cadmium (Cd)	mg/l	ALMA 31	0.003	0.003	<0.002
A	AQL	Acid Soluble Lead (Pb)	mg/l	ALMA 31	<0.004	0.012	<0.004
A	AQL	E.coli	CFU/100ml	ALM 40	<1	<1	7
A	AQL	Total coliform	CFU/100ml	ALM 40	5	<1	40

A = Accredited N = Non accredited Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report ; Results relate only to the items received and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

Test Report

Client: Groundwater Abstract Pty Ltd GWA
Address: 828 20th Avenue , Rietfontein, Pretoria, 0084
Report no: 213427
Project: Valley Silts

Date of report: 12 March 2025
Date accepted: 28 February 2025
Date completed: 12 March 2025
Date received: 28 February 2025

					212841	212842	212843
Lab no:							
Date sampled:					27-Feb-25	27-Feb-25	27-Feb-25
Aquatico sampled:					No	No	No
Sample type:					Water	Water	Water
Locality description:					Val1	Val2	Val4
		Analyses	**Unit**	**Method**			
A	AQL	Turbidity	NTU	ALM 21	302	317	42.5
A	AQL	Total hardness	mg $CaCO_3$/l	ALM 26	855	1278	163
A	AQL	Total organic carbon (TOC)	mg/l	ALM 63	18.9	11.2	2.18
A	AQL	Langelier Saturation Index	LSI	ALM 26	-0.39	-0.24	-0.21

A = Accredited N = Non accredited Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report ; Results relate only to the items received and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

Authenticated signature on first page

aquatico Laboratories (Pty). Ltd.

ilac-MRA sanas Testing Laboratory T0685

Test Report

Client: Groundwater Abstract Pty Ltd GWA
Address: 828 20th Avenue , Rietfontein, Pretoria, 0084
Report no: 213830
Project: ERGO samples

Date of report: 12 March 2025
Date accepted: 04 March 2025
Date completed: 12 March 2025
Date received: 04 March 2025

Lab no:					214464	214465
Date sampled:					03-Mar-25	03-Mar-25
Aquatico sampled:					No	No
Sample type:					Water	Water
Locality description:					VSBH-1D	VSBH-1S
		Analyses	**Unit**	**Method**		
A	AQL	pH @ 25°C	pH	ALM 20	4.52	4.87
A	AQL	Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	403	317
A	AQL	Total dissolved solids (TDS)	mg/l	ALM 26	4134	2991
A	AQL	Total Alkalinity	mg $CaCO_3$/l	ALM 01	21.3	14.5
A	AQL	Chloride (Cl)	mg/l	ALM 02	31.0	59.0
A	AQL	Sulphate (SO_4)	mg/l	ALM 03	3126	2395
A	AQL	Nitrate (NO_3) as N	mg/l	ALM 06	1.49	1.01
A	AQL	Total oxidised nitrogen as N	mg/l	ALM 06	1.49	1.01
A	AQL	Ammonium (NH_4) as N	mg/l	ALM 05	0.263	0.758
A	AQL	Fluoride (F)	mg/l	ALM 08	<0.263	<0.263
A	AQL	Acid Soluble Calcium (Ca)	mg/l	ALMA 30	493	341
A	AQL	Acid Soluble Magnesium (Mg)	mg/l	ALMA 30	246	96.6
A	AQL	Acid Soluble Sodium (Na)	mg/l	ALMA 30	210	77.7
A	AQL	Acid Soluble Potassium (K)	mg/l	ALMA 30	9.09	6.94
A	AQL	Acid Soluble Aluminium (Al)	mg/l	ALMA 31	2.07	25.1
A	AQL	Acid Soluble Iron (Fe)	mg/l	ALMA 31	296	441
A	AQL	Acid Soluble Manganese (Mn)	mg/l	ALMA 31	38.2	34.7
A	AQL	Acid Soluble Chromium (Cr)	mg/l	ALMA 31	<0.003	<0.003
A	AQL	Acid Soluble Copper (Cu)	mg/l	ALMA 31	0.043	0.077
A	AQL	Acid Soluble Nickel (Ni)	mg/l	ALMA 31	5.21	10.2
A	AQL	Acid Soluble Zinc (Zn)	mg/l	ALMA 31	2.19	7.99
A	AQL	Acid Soluble Cadmium (Cd)	mg/l	ALMA 31	0.063	0.117
A	AQL	Acid Soluble Lead (Pb)	mg/l	ALMA 31	<0.004	<0.004
A	AQL	E.coli	CFU/100ml	ALM 40	<1	<1
A	AQL	Total coliform	CFU/100ml	ALM 40	20	5

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Client: Groundwater Abstract Pty Ltd GWA
Address: 828 20th Avenue , Rietfontein, Pretoria, 0084
Report no: 213830
Project: ERGO samples

Date of report: 12 March 2025
Date accepted: 04 March 2025
Date completed: 12 March 2025
Date received: 04 March 2025

Lab no:					214464	214465
Date sampled:					03-Mar-25	03-Mar-25
Aquatico sampled:					No	No
Sample type:					Water	Water
Locality description:					VSBH-1D	VSBH-1S
		Analyses	**Unit**	**Method**		
A	AQL	Turbidity	NTU	ALM 21	626	730
A	AQL	Total hardness	mg $CaCO_3$/l	ALM 26	2243	1249
A	AQL	Total organic carbon (TOC)	mg/l	ALM 63	4.18	5.42
A	AQL	Langelier Saturation Index	LSI	ALM 26	-3.51	-3.48

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aquatico Laboratories (Pty). Ltd.

ilac-MRA sanas Testing Laboratory T0685

Test Report

Client: Groundwater Abstract Pty Ltd GWA
Address: 828 20th Avenue , Rietfontein, Pretoria, 0084
Report no: 217438
Project: Valley Silts

Date of report: 04 April 2025
Date accepted: 02 April 2025
Date completed: 04 April 2025
Date received: 02 April 2025

Lab no:					230882	230883
Date sampled:					02-Apr-25	02-Apr-25
Aquatico sampled:					No	No
Sample type:					Water	Water
Locality description:					VS BH2S	VS BH2D
		Analyses	**Unit**	**Method**		
A	AQL	pH @ 25°C	pH	ALM 20	6.22	5.69
A	AQL	Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	299	341
A	AQL	Total dissolved solids (TDS)	mg/l	ALM 26	2757	3085
A	AQL	Total Alkalinity	mg $CaCO_3$/l	ALM 01	43.5	41.4
A	AQL	Chloride (Cl)	mg/l	ALM 02	77.2	78.1
A	AQL	Sulphate (SO_4)	mg/l	ALM 03	2011	2246
A	AQL	Nitrate (NO_3) as N	mg/l	ALM 06	<0.194	<0.194
A	AQL	Total oxidised nitrogen as N	mg/l	ALM 06	<0.194	<0.194
A	AQL	Ammonium (NH_4) as N	mg/l	ALM 05	0.328	0.196
A	AQL	Fluoride (F)	mg/l	ALM 08	<0.263	<0.263
A	AQL	Acid Soluble Calcium (Ca)	mg/l	ALMA 30	334	414
A	AQL	Acid Soluble Magnesium (Mg)	mg/l	ALMA 30	168	149
A	AQL	Acid Soluble Sodium (Na)	mg/l	ALMA 30	121	145
A	AQL	Acid Soluble Potassium (K)	mg/l	ALMA 30	18.5	26.9
A	AQL	Acid Soluble Aluminium (Al)	mg/l	ALMA 31	0.023	0.071
A	AQL	Acid Soluble Iron (Fe)	mg/l	ALMA 31	83.5	72.7
A	AQL	Acid Soluble Manganese (Mn)	mg/l	ALMA 31	68.3	74.3
A	AQL	Acid Soluble Chromium (Cr)	mg/l	ALMA 31	<0.003	0.017
A	AQL	Acid Soluble Copper (Cu)	mg/l	ALMA 31	0.019	0.022
A	AQL	Acid Soluble Nickel (Ni)	mg/l	ALMA 31	1.40	5.83
A	AQL	Acid Soluble Zinc (Zn)	mg/l	ALMA 31	0.036	0.391
A	AQL	Acid Soluble Cadmium (Cd)	mg/l	ALMA 31	0.012	0.008
A	AQL	Acid Soluble Lead (Pb)	mg/l	ALMA 31	<0.004	0.012
A	AQL	E.coli	CFU/100ml	ALM 40	<1	<1
A	AQL	Total coliform	CFU/100ml	ALM 40	<1	<1

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Lab no:					230882	230883
Date sampled:					02-Apr-25	02-Apr-25
Aquatico sampled:					No	No
Sample type:					Water	Water
Locality description:					VS BH2S	VS BH2D
		Analyses	**Unit**	**Method**		
A	AQL	Turbidity	NTU	ALM 21	566	133
A	AQL	Total hardness	mg $CaCO_3$/l	ALM 26	1525	1650
A	AQL	Total organic carbon (TOC)	mg/l	ALM 63	19.1	12.3
A	AQL	Langelier Saturation Index	LSI	ALM 26	-1.69	-2.16

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Appendix E

Impact Assessment Table

No.	Affected Environment	Activity	Impact Description	BEFORE MITIGATION						Cumulative Impact	Mitigation measures / Recommendations	AFTER MITIGATION					
				Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE			Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE
	Construction																
1	Groundwater	Site clearing and infrastructure development	**Quantity** - Quantity impacts are not expected during Construction.	*Minor -*	*Short Term < 18 months*	*Site or Local*	Low	*Possible*	Low	Yes	Implement a surface water management plan to minimise the volume of dirty water produced thereby reducing the probability of contamination of groundwater from infiltration of dirty surface water. Allow clean water to bypass the dirty areas and flow into the natural environment. Time-series groundwater monitoring is required to predict the groundwater level and related impacts. Dedicated groundwater monitoring boreholes must be used.	*Minor +*	*Short Term < 18 months*	*Site or Local*	Low	*Possible*	Low
2	Groundwater	Site clearing and infrastructure development	**Quality** - Any activity in the stream and opening of ground and may allow water and air to enter the silt, likely after rainfall. Deterioration in groundwater quality due to the increased suspended solids seeping in from exposed surfaces, plus pyrite starting to react. Additional quality impacts are suspected to be low during Construction.	*Minor -*	*Short Term < 18 months*	*Site or Local*	Low	*Possible*	Low	Yes	The slimes dams and sand dumps along the Russell Stream are all potential sources of pollution. In the current state of the stream (with silt) and after removal of the silt these pollution sources next to the stream must be managed more effectively to ensure no contaminated silt, surface or groundwater enters the rehabilitated Russell Stream. Current water qualities indicate high salt and metal concentrations, with a low pH water found in the drains along the TSF footprint areas. Implement a groundwater monitoring program before excavation starts. Dedicated groundwater monitoring boreholes along the Russell Stream and borehole VAL1 must be used to effectively measure the groundwater status, impacts of the activities on the groundwater environment. Develop sound surface runoff management plans to ensure that all dirty runoff from the stockpile areas, but also from the adjacent slimes dams and sand dumps are contained and diverted to the intercept trench and sumps. No pooling of water on surface allowed. Implement cutoff trenches and berms to avoid washing in of additional silt and slimes from the nearby tailings dams. Also refer to Section 11 in the groundwater impact assessment report.	*Minor +*	*Short Term < 18 months*	*Site or Local*	Low	*Possible*	Low
	Operation																
3	Groundwater	Russell Stream reclamation	**Quantity** - The proposed stream rehabilitation will not have any significant impacts on the groundwater quantity. There is a possibility that water will seep into the underlaying formations, but the additional recharge should be neglectable.	*Minor +*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium	Yes	The dedicated groundwater monitoring network must be used and level and quality sampling must be done according to the Licence conditions. More important - the monitoring data is requiredcto assess possible impacts on the local surface water and groundwater environments. Also refer to Section 11 in the groundwater impact assessment report.	*Minor -*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium
4	Groundwater	Russell Stream reclamation	**Quality** - Possible acidic water and an increase in salt and metal concentrations associated with leaching from excavation and stockpiles. Water quality in the area will slowly start deteriorating if surface water management is ineffective, which can be magnified with the oxidation of pyrite: high concentrations of sulphate and iron suspected. This should be contained on site and the water moved of the open surfaces as soon as possible to avoid contamination.	*Major -*	*Long Term > 5 years*	*Site or Local*	High	*Possible*	High	Yes	Maintain an effective storm water management program and infrastructure to contain all waste water. All sumps should be lined to prevent infiltration of contaminated seepage water. Monitor groundwater quality in all boreholes installed. The groundwater monitoring network efficiency must be assessed and new monitoring boreholes drilled, if required. Ensure that intercept trench and sumps can contain all dirty water generated during the excavation process to prevent overflows and spillages. Ensure that sufficient cutoff trenches and berms are implemented to avoid future wash of silt and slimes from the historical TSF situated adjacent to the Valley Silts Project. Also refer to Section 11 in the groundwater impact assessment report.	*Minor -*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium
	Decomissioning																
5	Groundwater	Break down and remove all infrastructure	**Quantity** - No negative impacts expected.	*Moderate +*	*Long Term > 5 years*	*Site or Local*	Medium	*Definite*	Medium	Yes	Monitor the water table.	*Moderate +*	*Long Term > 5 years*	*Site or Local*	Medium	*Definite*	Medium
6	Groundwater	Break down and remove all infrastructure	**Quality:** The spread of contamination in the weathered aquifer will most probably reduce as the source of in-stream contamination has been removed	*Minor +*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium	Yes	Maintain cut off trenches and sumps. Most element concentrations in the ground will reduce in the long-term. Time-series groundwater monitoring must continue.	*Moderate +*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium
	Post- Closure																
7	Groundwater	No activities	**Quantity** -No impacts forseen	*Minor +*	*Long Term > 5 years*	*Site or Local*	Medium	*Definite*	Medium	Yes	Monitor the water table.	*Moderate +*	*Long Term > 5 years*	*Site or Local*	Medium	*Definite*	Medium
8	Groundwater	No activities	**Quality:** The spread of contamination in the weathered and fractured aquifers will most probably reduce as the source of in-stream contamination has been removed	*Moderate -*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium	Yes	Maintain cut off trenches and sumps. Most element concentrations in the ground will reduce in the long-term. Time-series groundwater monitoring must continue.	*Moderate +*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium

APPENDIX D:

Specialist Studies

- ❖ **Appendix D7 – Heritage Report**

Valley Silts Expansion Project

Located on various properties in Wards 68 and 124 of the City of Johannesburg Metropolitan Municipality, Gauteng Province

Heritage Impact Assessment

Template Number	Document Number	Revision	Date
PGS PJ REP 007 01	840HIA-001	1.0	23 April 2025

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REVISION HISTORY

Version	Issue Date	Description of Changes
01	23/04/2025	

Declaration of Independence

- I, Tyron Hopf, declare that –
- General declaration:
- I act as the independent heritage 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 heritage 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;

HERITAGE CONSULTANT: PGS Heritage (Pty) Ltd

CONTACT PERSON: Tyron Hopf – Archaeologist

Tel: +27 (0) 12 332 5305

Email:

SIGNATURE: _____ _____

ACKNOWLEDGEMENT OF RECEIPT

Report Title			
Control	**Name**	**Signature**	**Designation**
Author	T.D. Hopf		PGS Heritage Archaeologist
Reviewer	W. Fourie		PGS Heritage Principal Heritage Specialist
Reviewer	J Angel		PGS Heritage Senior Archaeologist
Reviewed	G. Wilreker		Kongiwe Environmental (Pty) Ltd – Technical Director

CLIENT: **Kongiwe Environmental (Pty) Ltd**

CONTACT PERSON: **Gerlinde Wilreker**
gwilreker@kongiwe.com



SIGNATURE: _____

The Heritage Impact Assessment Report has been compiled considering the National Environmental Management Act (Act No. 107 of 1998) (NEMA): Appendix 6 of the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended, 2017) requirements for specialist reports as indicated in the table below.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii of Report – Contact details and company
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 1.2 – refer to Appendix C
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
(cA) An indication of the quality and age of base data used for the specialist report	N/A
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 4.4
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Appendix A and B
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 4
(g) An identification of any areas to be avoided, including buffers	Section 4
(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;	Section 4.3
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
(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 4
(k) Any mitigation measures for inclusion in the EMPr	Section 6
(l) Any conditions for inclusion in the environmental authorization	Section 6
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorization	Section 6
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 6 and 7
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and	
(n)(ii) If the opinion is that the proposed activity, activities 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	Section 6
(o) A description of any consultation process that was undertaken during the course of carrying out the study	Informal consultation in fieldwork.
(p) A summary and copies if any comments that were received during any consultation process	Not applicable. To date no comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.	Not applicable.
(2) Where a government notice 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.	No protocols or minimum standards for HIAs or PIAs

EXECUTIVE SUMMARY

PGS Heritage (Pty) Ltd was appointed by Kongiwe Environmental (Pty) Ltd (Kongiwe) to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Authorisation (EA) process for the proposed Valley Silts Expansion Project located on various properties (see **Table 2**) in Wards 68 and 124 of the City of Johannesburg Metropolitan Municipality, Gauteng Province.

During the fieldwork the following two heritage features were identified:

- One historical structure (**VS1**),
- One Cemetery (**VS2**).

Historical Structures

VS1 is the remains of a historical structure comprised of a linear coursed sandstone wall and a coursed sandstone lined rectangular pit adjacent to the Russell Stream. See **Figure 14** and the individual site descriptions as contained in **Appendix C**. The field description forms were collected with ArcGIS Survey123 in field software.

Burial Grounds and Graves

It is for noting that a cemetery, previously identified as **VS2** (PGS, 2019), is contained within the project boundary but **does not fall within the current planned infrastructure area**. The proposed project expansion will now bring the cemetery to within 100 m of the proposed project activity. This cemetery consists of an estimated 50 graves which appear to be arranged in rows. The majority of graves were stone packed with many featuring well-defined stone-packed linings. A child's grave marked with a formal headstone dates to the early 20th century.

Palaeontology

The Valley Silts project occurs in an area where the palaeontology is assessed as being almost entirely of Low sensitivity (coloured blue) and no palaeontological studies are required. Since it is anticipated that there should be no excavation into the underlying geology and the area surrounding the dumps has been disturbed extensively in the past, it is recommended that an application for exemption from the standard requirement for a Palaeontological Impact Assessment be made to SAHRA.

Mitigation measures

All burial grounds and graves must be retained and avoided with a **buffer zone of 50 m** as per SAHRA guidelines.

In the event that the historical site cannot be excluded from the planned reclamation activities, further research into the site must include:

- Exposing the structure through archaeological excavation
- Archival research on the structure
- Analysis of any artefacts recovered during the excavations
- If it is found that after mitigation the site is not conservation worthy an application for destruction must be lodged under s35 of the NHRA.
- If the site is to be retained after mitigation a site-specific heritage management plan for the site must be developed and submitted for approval to the SAHRA.

Historical Structures

The finds are provisionally rated as having a **low** heritage significance with a heritage rating of **IIIC**. The impact significance before mitigation on the historical structures will be **Medium** negative before mitigation. Implementation of the recommended mitigation measures will modify this impact rating to an acceptable **LOW** negative.

In the event that the site cannot be excluded from the planned reclamation activities, further research into the site must include:

- Exposing the structure through archaeological excavation
- Archival research on the structure
- Analysis of any artefacts recovered during the excavations
- If it is found that after mitigation the site is not conservation worthy an application for destruction must be lodged under s35 of the NHRA.

If the site is to be retained after mitigation a site-specific heritage management plan for the site must be developed and submitted for approval to the SAHRA.

Burial Grounds and graves

Burial grounds and graves are always regarded as having **high** heritage significance and a grading of **IIIA**. While the cemetery is not anticipated to be affected project related infrastructure, it is recommended that the area be demarcated as a cemetery with an appropriate buffer in place. The impact significance before mitigation on the cemetery and graves sites will be High negative before mitigation. Implementation of the recommended mitigation measures will modify this impact rating to an acceptable Medium to Low negative.

All burial grounds and graves must be retained and avoided with a **buffer zone of 50 m** as per SAHRA guidelines.

If this is not possible, the graves should be relocated after completion of a detailed grave relocation process, that includes a thorough stakeholder engagement component, adhering to the requirements of Section 36 of the NHRA and its regulations as well as the National Health Act and its regulations and any provincial legislation.

Mitigation measures are described in **Table 10** of this report.

Conclusion

It is the author's considered opinion that overall impact on heritage resources is Medium to Low. Provided that the recommended mitigation measures are implemented, the impact would be acceptably low or could be totally mitigated to the degree that the project could be approved from a heritage perspective. The management and mitigation measures as described in Section 6 of this report have been developed to minimise the project impact on heritage resources

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This 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:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2 500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Abbreviations	Description
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DFFE	Department of Forestry, Fisheries, and the Environment
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NHRA	National Heritage Resources Act, 1999 (Act 25 of 1999)
PHRA-G	Gauteng Provincial Heritage Resources Authority
PHS	Provincial Heritage Site
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

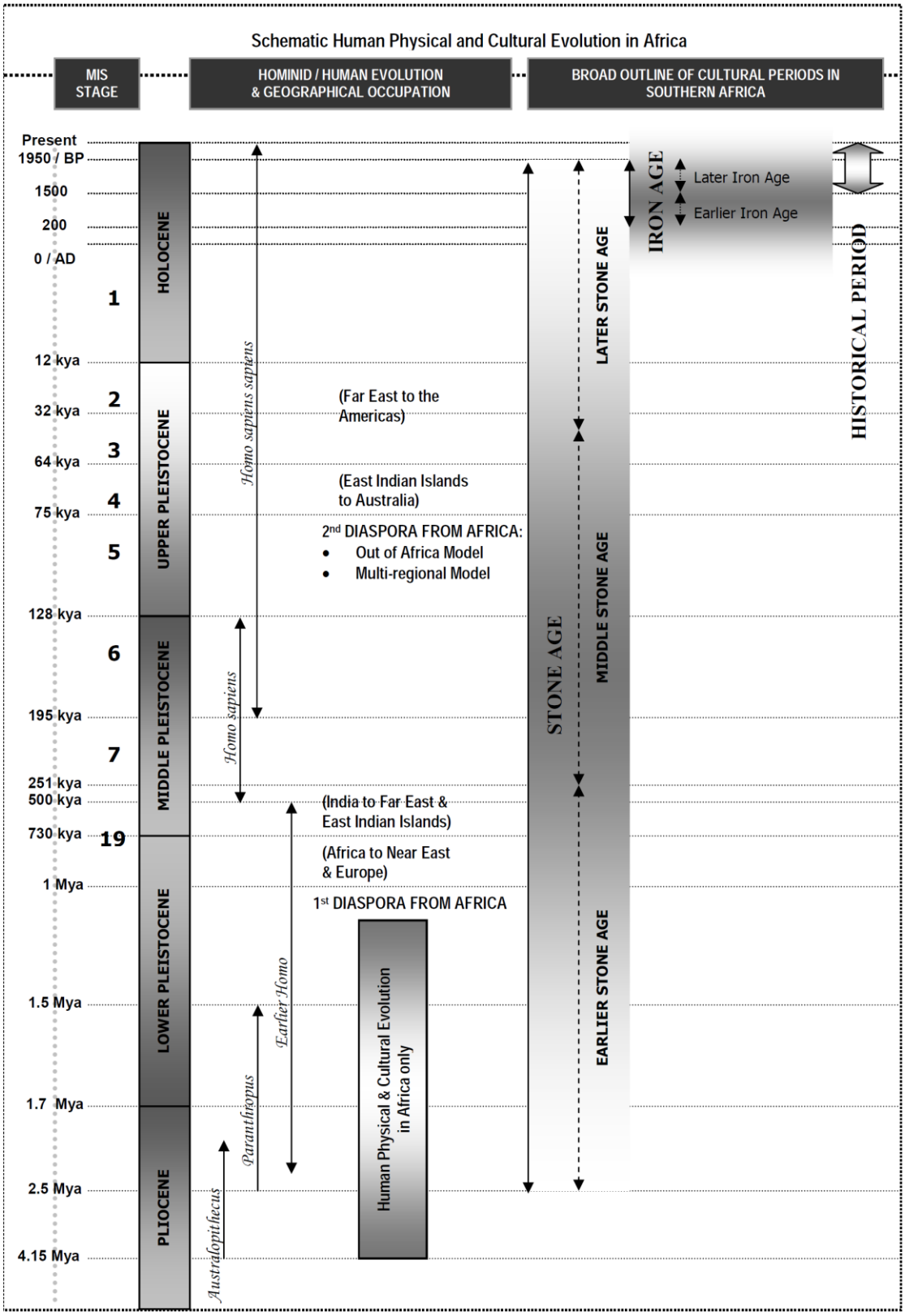


Figure 1 – Human and Cultural Timeline in Africa

1 INTRODUCTION

PGS Heritage (Pty) Ltd was appointed by Kongiwe Environmental (Pty) Ltd (Kongiwe) to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Authorisation (EA) process for the proposed Valley Silts Expansion Project located on various properties (see **Table 2**) in Wards 68 and 124 of the City of Johannesburg Metropolitan Municipality, Gauteng Province.

1.1 Scope of the Study

The aim of the study is to identify heritage sites and finds that may occur in the proposed project area. The HIA aims to inform the EIA phase and assist the developer in managing any discovered heritage resources in a responsible manner. This is done to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This HIA Report was compiled by PGS Heritage (PGS).

The staff at PGS has a combined experience of nearly 70 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Tyron Hopf, the author of this report, is a registered Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA). He has 3 years of experience in the Cultural Resources Management industry and holds a Master's degree (MA) in Archaeology from the University of the Pretoria.

Jessica Angel, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA). She has 10 years of experience in the heritage assessment field and holds a Master's degree (MSc) in Archaeology from the University of the Witwatersrand.

Wouter Fourie, the Project Coordinator and Archaeologist is registered with the ASAPA as a Professional Archaeologist and is accredited as a Principal Investigator; he is further an Accredited

Professional Heritage Practitioner with the Association of Professional Heritage Practitioners (APHP).

1.3 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and existing vegetation cover. Overall, the accessibility of the project footprint area was variable, with some sections more accessible than others. In the accessible areas, the site detection visibility was relatively good, as some areas had been burned, although other areas were obscured by dense vegetation.

Fieldwork was also focussed on areas that have not previously been disturbed by reclamation or other activities, thus focussing on areas with the highest potential to yield heritage resources.

Should any heritage features and/or objects be located or observed during the construction or development activities, a heritage specialist must be contacted immediately. Such observed or located heritage features and/or objects may not be further disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. If any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply as set out below.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

- Notice 320 of the Government Gazette 43110- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified (20 March 2020);
- National Environmental Management Act (NEMA), Act 107 of 1998 – Appendix 6
- National Heritage Resources Act (NHRA), Act 25 of 1999

1.4.1 Notice 320 of the Government Gazette 43110

Although minimum standards for archaeological (2007) and palaeontological (2012) assessments were published by SAHRA, GN.320 requires sensitivity verification for a site selected on the national web based environmental screening tool for which no specific assessment protocol related to any theme has been identified. The requirements for this Government Notice (GN) are listed in **Table 1** and the applicable section in this report noted.

Table 1: Reporting requirements for GN320

GN 320	Relevant section in report	Where not applicable in this report
1.2 (a) a desktop analysis, using satellite imagery;	Section 4.3	
1.2 (b) a preliminary on-site inspection to identify if there are any discrepancies with the current use of land and environmental status quo versus the environmental sensitivity as identified on the national web-based environmental screening tool, such as new developments, infrastructure, indigenous/pristine vegetation, etc.	Section 4	-
1.3(a) confirms or disputes the current use of the land and environmental sensitivity as identified by the national web-based environmental screening tool;	Section 4.3	-
1.3(b) contains motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity;	Section 4.1	-

1.4.2 NEMA – Appendix 6 requirements

The HIA report has been compiled considering the NEMA Appendix 6 requirements for specialist reports as indicated in the table below. For ease of reference, the table below provides cross-references to the report sections where these requirements have been addressed.

1.4.3 The National Heritage Resources Act

- National Heritage Resources Act (NHRA) Act 25 of 1999
    - Protection of Heritage Resources – Sections 34 to 36; and
    - Heritage Resources Management – Section 38

The NHRA is utilized as the basis for the identification, evaluation, and management of heritage resources and in the case of Cultural Resource Management (CRM) those resources specifically impacted on by development as stipulated in Section 38 of NHRA. This study falls under s38(8) and requires comment from the relevant heritage resources authority.

Section 24(2) of the NEMA requires environmental authorisation from the environmental authority for certain activities that have been identified and must undergo an EIA or Basic Assessment (BA) process. Similarly, Section 38 NHRA lists specific development activities that require notice to the heritage resources authority to determine if an HIA process is necessary. Approval from the heritage authority is mandatory before proceeding with the development activities.

To avoid redundancy and facilitate coordination between NEMA and NHRA requirements, Section 38(8) of the NHRA states that if the development activities listed in Section 38(1) require an EIA under NEMA, a separate HIA and approval from the heritage resources authority are unnecessary. However, the environmental authority must ensure that the heritage resources authority's requirements for HIA are fulfilled and that its comments and recommendations are considered before granting environmental authorisation.

Therefore, if a NEMA EIA is required for the development activities listed under Section 38 of the NHRA, separate HIA and EIA processes may not be followed, and different decisions may not be issued under NHRA and NEMA. The EIA process will be followed, and if the heritage resources authority requires HIA, it must be conducted as one of the EIA specialist studies.

The environmental authority must ensure that the heritage resources authority's requirements for the assessment are met. A separate heritage approval may not be issued, but the environmental authority must consider the heritage resources authority's comments and recommendations before granting or refusing environmental authorisation.

It must however be noted that if no environmental process is required, but the proposed development still triggers the requirements for and HIA under section 38(1) of the NHRA, SAHRA or the relevant provincial heritage authority will be the authorising authority. This entity could then require a full HIA completed taking into account the requirements for public participation and stakeholder engagement as contemplate in the regulations under the NHRA.

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Locality

The Valley Silts Project is located in Wards 68 and 124 of the City of Johannesburg Metropolitan Municipality, Gauteng Province (**Figure 2**) on the following properties:

Table 2: properties on which the Valley Silts Project is located.

Portion	Parcel No	Parent Farm
10/225	225	RANDSKOU 324 IQ
107/224	224	MAYFAIR WEST 221 IQ
12/225	225	RANDSKOU 324 IQ
12/225	225	RANDSKOU 324 IQ
13/225	225	RANDSKOU 324 IQ
172/224	224	MAYFAIR WEST 221 IQ
173/224	224	MAYFAIR WEST 221 IQ
174/224	224	MAYFAIR WEST 221 IQ
200/224	224	MAYFAIR WEST 221 IQ
201/224	224	MAYFAIR WEST 221 IQ
204/224	224	MAYFAIR WEST 221 IQ
212/224	224	MAYFAIR WEST 221 IQ
296/224	224	MAYFAIR WEST 221 IQ
297/224	224	MAYFAIR WEST 221 IQ
298/224	224	MAYFAIR WEST 221 IQ
299/224	224	MAYFAIR WEST 221 IQ
300/224	224	MAYFAIR WEST 221 IQ
380/224	224	MAYFAIR WEST 221 IQ
381/224	224	MAYFAIR WEST 221 IQ
381/224	224	MAYFAIR WEST 221 IQ
388/224	224	MAYFAIR WEST 221 IQ
9/224	224	MAYFAIR WEST 221 IQ
9/224	224	MAYFAIR WEST 221 IQ
RE/106/224	224	MAYFAIR WEST 221 IQ
RE/11/224	224	MAYFAIR WEST 221 IQ
RE/225	225	RANDSKOU 324 IQ
RE/3/224	224	MAYFAIR WEST 221 IQ
RE/5/225	225	RANDSKOU 324 IQ
RE/8/224	224	MAYFAIR WEST 221 IQ

2.1.1 Site Description

Ergo holds various Mining Rights (MR) in respect of slimes dams and sand dumps extending 65 km from Western Johannesburg to Eastern Ekurhuleni with most activities occurring on the central and eastern sections of the Witwatersrand mining belt. Ergo obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of NASREC near Booysens Reserve, in Johannesburg. This is known as the Valley Silts project (**Figure 2**). The mining authorisation for the Valley Silts project falls within Mining Right GP 184 MR.

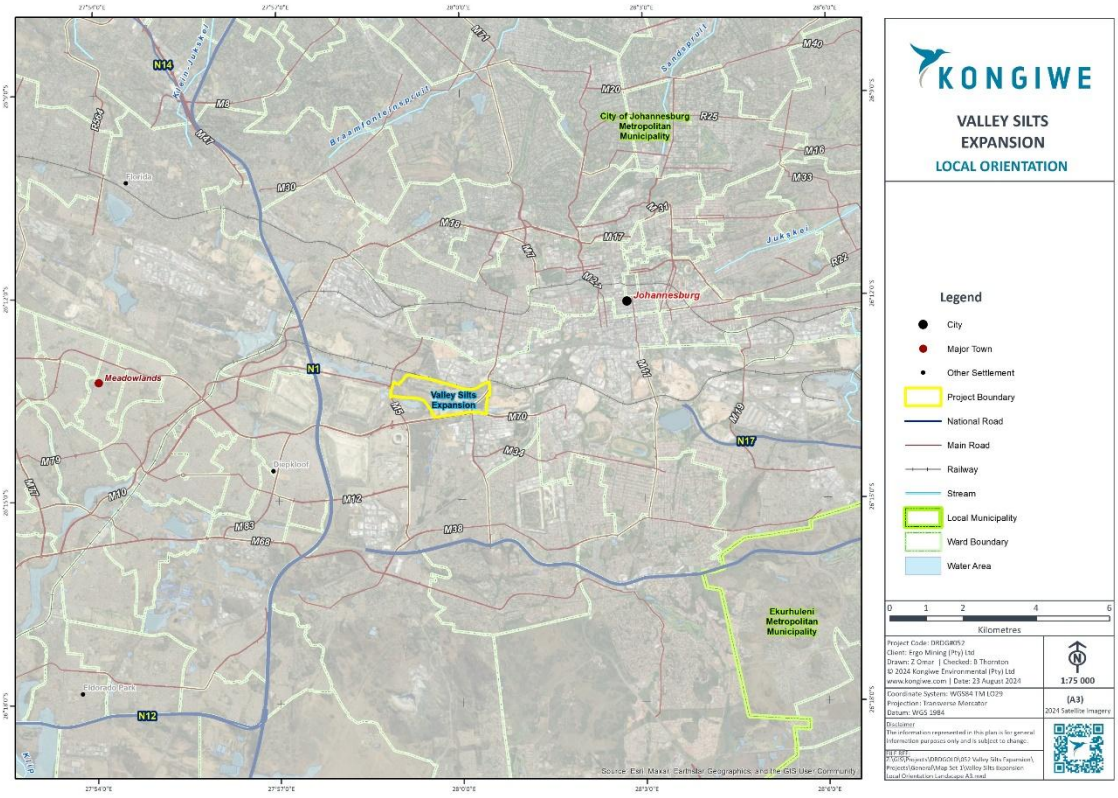


Figure 2 - Regional Locality of study area. Map courtesy – Kongiwe Environmental

2.2 Technical Project Description

2.2.1 Project description

The removal of silts within the already approved area has been ongoing for a period of time and as such, the requirement to prepare the remaining area fully is now necessary, so as to maintain an efficient reclamation operation, as well as a sustainable feed source to the process plant.

The Valley Silts resource has three primary sectors. The currently approved reclamation area is Sector 1 and extends from the dam wall to the end of the stockpile area near Crownwood Road. The site is already established with fully fenced hard park facilities, solar powered security lights, well maintained haul roads, and site offices. Ingress/egress is fully controlled by security for all vehicles.

The Expansion Phase of the project will consist of Sector 2 and Sector 3. See **Figure 3** for the infrastructure plan of the project area.

Sector 2 will extend from the dam wall to Nasrec Road (N1 to N20), with the remaining blocks (Sector 3: N21 and N22) being located either side of Crownwood Road. Because reclamation exceeds the delivery rate, stockpile areas are therefore required for temporary storage as shown in Figure 3. Stock is moved in a sequential manner due to the moisture content, the drying process, as well as oxidation.

The detailed plans are based on a 1:1000 scale survey plan and all blocks are based on a delivery rate required by Ergo. Individual blocks will be removed in sequence.

Exploration trenching will determine the depositional flank extents, and all material will be removed from the natural flow path as well as the flanks. Paddocks and stormwater controls are required to protect the river from any extraneous ingress and these will be installed as indicated Figure 3. The current facilities in Sector 1 will be utilised for the remaining extensions. Hard park, cut off trenches and sumps are pre-installed and are appropriate for further use. The new activities for the Expansion Project include:

- Reclamation blocks (N1 to N22);
- Drying stockpiles (8 locations);
- Stormwater control berms/paddocks;
- Culverts (8); and
- Haul and site roads.

Existing silt traps will move as the reclamation blocks progress. The existing sump will discharge to the stream.

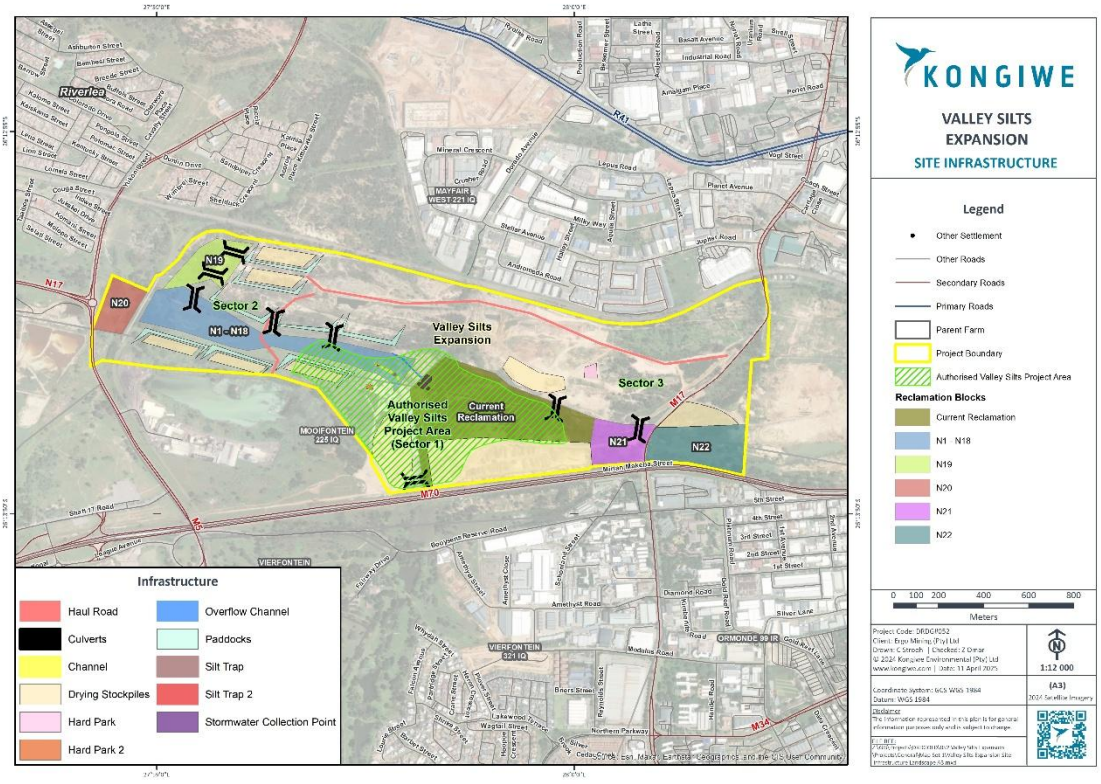


Figure 3: Valley Silts project site infrastructure layout. Map courtesy – Kongiwe Environmental

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

This HIA report was compiled by PGS for the proposed project. The applicable maps, tables and figures are included, as stipulated in the NHRA and the NEMA. The HIA process consists of three steps:

Step I – Literature Review and initial site analysis: The background information to the field survey relies greatly on the Heritage Background Research which was undertaken through archival research and evaluation of satellite imagery and topographical maps of the study area.

Step II – Physical Survey: A physical survey was conducted by a combination of vehicle and pedestrian access through the proposed project area by a qualified heritage specialist, aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant heritage resources identified in the physical survey, the assessment of these resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

The significance of heritage sites is based on four main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
    - Low - <10/50m^2
    - Medium - 10-50/50m^2
    - High - >50/50m^2
- Uniqueness; and
- Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate development activity position;

D - Preserve site, or extensive data collection and mapping of the site; and

E - Preserve site.

Impacts on these sites by the development will be evaluated as follows:

3.1.1 Site Significance

Site significance classification standards use is based on the heritage classification of s3 in the NHRA and developed for implementation keeping in mind the grading system approved by SAHRA for archaeological impact assessments. The update classification and rating system as developed by Heritage Western Cape (2021) is implemented in this report

Site significance classification standards prescribed by the Heritage Western Cape Guideline (2016)[1], were used for the purpose of this report (**Table 3** and **Table 4**).

Table 3: Rating system for archaeological resources

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
I	Heritage resources with qualities so exceptional that they are of special national significance. Current examples: Langebaanweg (West Coast Fossil Park), Cradle of Humankind	May be declared as a National Heritage Site managed by SAHRA. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	Highest Significance
II	Heritage resources with special qualities which make them significant, but do not fulfil the criteria for Grade I status. Current examples: Blombos, Paternoster Midden.	May be declared as a Provincial Heritage Site managed by Provincial Heritage Authority. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	Exceptionally High Significance
III	Heritage resources that contribute to the environmental quality or cultural significance of a larger area and fulfils one of the criteria set out in section 3(3) of the Act but that does not fulfil the criteria for Grade II status. Grade III sites may be formally protected by placement on the Heritage Register.		
IIIA	Such a resource must be an excellent example of its kind or must be sufficiently rare. Current examples: Varschedrift; Peers Cave; Brobartia Road Midden at Bettys Bay	Resource must be retained. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	High Significance
IIIB	Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree.	Resource must be retained where possible where not possible it must be fully investigated and/or mitigated.	Medium Significance
IIIC	Such a resource is of contributing significance.	Resource must be satisfactorily studied before impact. If the recording already done (such as	Low Significance

[1] No similar Guide exists for Gauteng and the Western Province Guide is deemed to be appropriate

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
		in an HIA or permit application) is not sufficient, further recording or even mitigation may be required.	
NCW	A resource that, after appropriate investigation, has been determined to not have enough heritage significance to be retained as part of the National Estate.	No further actions under the NHRA are required. This must be motivated by the applicant or the consultant and approved by the authority.	No research potential or other cultural significance

Table 4: Rating system for built environment resources

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
I	Heritage resources with qualities so exceptional that they are of special national significance. Current examples: Robben Island	May be declared as a National Heritage Site managed by SAHRA.	Highest Significance
II	Heritage resources with special qualities which make them significant in the context of a province or region, but do not fulfil the criteria for Grade I status. Current examples: St George's Cathedral, Community House	May be declared as a Provincial Heritage Site managed by Provincial Heritage Authority.	Exceptionally High Significance
II	Such a resource contributes to the environmental quality or cultural significance of a larger area and fulfils one of the criteria set out in section 3(3) of the Act but that does not fulfil the criteria for Grade II status. Grade III sites may be formally protected by placement on the Heritage Register.		
IIIA	Such a resource must be an excellent example of its kind or must be sufficiently rare. These are heritage resources which are significant in the context of an area.	This grading is applied to buildings and sites that have sufficient intrinsic significance to be regarded as local heritage resources; and are significant enough to warrant that any alteration, both internal and external, is regulated. Such buildings and sites may be representative, being excellent examples of their kind, or may be rare. In either case, they should receive maximum protection at local level.	High Significance
IIIB	Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree. These are heritage resources which are significant in the context of a townscape, neighbourhood, settlement or community.	Like Grade IIIA buildings and sites, such buildings and sites may be representative, being excellent examples of their kind, or may be rare, but less so than Grade IIIA examples. They would receive less stringent protection than Grade	Medium Significance

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
		IIIA buildings and sites at local level.	
IIIC	Such a resource is of contributing significance to the environs These are heritage resources which are significant in the context of a streetscape or direct neighbourhood.	This grading is applied to buildings and/or sites whose significance is contextual, i.e. in large part due to its contribution to the character or significance of the environs. These buildings and sites should, as a consequence, only be regulated if the significance of the environs is sufficient to warrant protective measures, regardless of whether the site falls within a Conservation or Heritage Area. Internal alterations should not necessarily be regulated.	Low Significance
NCW	A resource that, after appropriate investigation, has been determined to not have enough heritage significance to be retained as part of the National Estate.	No further actions under the NHRA are required. This must be motivated by the applicant and approved by the authority. Section 34 can even be lifted by HWC for structures in this category if they are older than 60 years.	No research potential or other cultural significance

3.2 Methodology used in determining the significance of environmental impacts

The methodology used to determine the environmental impact significance was provided by Kongiwe and is explained in **Appendix B**.

4 CURRENT STATUS QUO

4.1 Site Description

The greater Johannesburg region has been affected by historical mining activities since the original farms including Langlaagte and Randjieslaagte were proclaimed as public diggings by the then Zuid-Afrikaansche Republiek (ZAR) government in 1886.

Existing surrounding land uses associated with the project area include a combination of:

- informal settlements, low-cost residential areas;
- community and municipal facilities;
- industrial areas;

- manufacturing and distribution facilities, commercial businesses;
- historical mine housing and historical mine infrastructure (slimes dams, shafts, derelict/abandoned buildings and water dams);
- illegal informal mining activities, formal mining activities;
- open land, and
- road infrastructure.

As a result, the vast majority of the Valley Silts Expansiono9 Project footprint overlays highly disturbed developed terrain. There is also evidence of illegal mining and dumping activities within the project area.



Figure 4 – Disturbed developed terrain.



Figure 5 – Vegetation along the banks of the Russell stream



Figure 6 – The old Crown Ave. bridge over the Russell stream.



Figure 7 – Dense vegetation found in parts of the study area.



Figure 8 – Train bridge over the western section of the project area.



Figure 9 – Illegal dumping in the western section of the project area.

4.2 Overview of the study area and surrounding landscape

DATE	DESCRIPTION
2.5 million to 250 000 years ago	The Early Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these is known as Oldowan and is associated with crude flakes and hammer stones. It dates to approximately 2 million years ago. The second technological phase is the Acheulian and comprises more refined and better made stone artefacts such as the cleaver and bifacial hand axe. The Acheulian dates back to approximately 1.5 million years ago (Korsman, & Meyer, 1999).
250 000 to 40 000 years ago	The Middle Stone Age (MSA) is the second oldest phase identified in South Africa's archaeological history. This phase is associated with flakes, points and blades manufactured by means of the so-called 'prepared core' technique (Korsman, & Meyer, 1999).
40 000 years ago, to the historic past	The Later Stone Age (LSA) is the third archaeological phase identified and is associated with an abundance of very small artefacts known as microliths. (Korsman, & Meyer, 1999).
AD 450 – AD 750	Early Iron Age (EIA) sites in the Witwatersrand area date between 500 AD and 900 AD. The Magaliesberg mountain range represents the most southern point of distribution of these sites. The Mzonjani facies of the Kwale Branch of the Urewe Ceramic Tradition represents the earliest known Iron Age period within the surroundings of the study area. The decoration on the ceramics from these facies is characterised by punctates on the rim as well as spaced motifs on the shoulder (Huffman, 2007). No EIA sites are known from the immediate vicinity of the footprint area
	The Late Iron Age (LIA) occupation of this area by Sotho-Tswana communities is represented by four ceramic sequences of the Urewe tradition: Ntsuanatsatsi (1450-1650), Olifantspoort (AD 1500 -1700), Uitkomst (AD 1700-1850) and Buispoort (1700-1840) (Huffman 2007). No LIA sites are known from the immediate vicinity of the footprint area.
AD 1450 – AD 1650	The Ntsuanatsatsi facies of the Blackburn Branch of the Urewe Ceramic Tradition represents the second known Iron Age period within the surroundings of the study area. The decoration on the ceramics from this facies is characterised by a broad band of stamping in the neck, stamped arcades on the shoulder and appliqué. Huffman (2007) suggest that the Ntsuanatsatsi

DATE	DESCRIPTION
	facies can be directly linked to the early Bafokeng who were the first Mbo Nguni people to leave present-day KwaZulu-Natal.
AD 1500 - AD 1700	The Olifantspoort facies of the Moloko Branch of the Urewe Ceramic Tradition is the third Iron Age facies to be identified within the surroundings of the study area. The Olifantspoort facies can likely be dated to between AD 1500 and AD 1700. The key features of the decoration used on the ceramics from this facies include multiple bands of fine stamping or narrow incision separated by colour (Huffman, 2007). The type site for this facies is located on the farm Olifantspoort 328 JQ, near Rustenburg in the North West Province. The Olifantspoort facies holds an important position in the sequence of the Moloko or Sotho-Tswana group. The earliest facies to be associated with the Moloko is the Icon facies (AD 1300 – 1500), with sites found across large sections of what is today the Limpopo Province. The Icon facies resulted in three different and parallel Iron Age facies, namely the Madikwe facies (AD 1500 – 1700) (which in turn led to the Buispoort facies between AD 1700 and 1850), the Letsibogo facies (AD 1500 – 1700) and thirdly the Olifantspoort facies. The Olifantspoort facies developed into the Thabeng facies (AD 1700 – 1850) (Huffman, 2007). It is therefore evident that the Olifantspoort facies represents a key pillar in our understanding of the origins and sequence of the Sotho-Tswana people of today (Huffman, 2007).
AD 1650 – AD 1850	The Uitkomst facies of the Blackburn Branch of the Urewe Ceramic Tradition represents the third Iron Age period to be identified for the surroundings of the study area. This facies can likely be dated to between AD 1650 and AD 1820. The decoration on the ceramics associated with this facies is characterised by stamped arcades, appliqué of parallel incisions, stamping and cord impressions and is described as a mixture of the characteristics of both Ntsuanatsatsi (Nguni) and Olifantspoort (Sotho) (Huffman, 2007). The type-site Uitkomst Cave, was excavated by Professor R.J. Mason of the University of the Witwatersrand as part of a project to excavate five cave sites (Glenferness, Hennops River, Pietkloof, Zwartkops and Uitkomst) in the Witwatersrand-Magaliesberg area. Uitkomst was chosen as the type site for the particular Iron Age material excavated at these sites, as its deposit was found to be well stratified and the site "...illustrates the combination of a certain kind of pottery with evidence for metal and food production and stone wall building found at the open sites..." (Mason, 1962:385). The Uitkomst pottery is viewed as a combination of Ntsuanatsatsi and Olifantspoort, and with the Makgwareng facies is seen as the successors to the Ntsuanatsatsi facies. The Ntsuanatsatsi facies is closely related to the oral histories of the Early Fokeng people and represents the earliest known movement of Nguni people out of Kwazulu-Natal into the inland areas of South Africa. Regarding this theory, the Bafokeng settled at Ntsuanatsatsi Hill in the present-day Free State Province. Subsequently, the BaKwena lineage had broken away from the Bahurutshe cluster and crossed southward over the Vaal River to come in contact with the Bafokeng. As a result of this contact a Bafokeng-Bakwena cluster was formed, which moved northward and became further 'Sotho-ised' by coming into increasing contact with other Sotho-Tswana groups. According to this theory, this eventually resulted in the appearance of Uitkomst facies type pottery which contained elements of both Nguni and Sotho-Tswana speakers (Huffman, 2007). Huffman states that the Uitkomst facies is directly associated with the Bafokeng (Huffman, 2007). However, it worth noting that not all researchers agree with this proposition of the Bafokeng origins. In their book on the history of the Bafokeng, Bernard Mbenga and

DATE	DESCRIPTION
	Andrew Mason indicate that the research of Prof. R.J. Mason and Dr. J.C.C. Pistorius "...would indicate that the Bafokeng originated from the Bahurutshe-Bakwena-Bakgatla lineage cluster. Tom Huffman holds a different view..." (Mbenga & Mason, 2010).
AD 1700 – AD 1840	The Buispoort facies of the Moloko branch of the Urewe Ceramic Tradition is the next phase to be identified within the greater Witwatersrand area. It is most likely dated to between AD 1700 and AD 1840. The key features on the decorated ceramics include rim notching, broadly incised chevrons and white bands, all with red ochre (Huffman, 2007). It is believed that the Madikwe facies developed into the Buispoort facies. The Buispoort facies is associated with sites such as Boschhoek, Buffelshoek, Kaditshwene, Molokwane and Olifantspoort (Huffman, 2007).

4.3 Historical Background of Johannesburg, including Riverlea, Booysens, Ophirton

4.3.1 Johannesburg,

The City of Johannesburg developed from a mining camp after gold-bearing conglomerate was discovered on the farm Langlaagte in 1886 by George Harrison and George Walker, more or less at the same time as discoveries in the Krugersdorp/Roodepoort area by JG Bantjies and the Struben brothers. By September 1886, around 2500 people were living in the general area and 1300 diggers licenses had been issued (Erasmus, 2014). Due to the discovery of the reef and the sudden influx of miners, a special proclamation was issued by the ZAR government, also in September 1886, listing nine farms that were proclaimed as public diggings. The southern portion of the farm Doornfontein was one of these farms. Another of the farms, Randjieslaagte, was owned by the State and was chosen as the site for the new mining town to provide revenue for the Government (Erasmus, 2014).

The town was accordingly surveyed and named Johannesburg (apparently, since both the vice-president, Joubert and the survey clerk Rissik were named Johannes – Erasmus 2014). A health committee was elected in November 1887. On 1 October 1897, the fledging town was granted a town council followed by municipal status. However, ongoing issues with the so-called *uitlander* population of the town and the British government, which were realised to be due to the rich gold resources, ultimately resulted in the Second South African War, more familiarly known as the Boer War. Notwithstanding this, Johannesburg was relatively unaffected by the conflict until it was occupied by the British forces on 31 May 1900 with virtually no resistance. The mines which had been closed reopened almost immediately after the end of the war in 1902. After this Johannesburg and its suburbs grew very rapidly (Erasmus, 2014).

4.3.2 Booysens and Booysens Reserve

Smith (1977) cites several sources as indicating that the original property was owned by a man called Boysen (Johannes or Jan or JA Booysen). She further states that the township was laid out by the Booysen Farm syndicate on the farm Turffontein in 1887. The first stands were apparently sold in May and June 1887.

Booysens Reserve was surveyed in 1896 and the first stands were auctioned the same year. The mynpacht on which the township was established was used as agricultural holdings at the time as it was one of the few properties that was unproclaimed.

4.3.3 Riverlea

This township was laid out on the farm Langlaagte No.13 on 25 May 1965 as a township for coloureds. The establishment of the township Riverlea (or riverly) had been recommended by the Johannesburg Council in August 1960. The street names were all based on rivers. By 1965 three extensions had been established. The name apparently indicates an area where there is a river (Smith 1977).

4.3.4 Ophirton

Smith (1977) notes that this suburb was one of the earliest residential areas in Johannesburg. The township was laid out in 1887 on the farm Turffontein No. 21, although the name of the area seems to have changed several times during the late 1800s. However, the present-day township dates from 1903 when the plan was confirmed by the Surveyor-General. By that date, the property belonged to the Robinson Deep Gold Mining Company although the name of the suburb probably derives from one of the previous land-owners, the Paarl-Ophir Gold Mining Co. Ltd. Smith (1977) also notes that the land changed ownership several times and was owned by CL Liebenberg before being purchased for the establishment of the township.

4.3.5 Brief History of Soweto

The township of Soweto was established on the farms Doornkop, Klipriviersoog, Diepkloof, Klipspruit and Vogelstruisfontein. Initially, the township comprised 26 individual areas, which were each designed to be a self-sufficient entity. After World War 2 the area was consolidated into the township of Soweto (an acronym for South Western Townships) (Erasmus, 2014).

Beginning with the establishment of Klipspruit in 1904, the process of Soweto's creation ended only with the final removal of all Africans from the Western Areas (the freehold townships of Sophiatown, Martindale and Newclare) in 1955-58 (Pohlandt-McCormick and Travis, 2010). By 1959, the patchwork of townships - Moroka, Pimville, Klipspruit, Orlando East, Dube, Mofolo North and South, Central Western Jabavu, Molapo, and Moletsane - still had no name and a competition was held to find a suitable name. However, the final name was approved only in 1963, being a composite of the opening letters of South West Townships (Pohlandt-McCormick and Travis, 2010).

By 1927 the Johannesburg City Council (JCC) had decided to create a Department of Native Affairs to deal with matters concerning local African administration. In 1929, with the pressures of influx of African people to Johannesburg, the removal of African people from the whites-only designated residential areas became a priority for the council. So began a process of segregation and removals to the area now known as Soweto (www.sahistory.org.za).

The already established Non-European Affairs Department (NEAD) was then tasked with the responsibility of establishing or acquiring large-scale housing scheme to accommodate approximately 80 000 Blacks into a township (Hanyane 2002). Subsequently, the Johannesburg City Council bought the farm Klipspruit No. 8 from one of the mining companies and established the township of Orlando East, named after Edwin Orlando Leake, the chairman of the NEAD at the time (Hanyane 2002; Van Rensburg, 1986).

Once the National Party government came into power in 1948, it embarked upon an aggressive policy of slum clearance. This policy involved the forced removal of Africans from the freehold townships of the Western Areas, such as Sophiatown, Martindale and Newclare to Diepkloof, Meadowlands, Dube and Rockville. Similar attempts of slum clearance in Alexandra resulted in communities removed from this township being resettled in Diepkloof and Meadowlands. Forced removals began in 1955 and five years later, the resettlement of African families from the Western Areas to Soweto had been completed.

James Mpanza founded the Sofasonke Party in 1938 and on 20 March 1944, he led a group of homeless people to a stretch of vacant land across the river and boundaries of Orlando Township where they erected their shacks. Within a short period of time, the number of people staying in Shantytown reached 4000. The land invasion in Orlando was followed by land invasions from Pimville, west and east of Johannesburg, in 1947. In the previous year, James Mpanza had led another invasion of houses still under construction, which were intended to house people removed from the city centre. These invasions forced the government to concede that the need for housing in the township was very dire and that the City Council lacked the financial resources required to house the township population. As the squatter problem became unwieldy, the JCC decided to set

up controlled site-and-service schemes in Moroka and Jabavu. The Moroka emergency camp was established in 1954. The arrangement of shacks was later consolidated into normal street blocks.

Between 1947 and 1960, the government embarked upon a massive housing scheme at the end of which the Moroka and Jabavu emergency camps were demolished. Residents of Moroka and Jabavu emergency camps were relocated in Moletsane, Molapo, Tladi, Naledi, Senaoane, Dlamini, White City and Jabulane (http://www.sahistory.org.za/topic/history-soweto)

On June 16, 1976, one of the most significant events in the history of Soweto and South Africa took place: a demonstration against the imposition of Afrikaans as a medium of instruction in schools, planned as a one-day protest in Soweto, escalated into a nationwide uprising after police shot dead a number of student demonstrators, including 13-year-old Hector Peterson, touching off a spiral of rioting and reprisal that rapidly spread to other areas (Gerhart, 1994).

4.3.6 History of Gold Mining within the Study Area and Surrounding Landscape (Birkholtz 2006 and 2017)

4.3.6.1 Langlaagte Farm

The original Langlaagte farm had been divided into four portions by 1885/86. Portion A was owned by Andries Luan Breedt, Portion B by Anna Elizabeth de Beer Mulder (formerly Oosthuizen), Portion C by Gerhardus Cornelis Oosthuizen and Portion D by the widow Petronella Oosthuizen and her son Johan Hendrik Oosthuizen (Davenport 2013). Portion D was the easternmost portion of the farm and Mr JH Oosthuizen had hired George Harrison, an Australian digger, to build a house on that portion (Davenport 2013; Stephens 2003).

Subsequently, Harrison and his friend George Walker, discovered an outcrop of the gold-bearing reef on the neighbouring portion of the farm, which belonged to G.C. Oosthuizen. Harrison and Walker then entered into an agreement with G.C. Oosthuizen during April 1886, which enabled them to prospect for gold and each to peg a claim on the property should the strike prove to be payable (Davenport 2013; Stephens 2003). Richardson (2001) states that the two claims given to Harrison and Walker were numbers 19 and 21. Shortly after the agreement between Oosthuizen and the two Georges, the news about the gold discovery on the farm spread quickly and resulted in a rush of prospectors to the outcrop, several of whom formed the Langlaagte Company, to work the outcrop on Portion B of the farm (Davenport 2013).

It was not long before the gold reef was located on a number of the neighbouring farms to Langlaagte, including Turffontein. Shortly after these discoveries, President Kruger received three petitions requesting that the farms Vogelstruisfontein, Roodepoort, Langlaagte and the two portions

comprising Paardekraal be declared public diggings, as well as several other farms. Subsequently, on 8 September 1886, a notice in the “De Staatscourant” informed all interested parties that the government had located yielding gold reefs on the Witwatersrand in the district of Heidelberg, on various farms, including Langlaagte and Turffontein. Langlaagte was to be declared a public prospecting area on the 4 October 1886 and Turffontein on Monday 27 September (Davenport 2013; Roux 1955).

When the news of the gold discoveries on Langlaagte and the surrounding farms reached Kimberley, JB Robinson was one of the first people to investigate the situation, arriving at Langlaagte in July 1886. He quickly arranged to first lease and then buy Portion D of the farm from the widow Oosthuizen, as well as buying Portion B from Anna de Beer Mulder. Robinson also bought shares in other properties that adjoined Langlaagte, including a half-share in a lease of the farm Turffontein. The Robinson Deep Mine and Crown Mines would later be established on these two farms (Davenport 2013).

4.3.6.2 Mooifontein Farm

Smith (1977) states that the farm Mooifontein is depicted on Wyld’s New Map of Witwatersrand Goldfields (1889) as being situated between the farms Langlaagte and Diepkloof. She notes that there was probably a “mooi fontein” located on the property at the time. She doesn’t provide any information on the ownership of the farm. Davenport (2013) notes that the mining properties on Mooifontein were among those amalgamated under the control of the Crown Mines Limited company sometime after the South African War.

4.3.6.3 Gold Mining companies

Troy’s Map of the Witwatersrand Goldfields (1890) indicates that there were several gold mining companies associated with the farm Langlaagte but no gold mining companies situated on Mooifontein. The farms situated on Langlaagte at that date were, Inter alia:

- Western Langlaagte
- Croesus
- Bantjies
- Block 8
- Langlaagte Estate
- Langlaagte United
- Langlaggte Main Reef
- Langlaagte Central
- Pritchards Claims

- Crown Reef Gold Mining Company

Troy's map also depicts the Booysen Land Company, on land situated to the south-east of Langlaagte, as well as several unnamed streams running across Langlaagte, including the present day stream known as the Russell Stream.

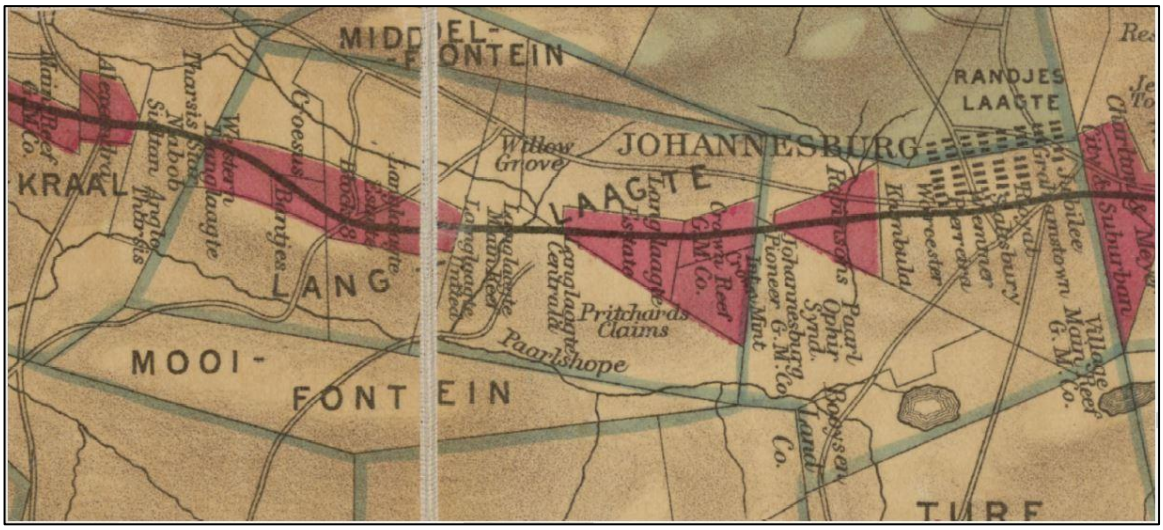


Figure 10 - Enlarged section of Troy's Map of the Witwatersrand Goldfields (The Digger's News Printing & Publishing Co Ltd.), dated 1890

Gold mining shares boomed in 1895. However, this boom and the progress of the gold mining industry was affected severely by the Jameson raid at the end of 1895. The farm of Vlakfontein, in the present-day Roodepoort area was the scene of the surrender of Jameson's party to Genl. Cronje., whose Boer forces held the koppie of Doornkop, blocking the way to Johannesburg (Payne, 1948).

The following gold. Mining companies were associated with the study area (**Figure 11**).

4.3.6.4 Crown Mines (Skinner 1911)

This company was registered on 31 March 1892 as the Rand Deep Level Gold Mining company, Limited. Crushing commenced in August 1897. In June 1894 the name was changed to Crown Deep Limited and in June 1909 to Crown Mines Limited, on the acquisition of various interests additional to the original properties. The company originally owned 183.7 Main Reef deep level claims on the farms Langlaagte and Turffontein. In 1898, 1 593 claims were sold to the Robinson Central Deep Limited for 107 538 shares in that company, and the right to subscribe for a further 35 846 shares at £2.

Crown Mines was controlled and administered as part of the larger Rand Mines Limited group (Skinner 1911).

4.3.6.5 Consolidated Langlaagte Mines, Limited.

This company was registered in the Transvaal September 20th, 1902, to acquire the undertakings of the New Croesus Gold Mining Co., Ltd. (registered October, 1891), and the Langlaagte Star Gold Mining Co., Ltd. (registered 1894). The property consists of a compact block of 343 claims and 210 deep level claims on the farm Langlaagte, Transvaal; also, three pieces of ground equal to 30 claims held under lease for erecting plant or buildings and six water rights. The deep level claims were acquired in November 1903, from the Johannesburg Consolidated Investment Co., Ltd.

4.3.6.6 Langlaagte Estate & Gold Mining Co., Ltd.

This company was registered on January 13th, 1888, to acquire three portions of the farm Langlaagte, viz., Restante, Block A and Block B, and adjoining farm Middelfontein, a total area of 4 070 acres, including mining claims and water-rights situated in the Witwatersrand district, close to Johannesburg, Transvaal. Crushing commenced in 1888 with 10 stamps. The Chairman was Sir J. B. Robinson.
This company was not indicated as being part of a larger group at the time of Skinner 1911.

4.3.6.7 Robinson Gold Mining Company Limited

This company was registered in the Transvaal in 1887, to acquire a lease of a portion of the farm Turffontein, Witwatersrand, with a mynpacht of about 220 acres on the Main Reef. Hermann Eckstein was one of the Directors. In 1889, the property of the Kambula Syndicate, comprising six Main Reef claims and 100 acres of the mynpacht was acquired. In 1891, the company acquired the freehold of the mynpacht. In 1893, 30 southern claims were acquired. In 1898, 616 claims were sold to the Robinson Central Deep Ltd. (now Crown Mines, part of the larger Rand Mines, Ltd. controlling group).

4.3.6.8 Robinson Deep Gold Mining Company, Limited.

This company was first registered in the Transvaal September 19th, 1894, as the Robinson Deep, Ltd., to acquire from the Goldfields Deep, Ltd., about 148 main reef dip claims south of the Robinson Mine, Witwatersrand, Transvaal. A further 86 claims on the dip of the Worcester and Ferreira mines were afterwards purchased from the Paarl Ophir Co.

4.3.6.9 Consolidated Gold Fields of S.A Ltd.

This company was registered August 2nd, 1892, to acquire the undertakings of the Gold Fields of South Africa, Ltd., the African Estates Agency, Ltd., and the African Gold Share Investment Co., Ltd., and the assets of the South African Gold Trust and Agency Co., Ltd. The company sold its holding of deep level claims in the Witwatersrand district of the Transvaal to the Goldfields Deep, Ltd , in 1893, but repurchased the entire undertaking of that company in 1898.

4.3.6.10 Rand Mines, Limited.

This company was registered in the Transvaal February 22nd, 1893, to acquire and deal with various mining claims in the Witwatersrand district, Transvaal, also the Mooifontein farm of 1 294 acres, south of Langlaagte, Witwatersrand. The company has dealt with a large number of claims and properties and has received blocks of shares in subsidiary and other concerns.

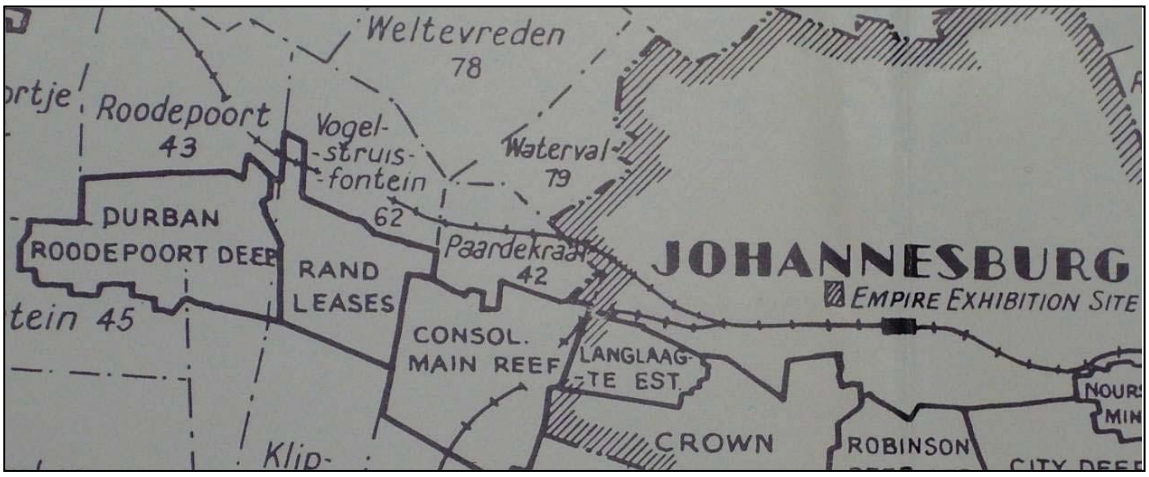


Figure 11 - A portion of the general plan of the Witwatersrand Gold Fields dated to 1936. The Durban Roodepoort Deep mine and the Rand Leases mine can be seen on the left (map from Letcher, 1936)

4.3.6.11 First World War

The First World War caused the cost of mining operations to rise considerably and this resulted in the closure of several mines between 1917 and 1928, including the Roodepoort United, which had been one of the biggest mines (Payne, 1948).

In 1934, the property and assets of the New Steyn Estate were taken over by the Durban Deep mining company. These included the claims, plant and building of the old Roodepoort United. By 1948, the Durban Deep owned 3,007 mining claims on the farms Roodepoort, Vogelstruisfontein,

Vlakfontein and Witpoortjie. In addition, its freehold property measured 4,443 morgen (Payne, 1948).

4.3.7 Conclusions

The archival and historical research has revealed that the entire area of the original Valley Silts area, on which the historical slimes dams and sand dumps are situated, has been affected on a continual basis by historical mining activities, since c.1886/87 and was associated with several historical gold mine companies, the major one being Crown Mines. These mining activities have continued to the present day, both formally and informally (illegal). The ground affected by the proposed environmental authorisation application is therefore, extremely disturbed. There is also high potential for the existence of heritage sites associated with the historical mining activities (e.g. historical mining structures, historical residential structures, and historical graves and burial grounds).

4.3.8 Archival and historical maps

The examination of historical data and cartographic resources represents a critical tool for locating and identifying heritage resources and in determining the historical and cultural context of the study area. Relevant topographic maps and satellite imagery were studied to identify structures, possible burial grounds or archaeological sites present in the footprint area.

Topographic maps (1:50 000) for various years (1939 and 1943) were available for utilisation in the background study. These maps were assessed to observe the development of the area, as well as the location of possible historical structures and burial grounds. The study area was overlain on the map sheets to identify structures or graves situated within or immediately adjacent to the study area that could possibly be older than 60 years and thus protected under Section 34 and 36 of the NHRA

The relevant topographical maps include:

- Johannesburg 2628AA, Edition 2 (a reprint of Edition 1): which was surveyed in 1939 and drawn in 1945 by the Trigonometric Survey Office and reprinted in 1950.
- Roodepoort 2627BB Edition 1, 1943: which was compiled and drawn by the Survey Depot South African Engineering Corps. (SAEC) and reprinted by the Government Printer in 1955

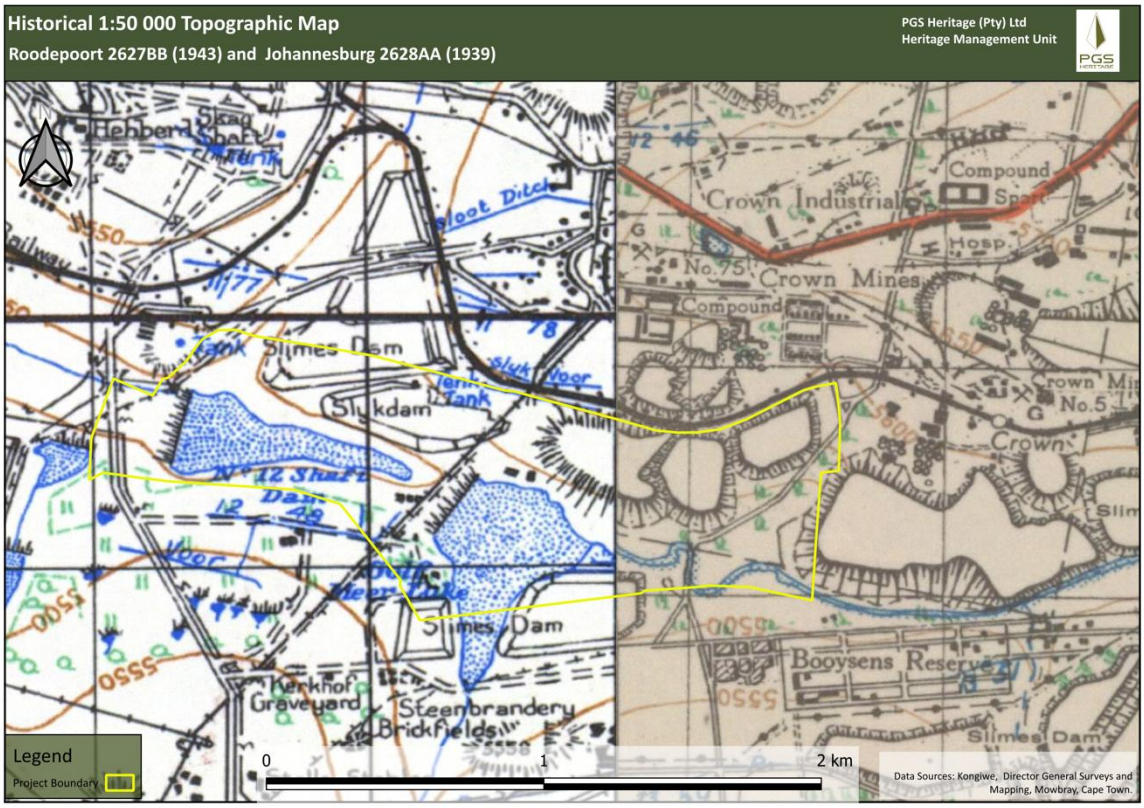


Figure 12: Map mosaic of Johannesburg 2628AA 2nd ed. (1939) and Roodepoort 2627BB 1st ed. (1943) with the project area overlain in yellow.

It can be seen that in the map sheets consulted the entire project area is surrounded by numerous built structures, including mine shafts and mine compounds, as well as mine slimes dams and sand dumps. Historical roads and railway lines are also depicted. Many of the historical buildings, features and infrastructure surrounding the project area belong to the original historical gold mines of Langlaagte Estates, Langlaagte Royal and Crown Mines, etc.

It should be noted that two declared heritage sites directly associated with the original mines are situated a short distance north of the proposed project area: the Main Reef Outcrop at the George Harrison Park and the Langlaagte Village. Both of these heritage sites are protected as formally declared provincial heritage sites.

Also important to note, is a cemetery that is depicted on the 1943 2627BB map as situated a short distance to the south of the proposed project area on the northern boundary of the Crown Mines golf course.

4.3.9 Previous heritage impact assessment reports from the study area and surroundings

A search of the South African Heritage Resources Information System (SAHRIS) database has revealed the following studies conducted in and around the study area of this report, including a previous heritage impact assessment study for the proposed Reclamation of the Soweto Cluster Dumps (du Piesanie 2014). These studies are summarised below in ascending date order:

- Application for Permit: Archaeological and Palaeontological Sites and Meteorites – Old Crown Mines Cemetery,
- **Fourie, M. 2010. Heritage Scoping Assessment and Notice of Intent to Develop for the Proposed Pipeline Project. For Crown Gold Recoveries (Pty) Ltd by Digby Wells & Associates**. No potential heritage resources were observed in the project area.
- **Van der Walt, J. 2013. Archaeological Impact Assessment for the Proposed Filling Station on Erf 330 Crown Extension 18, Crown Mines, Gauteng Prepared for Marinda le Roux**. Apart from an avenue of Plane trees on the northern periphery of the site no other sites of heritage significance were identified on Erf 330. However, the site is adjacent to the Provincial Heritage site of Langlaagte Deep Mining village also known as Crown Village
- **Van Schalkwyk, 2016. Heritage Impact Assessment for the Proposed Installation of Turffontein Corridor Conduits and Outfalls Storm Water Management Systems, City of Johannesburg District Municipality, Gauteng Province. For Envirolution Consulting.** A very large number of features, mostly houses and infrastructure related features, occur in the region. All of these are very formal and clearly visible. Due to the fact that the development will take place inside the road reserve, it was considered unlikely that any such features would be impacted by the construction of the storm water corridor conduits and outfalls.
- **Kitto, 2020. The Proposed Valley Silts Rehabilitation Project, City Of Johannesburg Metropolitan Municipality, Gauteng Province.** One cemetery and one historical building were identified in this assessment.

4.3.10 Heritage screening

A heritage screening report was compiled using the Department of Forestry, Fisheries and the Environment National Web-based Environmental Screening Tool as required by Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended.

According to the heritage screening report, the project area has a Very High Heritage Sensitivity (**Figure 13**), largely due to the historical built environment of the early mining operations. The fieldwork has shown that some archaeological and heritage resources were present in the area and therefore finds a measure of agreement with the DFFE screening map.

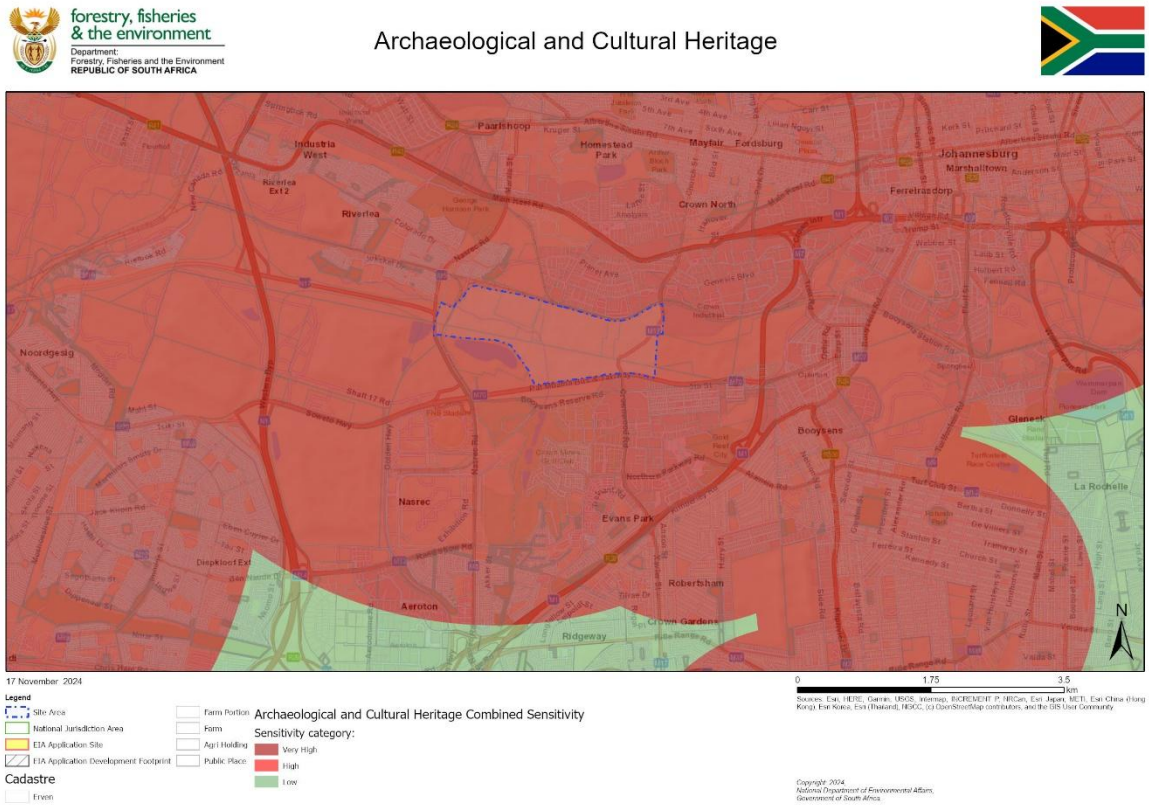


Figure 13 - Screening tool map indicating a very high sensitivity rating for archaeology and heritage

4.3.11 Heritage sensitivity

By analysing maps and satellite imagery of the broader region the identification of potential heritage sensitive areas is made possible. By superimposition and analysis, it was possible to rate these structures according to age and thus their level of protection under NHRA. **Table 5** lists the possible tangible heritage sites identified in the vicinity of the study area and the relevant legislative protection.

Table 5: Tangible heritage site in the study area.

Name	Description	Legislative protection
Archaeology	Older than 100 years	NHRA Sections 3 and 35
Structures	Possibly older than 60 years	NHRA Sections 3 and 34
Burial grounds	Graves	NHRA Sections 3 and 36 and MP Graves Act

Additionally, evaluation of satellite imagery has indicated the following landscape features that may be sensitive from a heritage perspective. The analysis of the studies conducted in the area assisted in the development of the following landform type to heritage find matrix (**Table 6**).

Table 6: Landform type to heritage find matrix

LANDSCAPE FEATURE	HERITAGE POTENTIAL
Crest and foot hill	LSA and MSA scatters, LIA settlements
Crest of small hills	Small LSA sites – scatters of stone artefacts, ostrich eggshell, pottery and beads
Water holes/pans/rivers	MSA and LSA sites, LIA settlements
Farmsteads	Historical archaeological material
Ridges and drainage lines	LSA sites, LIA settlements

4.4 Fieldwork findings[2]

The fieldwork was conducted on the 10th of October 2024 by a team from PGS Heritage. Their movement on site was tracked by GPS and a tracklog map can be seen in **Figure 14**.

During the fieldwork a total of two heritage resources were identified (
Figure *15***)** within the greater project boundary. These resources were identified in the previous assessment (PGS 2019) and were found to be in similar condition as previously reported. These sites are:

- One historical structure (**VS1**)
- One burial ground (**VS2**).

Note that while both sites fall within the Project Boundary, only site **VS1** will be affected by the proposed infrastructure footprint.

Detailed individual site descriptions can be found in **Appendix B**. The field description forms were collected with ArcGIS Survey123 in field software.

Site **VS1** is a partially exposed stone-built structure. The masonry exposed consists of coursed stone blocks used to construct a stone wall. The structure is however not entirely exposed and determining the extent was impossible. Historical maps show no structures present in the area.

[2] *Site in this context refers to a place where a heritage resource is located and not a proclaimed heritage site as contemplated under s27 of the NHRA.*

It is evident that the wall is part of a larger subsurface structure and in all probability associated with early mining activities. The exposed section of the wall is approximately 10m in length.
With the sparse information on the structure and the fact that very little has remained of structures related to the early mining history of the Witwatersrand this site can potentially hold further information on the history of the area. The finds are provisionally rated as having a **low** heritage significance with a heritage rating of **IIIC**.

The burial ground at **VS2** is situated between Crownwood road and the reclaimed Crown Mine dump. Numerous stone packed graves were identified during the fieldwork. The vegetation overgrowth precluded an accurate grave count, but an estimated 50-110 graves are located across an approximate 1-hectare area**.**

An inscribed headstone bearing only the name “Rosa” provides a date of 1930 for the cemetery. Some of the graves do have large eucalyptus trees growing on them. Burial grounds and graves are always regarded as having **high** heritage significance and a grading of **IIIA**.

While the cemetery is not anticipated to be affected project related infrastructure, it is recommended that the area be demarcated as a cemetery with an appropriate buffer in place (50m).

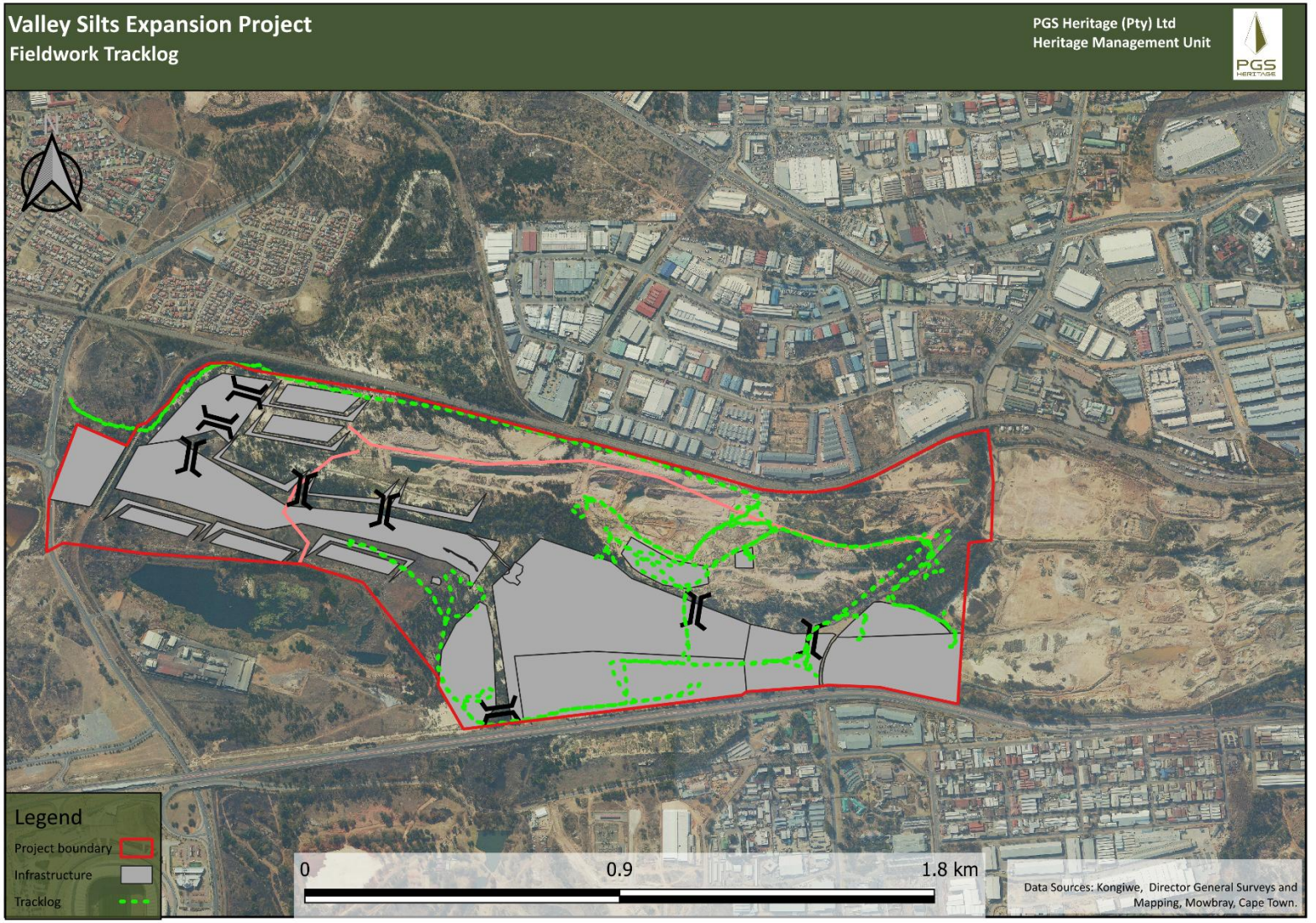


Figure 14 - Fieldwork tracklogs.

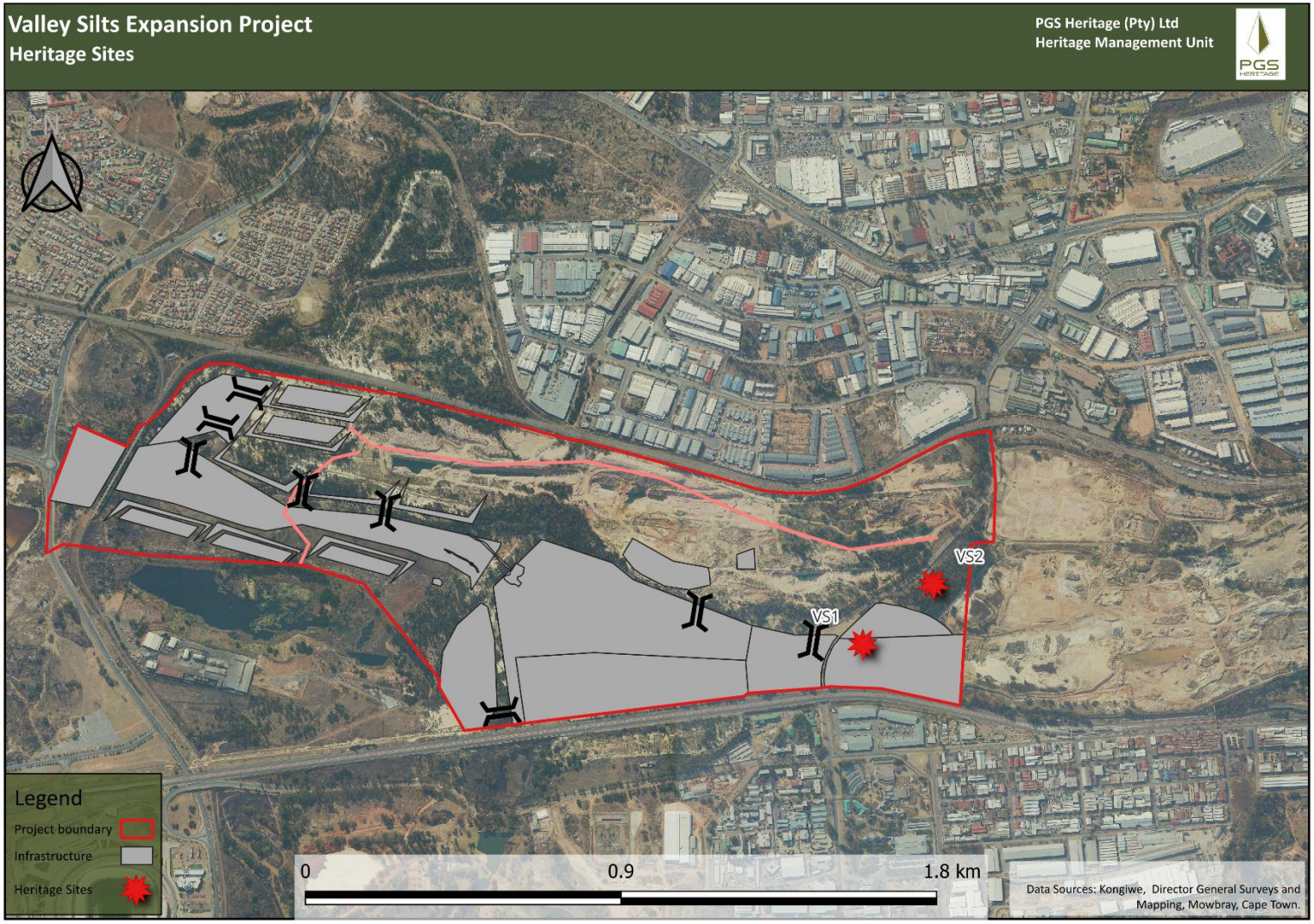


Figure 15 - Identified heritage resources within the Valley Silts Expansion Project area.



Figure 16 – Security control on Crownwood road entrance



Figure 17 – Inscribed headstone at site VS2



Figure 18 - View of the Russell stream inside the project area



Figure 19 – View of the project area



Figure 20 – Exposed stone walling at VS1



Figure 21 – Exposed stone walling at VS1

4.5 Palaeontology

The Proposed Project is underlain by the Turffontein and Johannesburg Subgroups, which are rated as Low to Zero Palaeontological Sensitivity on the SAHRIS palaeosensitivity map. These subgroups generally consist of quartzites and conglomerates formed by braided river systems, as well as pyritic sands, insignificant shales, and volcanics as well as debris-flow diamictites. Rock formations with a zero palaeontological sensitivity are unfossiliferous (Kongiwe 2019).

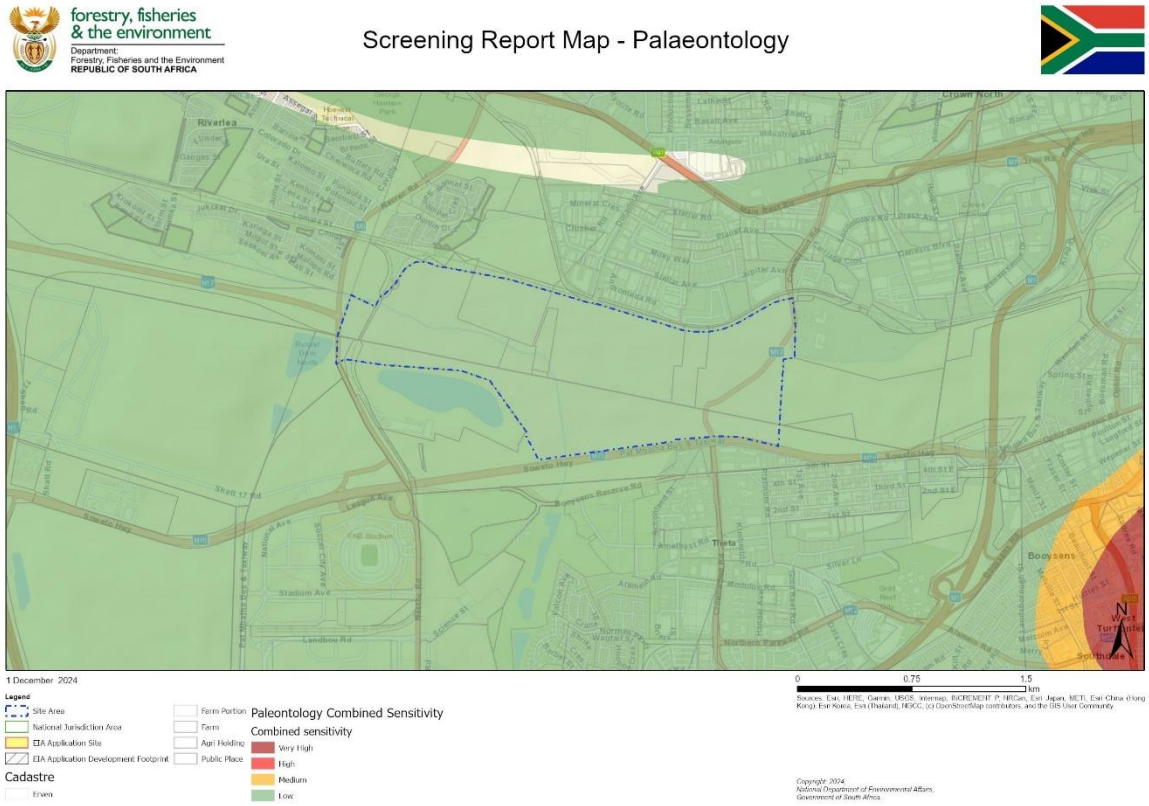


Figure 22 – DFFE Screening Tool map showing a low palaeontological sensitivity.

A basic palaeontological sensitivity was determined using both the DFFE Environmental Screening Tool (Fig) as well as the higher resolution palaeosensitivity map on the SAHRIS database (South African Heritage Resources Information System) (http://www.sahra.org.za/sahris/map/palaeo).

As can be seen in **Figure 22** and **Figure 23** the proposed area of the project footprint occurs in an area where the palaeontology is assessed as being entirely of Low sensitivity (coloured blue) and no palaeontological studies are required. Since it is anticipated that there should be no excavation into the underlying geology and the area surrounding the dumps has been disturbed extensively in the past, it is recommended that an application for exemption from the standard requirement for a Palaeontological Impact Assessment be made to SAHRA.

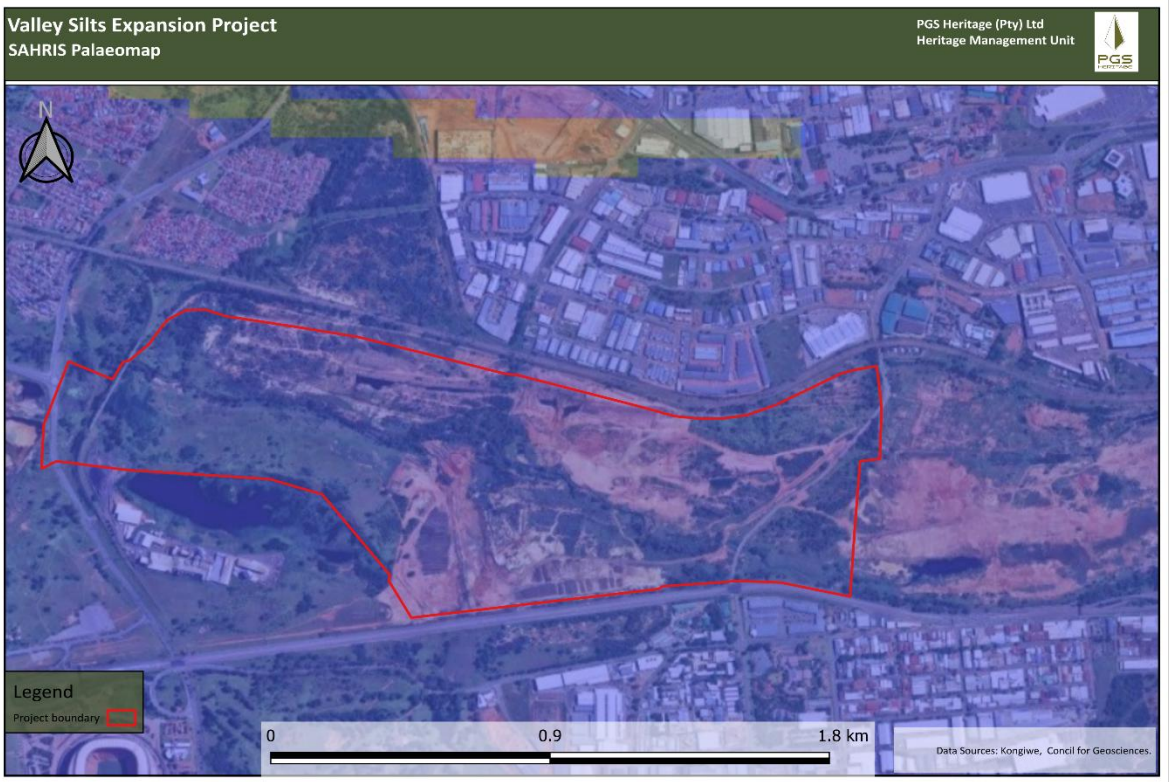


Figure 23 – Overlay of the Valley Silts rehabilitation area on the palaeosensitivity map from the SAHRIS database. This shows that most of the area is coloured blue (purple), which is rated as Low sensitivity

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 24 - SAHRIS palaeosensitivity ratings table

5 IMPACT ASSESSMENT

The impact assessment rating is based on the rating scale as contained in **Appendix B**.

The following section provides an analysis of the impact of the proposed project area on heritage resources identified within the Valley Silts Expansion project.

5.1 Details of all alternatives considered

This section describes alternative means of carrying out the operation and the consequences of not proceeding with the proposed project.

The “no-go” alternative refers to the option of not going ahead with the proposed project. This will entail maintaining the current status quo with no impact from the project. No alternatives are being considered.

5.1.1 Burial grounds and graves

The cemetery at **VS2** has a **high** heritage rating and a heritage grading of **IIIA**. It should be noted that while the cemetery falls within the Valley Silts project boundary, it is not within the current infrastructure footprint of the Valley Silts Expansion Project.

The impact significance before mitigation on the cemetery and graves sites will be High negative before mitigation. Implementation of the recommended mitigation measures will modify this impact rating to an acceptable Medium to Low negative.

It should be further noted that, in addition to the large burial ground (**VS2**) identified during the fieldwork for this project, several unmarked burial grounds have been identified and uncovered by previous development and construction projects in the surrounding area (i.e. two at Fleurfhof and one at Stormill). In addition, an example of a burial ground that had been covered by a slimes dam/sand dump and was exposed after the dump had been reclaimed is known from the Crown Mines/ Langlaagte area in Johannesburg (Anton Pelser 2012; Esterhuysen *et al* 2018).

5.1.2 Historical Structures

VS1 has a medium heritage significance with a heritage grading of IIIB.

The impact significance before mitigation on the historical structures will be **Medium** negative before mitigation. Implementation of the recommended mitigation measures will modify this impact rating to an acceptable **LOW** negative.

5.2 Palaeontological Impacts

As noted above, the Valley Silts occur in an area where the palaeontology is assessed as being almost entirely of Low sensitivity (coloured blue) and no palaeontological studies are required. Since it is anticipated that there should be no excavation into the underlying geology and the area surrounding the dumps has been disturbed extensively in the past, it is recommended that an

application for exemption from the standard requirement for a Palaeontological Impact Assessment be made to SAHRA.

5.3 Impact assessment summary table

Implementing the impact assessment methodology as supplied by the Kongiwe**,** (**Table 7**) provides a quantitative assessment of the impacts of the proposed Valley Silts Expansion project.

Table 7: Impact Table – Archaeological sites

No.	Affected Environment	Activity	Impact Description	BEFORE MITIGATION						Cumulative Impact	Mitigation measures / Recommendations	AFTER MITIGATION					
				Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE			Magnitude	Duration	Spatial Scale	Consequence	Probability	SIGNIFICANCE
	Construction																
1	Historical structure - VS1	Reclamation	Destruction of stone structure	*Moderate -*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium	No	Demarcate as no-go	Minor +	Short Term < 18 months	Site or Local	Low	Minor +	Medium
2	Cemetery - VS2	Reclamation	Destruction of graves	*Major -*	*Long Term > 5 years*	*Site or Local*	High	*Possible*	High	No	Demarcate as no-go	Minor +	Short Term < 18 months	Site or Local	Low	Minor +	Medium
3	Possible burials	Reclamation	Destruction of graves	*Major -*	*Long Term > 5 years*	*Site or Local*	High	*Possible*	High	No	Implement chance finds procedures	*Minor -*	*Long Term > 5 years*	*Site or Local*	Medium	*Possible*	Medium

Table 8: Impact Summary Impact table

DESCRIPTION OF IMPACT	Overall Significance		Overall Significance with mitigation
	No-Go Alternative	Preferred Alternative	Preferred Alternative
Impact on recent historic structures	4	-12 (Low)	-12 (Low)
Impact on archaeological resources	4	-24 (Low)	-12 (Low)
Impact on burial grounds	4	-72 (Medium)	-12 (Low)
Impact on palaeontology		-16 (Low)	-8 (Low)

6 MANAGEMENT RECOMMENDATIONS AND GUIDELINES

The following section must be read in conjunction with **Table 10** of this report.

6.1 Construction and operational phases

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camp areas and small-scale infrastructure development associated with the project.

It is possible that cultural material will be exposed during construction and may be recoverable, keeping in mind delays can be costly during construction, and as such must be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, however foundation holes do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project, and these must be catered for. Temporary infrastructure developments, such as construction camps and laydown areas, are often changed or added to the project as required. In general, these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following chance find procedure should be implemented.

6.2 Chance finds procedure

- A heritage practitioner / archaeologist should be appointed to develop a heritage induction program and conduct training for the ECO as well as team leaders in the identification of heritage resources and artefacts **during the implementation of the EMPr**.

- An appropriately qualified heritage practitioner / archaeologist must be identified to be called upon in the event that any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated, and construction activities halted.
- The qualified heritage practitioner / archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and the impact on the heritage resource.
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the materials and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the heritage practitioner / archaeologist.

6.3 Possible finds during construction

The study area occurs within a greater historical and archaeological site as identified during the desktop and fieldwork phase. Soil clearance for infrastructure as well as the proposed reclamation activities, could uncover the following:

- Historical structures and foundations
- unmarked burial grounds and graves

6.4 Timeframes

It must be kept in mind that mitigation and monitoring of heritage resources discovered during construction activity will require permitting for collection or excavation of heritage resources and lead times must be worked into the construction time frames. **Table 9** gives guidelines for lead times on permitting.

Table 9: Lead times for permitting and mobilisation

Action	Responsibility	Timeframe
Preparation for field monitoring and finalisation of contracts	The contractor and service provider	1 month
Application for permits to do necessary mitigation work	Service provider – Archaeologist and SAHRA	3 months
Documentation, excavation and archaeological report on the relevant site	Service provider – Archaeologist	3 months
Handling of chance finds – Graves/Human Remains	Service provider – Archaeologist and SAHRA	2 weeks
Relocation of burial grounds or graves in the way of the development	Service provider – Archaeologist, SAHRA, local government and provincial government	6 months

6.5 Heritage Management Plan for EMPr implementation

Table 10: Heritage Management Plan for EMPr implementation

Area and site no.	Mitigation measures	Phase	Timeframe	Responsible party for implementation	Monitoring Party (frequency)	Target	Performance indicators (monitoring tool)
General project area	Implement chance find procedures in case where possible heritage finds are uncovered	Construction and operation	During construction and operation	Applicant ECO Heritage Specialist	ECO (monthly / as or when required)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report
VS1 – historical mine compound complex	In the event that the site cannot be excluded from the planned Reclamation activities, further research into the site must include: ▪ Exposing the structure through archaeological excavation ▪ Archival research on the structure ▪ Analysis of any artefacts recovered during the excavations ▪ If it is found that after mitigation the site is not conservation worthy an application for destruction must be lodged under s35 of the NHRA.	Construction through to operation	Prior to and during construction	Applicant ECO	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report

Area and site no.	Mitigation measures	Phase	Timeframe	Responsible party for implementation	Monitoring Party (frequency)	Target	Performance indicators (monitoring tool)
	▪ If the site is to be retained after mitigation a site-specific heritage management plan for the site must be developed and submitted for approval to the SAHRA.						
VS2 – Burial ground	All burial grounds and graves must be retained and avoided with a **buffer zone of 50 m** as per SAHRA guidelines. If this is not possible, the graves should be relocated after completion of a detailed grave relocation process, that includes a thorough stakeholder engagement component, adhering to the requirements of Section 36 of the NHRA and its regulations as well as the National Health Act and its regulations and any provincial legislation.	Construction through to Operational	Prior to and during construction	Applicant ECO Heritage specialist	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report
Possible graves	Undertake archaeological monitoring at earth clearance stage If any human remains are uncovered, contact SAHRA and appoint a qualified	Construction through to Operational	During Construction and Operation	Applicant Environmental Control Officer (ECO)	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under	ECO Monthly Checklist/Report

Area and site no.	Mitigation measures	Phase	Timeframe	Responsible party for implementation	Monitoring Party (frequency)	Target	Performance indicators (monitoring tool)
	heritage specialist to undertake appropriate mitigation (usually exhumation and relocation).					Section 36 and 38 of NHRA	

7 CONCLUSIONS AND RECOMMENDATIONS

The HIA has shown that the study area and surrounding area has some heritage resources situated within the proposed development boundaries. Through data analysis and a site investigation the following issues were identified from a heritage perspective.

The fieldwork identified two heritage features (**VS1** and **VS2**). **VS1** is a partly exposed stone structure probably related to early mining history, while **VS2** is a cemetery with approximately 50 visible graves.

7.1 Historical Structures

The finds are provisionally rated as having a **low** heritage significance with a heritage rating of **IIIC**. The impact significance before mitigation on the historical structures will be **Medium** negative before mitigation. Implementation of the recommended mitigation measures will modify this impact rating to an acceptable **LOW** negative.

In the event that the site cannot be excluded from the planned reclamation activities, further research into the site must include:

- Exposing the structure through archaeological excavation
- Archival research on the structure
- Analysis of any artefacts recovered during the excavations
- If it is found that after mitigation the site is not conservation worthy an application for destruction must be lodged under s35 of the NHRA.

If the site is to be retained after mitigation a site-specific heritage management plan for the site must be developed and submitted for approval to the SAHRA.

7.2 Burial grounds and graves

The cemetery at **VS2** has a high heritage rating and a heritage grading of IIIA.

Burial grounds and graves are always regarded as having **high** heritage significance and a grading of **IIIA**.

While the cemetery is not anticipated to be affected project related infrastructure, it is recommended that the area be demarcated as a cemetery with an appropriate buffer in place. The impact significance before mitigation on the cemetery and graves sites will be High negative before

mitigation. Implementation of the recommended mitigation measures will modify this impact rating to an acceptable Medium to Low negative.

All burial grounds and graves must be retained and avoided with a **buffer zone of 50 m** as per SAHRA guidelines.

If this is not possible, the graves should be relocated after completion of a detailed grave relocation process, that includes a thorough stakeholder engagement component, adhering to the requirements of Section 36 of the NHRA and its regulations as well as the National Health Act and its regulations and any provincial legislation.

Mitigation measures are described in **Table 10** of this report.

It should be noted that, in addition to the large informal burial ground (**VS2**) identified during the fieldwork for this project, several unmarked burial grounds have been identified and uncovered by previous development and construction projects in the surrounding area (i.e. two at Fleurfhof and one at Stormill). In addition, an example of a burial ground that had been covered by a slimes dam/sand dump and was exposed after the dump had been reclaimed is known from the Crown Mines/ Langlaagte area in Johannesburg (Anton Pelser 2012; Esterhuysen *et al* 2018).

7.3 Palaeontology

As noted in Section 5 above, the Valley Silts occur in an area where the palaeontology is assessed as being almost entirely of Low sensitivity (coloured blue) and no palaeontological studies are required. Since it is anticipated that there should be no excavation into the underlying geology and the area surrounding the dumps has been disturbed extensively in the past, it is recommended that an application for exemption from the standard requirement for a Palaeontological Impact Assessment be made to SAHRA.

7.4 Mitigation measures

Mitigation measures are described in **Table 10** of this report.

7.5 General

It is the author's considered opinion that overall impact on heritage resources is Medium to Low. Provided that the recommended mitigation measures are implemented, the impact would be acceptably low or could be totally mitigated to the degree that the project could be approved from

a heritage perspective. The management and mitigation measures as described in Section 6 of this report have been developed to minimise the project impact on heritage resources

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8.2 Google Earth

All the aerial depictions and overlays used in this report are from Google Earth.

APPENDIX A

ENVIRONMENTAL IMPACT METHODOLOGY

KONGIWE ENVIRONMENTAL: IMPACT ASSESSMENT METHODOLOGY

1 IMPACT ASSESSMENT METHODOLOGY

The impact significance rating system is presented in Table 11,

Part B: Determining Consequence Rating:

Rate consequence based on definition of magnitude, spatial extent and duration.

Table 12, and

Part C: Determining Significance Rating:

Rate significance based on consequence and probability.

Table 13 and involves three parts:

1. **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/ population and duration;

2. **Part B**: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and

3. **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from **Part B**) and the probability of occurrence.

Part A: Defining Consequence in Terms of Magnitude, Duration and Spatial Scale:

Use these definitions to define the consequence in Part B.

Table 11: Consequence Rating Methodology

Impact characteristics	Definition	Criteria
Magnitude	Major -	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded

Impact characteristics	Definition	Criteria
	Moderate -	Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor -	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded
	Minor +	Minor improvement; change not measurable; or threshold never exceeded
	Moderate +	Moderate improvement; within or better than the threshold; or no observed reaction
	Major +	Substantial improvement; within or better than the threshold; or favourable publicity
Spatial scale or population	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral, catchment, topographic
	National/ International	Nationally or beyond
Duration	Short term	Up to 18 months.
	Medium term	18 months to 5 years
	Long term	Longer than 5 years

Part B: Determining Consequence Rating:

Rate consequence based on definition of magnitude, spatial extent and duration.

Table 12: Consequence Rating Methodology

			Spatial scale/ Population		
			Site or Local	Regional	National/ International
MAGNITUDE					
Minor	**DURATION**	**Long term**	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium

Moderate	**DURATION**	**Long term**	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium
Major	**DURATION**	**Long term**	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

Part C: Determining Significance Rating:

Rate significance based on consequence and probability.

Table 13: Significance Rating Methodology

Probability (of Exposure to Impacts)	Consequence Negative			Consequence Positive		
	Low	**Medium**	**High**	**Low**	**Medium**	**High**
Definite	Medium	Medium	High	Medium	Medium	High
Possible	Low	Medium	High	Low	Medium	High
Unlikely	Low	Low	Medium	Low	Low	Medium

NATURE OF THE IMPACT: ***DESCRIBE THE IMPACT IN RESPECT TO THE ACTIVITY TO BE UNDERTAKEN***		
	Impact Rating Without Mitigation	**Impact Rating With Mitigation**
Extent *(Local, Regional, International)*		
Duration *(Short term, Medium term, Long term)*		
Magnitude *(Major, Moderate, Minor)*		
Probability *(Definite, Possible, Unlikely)*		
Calculated Significance Rating (Low, Medium, High)		
Impact Status: (positive or negative)		
Reversibility: (Reversible or Irreversible)		
Irreplaceable loss of resources: (Yes or No)		
Can impacts be enhanced: (Yes or No)		
Residual impacts ❖ (List these below)		

Mitigation measures

- (List these below)

APPENDIX B

SITE DESCRIPTION FORMS

Site coordinates		
site_nr	**X**	**Y**
VS1	-26.227	28.0040
VS2	-26.226	28.0060

Site[3] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
VS1	S 26,227	E 28,0040	The site consists of a semi exposed stone walled structure. The stone worked exposed consist of masoned stone blocks used to construct a stone wall. The structure is however not entirely exposed and determining the extent was impossible. Historical maps show no structures present in the area. It is evident that the wall is part of a larger subsurface structure and in all probability associated with early mining activities. The exposed section of the wall is approximately 10m in length. With the sparse information on the structure and the fact that very little has remained of structures related to the early mining history of the Witwatersrand this site can potentially hold further information on the history of the area. The finds provisionally rated as having a medium heritage significance with a heritage rating of IIIC. In the event that the site cannot be excluded from the planned mining activities, further research into the site must include: ▪ Exposing the structure through archaeological excavation ▪ Archival research on the structure ▪ Analysis of any artefacts recovered during the excavations ▪ If it is found that after mitigation the site is not conservation worthy an application for destruction must be lodged under s35 of the NHRA.	Medium	Grade IIIC

[3] *Site in this context refers to a place where a heritage resource is located and not a proclaimed heritage site as contemplated under s27 of the NHRA.*

Site[3] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
			▪ If the site is to be retained after mitigation a site-specific heritage management plan for the site must be developed and submitted for approval to the SAHRA.		



Figure 25 – Exposed stone walling at VS1



Figure 26 – Exposed stone walling at VS1

Site[3] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
					

Site[4] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
VS2	S 26,226	E 28,0060	The cemetery is situated between Crownwood road and the reclaimed Crown Mine dump. Numerous stone packed graves were identified during the fieldwork. Due to the vegetation growth it was impossible to do an accurate grave count, but an estimated 50-110 graves are located in the area. Discussions with the archaeologist, Anton Pelser, who was responsible for the grave relocations at Crown Mines, indicated that the cemetery may be related to Indian labourers. This is however hearsay. **The extent is approx. 1ha** The age of the cemetery is difficult to estimate. Some of the graves do have large eucalyptus trees growing on them. The locality in relation to the grave relocated just to the east of this cemetery as well as the possibility of the graves linked to indentured labour indicates as high heritage significance and a grading of IIIA. It is recommended that the area is avoided and demarcated as a cemetery.	High	IIIA

[4] *Site in this context refers to a place where a heritage resource is located and not a proclaimed heritage site as contemplated under s27 of the NHRA.*

Site[4] number	Lat	Lon	Description	Heritage Significance	Heritage Rating



Figure 27 – Stone packed graves in the cemetery



Figure 28 – Trees growing on some graves

Site[4] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
					

APPENDIX C

PGS TEAM CVS



TYRON HOPF

Professional Heritage Practitioner

PROFILE

I am an Archaeologist and Heritage Specialist with an M.A. degree in Archaeology from the University of Pretoria.

A registered member of the Association of Southern African Professional Archaeologists as an Accredited Professional Heritage Practitioner, my work focuses on heritage management through Heritage Impact Assessments, implementation of recommendations and large-scale heritage mitigation projects.

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PGS HERITAGE

EDUCATION

University of Pretoria
2018 - 2023
MA Archaeology - Using stable isotopes to understand the management strategies of domesticate livestock in the hinterlands of the 13th century Mapungubwe civilization.

University of Pretoria
2010 – 2017
BA (Hons) Archaeology – Middle Iron Age material culture with undergraduate majors in Anthropology and English.

WORK EXPERIENCE

PGS Heritage (Pty) Ltd - Archaeologist– Heritage Impact Assessments
January 2024- present
Responsible for conducting heritage impact assessments, arranging day-to-day fieldwork activities and logistics around fieldwork, and writing reports for projects as allocated in consultation with senior management.

PGS Heritage (Pty) Ltd – Junior Archaeologist – Heritage Mitigation
June 2022 – October 2022
Directed and conducted an extensive Phase II Heritage Mitigation excavation of several Iron Age sites in the Steelpoort Valley, Limpopo province.

Digby Wells Environmental– Intern – Heritage Resource Management
2021 – 2022
Conducted baseline research and fieldwork for Phase I HIAs.

University of Pretoria Enterprises - Heritage **Impact Assessment**
August 2020
Assisted Dr. Antonites with the field survey and report compiling for a phase I HIA.

PROFESSIONAL AFFILIATION

Accredited Professional Heritage Practitioner
Association of Professional Heritage Practitioners
Since 2021



JESSICA ANGEL

Professional Heritage Practitioner

PROFILE

Senior Heritage Specialist with an MSc degree in Archaeology and Geography. I am accredited as a Professional Archaeologist by the Association of Southern African Professional Archaeologists and as a Field Supervisor for Colonial Period, Iron Age, and Stone Age archaeology. My primary focus is on heritage management, which includes conducting Heritage Impact Assessments, managing heritage mitigation, and overseeing lab operations.

I have successfully managed various aspects of large-scale mitigation projects in South Africa and Lesotho. My responsibilities included conducting archaeological research, documentation, GIS, artefact photography, and archaeological illustration. I also managed archaeological assemblage storage and curation, as well as specialist analysis.

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PGS HERITAGE

EDUCATION

University of the Witwatersrand
2003-2005
BA Degree - Majors in Archaeology and Geography

University of the Witwatersrand
2006
BSc Hon Geography, with further specialisation in Environmental Management, Advanced GIS, Palaeogeomorphology and Globalisation and Agro Food restructuring.

University of the Witwatersrand
2010 - 2013
MSc Archaeology and Geography

WORK EXPERIENCE

PGS Heritage – Heritage Specialist/Senior Archaeologist
2023- present
Working in the Heritage Unit, managing Heritage Impact Assessments. Training of interns and Junior archaeologists

PGS Heritage, Lesotho– Senior Archaeologist
2018-2023
Laboratory and collections manager for the Heritage Mitigation of Polihali Dam Project. The Polihali Dam Project was a 2nd Phase CRM operation to mitigate the total inundation of various cultural sites.

PGS Heritage – Junior Archaeologist
2015-2018
Heritage Impact Assessments, Second Phase Heritage Mitigation on the Raising of the Clanwilliam Dam Wall.

PGS Heritage – Internship
2012 – 2014
My duties included gaining familiarity with gathering relevant background data, field surveys, exhumations, and report writing.

NGT Projects and Heritage Consultants
2013
Heritage Impact Assessments - Background research, report writing and ground surveys

Department of Geography, Archaeology and Environmental Science (University of the Witwatersrand)
2011
Research Assistant

PROFESSIONAL AFFILIATION

Accredited Professional Archaeologist
Association of Southern African Professional Archaeologists (ASAPA)– Since 2015



WOUTER FOURIE

Professional Heritage Practitioner

PROFILE

Project Manager and Principal Heritage Specialist holds a post-graduate degree in Archaeology and is registered with the Association of Southern African Professional Archaeologists as a Professional Archaeologist and is accredited as a Principal Investigator; he is further an Accredited Professional Heritage Practitioner with the Association of Professional Heritage Practitioners in South Africa.

My work focuses on heritage management through Heritage Impact Assessments, implementation of recommendations and large-scale heritage mitigation projects. I have worked, completed and implemented heritage projects in South Africa, Botswana, Mozambique, Mauritius, Zambia, Lesotho, and the Democratic Republic of the Congo.

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PGS HERITAGE

EDUCATION

University of Pretoria
1993-1996
BA Degree - Majors in Archaeology, Anthropology and Geography

University of Pretoria
1997
BA Hon Archaeology, with further specialisation in environmental management.

University of Cape Town
2016 – present
MPhil Conservation of the Built Environment

WORK EXPERIENCE

PGS Heritage Group of Companies
(***South Africa, Lesotho, Mozambique, and Portugal***)
Director – Heritage Specialist
2003- present
I am actively involved in the management of the business and focus on marketing and new business for PGS, specifically the broader SADC region. Acting as heritage specialist in multidisciplinary teams

The University of the Witwatersrand - Project Manager – Archaeological Contracts Unit
2007-2008
Responsible for conducting heritage and archaeological impact studies, archaeological excavations and general management of the unit

Matakoma Consultants – Director – Heritage Specialist
2000 – 2008
Heritage specialist and Director responsible for heritage and archaeological impact studies

Randfontein Estate Gold Mine – Environmental Coordinator
Oct 1998- Feb 2000
Coordinating all environmental Rehabilitation work

Department of Minerals and Energy Environmental Officer
Oct 1997– Sept 1998

PROFESSIONAL AFFILIATION

Accredited Professional Heritage Practitioner
Association of Professional Heritage Practitioners
Since 2014

Accredited Professional Archaeologist
Association of Southern African Professional Archaeologists – Since 2001

APPENDIX D:

Specialist Studies

- ❖ **Appendix D8 - Socio-Economic**

Socio-Economic Impact Assessment of the Valley Silts Expansion Project, City of Johannesburg, Gauteng



Photo: Eastern Section of Valley Silts

March 2025
FINAL DRAFT

PREPARED BY:
Southern Economic Development (Contact: +27 (0) 82 335 4126)

FOR KONGIWE ENVIRONMENTAL PTY LTD
ON BEHALF OF ERGO MINING (PTY) LTD

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LIST OF ABBREVIATIONS

Abbreviation	Description
CBD	Central Business District
CoJ	City of Johannesburg
CHC	Community Health Care
COGTA	Department of Cooperative Governance and Traditional Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme Report
GGDA	Gauteng Growth and Development Agency
GVA	Gross Value Added (Economic output concept)
HDI	Historically Disadvantaged Individuals
IDP	Integrated Development Plan
JSE	Johannesburg Stock Exchange
LED	Local Economic Development
NASREC	National Recreation Centre
MR	Mining Right
NEM: WA	National Environmental Management: Waste Act, 2008 (Act No 59 of 2008)
NEMA	National Environmental Management Act, 1998 (Act No 107 of 1998)
NWA	National Water Act, 1998 (Act No 36 of 1998)
NNR	National Nuclear Regulator
PIE (Act)	The Prevention of Illegal Eviction from and Unlawful Occupation of Land Act, 1998 (Act No. 19 of 1998))
SAPS	South African Police Service
SDF	Spatial Development Framework
SEIA	Social and Economic Impact Assessment
SLP	Social Labour Plan
SPLUMA	Spatial Planning and Land Use Management Act
TSF	Tailings Storage Facility

EXECUTIVE SUMMARY

Project background: Ergo (Pty) Ltd (Ergo), a wholly owned subsidiary of DRDGOLD Limited, obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of Nasrec near Booysens Reserve, in the City of Johannesburg, i.e. the Valley Silts Project. This new environmental application process concerns an expansion of the current project activities. The Expansion Phase of the project will consist of the processing of silt in areas further to the west and east of the current project area (Sectors 2 and 3).

Project Scope: The scope and purpose of the Social and Economic Impact Assessment (SEIA) report are to provide the background of the socio-economic characteristics of the local area relevant to the project; to provide an assessment of potential impacts that are anticipated during the construction, operational, and decommissioning phases and provide a socio-economic management plan to enhance positive impacts and mitigate negative impacts.

Main Socio-Economic Baseline Characteristics of Receiving Environment: The project is situated in Gauteng in the central parts of the City of Johannesburg (CoJ) about 7km south of the Central Business District (CBD). The Ward is situated in CoJ Ward 68 with Wards 54 (south); 124 (east) and 125 (south west) surrounding the project area. The main socio-economic characteristics of the local environment can be summarised as follows:

- Valley Silts is situated in an urban and industrial area of Johannesburg surrounded by industrial and business parks to the north and south east of the project area;
- Riverlea, the closest residential area, lies to the project's north west. The other residential area is located in Ormonde to the south of the project area;
- The CoJ experienced relatively low population growth since 2011 signifying some exodes from the city to the other urban centres such as Ekurhuleni and the City of Pretoria;
- Compared to population growth, household growth remained high in the CoJ, possibly also due to the relative high number of low-cost housing programmes being rolled-out by CoJ the past decade;
- The relatively low female ratios and high ratios of economically active population in wards 124 and 125 close to the project area signifies to the presence of single male workers that have migrated to these areas in search of work;
- CoJ on average experienced lower municipal service backlogs in 2022 compared to provincial and national averages. The wards around the project area experienced lower municipal service backlogs compared to CoJ averages apart from the relatively high sanitation backlogs in Ward 68 (Riverlea). The lack of maintenance of municipal services in Riverlea furthermore poses potential health and safety risks to the community.
- The education levels of the adult population are in higher in Gauteng and the CoJ than nationally. That is also the case in the project wards around the project area. The education levels of the population in Ward 68 are lower than in the other wards with 46% being unskilled (without matric) and only 8% with tertiary qualifications.
- There is a potential shortage in primary and secondary schools as well as educators in the CoJ. The lack of schools and educators is also more pronounced in the Riverlea area;

- Apart from the possible shortage in public health facilities, other health challenges that the local community face include the compromised surface water quality in the local area, the lack of maintenance of municipal infrastructure and illegal dumping activities;
- The proximity of old gold tailings facilities in the area increases the exposure risk to elevated levels of Uranium (U) deposited within the gold tailings. Based on tests done in the Valley Silts area it was however found that the material in the area is not radioactive;
- Per capita crime rates are higher in CoJ than nationally and in particular high in the Riverlea area. The high crime levels in the Riverlea area could partially be ascribed the high levels of illegal mining in the surrounding areas;
- The finance and sectors are dominant sectors in CoJ in terms of output and employment. Sectors that made a relatively smaller contribution compared to their national contribution include the primary sectors (agriculture and mining) as well as manufacturing, utilities and transport;
- The mining and industrial sectors play a relatively large role in the project area with current Ergo reclamation activities as well as the industrial and warehouse activities taking place in the business and industrial zones adjacent to the project area;
- CoJ experienced low growth in employment and output with the mining sector in particular showing a steep decline the past decade;
- Low economic growth resulted in rising unemployment and poverty in CoJ in general and in particular in Ward 68 where the project is situated;
- Gauteng provincial development priorities revolve around output and employment growth and skills development. On a spatial level, focus areas include increasing available land from mine dumps to be used for other purposes, in line with government priorities;
- The Joburg Spatial Development framework prioritises the rehabilitation and development of land in the mining belt area to unlock land for mixed use developments that could bridge the historic spatial divide between the developed north, and southern areas such as Soweto.

Socio-Economic Impacts: As indicated in the table below, the project has a number of potential positive socio-economic impacts during the operational phase related to facilitating continued operations with associated employment creation and social funds generated through Ergo activities. A large number of positive impacts of the project are also expected to occur over the long-term after closure including the regaining of land for development, potential improvement in the safety of the local community and the reduction in nuisance factors such as dust and reduced air quality due to the current gold tailings present in the local area.

Potential negative impacts on the local community are largely expected to occur over the short operational period. These risks include nuisance factors (increased noise and dust) as well as potential impacts on community safety. The communities of most at risk in terms of nuisance and health and safety impacts during operations. With the possible exception of increased informal influx due to potential job seekers seeing opportunities on the project, the social risks of the project can be effectively reduced.

Due to the project's proximity to the Johannesburg CBD, there is a potential high risk for land invasions on the reclaimed area. If the recommended management measures are implemented this risk is however expected to be effectively reduced to a medium social risk. In addition to the management measures related to each impact, on-going stakeholder engagement is also recommended to understand issues on the ground. To this end it is recommended that a Community Consultation Forum (Forum) be established.

Table: Summary of Socio-Economic Impacts

Impact Description	BEFORE MITIGATION SIGNIFICANCE	AFTER MITIGATION SIGNIFICANCE	Cumulative Impact
Operation (including short construction and decommissioning phases)			
Employment and Income	Low +	Medium +	Yes
Social funds	Low +	Medium +	No
Community health and safety	Medium -	Medium -	Yes
Informal influx	Medium-	Medium -	Yes
Nuisance factors	Medium -	Low -	Yes
Post- Closure			
Land restoration	Medium +	Medium +	No
Cessation of employment	Medium -	Medium -	No
Improved community safety	Medium +	Medium+	No
Land invasion	High -	Medium -	No

Conclusion: The proposed Project is in line with development priorities to support continued job creation in the local area. The project also holds potential in terms of the Johannesburg SDF objectives to unlock scarce land to the south of the CBD, an area that has been ear-marked as integrating land-use area between the CBD and Soweto.

There are no fatal flaws associated with the social risks of the project and most negative impacts can be effectively managed. Based on the findings of the socio-economic impact assessment for the project it is therefore recommended that the proposed project be approved.

1. PROJECT BACKGROUND

Ergo Mining (Pty) Ltd (Ergo), a subsidiary of DRDGOLD Limited, holds various Mining Rights (MR) in respect of slimes dams and sand dumps extending 65 km from Western Johannesburg to Eastern Ekurhuleni with most activities occurring on the central and eastern sections of the Witwatersrand mining belt.

Ergo obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of Nasrec near Booysens Reserve, in the City of Johannesburg, i.e. the Valley Silts Project. The mining authorisation for the removal of silts, falls within Mining Right GP 184 MR.

The Valley Silts Project is located within the Russell Stream valley, near Booysens Reserve. The project area stretches from New Canada Road, following the valley south east, past the Nasrec Road bridge and past Crownwood Road until the stream meets the M1. The Valley Silts resource has three primary sectors. The current approved reclamation area is Sector 1 and extends from the dam wall to the end of the stockpile area near Crownwood Road. The site is already established with fully fenced hard park facilities, solar powered security lights, well maintained haul roads, and site offices. Ingress/egress is fully controlled by security for all vehicles.

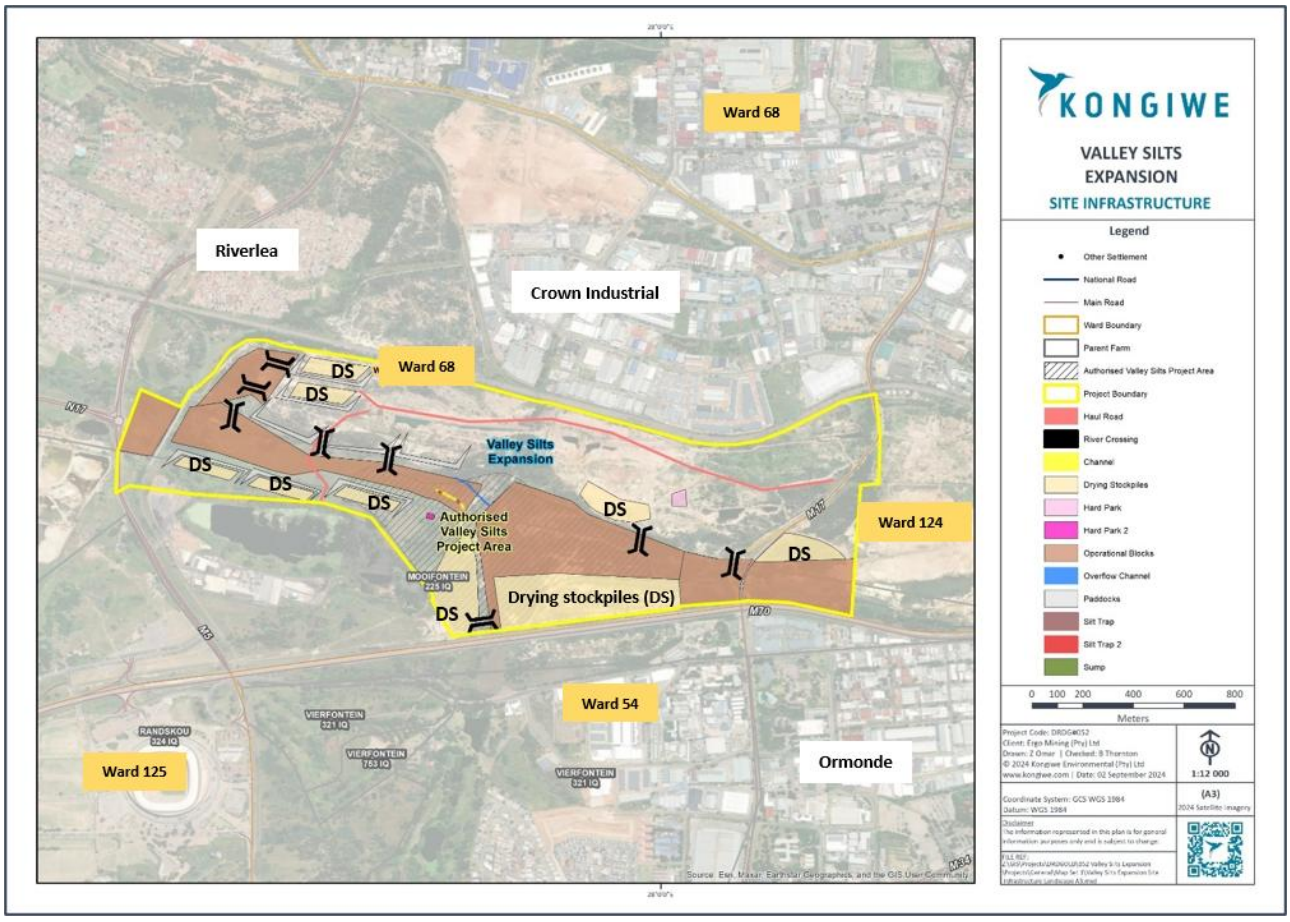


Figure 1: The Proposed Valley Silts Expansion Project

The Expansion Phase of the project will consist of Sector 2 and Sector 3. Refer to Figure 1 below for the infrastructure plan of the project area. Sector 2 will extend from the dam wall to Nasrec Road, with Sector being located either side of Crownwood Road. Because reclamation exceeds the delivery rate, stockpile areas are therefore required for temporary storage. Stock is moved in a sequential manner due to the moisture content, the drying process, as well as oxidation.

The current facilities in Sector 1 will be utilised for the remaining extensions. Existing infrastructure to be utilised at stages during the project include:

- Site offices
- Hard Park areas
- Existing site access roads;
- Hauling road: access roads and main roads.

Additional infrastructure will include:

- Additional haul roads
- Additional stockpile drying areas
- Additional stream crossings
- Additional silt traps and stormwater control berms/ paddocks

The Valley Silts approved Mining Right covers an approximate area of 122 Hectares (ha). The anticipated life span of the project is approximately 5 years maximum. The silt removal is planned for three years and rehabilitation 2 years.

2. DETAILS OF SPECIALISTS

2.1 EXPERTISE OF THE SPECIALIST

2.1.1 QUALIFICATIONS OF THE SPECIALIST

An Kritzinger *(Masters Economics)* is the specialist responsible for the economic baseline description and economic impact assessment of the proposed project.

2.1.2 PAST EXPERIENCE OF THE SPECIALIST

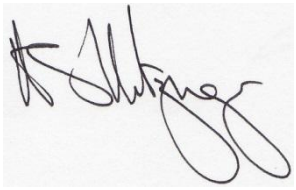
An Kritzinger has been working as a consultant in the economic development field for the past twenty years. She has extensive experience in the economic assessments of projects in various countries in Sub Saharan Africa. Her work has also focussed on applied economic modelling in South Africa, Namibia, Botswana and Mozambique including economic impact analysis, economic cost benefit analysis, social incidence studies and macroeconomic forecast modelling.

2.2 CV OF THE SPECIALIST

The detailed Curriculum Vitae (CV) of the specialist is provided in Section 13 below.

3. DECLARATION OF INDEPENDANCE

This report has been prepared as per the requirements of Appendix 6 of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 2014, as amended in June 2021). I, Anna Sophia Kritzinger declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Forestry, Fisheries and the Environment (DFFE).



Anna Sophia Kritzinger

Signature of the specialist: `

Southern Economic Development (Pty) Ltd

Name of group

18 December 2024

4. RELEVANT LEGISLATION AND GUIDELINES

The relevant legislation and guidelines are summarised in Table 1 below.

Table 1: Policy and Legislative Context

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied during SEIA	How does this project Comply with and Respond to the Policy and Legislative Context
Constitution of the Republic of South Africa, 1996 Section 24 of the Constitution states that everyone has the right to an environment that is not harmful to their health or well-being; 9and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.	The SEIA has covered the identification of and proposed management measures for socio-economic impacts relevant to the Project.	A comprehensive SEIA process has been undertaken to identify the potential socio-economic impacts associated with the Project and to prescribe management measures to minimise negative impacts and enhance the Project's contribution to socio-economic development.
National Environmental Management Act (Act 107 of 1998) (NEMA), as amended. NEMA EIA Regulations, 2014 (GNR 982, as amended) **NEMA and the EIA Regulations** provide a suite of principles and tools to guide South Africa on a path to sustainable development. "Environment' is defined in holistic terms and includes biophysical, social, and economic components, as well as the connections within and between these components. While NEMA does not prescribe a specific methodology for socio-economic impact assessment, the following principles in section 2 of NEMA (that apply to all identified impacts) highlight the necessity to include socio-economic issues in EIAs: • Responsibility for the impact should apply throughout its lifecycle. • The participation of all interested and affected parties (I&AP) in environmental governance must be promoted. • Decisions must take into account the interests, needs, and values of all interested parties. • The costs of remedying pollution, environmental degradation, consequent adverse health effects, and of preventing, controlling, or mitigating further pollution, environmental damage, or adverse health effects must be paid for by those responsible for harming the environment, i.e., the so-called polluter-pay principle. The EIA Regulations also make provision for a cumulative effects assessment, to identify and evaluate the significance of effects from multiple actions representing potential causes of impacts. They also provide for baseline/scoping, impact assessment and management reports, including the identification of measures to monitor adherence to the Environmental Management Programme (EMP).	The SEIA has covered the identification of and proposed management measures for socio-economic impacts relevant to the Project.	A comprehensive SEIA process has been undertaken to identify the socio-economic baseline of the Project Area and potential socio-economic impacts associated with the Project; and to prescribe management measures to enhance or mitigate impacts to minimise negative impacts and enhance the Project's contribution to socio-economic development.

Applicable Legislation and Guidelines used to Compile the Report	Reference where Applied during SEIA	How does this project Comply with and Respond to the Policy and Legislative Context
The National Water Act No 36 of 1998, the Water Use Licence Application and Appeals Regulations, 2017 (published under GN R267 in GG 40713 of 24 March 2017) states that in issuing a water use license the relevant authorities must take all relevant factors into account including: • The need to redress the results of past racial and gender discrimination; • Efficient and beneficial use of water in the public interest; and • The socio-economic impact related to the application.	The SEIA has covered the identification of and proposed management measures for socio-economic impacts relevant to the Project	A comprehensive SEIA process has been undertaken to identify the socio-economic baseline of the Project area and potential socio-economic impacts associated with the Project; and to prescribe management measures to mitigate or minimise negative impacts and enhance the Project's contribution to socio-economic development.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) – NEMWA. The environmental management of residue stockpiles, including TSFs, is currently governed under NEMWA and the Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, published under NEMWA in GN 632 of GG 39020 on 24 July 2015 (RS Regulations). The construction and expansion of residue stockpiles are currently listed in the List of Waste Management Activities that have, or are likely to have, a Detrimental Effect on the Environment, published in GN 921 in GG 37083 of 29 November 2013 (Waste List). NEMWA stipulates that the effect of pollution on the environment by a waste disposal activity be considered in an application for a waste management licence. This includes impacts on socio-economic conditions. NEMWA furthermore requires that best practicable environmental options available and alternatives should be taken to protect the environment, including socio-economic conditions due to the undertaking of the waste management activity. Similar provisions are contained in NEMA.	The SEIA has covered the identification of and proposed management measures for socio-economic impacts relevant to the Project	A comprehensive SEIA process has been undertaken to identify the socio-economic baseline of the Project area and potential socio-economic impacts associated with the Project; and to prescribe management measures to mitigate and minimise negative impacts and enhance the Project's contribution to socio-economic development.
Spatial Planning and Land Use Management Act, 2013 (Act No. 16 of 2013) (SPLUMA) The SPLUMA was promulgated in May 2015. SPLUMA is a framework act for all spatial planning and land use management legislation in South Africa. It seeks to promote consistency and uniformity in procedures and decision-making in this field. SPLUMA will also assist municipalities to address historical spatial imbalances and the integration of the principles of sustainable development into land use and planning regulatory tools and legislative instruments.	Planning legislation and guidelines guided the final evaluation of impacts	Planning guidelines were considered in the final evaluation of the impacts
Integrated and Spatial Development Plans of provincial and local government	Planning guidelines guided the final evaluation of impacts	Planning guidelines were considered in the final evaluation of the impacts
Other guidelines and standards: • The Prevention of Illegal Eviction from and Unlawful Occupation of Land Act, 1998 (Act No. 19 of 1998) • Labour Relations Act 66 of 1995 • Basic Conditions of Employment Act 75 of 1997	The legislation and guidelines were taken into consideration in the assessment of impacts and management measures	Legal requirements in terms of air, quality, Social and Labour Plans were considered in the assessment of the social impacts of the project and guided the recommended mitigation measures

5. INFORMATION REQUESTED BY THE COMPETENT AUTHORITIES

A Specialist Report Checklist Table has been compiled in accordance with the guideline as set out in Appendix 6 of the EIA Regulations. Appendix 6 relays the specific information required as per the guideline is given in the second column of the Table. Any other information requested by the Competent Authorities will be included in this chapter.

Table 2: Specialist Checklist

Specialist Report Guideline: Appendix 6 GNR 982 EIA Regulations 4 December 2014 as amended	
Details to be included in the Report	**Section in Report**
Details of	
Specialist who prepared the report	Section 2
Expertise of the specialist	Section 2
CV of the specialist	Section 13
Declaration that the Specialist is Independent in a form as may be specified by the CA	Section 3
An indication of the Scope of and the Purpose for which the report was prepared	Section 6.1
An indication of the Quality and Age of base data used for the specialist report	Sections 6.7 and 7
A Description of existing impacts on the site, cumulative impacts of the proposed development, and levels of acceptable change	Section 8
The Duration, Date, and Season of the site investigation and the relevance of the season to the outcome of the assessment	Section 6.2
A Description of the Methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 6.2
Details of an Assessment of the specific identified Sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 8.2
An identification of any areas to be avoided including buffers	Not applicable
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	Section 8.2
A Description of any Assumptions made and any Uncertainties or Gaps in Knowledge	Section 7.2
A Description of the Findings and Potential implications of such findings on the Impact of the proposed activity, including identified Alternatives on the environment, or activities	Section 9
Any Mitigation Measures for inclusion in the EMPr	Section 9
Any Conditions for inclusion in the Environmental Authorisation	Section 9
Any Monitoring Requirements for inclusion in the EMPr or Environmental Authorisation	Section 9
As to whether the proposed activity/ activities or portions thereof should be authorised	Section 11
Regarding the acceptability of the proposed activity or activities	Section 11
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	Section 11
A Description of any Consultation Process that was undertaken during the course of preparing the specialist report	Section 6.2
A Summary and copies of any comments received during any consultation process and where applicable all responses thereto	Not applicable
Any other information requested by the CA	Not applicable

6. SCOPE, PURPOSE, APPROACH, AND METHODOLOGY

6.1 SCOPE AND PURPOSE OF REPORT

The scope and purpose of the SEIA report are to provide the background of the socio-economic characteristics of the local area relevant to the project; to provide an assessment of potential impacts that are anticipated during the construction, operational, and decommissioning phases, and provide a socio-economic management plan to enhance positive impact and mitigate negative impacts.

6.2 APPROACH AND METHODOLOGY

The socio-economic impact assessment report was based on primary as well as secondary resources.

Primary sources include a site visit on 17 December 2024.

Secondary sources include (see Section 12 for the full list of sources):

- Academic literature review
- Internet searches
- Updated policy documents relevant to the local and regional area, such as:
  - Integrated development plans, including spatial development frameworks; and
  - Local economic development plans
- Official government data from Stats SA
- Public reports from the Municipal Demarcation Board, South African Police Service (SAPS), etc.

7. ASSUMPTIONS, UNCERTAINTIES, AND KNOWLEDGE GAPS

7.1 ASSUMPTIONS

- Where up to date site specific / ward level socio-economic data is missing, municipal and provincial trends were used as proxy for trends in the local area.
- It is assumed that the local community development priorities are expressed through public processes and public documents such as municipal integrated development plans.

7.2 UNCERTAINTIES AND LIMITATIONS

With regards to the SEIA being undertaken, the following should be noted:

- The SEIA includes consultations with key stakeholders and potentially affected parties as part of the impact assessment phase. This does not form part of the Public Participation Process (PPP) required for the overall EIA process, except where it was specifically specified as such during the consultation session.
- Socio-economic baseline information was mainly based on official statistics from Stats SA, as well as municipal documentation. Sub-municipal data was only available for 2011. Recent trends, as well as information on a sub-municipal level, were also based on quantitative and qualitative information received from local representatives with local knowledge. The lack of more recent official socio-economic data is therefore seen as a limiting factor, although it is not anticipated to influence the outcome of the report.

8. BASELINE DESCRIPTION

8.1 THE LOCAL AREA

Based on evidence from local as well as international studies and the potential health impact of gold mine dumps as well as drying stockpiles containing gold residue), we have used a 2km radius around the Project Area to represent communities that could possibly be affected physically by the project activities, e.g. through dust and noise related to the project activities ((Kootbodien et. al., 2020).

The project is situated in Gauteng in the central parts of the City of Johannesburg about 7km south of the Central Business District (CBD). As indicated in Figure 1 above, the following municipal wards are within the project area or adjacent to the project and falls within the 2km physical influence zone of the project:

- Ward 68 including Crown industrial area to the north and Riverlea to the west;
- Ward 54 south of the project area including Ormonde, Booysens Reserve, Theta light industrial area extending south across the N12 to include Mondeor, Ridgeway, Wincester Hills and Suideroord;
- Ward 124 to the east covering an old abandoned gold mine; and extending eastwards to Booysens and Ophirton;
- Ward 125 to the south west including the FNB soccer stadium (Soccer City) extending all the way south from the M70 towards Aeroton, Allan Manor and Kibler Park.

8.2 SOCIO-ECONOMIC SENSITIVE AREAS IN THE VICINITY OF THE PROJECT SITE

The Valley Silts is situated in an urban and industrial area of Johannesburg. As indicated in Figure 2 below the main roads around the project area include the provincial M70 (Soweto Highway); M17, M1 (De Villiers Graaf Highway) and the Nasrec road that runs past Riverlea, the closest residential area to the project's north west. This township of Riverlea was established in 1965 as a township for coloureds. The other residential area is located in Ormonde to the south of the project area. Within both these residential areas there are also a number of educational, business, health, religious and recreational facilities.

Other socio-economic receptors within the project's zone of influence as illustrated in Figure 2 below and include:

- The industrial area of Crown to the north;
- Within Ormonde business area there are two business parks namely Booysens Reserve and Theta that currently hosts a variety of warehouses, factories and distribution centres;
- The entertainment centre of Gold Reef City to the south east;
- The FNB soccer stadium;
- Gauteng oil and cake mill;
- Old mine tailings facilities to the west, north and east with possible illegal mining activities taking place on some of these facilities;
- An abandoned open pit gold mine belonging to Central Rand Gold, east of the project area. The mine was opened in 2010 and went bankrupt in February 2019. The mine now lies unregulated and unrehabilitated within the community (Kongiwe, 2019).



Figure 2: Socio-Economic Receptors Around the Project Site

8.3 DEMOGRAPHIC BASELINE

Table 3 below also shows that the relatively low population growth in the City of Johannesburg (CoJ) signifying some exodes from the city to the other centres such as Ekurhuleni and the City of Pretoria. The table also shows a high portion of the population in the economically active years, indicating to CoJ as a place where people tend to migrate to for work. The relatively low female ratios and high ratios of economically active population in wards 124 and 125 close to the project area signifies to the presence of single male workers migrating to these areas in search of work. In Ward 124 east of the project area there is also a high portion born outside the country (27% in 2011) that shows the presence of foreign migrants in the proximity of the project area.

Table 3: Basic Demographics of the Area, 2011 and 2022

AREA	Population nr	Population growth %	Households nr	Household growth nr	Population density, persons/km²	Average household size	% Females	Econ active
	2022	2011-2022	2022	2011-2022	2022	2022	2022	2022
CoJ ward 68	30 698	0.7%	11 233	2.3%	1 744	3.2	49.9%	70%
CoJ ward 54	44 320	0.7%	16 873	2.3%	2 462	3.1	53.2%	72%
CoJ ward 124	46 647	0.7%	21 594	2.3%	2 606	2.6	47.0%	79%
CoJ ward 125	39 452	0.7%	11 504	2.3%	1 154	4.1	43.0%	79%
CoJ	4 803 262	0.7%	1 841 917	2.3%	2 915	2.6	49.6%	73%
Gauteng	15 099 422	1.9%	5 318 665	2.8%	830	2.8	49.5%	72%
South Africa	62 027 503	1.7%	17 828 778	1.9%	50	3.5	51.5%	67%

Source: Stats SA, Census 2011 and 2022 Note: Ward information based on population and household growth rates in CoJ since 2011

Apart from relatively high population growth rates, households also tend to split into smaller units over time resulting in household growth rates above population growth in all the local ward areas. The high growth in the number of households furthermore place extra pressure on municipal service delivery within the local area. Household growth is higher in Gauteng and CoJ compared to rest of country. This could also possibly be ascribed to the relative high number of low-cost housing programmes being rolled-out by CoJ the past decade.

8.4 BASIC HOUSEHOLD SERVICES

As indicated in Table 4 below, the CoJ experienced on average experienced lower municipal service backlogs in 2022 compared to provincial and national averages.

Table 4: Access of Households to Basic Services, 2011 and 2022

Category	CoJ	Gauteng	National
Informal houses (shacks), 2022	10%	12%	12%
Informal houses (shacks), 2011	18%	18%	13%
Piped water inside the house 2022	77%	75%	60%
Without flush toilets, 2022	7%	10%	29%
Without flush toilets, 2011	11%	14%	26%
No electricity for lighting, 2022	6%	7%	7%
Regular waste services, 2022	91%	85%	66%
Regular waste services, 2011	95%	87%	59%

Source: Stats SA, Census 2011 and 2022

The wards around the project area on average experienced lower municipal service backlogs compared to CoJ averages apart from the relatively high sanitation backlogs in Ward 68 (Riverlea). The lack of maintenance of municipal services in Riverlea furthermore poses a potential health and safety risks to the local community as illustrated in Figures 3 below.

Table 5: Access of Households to Basic Services on Ward Level, 2011

Category	Ward 68	Ward 54	Ward 124	Ward 125
Informal houses (shacks)	10%	1%	2%	2%
Without flushed toilet	13%	2%	3%	3%
Regular Waste removal services	97%	98%	93%	98%

Source: Stats SA, Census 2011



Figure 3: Example of overflowing manhole and poor waste collection services in Riverlea
(Source: Kongiwe, 2019)

8.5 EDUCATION AND SKILLS LEVELS OF THE LABOUR FORCE

As indicated in Table 6 below, the levels of education of the adult population are in general higher in Gauteng and the CoJ than nationally. That is also the case in the project wards around the project area. The education levels of the population in Ward 68 are lower than in the other wards with 46% being unskilled (less than matric); 46% semiskilled and only 8% with tertiary qualifications. The skill levels of the wards south of the M70 (Soweto highway) are the highest with 34% of the adult population in Ward 54 holding tertiary qualifications and 35% in Ward 125.

Table 6: Education levels: Percentage of the adult population above 21 years, 2022

Category	Ward 68	Ward 54	Ward 124	Ward 125	CoJ	Gauteng	National
Without schooling	3%	1%	2%	1%	4%	4%	7%
Some secondary education	43%	18%	37%	15%	37%	37%	43%
Completed secondary education	46%	47%	49%	49%	44%	43%	38%
With tertiary education	8%	34%	12%	35%	15%	16%	12%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: Stats SA Census, 2011 and 2022 Ward information based on change in skill levels in CoJ since 2011

There is a shortage in primary and secondary schools as well as educators in the CoJ in general as indicated in the schools per capita ratios and pupil:educator ratio in Table 7 below. The lack of schools and educators are also more pronounced in the case of Ward 68 while Ward 125 could face a potential shortage in schools but not in educators. The high school per capita ratios in Ward 124 east of the project area could be ascribed to the large number of indepent schools that serve the foreign inhabitants of the ward.

Table 7: Educational facilities, 2022

Category	Ward 68	Ward 54	Ward 124	Ward 125	CoJ	National
Primary schools/10 000 people	1.3	2.0	4.1	1.3	2.0	3.8
Secondary schools/10 000 people	0.7	1.1	3.4	1.0	1.1	3.3
Pupil: educator ratio	29.5	21.4	26.4	24.6	28.4	24.9

Source: Department of Basic Education, 2020 and 2022

8.6 HEALTH STATUS AND SERVICES

As indicated in Table 8 below, the relatively low per capita ratios of public medical facilities could indicate to the shortage of facilities in the CoJ. This is also the case in CoJ Regions B and F (also see Figure 4 below) relevant to the project area.

Medical aid coverage is however higher in the CoJ compared to the national average which means some 25% of the population are able to attend private clinics and hospitals. The academic public hospital Chris Hani Baragwanath is also very close to project area located in Region D just 7km south west of the project area.

Table 8: Basic Health Indicators, 2018

Indicator	Region B (Ward 68)	Region F (Wards 54, 124, 125)	CoJ	South Africa
Primary Health Care (PHC) Clinics / 100 000 persons	4	3	2	6
Community Health Care facilities as % of PHC clinics	8%	11%	10%	25%
Hospitals/ 100 000 persons	1	1	1	2
Medical aid coverage	n.a.	n.a.	25%	16%

Source: Health Systems Trust, 2018

Apart from the possible shortage in public health facilities, other health challenges that the local community face include the compromised surface water quality in the local area due to elevated levels of salts, iron, lead amongst other substances posing a chronic health risk to the local community (Kongiwe, 2019). The lack of maintenance of municipal infrastructure (see Figure 3 above) and illegal dumping further contributes to deteriorated health conditions for the local communities.

The proximity of old gold tailings facilities and residue in the area furthermore increases the risk to elevated levels of Uranium (U) deposited within the gold tailings. Communities living in proximity to gold tailings facilities face an increased risk for radioactive pollution mainly caused by uranium.

However, a site survey which sampled 50 readings within the Valley Silts project area closest to the highway found that the highest measurements were for 0.349 Bq/g for Uranium (U) and 0,281 Bq/g for Thorium (Th). Therefore, this material is below the 0.5 Bq/g limit and currently not regarded as radioactive (Kongiwe, 2019).

A Health Environment and Development study (HEAD) study that was conducted over a 5-year period (2012-2017) as collaborative effort between the Medical Research Council (MRC), the University of Johannesburg (UJ), the University of the Witwatersrand, and the CoJ, indicated that the community of Riverlea experienced high levels of chronic illnesses such as asthma, diabetes and hypertension as well as high levels of depression and anxiety. Unhealthy lifestyle choices including high levels of smoking, alcohol and drug abuse were also prevalent in the area (University of Johannesburg, 2020).

8.7 COMMUNITY SAFETY AND SECURITY

The local area mainly served by SAPS police stations of Langlaagte and Booysens. As indicated in Table 9 below, per capita reported crime rates (including violent crimes) were substantially higher in the local precinct area compared to the national average as well as the already high average for CoJ.

Table 9: Crime Statistics, 2022

Indicator	Project area	CoJ	National average
Crime rate per 1000 people	39.3	32.8	26.4
Violent crimes [1)] per 1000 people	17.4	14.3	10.2
Change in crimes (2015-2022)	-6.4%	-17.5%	-22.6%

Source: SAPS (2023) [1)] Including murder, attempted murder, rape, robbery, assault

One of the reasons behind the high crime rates in the local area is the prevalence of illegal mining activities in the large number of old gold tailing dumps that are scattered throughout the area, including around the community of Riverlea. According to the community of Riverlea, there are around 26 open shafts around their area and while 14 of these shafts have been closed, the community have reported limited change in the activities of zama zamas (Illegal miners) in the area (GroundUp, 2023).

Outbreaks of violence between rival zama-zama factions resulted in a community member being killed in 2023. Residents say they live in constant fear which, in turn, resulted in the community staging several protests in 2023. The community of Riverlea is of the opinion that illegal mining mainly stems from an informal settlement Zamimpilo (See Figure 2 above) and had handed over a petition to government calling for the demolishment of the Zamimpilo informal settlement (EWN, 2024).

The baseline report for the Sector 1 activities of Ergo at Valley Silts also observed flood risks in the Riverlea area. According to the report Russell Stream has become displaced and has since changed its original course northward toward the areas of Riverlea and Crown Industrial. As the population of Riverlea expanded over time, houses have been built adjacent to the Russell Stream and along the floodplains. During heavy rainfall events, the river overflows and houses along Sand, Seekoei, Mogol and Selati Street begin to flood causing irreversible damage to resident's houses (Kongiwe, 2019).

8.8 THE STRUCTURE OF THE LOCAL ECONOMY

In 2022, the GDP of CoJ was R 967 billion (current prices) accounting for 43% of Gauteng's GDP and 15% of South Africa's total GDP (City of Johannesburg, 2024). Economic output grew at a low pace of around 0.5% per annum since 2016. The city employed close to 1.9m people in 2022, increasing at an average annual growth rate of 0.7% since 2011 (Stats SA, 2022).

The low growth in employment and output could be ascribed to a variety of factors including low domestic spending, low business confidence, a decline in global commodity prices reducing exports as well as infrastructure challenges. The trade, transport, finance, community services and agricultural sectors showed the highest growth while the mining, manufacturing, electricity, and construction sectors showed low growth the past decade (Gauteng Province Treasury, 2024).

Table 10 below shows the dominance of the finance and services sectors in CoJ in terms of output and employment. The trade and construction sectors also play relatively large roles in CoJ compared to nationally. Sectors that made a relatively smaller contribution compared to their national contribution include the primary sectors (agriculture and mining) as well as manufacturing, utilities and transport. These smaller sectors however play a relatively large role in the project area with current Ergo activities as well as the industrial and warehouse activities taking place in the business and industrial zones adjacent to the project area.

Table 10: Distribution of Economic Activities, 2020

	EMPLOYMENT		OUTPUT	
Sector	CoJ	National	CoJ	National
Agriculture	0.6%	5.6%	0.4%	2.7%
Mining	0.8%	2.7%	2.0%	8.4%
Manufacturing	11.0%	10.2%	14.0%	12.9%
Utilities	0.8%	0.7%	2.9%	3.8%
Construction	7.0%	7.5%	4.0%	3.2%
Trade	22.8%	20.4%	14.7%	14.8%
Transport	6.0%	6.1%	9.0%	8.9%
Finance	25.0%	15.5%	28.0%	19.9%
Services	26.0%	31.2%	25.0%	25.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: COCTA (2020); Stats SA (2022)

The CoJ is sub-divided into 7 regions as indicated in Figure 4 below. The economic output of the CoJ is unevenly spread among the seven CoJ regions. One section of the affected communities of the project area falls within Region B. This region used to be the growth point for the central northern business districts including Parktown, Randburg and Northcliff where some telecommunications companies and financial services companies have their headquarters. The poorer communities of Riverlea, Vrededorp, Sophiatown and Brixton also fall under Region B. Since 1996 Region B contributed 13% to the Johannesburg economy, while housing about 6% of its population (COCTA, 2020).

Region F houses the Central Business District (CBD) which once dominated as financial district for the city, housing some banking headquarters as well as provincial government offices. The Johannesburg Fresh Produce Market is also located here as well as Aerton, a warehousing and manufacturing pole in the city. There are some small holdings to the south of South Gate which are slowly transforming but still are an important agricultural link to the neighbouring city of Ekurhuleni. The decline in manufacturing and the relocation of the Johannesburg Stock Exchange (JSE) has led to this region's output contribution declining from 27% in 1996 to 23% in 2018. The region hosts 13% of the CoJ population (COCTA, 2020).

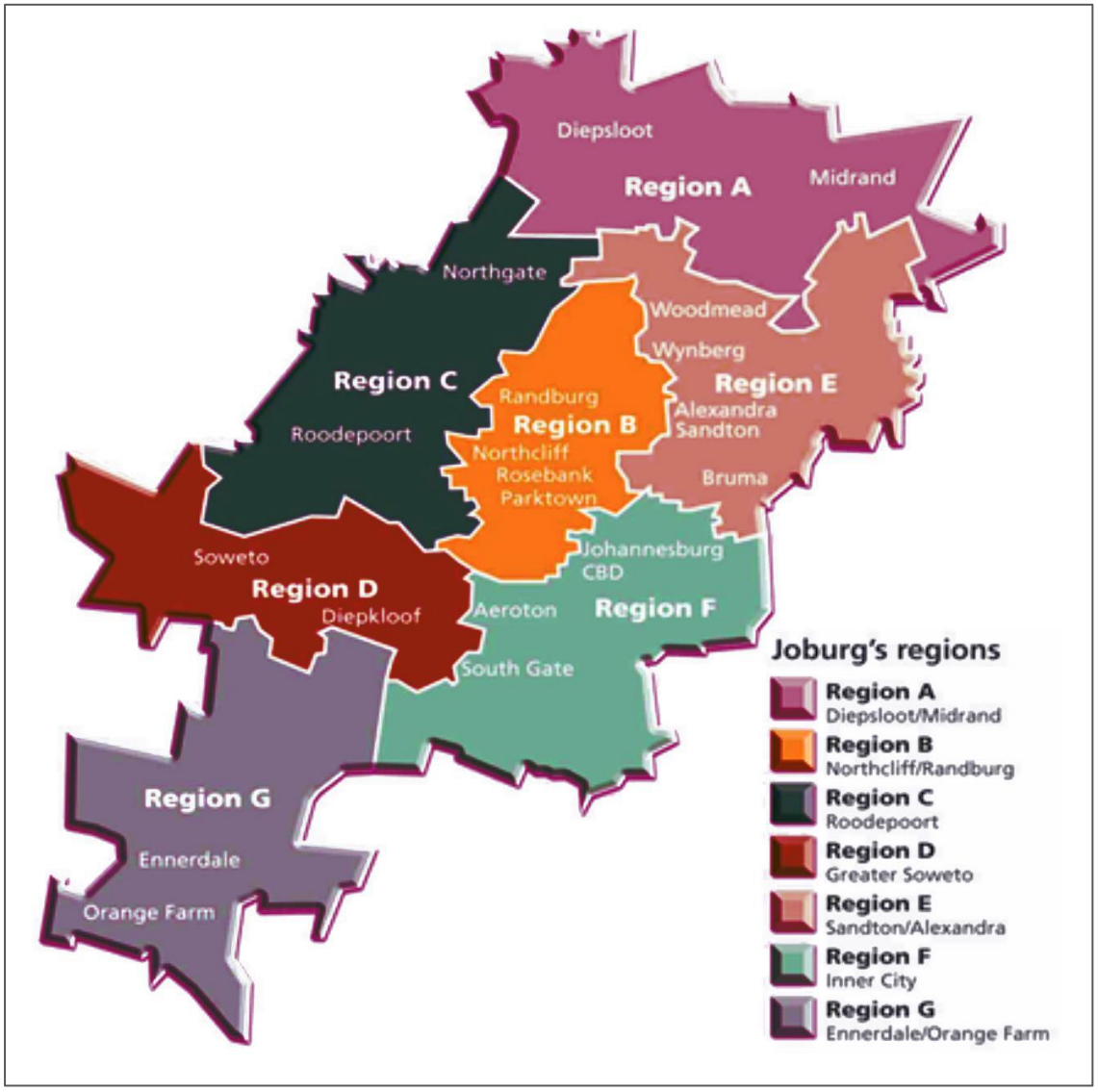


Figure 4: The Regions of the City of Johannesburg

8.9 THE LOCAL ECONOMIC CONTRIBUTION OF DRDGOLD RECLAMATION ACTIVITIES

DRDGOLD's reclamation activities through Ergo and its Far West operations create numerous direct employment opportunities to 927 permanent employees and 2 155 specialist service providers (DRDGOLD, 2023).

According to former Social and Labour Plan for Ergo (2018-2022), Ergo directly employed 827 employees and 507 through a contractor. Of the total workforce directly employed by Ergo, 85% were Historically Disadvantaged Individuals (HDIs) and 19% women. Of the total workforce, 58% could be classified as unskilled, 35% as semi-skilled and 7% skilled labour. Close to 51% of Ergo's total workforce of 1 334 in 2018 resided in the CoJ (Ergo Mining, 2018).

In addition to creating the direct employment opportunities above, the company also create supply-linked jobs through its spending on local suppliers.

Apart from its R 405m annual income tax contribution, DRDGOLD has a total corporate social investment budget of close to R53m per annum that covers the local areas of all its projects in the East Rand (Ekurhuleni Metropolitan Municipality); West Rand (City of Johannesburg Metro Municipality Regions D and F) towards Carletonville in the Merafong Municipality. Local economic development projects focus on poverty alleviation, income generation and job creation (DRDGOLD, 2023).

The Broad-Based Livelihoods (BBL) Programme forms part of their local economic development focus and were designed in partnership with the University of Pretoria Enterprises Research Project. The BBL Programme has reached over 8,000 participants across Ekurhuleni, the City of Johannesburg (including Riverlea community) and Merafong municipalities. The programme focuses on a wide variety of sub-programmes in response to participants' interests and ideas for increased economic activity in their local contexts, in retail and services, crop and livestock agriculture, and the health, wellness and beauty sector (DRDGOLD, 2023).

8.10 COMPOSITION OF THE LABOUR FORCE

As indicated in Table 11 below, the continued growth in the labour force coupled with low growth in output and employment resulted in an increase in the CoJ unemployment rate from 26% in 2011 to 35% in 2022, slightly higher than the already high national average of 34%. As is the case nationally, the youth unemployment was much higher than the official unemployment rate with around 53% of the labour force in COJ between 18-64 being unemployed (City of Johannesburg, 2024).

Informal employment in the CoJ also increased its share with around 22% of the employed being employed in the informal sector in 2022 compared to 15% in 2011.

As indicated in Table 11 the unemployment rate in most of the wards around the project area were well below the average for CoJ apart in Ward 68 where the unemployment rate was higher than the national and city's average, increasing to around an estimated 37% in 2022.

Table 11: The local labour force, 2011 and 2022

Indicator	Ward 68	Ward 54	Ward 124	Ward 125	CoJ	Gauteng	National
estimated employment 2022	10 620	21 500	21 900	15 000	1 882 720	4.8m	15.4m
estimated employment 2011	9 800	19 950	20 300	13 800	1 745 000	4.5m	14 ,1m
average annual growth 2022-2011	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0,9%
informal employment as % of employment 2022	na	na	na	na	22%	19%	19%
informal employment as % of employment 2011	8%	4%	10%	5%	15%	13%	16%
unemployment % 2022	37%	17%	17%	10%	35%	35%	34%
unemployment % 2011	30%	9%	17%	10%	26%	27%	25%

Source: Stats SA, 2011 (Census) and Stats SA, 2022 (Growth in employment in the wards were based in employment growth in CoJ)

8.11 INCOME AND POVERTY LEVELS

As indicated in Table 12 below, lower bound poverty rates in the CoJ were below the national and provincial average in 2011. A much higher portion of households furthermore earned more than R150 000 per year compared to nationally. With rising unemployment rates in the CoJ since 2011, the lower bound poverty rate has increased to an estimated 44% of households in 2022. Moreover, race and poverty remain stubbornly linked. Across the city, poverty levels are highest among black/Africans with higher levels of poverty experienced in Region G (COCTA, 2020).

Table 12: Percentage of households in different income, categories, 2011

Income category (per year)	Ward 68	Ward 54	Ward 124	Ward 125	CoJ	Gauteng	National
Less than R20 000 (lower bound poverty rate[1])	37%	16%	30%	16%	36%	37%	45%
Between R20 000 and R 75 000	28%	12%	34%	10%	31%	31%	32%
Between R 75 000 and R 150 000	14%	12%	17%	13%	10%	11%	9%
More than R 150 000	21%	60%	19%	61%	23%	21%	14%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: Stats SA, 2011 (Census)

As indicated in Table 12 above, Ward 68 had the highest poverty levels, followed by Ward 124 just east of the project area. As is the case with unemployment rates, the wards south of the M70 (Wads 54 and 125) experienced the lowest levels of poverty. In both wards around 60% of households earned more than R150 000 per year in 2011.

8.12 SOCIO-ECONOMIC DEVELOPMENT PRIORITIES AND INITIATIVES

The most relevant regional and local priorities relevant to the project area are summarised below:

[1] Statistics South Africa published 3 poverty rates for South Africa in 2011, namely the food poverty line (FPL) that allows for a minimum food intake; the lower bound poverty level (LBPL) that allows for basic food and some clothing; as well as the upper bound poverty level (UBPL) that allows for basic food clothing and some basic education. The percentage of households that earned less than R 20 000 per year in 2011 largely corresponds with the lower bound poverty rate in that year.

Gauteng Growth and Development Agency (GGDA) Objectives: The GGDA was created in 2013 through a merger of two former Gauteng development agencies. The objectives of the GGDA are in line with a number of Gauteng policy directives such as the Ten Pillar Programme for Transformation, Modernisation and Reindustrialsation (TMT) and the Growing Gauteng Together (GTT) 2030 Agenda GGDA (2014):

- Enable economic development focused on inclusive growth and sustainable jobs;
- Drive output and employment growth through improved education, training, innovation; governance; re-industrialisation and infrastructure development;
- Strategically position province into a globally competitive city region;
- Facilitate partnerships to foster growth;
- Support the development of key sectors in the economy.

Spatial Planning and Land Use Management Act, 2013 (Act No. 16 of 2013) (SPLUMA) promulgated in 2015, SPLUMA is a framework act for all spatial planning and land use management legislation in South Africa. SPLUMA will also assist municipalities to address historical spatial imbalances and the integration of the principles of sustainable development into land use and planning regulatory tools and legislative instruments.

Gauteng Mine Residue Areas Strategy, 2012

The aim of the Gauteng Mine Residue Areas Strategy as a whole is to make more land available from the mine dumps in Gauteng to be used for other purposes, in line with government priorities. The objectives for the strategy are as follows:

- To evaluate current pollution problems caused by mining activities and suggest how they should be addressed;
- To quantify the amount of land under mining activities and classify them in terms of impacts and potential for reclamation;
- To investigate which mining areas could be made available to be used for other purposes; and
- To provide preliminary and conceptual recommendations on the short-term priorities for the reclamation of the mining sites which could be economically sustainable.

The Integrated Development Plan (IDP) of Johannesburg (City of Johannesburg, 2024) identifies the following strategies relevant to the larger area of CoJ:

Joburg 2040: Growth and Development Strategy: The strategy prioritises outcomes that revolves around goals such as quality of life, poverty reduction, self-sustainability, improved health, social inclusivity, a healthy natural environment and sustained, job-intensive growth. One of the priority strategies to reach these outcomes is the focus in the green economy that, among other things, will focus on mitigating environmental pollution, including air, water, and waste to land as well as protecting the city's natural environment and related ecosystem goods and services.

The Spatial Development Framework for Johannesburg 2045: The SDF classified the local area where the project is located as per-urban and industrial and ear-marked the area for higher densities. The SDF is aligned to the principles of SPLUMA and aim to address seven major issues in Johannesburg's spatial and social landscape:

- Increasing pressure on the natural environment and green infrastructure;

- Urban sprawl and fragmentation including spatial inequalities and the job-housing mismatch;
- Uncontrolled urbanisation leading to informal settlements, overcrowding, and inadequate access to basic services;
- The mining belt area where the project is located, is seen as playing a significant role in facilitating the southern expansion of the existing Johannesburg Inner City area. The objective is to unlock mixed use, vibrant growth area that bridges the historic spatial divide between the developed north, and southern areas such as Soweto. Through strategic interventions along the belt, (road-linkages, mixed-use redevelopments, mining land rehabilitation, increased house stock, re-industrialisation) it seeks to draw economic energy into the Soweto Core area and to use the belt as a space of inclusion and re-connection. It is also viewed as, potentially, a specific and specialised industrial-type node with the opportunity of creating/re-locating jobs near areas where they are needed most;
- Priority areas in the SDF include the Inner City, the Mining Belt, Corridors of Freedom, and the Greater Soweto Area. The focus in these areas include the provision of new housing units; upgrading of infrastructure, improving the public environment, new roads, and new social facilities.

9. SOCIO-ECONOMIC IMPACT ASSESSMENT OF THE PROPOSED PROJECT

9.1 RATING METHODOLOGY

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impact significance rating system is presented in Table 13 -15 and involves three parts:

- **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/ population and duration;
- **Part B**: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and
- **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from **Part B**) and the probability of occurrence.

Part A: Defining Consequence in Terms of Magnitude, Duration and Spatial Scale

Use these definitions illustrated in the table below to define the consequence in Part B.

Table 13: Consequence Rating Methodology

Impact Characteristics	Definition	Criteria
Magnitude	Major -	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate -	Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor -	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded
	Minor +	Minor improvement; change not measurable; or threshold never exceeded
	Moderate +	Moderate improvement; within or better than the threshold; or no observed reaction
	Major +	Substantial improvement; within or better than the threshold; or favourable publicity
Duration	Short term	Up to 18 months.
	Medium term	18 months to 5 years
	Long term	Longer than 5 years
Spatial scale or population	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral, catchment, topographic
	National/ International	Nationally or beyond

Part B: Determining Consequence Rating

Rate consequence based on definition of magnitude, spatial extent and duration.

Table 14: Consequence Rating Methodology

			Spatial Scale/ Population		
			Site or Local	Regional	National/ international
MAGNITUDE					
Minor	**Duration**	**Long term**	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	**Duration**	**Long term**	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium
Major	**Duration**	**Long term**	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

Part C: Determining Significance Rating

Rate significance based on consequence and probability.

Table 15: Significance Rating Methodology

Probability (of exposure to impacts)	Consequence Negative			Consequence Positive		
	Low	Medium	High	Low	Medium	High
Definite	Medium	Medium	High	Medium	Medium	High
Possible	Low	Medium	High	Low	Medium	High
Unlikely	Low	Low	Medium	Low	Low	Medium

9.1 CONSTRUCTION/OPERATIONAL PHASE IMPACTS

9.1.1 Introduction

The gold bearing silts will be mechanically excavated from the project area. 30-ton Articulated Dump Trucks (ADT) will be used to transport and stockpile the silts from the Russell Stream. The silts will be left to dry on stockpile footprints as indicated in Figure 2 above.

As indicated above, the current facilities in Sector 1 will be utilised for the remaining extensions. Additional infrastructure will include:

- Additional haul roads
- Additional stockpile drying areas
- Additional stream crossings
- Additional silt traps and stormwater control berms/ paddocks

Access to the site is directly off Crownwood Street. This access to the site is approximately 440 m to the south of the intersection with Jupiter Road. The access is 10 m wide, with one lane 'IN' and one lane 'OUT'. Traffic from Crownwood Road (M17) has the right of way and a 'STOP' condition is implemented. As far as possible, existing access roads will be utilised, and where this is not possible, these will be constructed as a two-by-two roadway, operating in both directions. Intersections will be properly designed to provide safe entry and exit into the reclamation area. Approvals from the provincial road's authority will be obtained where necessary.

This project will not require any additional process water for the mechanical excavation of gold bearing silts from an area in the Russell Stream. Potable drinking water will be sourced from the municipality and will be available to employees on site. No domestic or industrial disposal sites are required. There will be bins on-site for any domestic waste generated.

The Valley Silts approved Mining Right covers an approximate area of 122 Hectares (ha). The anticipated life span of the project is approximately 5 years maximum. The silt removal is planned for three years and rehabilitation 2 years.

Due to the short construction period, the operational and construction period are jointly assessed.

9.1.2 Impact on employment and income

Employment opportunities created by the Project include direct employment provided on the Project itself, indirect employment through the procurement of inputs/supplies as well as induced employment generated through an overall increase in income due to higher income levels of direct employees and suppliers.

In terms of direct employment, Ergo plans to use its existing personnel on the project. This means that the project will not create additional employment for the local community but will provide job security for the current personnel. The majority of DRDGOLD's managerial and supervisory positions are Historically Disadvantaged Persons (HDP's) (74%) and female employees contributed 23% to the total

workforce compared to the industry average of 14% (DRDGOLD, 2023). In terms of supply-linked employment, Ergo could also procure intermediary inputs from the local area during the operational phase which will mainly be spent on suppliers outside the local area, within the larger Gauteng region. This could potentially create additional indirect jobs at suppliers.

Table 16: Rating of Impact on Local Employment and Income

Impact Name	**Employment and Income**	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**
Nature	Positive	Positive
Magnitude	Minor +	Moderate +
Duration	Medium term (18 months - 5 years)	Medium term (18 months - 5 years)
Scale	Site or local	Site or local
Consequence	Low	Medium
Probability	Possible	Possible
Environmental Risk Significance (Pre-mitigation)		Low +
Management Measures:		
• Ergo should consider a local internship/job shadowing strategy that could benefit talented youth from the local communities in Ward 68 • Develop a database of potential suppliers within the local area (including the wards around the project). • Ergo to earmark a percentage of potential intermediary inputs that it could source from local suppliers, HDSAs and Small, Medium and Micro-sized Enterprises (SMMEs). • Preference should be given to capable subcontractors who based within the local municipal area. • Encourage the company's existing suppliers to enter into a Joint Venture (JV) with local SMMEs to aid with the transfer of skills. • Develop skills development and training targets for local procurement and include these in contractor management plans. • Communicate the local employment strategy clearly to the local communities adjacent to the mine (See Section 10 below for recommendations regarding stakeholder engagement).		
Environmental Risk Significance (Post-mitigation)		Medium +
Cumulative Impacts		Yes, current local activities

9.1.3 Positive contribution to social funds

While DRDGOLD has a Social and Labour Plan (SLP), the reclamation of certain TSFs falls outside the scope of the MPRDA and does not require a dedicated SLP. The Valley Silts project is however included in an Ergo Mining Right and is covered by the SLP; as such, it will make a social contribution towards national taxes and social contributions (also see Section 8.9 above)

The expansion of the reclamation activities will enable DRDGOLD to continue its social commitment to communities in the local area, especially programmes focussed on Riverlea (Ward 68).

Table 17: Rating of Impact on Social Funds

Impact Name	**Continuing with Social Contribution**	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**

Impact Name	Continuing with Social Contribution	
Nature	Positive	Positive
Magnitude	Minor +	Moderate +
Duration	Medium term (18 months - 5 years)	Medium term (18 months - 5 years)
Scale	Site or local	Site or local
Consequence	Low	Medium
Probability	Possible	Possible
Environmental Risk Significance (Pre-mitigation)		Low+
Management Measures:		
• Develop a targeted social development strategy in the local wards around the project area that support the local procurement strategy through the support of local SMMEs and contractors. • Communicate the local employment strategy clearly to the local communities adjacent to the mine (See Section 10 below for recommendations regarding stakeholder engagement).		
Environmental Risk Significance (Post-mitigation)		Medium +
Cumulative Impacts		No

9.1.4 Impact on community health and safety

There is a risk for community protests if there is the perception that local communities do not receive the anticipated benefits from employment on the project. Road blockages and protest action not only pose a risk to the Project itself, but also to other businesses in close proximity to the Project.

The Project will also increase traffic flows on the adjacent flows due to employees, contractors and heavy vehicles traveling to and from the project area. The risk is especially high during the few months' construction period in the beginning of the project and the few months' decommissioning period at the end of the project.

Disturbance of the silts during the operational phase could furthermore increase dust fall-out from the TSF. Based on the findings of the Air Quality Report (Gondwana Environmental Solutions, 2024), the areas exposed to exceedances, however, are not expected to extend as far as sensitive receptors. Increases in ambient concentrations of particulate matter mostly affects the closest residents of Riverlea situated to the east of Nasrec Road, and to a lesser extent the Crown industrial area to the north and the Theta industrial area to the south of the project area. Although the maximum modelled concentrations for these receptors are less than 50% of the NAAQS, the report concluded that additional care should be taken in drying area 1 and drying area 3, as ambient concentrations of particulate matter are already high in the City of Johannesburg metropolitan area.

Regarding the safety of both the public and the employees, Ergo has completed a workers' safety assessment as well as a public safety assessment. The public safety assessment for all the proposed operations of Ergo are currently being updated. This is being done in relation to the requirements of the National Nuclear Regulator (NNR).

The impact assessment of the surface water hydrological report to this EIA application indicates that potential surface water impacts on water quality might be expected during the operational phase. This is due to the close proximity of mining to the Russell Stream and the possible leaching of metals, salts and acidic water due to oxidisation as a result of excavation of the silt (Hydrospatial, 2025).

However, the water quality trends are not showing any decreases in water quality from the current operations. Deteriorating water quality could, in turn, have indirect negative implications on the health of the local community, in the case of direct access of Russell Stream used as recreational or water source by local communities.

Table 18: Rating of Impact on Community Health and Safety

Impact Name	**Community health and safety**	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**
Nature	Negative	Negative
Magnitude	Moderate-	Moderate -
Duration	Medium term (18 months - 5 years)	Medium term (18 months - 5 years)
Scale	Site or local	Site or local
Consequence	Medium	Medium
Probability	Possible	Possible
Environmental Risk Significance (Pre-mitigation)		Medium -
Management Measures:		
• Strict security measures to apply at the Project. • The company to cooperate with the local SAPS and community safety forums. • Establish a communication strategy and network with the local community in Wards 68, 54 and 124 and 125. The communication strategy should include protocols to lodge complaints, complaints register, speedy resolution of complaints and meetings with community leaders on a regular (quarterly) basis (also see Section 10 below). • Strict adherence to the mitigation measures of the air quality impact report related to this EIA application. • Strictly adhere to the mitigation measures of the surface water hydrological study relevant to this EIA application.		
Environmental Risk Significance (Post-mitigation)		Medium -
Cumulative Impacts		Yes, current on-site activities

9.1.5 Potential influx of people to the project area

High historic rates of job seekers might result in continued influx into the local ward areas close to the project due to perceived continuation of economic activities. This could place additional strain on local municipal services and potentially result in the growth of informal settlements in area around the Project sites.

Table 19: Rating of Impact on Informal Influx

Impact Name	**Informal Influx Impact**	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**
Nature	Negative	Negative
Magnitude	Moderate -	Moderate-
Duration	Medium term (18 months - 5 years)	Medium term (18 months - 5 years)
Scale	Site or local	Site or local
Consequence	Medium	Medium

Impact Name	Informal Influx Impact	
Probability	Probable	Possible
Environmental Risk Significance (Pre-mitigation)		Medium -
Management Measures:		
• Engage with local representatives to communicate the recruitment strategy of the Project and to register complaints related to increase level of influx into informal settlements (See Section 10 below). • Solutions to address service delivery require interventions from the local authorities. However, the applicant can address potential issues that could lead to unrest by ensuring that an effective grievance mechanism is put in place to ensure that stakeholders are provided with a platform to raise their concerns/complaints.		
Environmental Risk Significance (Post-mitigation)		Medium -
Cumulative Impacts		Yes, current on-site activities

9.1.6 Increase in nuisance factors (traffic, noise and dust)

It is anticipated that the Project will lead to an increase in traffic volumes on existing traffic network, resulting in increased congestion and delays on the local roads. The Project is also expected to increase in ambient noise levels as well as increase dust levels in the local area. As the reclamation activities will be conducted 7 days a week; 24 hours a day during the operational phase, local communities will experience the nuisance factors on a continuous basis throughout the operational period. Dust, noise and traffic volumes could have impacts on the adjacent wards, especially Wards 68 and Wards 54 and 125 adjacent to the M70 (Soweto Highway).

Table 20: Rating of Impact on Nuisance factors (noise, dust and traffic)

Impact Name	Impact of Nuisance Factors	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**
Nature	Negative	Negative
Magnitude	Moderate-	Minor -
Duration	Medium term (18 months - 5 years)	Medium term (18 months - 5 years)
Scale	Site or local	Site or local
Consequence	Medium	Medium
Probability	Possible	Possible
Environmental Risk Significance (Pre-mitigation)		Medium -
Management Measures:		
• Strict adherence to the mitigation measures of the traffic and air quality impact reports. • A grievance management mechanism should be in place to receive incident related queries (See Section 10).		
Environmental Risk Significance (Post-mitigation)		Low -
Cumulative Impacts		Yes, current on-site activities

9.2 DECOMMISSIONING AND POST-CLOSURE IMPACTS

9.2.1 Introduction

Once the silts have been removed from the targeted areas, decommissioning will commence with the removal of all associated vehicles and infrastructure from the site as well as the removal of berms, paddocks, diversion trenches, infrastructure, and anything else installed during construction and operations.

Ergo aims to rehabilitate the Valley Silts area by shaping the areas where silt was removed and make the area free draining. Thereafter, appropriate species will be planted to stabilise the soil.

Post-decommissioning activities will entail the assessment of rehabilitation and will address any further rehabilitation requirements. Monitoring must occur for at least five years after decommissioning and rehabilitation, or until satisfactory results are achieved. Maintenance will specifically need to focus on the rehabilitated areas. Furthermore, groundwater and surface water monitoring will have to take place surrounding in the surrounding project area. It has been recommended that the groundwater is monitored for at least a period of five years on a quarterly basis after closure.

9.2.2 Land restoration and unlocking of land of land for future use

Should the project proceed, land will be liberated for future development. As indicated in Section 8.12 above, Johannesburg SDF 2045 The SDF classified the local area where the project is located as peri-urban and industrial and ear-marked the area for higher densities. The SDF furthermore highlights the importance of the area in facilitating the southern expansion of the existing Johannesburg Inner City area through mixed land-use that could attract economic opportunities into the Soweto Core area and to use the belt as a space of inclusion and re-connection.

Table 21: Rating of Land Restoration

Impact Name	**Land Restoration**	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**
Nature	Positive	Positive
Magnitude	Moderate +	Moderate +
Duration	Long Term > 5 years	Long Term > 5 years
Scale	Site or local	Site or local
Consequence	Medium	Medium
Probability	Definite	Definite
Environmental Risk Significance (Pre-mitigation)		Medium +
Management Measures:		
• Facilitate the develop a future land use plan in consultation with the CoJ and local communities.		
Environmental Risk Significance (Post-mitigation)		Medium +
Cumulative Impacts		No

9.2.3 Decrease/cessation of employment

The termination of the Project will end the employment contracts with the workforce at the Project.

Table 22: Rating of Cessation of Employment and Income

Impact Name	**Cessation of employment and income**	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**
Nature	Negative	Negative
Magnitude	Moderate -	Minor -
Duration	Long Term > 5 years	Long Term > 5 years
Scale	Site or local	Site or local
Consequence	Medium	Medium
Probability	Possible	Possible
Environmental Risk Significance (Pre-mitigation)		Medium -
Management Measures:		
• Consider implementing a portable skills programme for the existing workforce. • Consider placement of workers in other Ergo operations.		
Environmental Risk Significance (Post-mitigation)		Medium -
Cumulative Impacts		No

9.2.4 Improved Community Health and Safety

Gold tailings are known to cause air and water pollution, as well as soil contamination. The dust usually contains fine particulate matter, which can be inhaled, causing damage to lung tissues. The Project will remove the gold tailings as a source of pollution to the surrounding areas. The positive impact associated with the removal of the dumps can only materialise once the land has been successfully rehabilitated and obtain an approved radiation land clearance certificate in terms of the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999) from the National Nuclear Regulator (NNR).

Once the area is cleared the open field will also provide less shelter for criminal activity and hence contribute to increased safety in the local area. The removal of the gold tailings could also eliminate the attraction of illegal/informal miners who seek gold.

The removal of the silt is expected to have a positive impact in the long-term on the water quality and flood levels of the Russell Stream, provided that rehabilitation is successfully implemented (Hydrospatial, 2025). The removal of the silt could therefor also potentially improve flood control in the local area and reduce the risk for floods as discussed in Section 8.7 above.

Table 23: Rating of Impact on Community Safety

Impact Name	**Community safety**	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**
Nature	Positive	Positive
Magnitude	Moderate +	Moderate +
Duration	Long Term > 5 years	Long Term > 5 years

Impact Name	Community safety	
Scale	Site or local	Site or local
Consequence	Medium	Medium
Probability	Possible	Possible
Environmental Risk Significance (Pre-mitigation)		Medium +-
Management Measures:		
• The applicant to apply for a land clearance certificate from the NNR-upon approval of the clearance certificate after complying with the conditions stipulated in the clearance certificate		
Environmental Risk Significance (Post-mitigation)		Medium +
Cumulative Impacts		No

9.2.5 Creation of informal settlements and land invasions

Although the removal of the dumps is seen as a positive impact, there is a possibility that the land (post reclamation process) may be viewed as vacant land and create an opportunity for land invasions. Being located relatively to the CBD in an area that face in-migration and informal settlements, the likelihood of land invasions is considered high.

Table 24: Rating of Potential Land Invasion Impact

Impact Name	Potential Land Invasion	
Environmental Risk		
Attribute	**Pre-mitigation**	**Post-mitigation**
Nature	Negative	Negative
Magnitude	High -	Medium-
Duration	Long Term > 5 years	Long Term > 5 years
Scale	Site or local	Site or local
Consequence	Medium	Medium
Probability	Possible	Possible
Environmental Risk Significance (Pre-mitigation)		High -
Management Measures:		
• Communicate upfront the proposed end land uses envisaged for the area once the reclamation process has been completed. • Mine security patrols should monitor the perimeters of the project site thereby providing an increased security presence. • Ergo to collaborate with the CoJ and implement CoJ's land use management system to prevent illegal settlements.		
Environmental Risk Significance (Post-mitigation)		Medium -
Cumulative Impacts		No

10. ADDITIONAL RECOMMENDATIONS

On-going stakeholder engagement is recommended to understand issues on the ground. To ensure effective consultation with community members during the authorisation, construction, operation and decommissioning phases of Ergo reclamation projects with CoJ, it is recommended that a Community Consultation Forum (Forum) be established. In establishing the Forum, that Ergo needs to take the following into consideration:

- Communities should democratically elect representatives to voluntarily sit on the Forum, which meets quarterly.
- Representatives would be responsible for disseminating project information to community members, and Ergo would be responsible for taking minutes and attendance registers at Forum meetings.
- The composition of the Forum might include the following Committee members:
    - Community members from the communities within the Projects area of interest;
    - Focus should especially be on areas that represents a larger risk in terms of social mobilisation including informal settlements – specifically in Wards 68;
    - Representatives from the Municipal Authorities; and
    - Ergo's representatives from the following divisions: Community Relations; Social Labour Plan and Environmental Management.
- Forum members would be required to hold meetings with their communities and provide Ergo with copies of the attendance registers and minutes of these meetings.
- Solutions to address service delivery require interventions from the local authorities. However, the applicant can address potential issues that could lead to unrest by ensuring that an effective grievance mechanism is put in place to ensure that stakeholders are provided with a platform to raise their concerns/complaints.
- Collaborate with the unit of the DMRE that deals with illegal mining-related issues and the SAPS to establish standard operating procedures for the control and/or removal of unauthorised individuals.

11. SUMMARY AND CONCLUSION

As indicated in Table 25 below, the project has a number of potential positive socio-economic impacts during the operational phase related to facilitating continued operations with associated employment creation and social funds generated through Ergo activities. A large number of positive impacts of the project are also expected to occur over the long-term after closure including the regaining of land for development, potential improvement in the safety of the local community and the reduction in nuisance factors such as dust and reduced air quality due to the current gold tailings present in the local area.

Potential negative impacts on the local community are largely expected to occur over the short operational period. These risks include nuisance factors (increased noise and dust) as well as potential impacts on community safety. The communities of most at risk in terms of nuisance and health and safety impacts during operations. With the possible exception of increased informal influx due to potential job seekers seeing opportunities on the project, the social risks of the project can be effectively reduced.

Due to the project's proximity to the Johannesburg CBD, there is a potential high risk for land invasions on the reclaimed area. If the recommended management measures are implemented this risk is however expected to be effective reduced to a medium social risk. In addition to the management measures related to each impact, on-going stakeholder engagement is also recommended to understand issues on the ground. To this end it is recommended that a Community Consultation Forum (Forum) be established.

Table 25: Summary of Socio-Economic Impacts

Impact Description	BEFORE MITIGATION SIGNIFICANCE	AFTER MITIGATION SIGNIFICANCE	Cumulative Impact
Operation (including short construction and decommissioning phases)			
Employment and Income	Low +	Medium +	Yes
Social funds	Low +	Medium +	No
Community health and safety	Medium -	Medium -	Yes
Informal influx	Medium-	Medium -	Yes
Nuisance factors	Medium -	Low -	Yes
Post- Closure			
Land restoration	Medium +	Medium +	No
Cessation of employment	Medium -	Medium -	No
Improved community safety	Medium +	Medium+	No
Land invasion	High -	Medium -	No

In conclusion, the proposed Project is in line with development priorities to support continued job creation in the local area. The project also holds promise in terms of the Johannesburg SDF objectives to unlock scarce land to the south of the CBD, an area that has been ear-marked as integrating land-use area between the CBD and Soweto.

There are no fatal flaws associated with the social risks of the project and most negative impacts can be effectively managed. Based on the findings of the socio-economic impact assessment for the project it is therefore recommended that the proposed project be approved.

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13. CURRICULUM VITAE OF SPECIALIST

1. **Family name:** Kritzinger
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8. **Education:**

Institution [Date]	Degree(s) or Diploma(s) obtained:
University of Stellenbosch, South Africa (1992)	M.Admin (Economics)
University of Pretoria, South Africa (1986)	B.Admin (Hons) (Economics)

9. **Language skills**: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
English	1	1	1
Afrikaans	1	1	1
French	2	2	3
Dutch	2	3	3
German	3	3	3

10. **Membership of professional bodies:** International Association for Impact Assessment (IAIA), Member ID: 10448490

11. **Other skills:**
    - Computer literacy –MS Office
    - Accredited Training Assessor
    - Social Accounting Matrix (SAM) (input and output modelling)

12. **Publications:**
    Kritzinger, A. S. (2011) Towards a Conceptual Framework for Local Economic Development (LED) Strategies. Skills @ Work, Volume 4: 67- 79.
    Kritzinger, A. S. and Baur P. (2012) Structuring Local Data to Determine LED Strategy Priorities: An Economic Development Perspective. Skills @ Work, Volume 5

13. **Present position:** Director of Southern Economic Development Services (SED) and freelance-associate of South African management consultancy Futurelead

14. **Years with the firm (SED):** 5 years (Director of SED); 20 years (associate of Futurelead)

15. **Areas of specialisation**
    - Socio-economic impact assessments
    - Applied economics
        - economic and social impact analysis
        - input-output modelling
        - economic cost benefit analysis
        - economic incidence analysis

- scenario planning
- Monitoring and evaluation
- Skills development in development profiling and strategies
- Economic databases & economic reviews
- Local social and economic development strategies
- Market and financial analysis

16. Professional experience:

Date from – Date to	Company (position)	Description of activities (country; year of assignment)
1998 – current	Consulting	Examples of assignments completed the included the past 8 years: **Economic and Socio-Economic impact analyses. Examples of main projects (including input-output modelling and economic cost benefit assessments):** • Economic Cost Benefit Assessment for Springfield Coal Mine, Gauteng (2022) • Economic Cost Benefit Assessment for Koppie Coal Mine, Mpumalanga (2021) • Economic Cost Benefit Assessment for Birmingham Coal Mine, Mpumalanga (2021) • Economic impact of COVID-19 on the SADC region (SADC, 2021) • Economic impact assessment of mine extension of Harmony Gold in North West (South Africa, 2021) • Economic impact assessment of Sierra Rutile Limited Mine to determine economic impacts of closure (Sierra Leone, 2021) • Comparative cost benefit analysis for different worker accommodation options for workers at Bokpoort Solar Plant, Western Cape (South Africa, 2021) • Comparative economic costs benefit assessment between an underground coal mine and existing agricultural activities in Mpumalanga (South Africa, 2021) • Socio-economic impact assessment of different bulk water augmentation measures proposed for the Richard's Bay area (South Africa, 2020) • Improved the potential impact of the national animal health technology investment programme in South Africa. The project entailed a socio-economic impact assessment with recommendations to the Animal Health Technology Innovation Programme (Technical Innovation Agency, South Africa, 2017) • Supported the evaluation of different design options as well as assessed the economic value for public money for the establishment a Health Technology Park (City of Cape Town, South Africa, 2016-2017) • Improved the programme design and facilitated the interaction between different project partners by conducting an economic cost effectiveness assessment as part of the monitoring and evaluation of a space technology (BDO-UK, South Africa, 2018-2019) • Improved the economic development impact of a national tourism investment programme by leading the sustainability assessment of the National Department of Tourism (South Africa) investment programme. The project entailed the establishment of a project management office as well as the development of guidelines specifically focussed on project sustainability including feasibility studies and operational support (GTAC, South Africa 2017-2018) • Strengthened the social investment programme of a major mining investment in the Northern Cape, South Africa. The project entailed a high-level economic impact assessment for various projects related to the mine closure programme for Sishen Mine, Northern Cape (Jones & Wagener Engineers, South Africa, 2019) • Headed a research project to reduce the social risks of project-related revenues (employment and public revenues) of a large-scale gas project (Anadarko Petroleum, Mozambique ,2012-2014)

Date from – Date to	Company (position)	Description of activities (country; year of assignment)
		• Enhanced/mitigated the socio-economic impacts on hosting communities though socio-economic impact assessments and management programmes as part of environmental authorisations for a number of projects including: o Socio-economic impact assessment of the Reclamation of the Delmore TSF in Gauteng (2023) o Olifantsfontein Land fill close to Thembisa (South Africa, 2021) o Proposed Kareerand Tailings Storage Facility (TSF) Reclamation Project in North West (South Africa, 2020) o Shondoni Colliery, Sasol Mining Pty(Ltd) (Secunda, South Africa, 2020) o Olifantsfontein Landfill (Thembisa, South Africa, 2020) o Blesboklaagte Colliery, Mpumalanga (2020) o Universal Coal Mine (Delmas, South Africa, 2019) o The planned closure of Nkomati Chrome Mine (Rainbow Minerals, Mpumalanga, South Africa, 2019) o Rustenburg Smelter (South Africa, 2019) o Four low-income housing projects that formed part of the Gauteng Province's Rapid Land Release Programme (RLRP) (South Africa, 2019) o Stonewall gold mines (Pilgrim's Rest, South Africa, 2019) o Lion Ferrocrhome Smelter, Steelpoort Mpumalanga (South Africa, 2018) **References:** • Thomas Keck (Particip, Germany); Phone: +49 761 790740, thomas.keck@particip.de • Johan Naude (Futurelead, South Africa); +27 (0) 82 335 1723; johan@futurelead.co.za; • Hendrik Prinsloo (HPM Consultants, US: California); +1 904 307 6004 (Mobile); hendrik@teamhpm.com • Emma Sauvanet (BDO Consultants; UK; London); + 44 (0)7870 268 715 (Mobile); emma.sauvanet@bdo.co.uk • Herman Marais (Exeo Capital Fund: South Africa/Nairobi/Mauritius); +27 (0)83 377 6234 (Mobile); hermanm@agrivie.com
1994-1997	Freelance	Freelance work in UK, travelling through Europe
1989 -1994	University of Stellenbosch (lecturer)	Tasks included: • Lecturing first to third year and marking of papers and assignments • Leading tutorial classes
1987-1988	Development Bank of Southern Africa (Researcher	Tasks included: • Profiling of selected development areas in South Africa • Analyses and database development pertaining to key economic indicators
1986	University of Pretoria	Junior lecturer: First year and third year (extra-mural)

APPENDIX D:

Specialist Studies

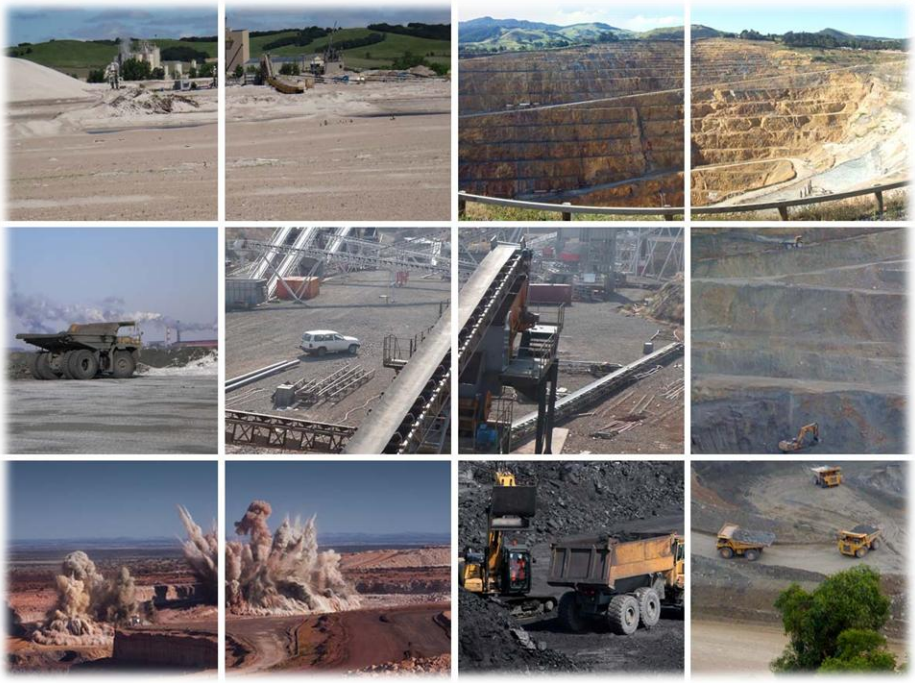
- ❖ Appendix D9 – Noise Report

Ergo Mining (Pty) Ltd

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

for the proposed

Valley Silts Expansion Project within Johannesburg, Gauteng Province



Study done for:

KONGIWE

Prepared by:

EAR
Enviro Acoustic Research

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EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Enviro-Acoustic Research ("EARES") was contracted by Kongiwe Environmental (Pty) Ltd (the "EAP") to determine the potential noise impact on the surrounding environment due to the proposed Valley Silts Expansion Project within Johannesburg, Gauteng.

This report describes ambient sound levels in the area, potential worst case noise rating levels and the potential noise impacts that the operation may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations.

PROJECT DESCRIPTION

Ergo Mining (Pty) Ltd (Ergo), a subsidiary of DRDGOLD Limited, holds various Mining Rights (MR) in respect of slimes dams and sand dumps extending 65 km from western Johannesburg to eastern Ekurhuleni with most activities occurring on the central and eastern sections of the Witwatersrand mining belt.

Ergo obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of NASREC near Booysens Reserve, in Johannesburg, known as the Valley Silts Project. The mining authorisation for the removal of silts, falls within Mining Right GP 184 MR.

The removal of silts within the already approved area has been ongoing for a period of time and as such, to maintain an efficient mining operation, as well as a sustainable feed source to the process plant, it is now necessary to prepare for the mining of the remainder of the Russell Stream.

The gold bearing silts will be mechanically excavated from the project area, using 30-ton Articulated Dump Trucks (ADT) to transport and stockpile the silts from the Russell Stream. The silts will be left to dry on stockpile footprints. Once dried, tailings/silts will be loaded onto tipper road trucks and transported to the City Deep plant for pre-processing using the existing road network. The activities for the Expansion Project include:

- Development of various new mining blocks and drying stockpiles;

- Stormwater control berms/paddocks with silt traps; and
- Haul and site roads with a number of river crossings.

SURROUNDING LAND USE AND POTENTIAL NOISE-SENSITIVE RECEPTORS

Considering aerial images (GoogleEarth ©) and observations made during the site visit, the surrounding land use is complex, including urban residential, roads, industrial, commercial as well as wilderness (mostly old mining area). There are a number of formal residential areas to the northwest and south of the project area.

BASELINE ASSESSMENT

Ambient sound levels were measured in the vicinity of the project area the day of 24 February 2025, as well as the nights of 12/13 and 13/14 February 2025.

Ambient sound levels were mainly dominated by natural noises (birds, running water and some wind-induced noises), sounds from anthropogenic origin (voices and domesticated animals) closer to residential structures and traffic noises. It should be noted that measurement locations were selected away from identifiable noise sources, and ambient sound levels were lower than expected when considering the developmental character of the area.

RATING LEVELS AND DESIRED NOISE LIMITS

Considering the average fast-weighted sound level data collected in the area, average:

- daytime fast-weighted sound levels were low, less than the typical rating levels for an urban area. While the ambient sound levels were less than expected, considering the developmental character of the area, this assessment will assume a rating level typical of an urban noise district (55 dBA); and
- night-time fast-weighted sound levels were low and typical of suburban noise district. Considering the developmental character of the area, this assessment will assume a rating level typical of an urban noise district (45 dBA).

Considering the requirements of the Gauteng Noise Control Regulations, activities relating to the proposed project should not raise ambient sound levels to higher than the typical rating level for the area. Nor should the noise levels exceed the World Bank Group (WBG) and the International Finance Corporation noise limits (see **section 5.4.4**). Upper noise limits therefore would be:

- 55 dBA for the daytime residential use, typical of an urban noise district; and
- 45 dBA (as recommended by the IFC) for night-time residential use and typical of an urban noise district. It should be noted that the night-time impact will not be assessed, because reclamation activities only take place between 06:00 and 16:00, with no night-time activities to take place.

NOISE IMPACT DETERMINATION AND FINDINGS

Using conceptual worst-case noise models, it was determined that the potential noise impacts at the project would be of a **low significant** for daytime activities. Due to this low significance, no additional mitigation is recommended.

NEED AND DESIRABILITY OF PROJECT

Due to economic advantages, mining does provide valuable employment, local taxes and foreign currency. It must be noted that when industrial projects are near to potential noise-sensitive receptors, consideration must be given to ensure a compatible co-existence. The potential sensitive receptors should not be adversely affected and yet, at the same time the project needs to reach an optimal scale in terms of layout and production.

While the proposed mining project will provide continued economic and social benefits to the area, the noises will be audible at the surrounding receptors, though noise levels will be insignificant. In terms of acoustics, there is no benefit to the surrounding environment (closest receptors).

However, the project will greatly assist in the economic growth and development challenges South Africa is facing by means of assisting in providing employment and other business opportunities. Considering only noise, people in the area not directly affected by increased noise levels could have a positive perception of the project and could see the need and desirability of the project.

CONCLUSION AND RECOMMENDATION

Using conceptual worst-case noise models, it was determined that the potential noise impacts at the project would be of a **low significance** for the reclamation activities.

It is expected that the mining activities may be audible at the closest NSR, though noise impacts will be insignificant for daytime activities. While complaints about noise can never

be ruled out, it is highly unlikely that noise complaints with the project will be registered. It is therefore recommended that the Valley Silts Expansion Project be authorized (from a noise impact perspective).

This noise impact assessment is sufficient, and no additional acoustic studies or noise monitoring is required.



Morné de Jager
Enviro-Acoustic Research cc
2025 – 03 – 03

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6 (as amended 2017)		**Relevant Section of Specialist study**
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	
	(i) the specialist who prepared the report; and	Section 1
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Section 1
(b)	a declaration that the specialist 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 4.1
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 6.1
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.1 and 6.2
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6.1
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4.6
(f)	details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Sections 6.1, 7 and 10
(g)	an identification of any areas to be avoided, including buffers;	No buffers required. Noise rating levels calculated and illustrated.
(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;	Sections 6.1
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 9
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Sections 10 and 11
(k)	any mitigation measures for inclusion in the EMPr;	Section 12
(l)	any conditions for inclusion in the environmental authorisation (EA);	Section 15 (no conditions)

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6 (as amended 2017)		**Relevant Section of Specialist study**
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 14.1
(n)	a reasoned opinion -	Section 15
	whether the proposed activity, activities or portions thereof should be authorised;	Section 15
	regarding the acceptability of the proposed activity or activities; and	Section 15
	if the opinion is that the proposed activity, activities 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;	Section 15
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	See Section 4.5
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	See Section 4.5
(q)	any other information requested by the competent authority.	None

This report should be cited as:

De Jager, M. (2025): "*Environmental Noise Impact Assessment for the Proposed Valley Silts Expansion Project within Johannesburg, Gauteng Province*". Enviro-Acoustic Research CC, Pretoria

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APPENDICES

APPENDIX A Glossary of terms and definitions
APPENDIX B Site Sensitivity Verification
APPENDIX C Calculated conceptual noise levels and potential significance

GLOSSARY OF ABBREVIATIONS

ADT	Articulated Dump Trucks
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
DFFE	Department of Forestry, Fisheries and Environment
EARES	Enviro Acoustic Research cc
ECA	Environment Conservation Act
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
ENIA	Environmental Noise Impact Assessment
ENM	Environmental Noise Monitoring
ENPAT	Environmental Potential Atlas for South Africa
EPs	Equator Principles
EPFIs	Equator Principles Financial Institutions

FEL	Front-end Loader
GN	Government Notice
HME	Heavy Mobile Equipment
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
ISO	International Organization for Standardization
METI	Ministry of Economy, Trade, and Industry
NASA	National Aeronautical and Space Administration
NCR	Noise Control Regulations
NSR	Noise-sensitive Receptor
PFA	Project Focus Area
PWL	Sound Power Level
SABS	South African Bureau of Standards
SANS	South African National Standards
SPL	Sound Power Level
UTM	Universal Transverse Mercator
WHO	World Health Organization

GLOSSARY OF UNITS

dB	Decibel (expression of the relative loudness of the un-weighted sound level in air)
dBA	Decibel (expression of the relative loudness of the A-weighted sound level in air)
Hz	Hertz (measurement of frequency)
kg/m^2	Surface density (measurement of surface density)
km	kilometre (measurement of distance)
m	Meter (measurement of distance)
m^2	Square meter (measurement of area)
m^3	Cubic meter (measurement of volume)
mamsl	Meters above mean sea level
m/s	Meter per second (measurement for velocity)
^oC	Degrees Celsius (measurement of temperature)
µPa	Micro pascal (measurement of pressure – in air in this document)

1 THE AUTHOR

The Author started his career in the mining industry as a bursar Learner Official (JCI, Randfontein), working in the mining industry, doing various mining-related courses (Rock Mechanics, Surveying, Sampling, Safety and Health [Ventilation, noise, illumination etc.] and Metallurgy. He did work in both underground (Coal, Gold and Platinum) as well as opencast (Coal) for 4 years. He changed course from Mining Engineering to Chemical Engineering after the second year of his studies at the University of Pretoria.

After graduation he worked as a Water Pollution Control Officer at the Department of Water Affairs and Forestry for two years (first year seconded from Wates, Meiring and Barnard), where duties included the perusal (evaluation, commenting and recommendation) of various regulatory required documents (such as EMPR's, Water Licence Applications and EIA's), auditing of licence conditions as well as the compilation of Technical Documents.

Since leaving the Department of Water Affairs, Morné has been in private consulting for the last 15 years, managing various projects for the mining and industrial sector, private developers, business, other environmental consulting firms as well as the Department of Water Affairs. During that period he has been involved in various projects, either as specialist, consultant, trainer or project manager, successfully completing these projects within budget and timeframe, gradually moving towards environmental acoustics, focusing on this field exclusively since 2007.

He has been interested in acoustics as from school days, doing projects mainly related to loudspeaker design. Interest in the matter brought him into the field of Environmental Noise Measurement, Prediction and Control. He has been doing work in this field for the past 8 years, and was involved with the following projects in the last few years:

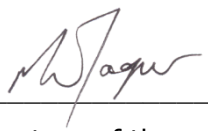
Wind Energy Facilities	*Zen (Savannah Environmental – SE), Goereesoe (SE), Springfontein (SE), Garob (SE), Project Blue (SE), ESKOM Kleinzee (SE), iNCa Gouda (Aurecon SA), Kangnas (Aurecon), Walker Bay (SE), Oyster Bay (SE), Hidden Valley (SE), Happy Valley (SE), Deep River (SE), Saldanha WEF (Terramanzi), Loeriesfontein (SiVEST), Noupoort (SiVEST), Prieska (SiVEST), Plateau East and West (Aurecon), Saldanha (Aurecon), Veldrift (Aurecon), Tsitsikamma (SE), AB (SE), West Coast One (SE), Namakwa Sands (SE), Dorper (SE), VentuSA Gouda (SE), AmakhalaEmoyeni (SE), Klipheuwel (SE), Cookhouse (SE), Cookhouse II (SE), Canyon Springs (Canyon Springs), Rheboksfontein (SE), Suurplaat (SE), Karoo Renewables (SE), Outeniqwa (Aurecon), Koningaas (SE), Eskom Aberdene (SE), Spitskop (SE), Rhenosterberg (SiVEST), Bannf (Vidigenix), Wolf WEF (Aurecon)*
Mining and Industry	*BECSA – Middelburg (Golder Associates), CESA Highwall Project (Geovicon Environmental), SASOL Borrow Pits Project (JMA Consulting), Lesego Platinum (AGES), Tweefontein Colliery (Cleanstream), EvrazVametco Mine and Plant (JMA),*

	Goedehoop Colliery (Geovicon), Hacra Project (Prescali Environmental), Der Brochen Platinum Project (J9 Environment), Delft Sand (AGES), Brandbach Sand (AGES), Verkeerdepan Extension (CleanStream), Dwaalboom Limestone (AGES), Jagdlust Chrome (MENCO), WPB Coal (MENCO), Landau Expansion (CleanStream), Stuart Coal – Weltevreden (CleanStream), Otjikoto Gold (AurexGold), Klipfontein Colliery (MENCO), Imbabala Coal (MENCO), ATCOM East Expansion (Jones and Wagner), IPP Waterberg Power Station (SE), Kangra Coal (ERM), Schoongesicht (CleanStream), EastPlats (CleanStream), Chapudi Coal (Jacana Environmental), Generaal Coal (JE), Mopane Coal (JE), Boshoek Chrome (JMA), Langpan Chrome (PE), Vlakpoort Chrome (PE), Sekoko Coal (SE), Frankford Power (REMIG), Strahrae Coal (Ferret Mining), Transalloys Power Station (Savannah), Pan Palladum Smelter, Iron and PGM Complex (Prescali)
Road and Railway	*K220 Road Extension (Urbansmart), Boskop Road (MTO), Sekoko Mining (AGES), Davel-Swaziland-Richards Bay Rail Link (Aurecon), Moloto Transport Corridor Status Quo Report and Pre-Feasibility (SiVEST), Postmasburg Housing Development (SE), Tshwane Rapid Transport Project, Phase 1 and 2 (NRM Consulting/City of Tshwane)*
Airport	*Oudtshoorn Noise Monitoring (AGES), Sandton Heliport (Alpine Aviation), Tete Airport Scoping*
Noise monitoring	*Peerboom Colliery (EcoPartners), Thabametsi (Digby Wells), DoxaDeo (DoxaDeo), Harties Dredging (Rand Water), Xstrata Coal – Witbank Regional, Sephaku Delmas (AGES), Amakhala Emoyeni WEF (Windlab Developments), Oyster Bay WEF (Renewable Energy Systems), Tsitsikamma WEF (Cennergi and SE), Hopefield WEF (Umoya), Wesley WEF (Innowind), Ncora WEF (Innowind), Boschmanspoort (Jones and Wagner), Nqamakwe WEF (Innowind), Dassiesfontein WEF Noise Analysis (BioTherm), Transnet Noise Analysis (Aurecon)*
Small Noise Impact Assessments	*TCTA AMD Project Baseline (AECOM), NATREF (Nemai Consulting), Christian Life Church (UrbanSmart), Kosmosdale (UrbanSmart), Louwlardia K220 (UrbanSmart), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), Safika Slag Milling Plant (AGES), Arcelor Mittal WEF (Aurecon), RVM Hydroplant (Aurecon), Grootvlei PS Oil Storage (SiVEST), Rhenosterberg WEF, (SiVEST), Concerto Estate (BPTrust), Ekuseni Youth Centre (MENCO), Kranskop Industrial Park (Cape South Developments), Pretoria Central Mosque (NomanShaikh), Soshanguve Development (Maluleke Investments), Seshego-D Waste Disposal (Enviroxcellence), Zambesi Safari Equipment (Owner), Noise Annoyance Assessment due to the Operation of the Gautrain (Thornhill and Lakeside Residential Estate), Upington Solar (SE), Ilangalethu Solar (SE), Pofadder Solar (SE), Flagging Trees WEF (SE), Uyekraal WEF (SE), Ruuki Power Station (SE), Richards Bay Port Expansion (AECOM), Babalegi Steel Recycling (AGES), SafikaLadium (AGES), Safika Cement Isando (AGES), Natref (NEMAI), RareCo (SE), Struisbaai WEF (SE)*
Project reviews and amendment reports	*Loperberg (Savannah), Dorper (Savannah), Penhoek Pass (Savannah), Oyster Bay (RES), Tsitsikamma (Cennergi), AmakhalaEmoyeni (Windlab), Spreeukloof (Savannah), Spinning Head (Savannah), Kangra Coal (ERM), West Coast One (Moyeng Energy), Rheboksfontein (Moyeng Energy)*

2 DECLARATION OF INDEPENDENCE

I, Morné de Jager declare that:

- I act as the independent specialist in this application
- I will perform the work relating to this study in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental noise impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2014, and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I 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 realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act, and;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014.



Signature of the specialist:

Name of company:

Enviro-Acoustic Research cc

Date:

2025 – 03 – 03

3 MINIMUM REQUIREMENTS – SCREENING OF SITE

The National Web based Environmental Screening Tool[1] was used to screen the proposed site (see **Figure 4-1** for the regional location) for the noise environmental sensitivity as per the requirements of GNR320 (20 March 2020), considering the site location. The site report generated by the Screening Tool highlighted that a Noise Impact Assessment must be completed and appended to the Environmental Authorization ("EA") documentation. The screening report was developed for both:

- *Mining => Mining Right*, and
- *Activity requiring permit or licence in terms of National or Provincial legislation governing the release or generation of emissions => Emissions*.

The potential noise sensitive areas layer is not included in the above-mentioned categories, but was obtained from the *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the screening tool indicating that the larger have a "Very High" sensitivity to noise.

Based on the output of the online screening tool, the area is considered to have a "very high" sensitivity to noise. This was also confirmed during the site visit that identified and confirmed various residential activities within the potential area of influence from the project activities (see also **Figure 4-2**). A map indicating areas defined to have a "Very High" sensitivity to noise were not included, as the larger area is defined to have a "Very High" sensitivity to noise.

In terms of GNR 320 (20 March 2020), the Noise Specialist Assessment must contain, as a minimum, the following information:

Clause	Reporting Requirements as per the Protocol for Noise Specialist Assessments	Compliance of current report / Reference
2.3.1	Current ambient sound levels recorded at relevant locations over a minimum of two nights and that provide a representative measurement of the ambient noise climate, with each sample being a minimum of ten minutes and taken at two different times of the night on each night, in order to record typical ambient sound levels at these different times of night	Section 6

[1] https://screening.environment.gov.za/screeningtool/#/pages/welcome

Clause	Reporting Requirements as per the Protocol for Noise Specialist Assessments	Compliance of current report / Reference
2.3.2	Records of the approximate wind speed at the time of the measurement	Section 6
2.3.3	Mapped distance of the receiver from the proposed development that is the noise source	
2.3.4	Discussion on temporal aspects of baseline ambient conditions	Section 6
2.4.1	Characterization and determination of noise emissions from the noise source, where characterization could include types of noise, frequency, content, vibration and temporal aspects	Section 7
2.4.2	Projected total noise levels and changes in noise levels as a result of the construction, commissioning and operation of the proposed development for the nearest receptors using industry accepted models and forecasts	Sections 10
2.4.3	Desired noise levels for the area	Section 6.2
2.5.1	Contact details of the environmental assessment practitioner or noise specialist, their relevant qualifications and expertise in preparing the statement, and a curriculum vitae	Section 1
2.5.2	a signed statement of independence by the environmental assessment practitioner or noise specialist.	Section 2
2.5.3	The duration and date of the site inspection and the relevance of the season and weather condition to the outcome of the assessment	Section 6
2.5.4	A description of the methodology used to undertake the on-site assessment, inclusive of the equipment and models used, as relevant, together with the results of the noise assessment	Sections 4.6, 6 and 10
2.5.5	a map showing the proposed development footprint (including supporting infrastructure) overlaid on the noise sensitivity map generated by the screening tool	Whole area having "Very High" sensitivity to noise
2.5.6	confirmation that all reasonable measures have been taken through micro- siting to minimise disturbance to receptors	Various layouts previously investigated
2.5.7	a substantiated statement from the specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development	Section 15
2.5.8	any conditions to which this statement is subjected	Section 15
2.5.9	the assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered	Project location limited by the presence of the coal resource

Clause	Reporting Requirements as per the Protocol for Noise Specialist Assessments	Compliance of current report / Reference
2.5.10	A motivation must be provided if there were development footprints identified as per paragraph 2.5.9 above that were identified as having a "low" noise sensitivity and that were not considered appropriate	Project location limited by the presence of the gold-bearing resource
2.5.11	where required, proposed impact management outcomes, mitigation measures for noise emissions during the construction and commissioning phases that may be of relative short duration, or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr), and	Section 12 and 14
2.5.12	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations	Section 9

4 INTRODUCTION

4.1 INTRODUCTION AND PURPOSE

Enviro-Acoustic Research ("EARES") was contracted by Kongiwe Environmental (Pty) Ltd (the "EAP") to determine the potential noise impact on the surrounding environment due to the proposed Valley Silts Expansion Project within Johannesburg, Gauteng.

This report describes ambient sound levels in the area, potential worst case noise rating levels and the potential noise impacts that the operation may have on the surrounding sound environment, highlighting the methods used, potential issues identified, findings and recommendations.

This study considered local regulations and both local and international guidelines, using the terms of reference as proposed by SANS 10328:2008 to allow for a comprehensive Environmental Noise Impact Assessment.

4.2 BRIEF PROJECT DESCRIPTION

Ergo Mining (Pty) Ltd (Ergo), a subsidiary of DRDGOLD Limited, holds various Mining Rights (MR) in respect of slimes dams and sand dumps extending 65 km from western Johannesburg to eastern Ekurhuleni with most activities occurring on the central and eastern sections of the Witwatersrand mining belt.

Ergo obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section of the Russell Stream north of NASREC near Booysens Reserve, in Johannesburg, known as the Valley Silts Project. The mining authorisation for the removal of silts, falls within Mining Right GP 184 MR. The regional location of the Project Focus Area ("PFA") is illustrated in **Figure 4-1**.

The removal of silts within the already approved area has been ongoing for since 2023 and as such, to maintain an efficient mining operation, as well as a sustainable feed source to the process plant, it is now necessary to prepare for the mining of the remainder of the Russell Stream.

The gold bearing silts will be mechanically excavated from the project area, using 30-ton Articulated Dump Trucks (ADT) to transport and stockpile the silts from the Russell Stream. The silts will be left to dry on stockpile footprints. Once dried, tailings/silts will be loaded

onto tipper road trucks and transported to the City Deep plant for pre-processing using the existing road network. The activities for the Expansion Project include:

- Development of various new mining blocks and drying stockpiles;
- Stormwater control berms/paddocks with silt traps; and
- Haul and site roads with a number of river crossings.

4.3 STUDY AREA

The PFA is an area selected to enclose all potential project infrastructure up to 1,000 m from activities or equipment that may generate significant noise. The PFA is located within the City of Johannesburg (CoJ) Municipality within the Gauteng Province. The PFA is further described in terms of environmental components that may contribute to or change the sound character in the area.

4.3.1 Topography

The Environmental Potential Atlas of South Africa ("ENPAT") (Van Riet *et al*, 1998) describes the topography as *"Hills and Lowlands"*, with the topography within the PFA very complex. With the project located on the side of a mountain, topography might assist in reducing the propagation of noise to the east, but will allow the undeterred propagation of noise to the west.

4.3.2 Surrounding Land Use

Considering aerial images (GoogleEarth ©) and observations made during the site visit, the surrounding land use can be classed mainly as wilderness and agricultural.

4.3.3 Roads and Railways

The project is located in the CoJ municipal area, with the project area roughly encircled by Nasrec Road to the west, the Soweto Highway (M70) to the south and Crownwood Road to the west. The "New Canada – Booysens" railway line borders the northern boundary of the project, though this railway line appears to be disused. The roads carry significant traffic, with road traffic noises having a potential to significantly influence ambient sound levels. Traffic volumes were briefly counted with the data was used to model potential noise levels due to road traffic noises. This is further discussed in **section 4.3.5**.

4.3.4 Ground conditions and vegetation

The area falls within the grassland biome, with the natural vegetation type being "*Rocky Highveld Grassland*"[2]. Most of the natural veldt has been destroyed by mining, industrial and urban development, though most of the veldt is well vegetated.

Taking into consideration available information it is the opinion of the author that the ground conditions (when considering acoustic propagation on a ground surface) can be classified as medium to soft, which implies that the ground surface will absorb some of the acoustic energy hitting the ground surface. It should be noted that this factor is only relevant for air-borne waves being reflected from the ground surface, with certain frequencies slightly absorbed by the vegetation.

4.3.5 Existing Ambient Sound Levels

Ambient sound levels were measured in the vicinity of the project area during the day of 24 February 2025, as well as the nights of 12/13 and 13/14 February 2025. The results and findings of the ambient sound level measurements are summarised in **Section 6.2**.

Ambient sound levels were mainly dominated by natural noises (birds, running water and some wind-induced noises), sounds from anthropogenic origin (voices and domesticated animals) closer to residential structures and traffic noises.

Noise from traffic in the area is considered significant and will be considered in this report. Potential noise levels due to existing road traffic were modelled for the day- and night-time period considering conceptual data as defined in **Table 4-1**. It should be noted, even though traffic volumes would be different on a day-to-day basis, this will not have an influence on the findings of the report, as the potential traffic volumes are mainly used to illustrate conceptual existing noise contours to estimate how the project activities may influence ambient sound levels. It should be noted, for road traffic to have an influence on noise levels, traffic volumes have to change with more than 50% to affect noise levels by more than 1 dBA.

Isopleths, illustrating contours of constant noise levels due to existing road traffic are illustrated in:

- **Figure 4-3** for potential existing daytime road traffic noise levels; and
- **Figure 4-4** for potential existing night-time road traffic noise levels.

[2] Van Riet, W. Claassen, P. van Rensburg, J. van Viegen & L. du Plessis, "*Environmental Potential Atlas for South Africa"*, Pretoria, 1998.

Table 4-1: Assumed traffic volumes for road traffic noise model

Road section	Average hourly LDV traffic (day)	Average hourly truck traffic (day)	Average hourly LDV traffic (night)	Average hourly truck traffic (night)	Average speeds assumed
R41	1560	240	30	0	60
M70 north	840	0	16	0	100
M70 south	480	0	24	0	100
M17	1890	0	0	0	60
N17	2280	0	60	0	100
NASREC north	2040	0	30	0	80
NASREC south	1080	0	30	0	80

4.4 POTENTIAL NOISE-SENSITIVE RECEPTORS (DEVELOPMENTS) AND NO-GO AREAS

Potentially sensitive receptors, also known as noise-sensitive developments ("NSR"), located within the PFA was identified using Google Earth®. Most of the NSR are concentrated to the south south-west; as well as to the north north-west of the proposed mining pit.

The online screening tool did identify that the PFA and surroundings areas do have "very high" sensitivity to noise. The NSR identified are illustrated in **Figure 4-2**, with each green marker representing a number of NSR.

Also indicated on **Figure 4-2** are generalized 200, 500 and 1,000 m buffer zones. Generally, noises from typical reclamation activities:

- could be high and very significant within 100 m from active reclamation activities both night and day;
- can be significant and clearly audible at receptors staying within 200 m from active mining/industrial activities. Noises are at a sufficient level to be considered disturbing at night in quiet areas;
- are normally limited to a distance of approximately 500 m from the active mining/industrial activities. Ambient sound levels may be increased due to noises from the activities, with the potential noise impact measurable. Noise levels from such activities are generally less than 45 dBA further than 500 m from these activities;
- may be audible up to a distance of 1,000 m at night, though the noises may be audible up to 2,000 m during very quiet periods at night (during certain meteorological conditions). These noises are normally of a low concern at distances greater than 1,000 m from activities at night.

These buffer distances may not be valid with very large mining or industrial operations, or in areas with very low ambient sound levels.

4.5 COMMENTS REGARDING NOISE RECEIVED DURING THIS PROJECT

The author is not aware of any comments raised by the authorities or interested and affected parties at the date this report was compiled. It should however be noted that the Noise Assessment is part of a suite of studies commissioned by the Environmental Assessment Practitioner ("EAP"), who is undertaking the Public Participation Process ("PPP") as part of the EIA. Comments regarding noise may only be available during the EIA and PPP process.

4.6 LEGISLATIVE REQUIREMENTS AND TERMS OF REFERENCE

A noise impact assessment must be completed for the following reasons:

- It was identified as an environmental theme needing further investigation in terms of the National Screening Tool as per the procedures of Government Gazette 43110 of 20 March 2020;
- A change in land use as highlighted in SANS 10328:2008, section 5.3;
- If an industry is to be established within 1,000 m from a potential noise sensitive development (SANS 10328:2008 [5.4 (h)]);
- If a wind farm (wind turbines - SANS 10328:2008 [5.4 (i)]) or a source of low-frequency noise (such as cooling or ventilation fans - SANS 10328:2008 [5.4 (l)]) is to be established within 2,000 m from a potential noise sensitive development *or vice versa*;
- It is a controlled activity in terms of the NEMA regulations and an ENIA is required, because it may cause a disturbing noise that is prohibited in terms of section 18(1) of the Government Notice ("GN") 579 of 2010; or
- It is generally required by the local or district authority as part of the environmental authorization or planning approval in terms of Regulation 2(d) of GN R154 of 1992 (and GN 5479 of August 1999).

4.6.1 Requirements as per Government Gazette 43110 of March 2020

The Department of Forestry, Fisheries and Environment (DFFE) also promulgated Regulation 320, dated 20 March 2020 as published in Government Gazette No. 43110. The 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 Management Act, 1998, when applying for Environmental Authorisation would be applicable to this project.

This regulation defines the requirements for undertaking a site sensitivity verification, specialist assessment and the minimum report content requirements for environmental impact where a specialist assessment is required but no protocol has been prescribed. It requires that the current land use be considered using the national web based environmental screening tool to confirm the site sensitivity available at: https://screening.environment.gov.za.

If an applicant intending to undertake an activity identified in the scope of this protocol for which a specialist assessment has been identified on the screening tool on a site identified as being of:

- "very high" sensitivity for noise, must submit a Noise Specialist Assessment; or
- "low" sensitivity for noise, must submit a Noise Compliance Statement.

On a site where the information gathered from the site sensitivity verification differs from the designation of "very high" sensitivity on the screening tool and it is found to be of a "low" sensitivity, a Noise Compliance Statement must be submitted.

On a site where the information gathered from the initial site sensitivity verification differs from the designation of "low" sensitivity on the screening tool and it is found to be of a "very high" sensitivity, a Noise Specialist Assessment must be submitted.

If any part of the proposed development footprint falls within an area of "very high" sensitivity, the assessment and reporting requirements prescribed for the "very high" sensitivity apply to the entire footprint excluding linear activities for which noise impacts are associated with construction activities only and the noise levels return to the current levels after the completion of construction activities, in which case a compliance statement applies. In the context of this protocol, development footprint means the area on which the proposed development will take place and includes any area that will be disturbed.

The minimum requirements for a Noise Specialist Study (i.t.o GNR 320 of 2020) are also covered in **Section 3** of this report in the form of a checklist.

This assessment is comprehensive and a Noise Specialist Assessment is required because there are a number of potential noise-sensitive receptors living within 2,000 m from the proposed project activities.

4.6.2 Requirements as per South African National Standards

In addition, Appendix 6 of GN 982 of December 2014 (Government Gazette ("GG") 38282), as amended in 7 April 2017 and 11 June 2021, issued in terms of the National Environmental

Management Act, No. 107 of 1998, also defines minimum information requirements for specialist reports.

In South Africa, the document that addresses the issues specifically concerning environmental noise is SANS 10103:2008. It has recently been thoroughly revised and brought in line with the guidelines of the World Health Organisation ("WHO"). It provides the maximum average ambient noise levels during the day and night to which different types of developments indoors may be exposed.

This standard specifies the methodology to assess the potential noise impacts on the environment due to a proposed activity that might impact on the environment. This standard also stipulates the minimum requirements to be investigated for environmental impact assessment ("EIA") purposes. These minimum requirements are:

1. The purpose of the investigation – **section 4.1**;
2. A brief description of the planned development or the changes that are being considered – **section 4.2**;
3. A brief description of the existing environment – **section 6**;
4. The identification of the noise sources that may affect the particular development, together with their respective estimated sound pressure levels or sound power levels (or both) – **section 7**;
5. The identified noise sources that were not taken into account and the reasons why they were not investigated – **section 7**;
6. The identified noise-sensitive developments and the estimated impact on them – **sections 4.4**, **10** and **11**;
7. Any assumptions made with regard to the estimated values used – **section 9**;
8. An explanation, either by a brief description or by reference, of the methods that were used to estimate the existing and predicted rating levels – **section 8**;
9. The location of the measurement or calculation points, i.e., a description, sketch or map – **section 10**;
10. Estimation of the environmental noise impact – **sections 10** and **11**;
11. Alternatives that were considered and the results of those that were investigated – **section 10.4**;
12. A list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation – **section 4.5**;
13. A detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them – **section 4.5**;
14. Conclusions that were reached – **section 15**;

15. Recommendations, i.e., if there could be a significant impact, or if more information is needed, a recommendation that an environmental noise impact assessment be conducted – **section 15**; and
16. If remedial measures will provide an acceptable solution, which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after a certain time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority – **section 12**.

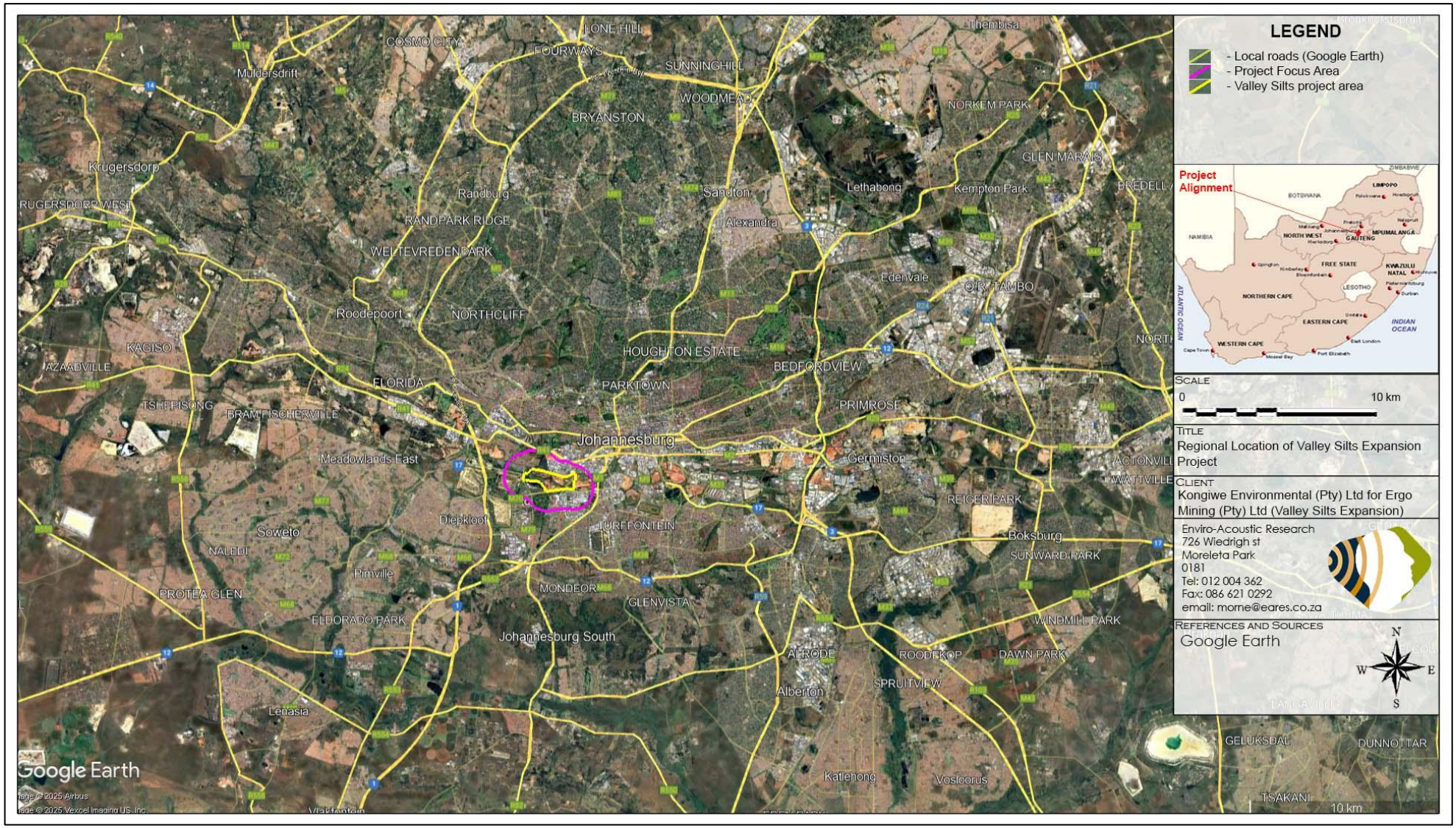


Figure 4-1: Aerial image indicating the regional location of the proposed Valley Silts ExpansionProject

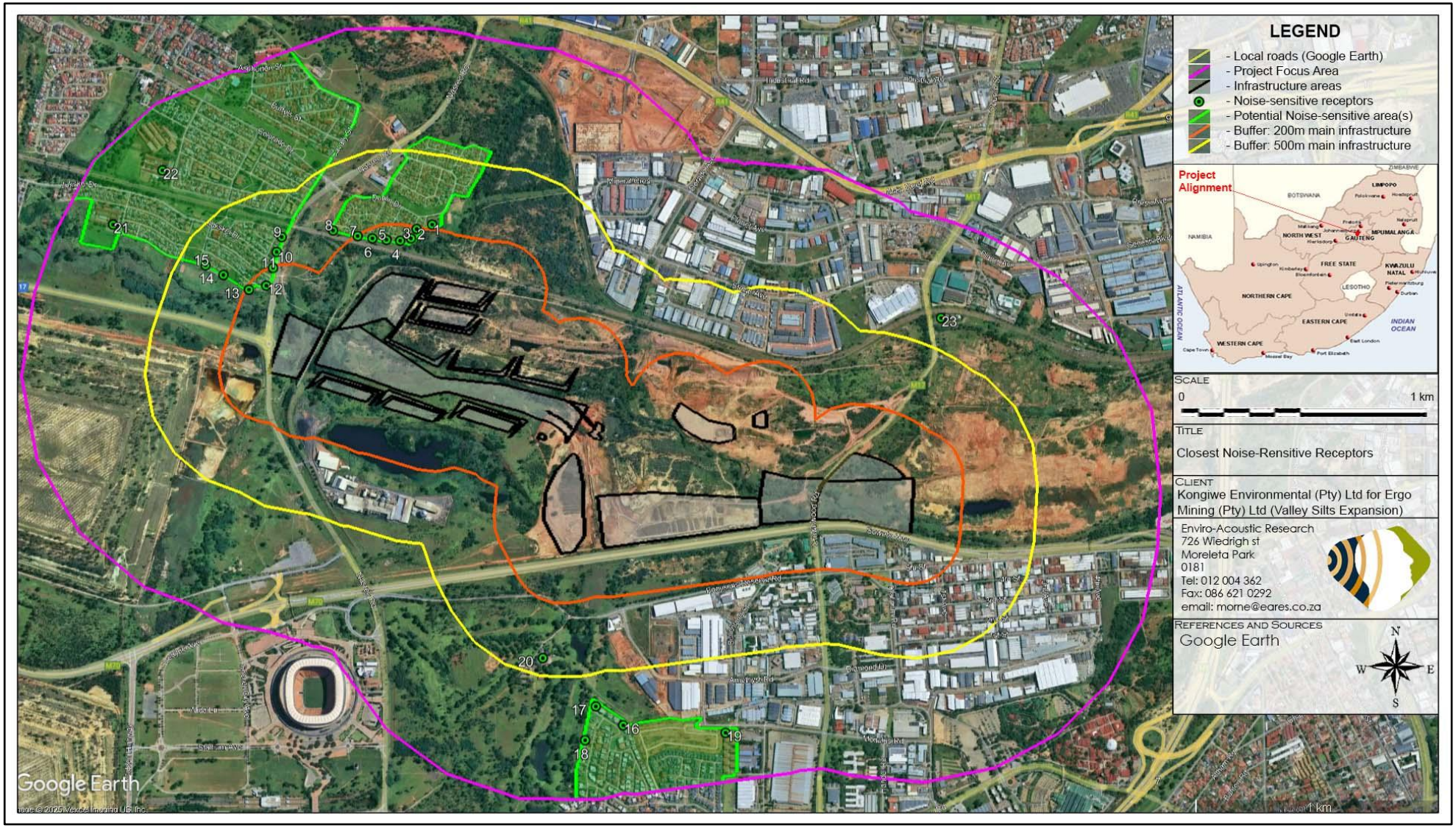


Figure 4-2: Aerial image indicating verified noise-sensitive receptors close to the Valley Silts Expansion project

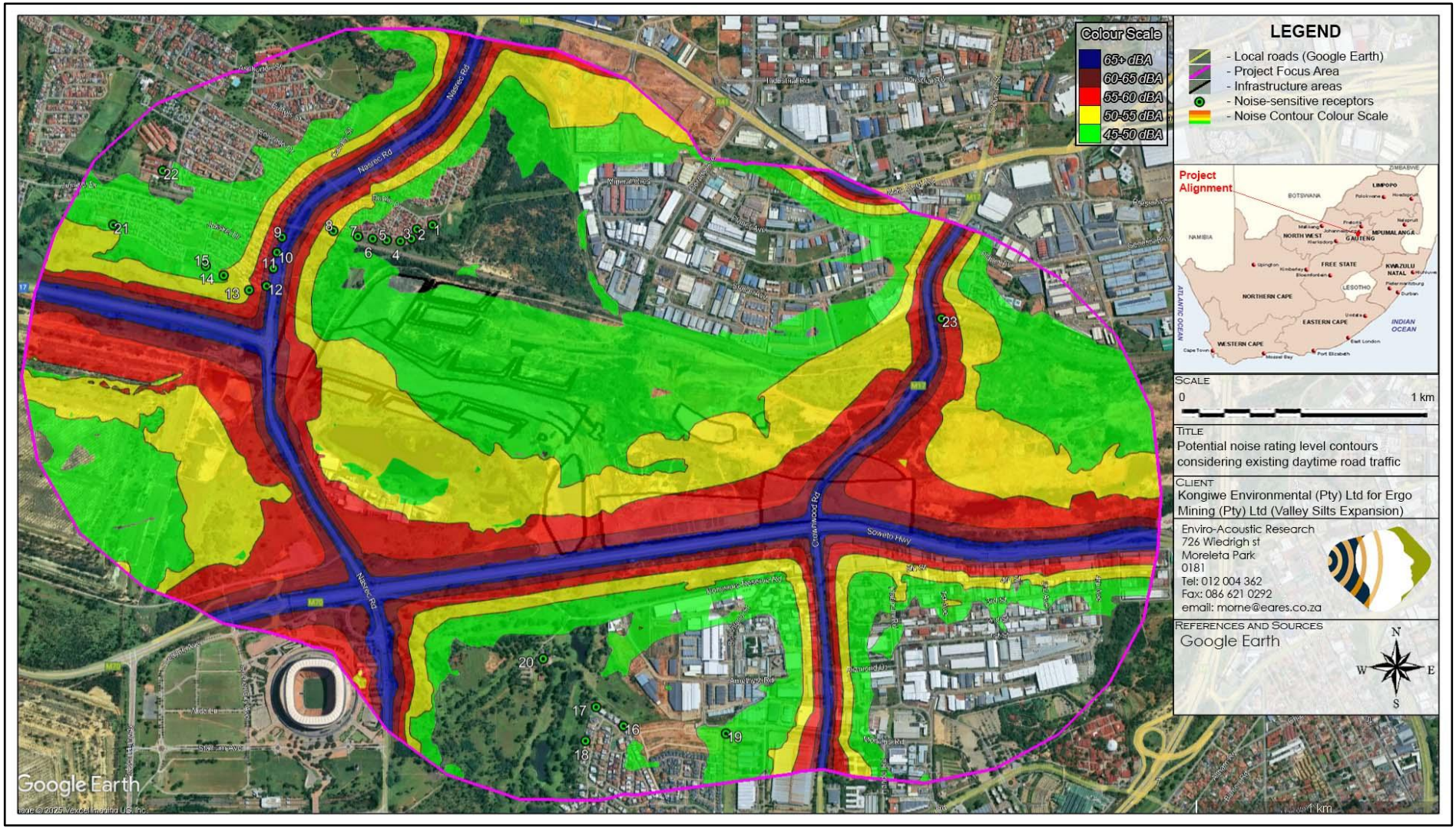


Figure 4-3: Aerial image illustrating potential daytime noise levels due to existing road traffic

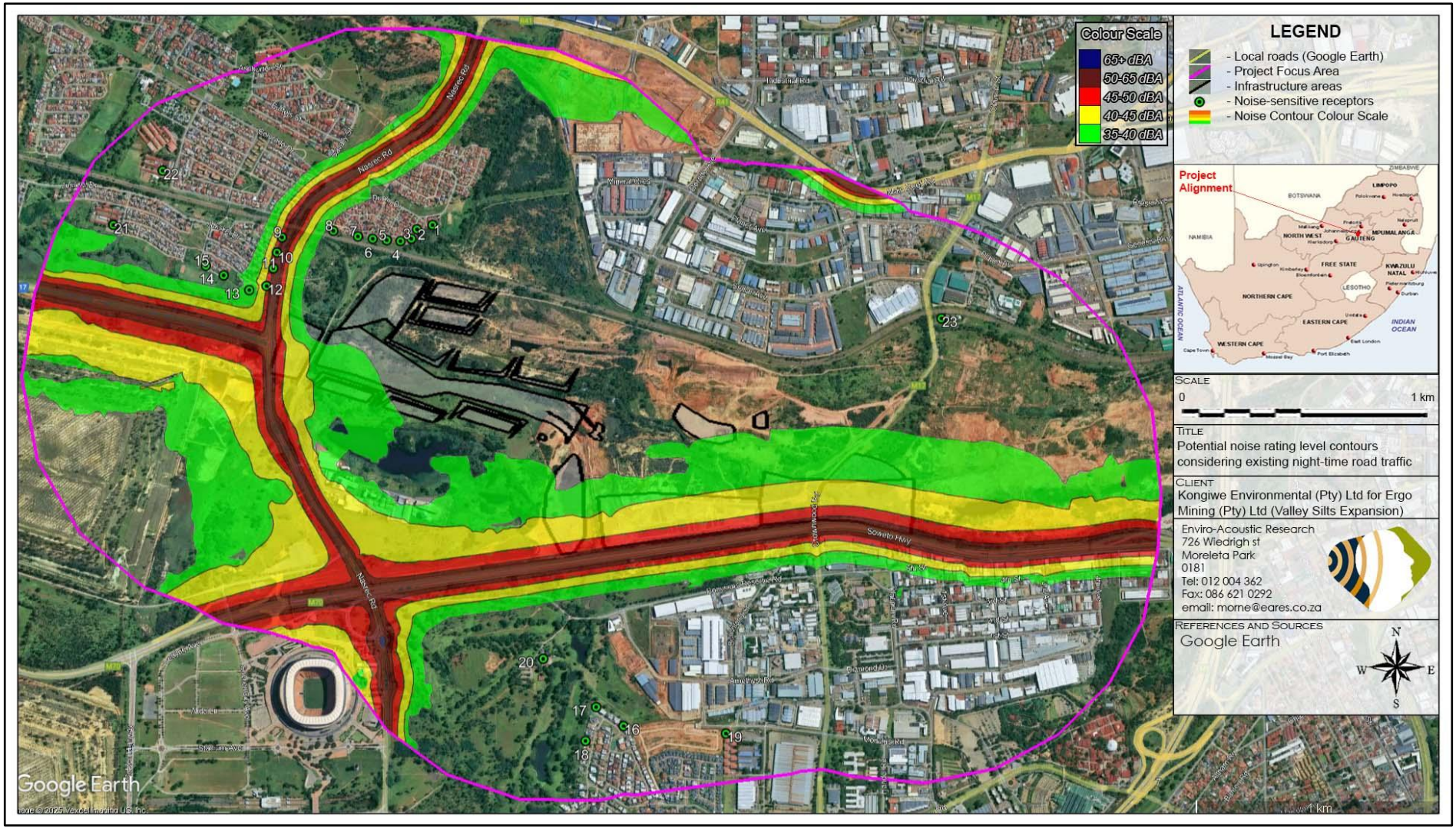


Figure 4-4: Aerial image illustrating potential night-time noise levels due to existing road traffic

5 LEGAL CONTEXT, POLICIES AND GUIDELINES

5.1 THE ENVIRONMENT CONSERVATION ACT (ACT 73 OF 1989)

The Environment Conservation Act ("ECA") allows the Minister of Environmental Affairs and Tourism ("now the Ministry of Environmental Affairs") to make regulations regarding noise, among other concerns. See also **Section 5.1.1**.

5.1.1 Noise Control Regulations (GN R154 of 1992)

In terms of section 25 of the ECA, the National Noise Control Regulations (GN R 154 of 1992) were promulgated. The NCRs were revised under Government Notice Number R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations.

Subsequently, in terms of Schedule 5 of the Constitution of South Africa, 1996, legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial noise control regulations exist in the Free State, Gauteng and Western Cape provinces and the Gauteng Noise Control Regulations will be in effect.

5.1.2 Noise Control Regulations: Gauteng Province (GN5479 of 20 August 1999)

The Gauteng Noise Control Regulations are based on the National Noise Control Regulations and most of the regulations are the same. It prohibits the generation of a disturbing noise in any manner (Regulation 8) and defines and prohibits activities that can result in a noise nuisance (Regulation 9). Regulation 11(1) allows a local authority to designate a controlled area as well as zone sound levels for specific areas and during specific times.

The difference between the National Noise Control Regulations and the Gauteng Province is the criteria set out for a controlled area, namely:

"controlled area" means a piece of land designed by a local authority where, in the case of-

(c) industrial noise in the vicinity of an industry -

i. the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter was in operation, exceeds 60 dBA; or

ii. the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 60 dBA

"disturbing noise" as the noise level that causes the ambient noise level to rise above the designated zone level, or if no zone level has been designated, the typical rating levels for ambient noise in districts, indicated in table 2 of SABS 10103.

"measuring point" relating to -

(a) a piece of land from which an alleged disturbing noise emanates, means a point outside the property projection plane where an alleged disturbing noise shall be measured in accordance with the provisions of regulation 16;

"noise level" means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation, and, if the alleged disturbing noise has a discernible pitch, for example, a whistle, buzz, drone or music, to which 5 dBA has been added;

Section 8 of the Gauteng Noise Control Regulations prohibits the making, producing or causing of a disturbing noise.

5.2 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT 107 OF 1998)

The National Environmental Management Act ("NEMA") defines "pollution" to include any change in the environment, including noise. A duty therefore arises under section 28 of NEMA to take reasonable measures while establishing and operating any facility to prevent noise pollution occurring. NEMA sets out measures, which may be regarded as reasonable. They include the following:

1. to investigate, assess and evaluate the impact on the environment;
2. to inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed to avoid causing significant pollution or degradation of the environment;
3. to cease, modify or control any act, activity or process causing the pollution or degradation;
4. to contain or prevent the movement of the pollution or degradation;
5. to eliminate any source of the pollution or degradation;
6. to remedy the effects of the pollution or degradation.

In addition, a number of regulations have been promulgated as Regulation 982 of December 2014 (Government Notice 38282) in terms of this Act. It defines minimum information requirements for specialist reports, with Government Gazette (GG) 43110 (20 March 2020) updating the minimum requirements for reporting.

GG 43110 prescribe general requirements for undertaking site sensitivity verification and for protocols for the assessment and minimum report content requirements of environmental impacts for environmental themes for activities requiring environmental authorisation. These protocols were promulgated in terms of sections 24(5)(a), (h) and 44 of the National Environmental Management Act, 1998.

When the requirements of a protocol apply, the requirements of Appendix 6 of the Environmental Impact Assessment Regulations, as amended, (EIA Regulations), promulgated under sections 24(5) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), are replaced by these requirements.

5.3 NOISE STANDARDS

There are a few South African scientific standards (SABS) relevant to noise from developments, industry and roads. They are:

- SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'.
- SANS 10210:2004. 'Calculating and predicting road traffic noise'.
- SANS 10328:2008. 'Methods for environmental noise impact assessments'.
- SANS 10357:2004. 'The calculation of sound propagation by the Concave method'.
- SANS 10181:2003. 'The Measurement of Noise Emitted by Road Vehicles when Stationary'.
- SANS 10205:2003. 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

The relevant standards use the equivalent continuous rating level (calculated from the sound pressure levels over the reference time, see **Appendix A**) as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land use purposes. With regards to SANS 10103:2008, the recommendations are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful *per se.*

5.3.1 SANS 10103:2008

The SANS 10328:2008 guideline covers various issues with regards to noise studies, including, amongst others:

- provide typical rating levels in section 4 (see also **sub-sections 5.3.1.1**, **5.3.1.2** & **5.3.1.3**);
- identifying issues that could have acoustics implications in section 5;

- a screening process to investigate potential acoustical implications in section 6;
- a process to assess a potential noise impact on a scoping level in section 7; and
- procedures to investigate and assess the environmental noise impact from a future project in section 8.

The SANS 10328:2008 recommends that the procedures provided in clause 6 to clause 8 in this guideline be followed if:

a) An application, in respect of any if the activities identified in terms of the current relevant national legislation and noise sources (defined in clauses 3.17 and 3.18), or the issues listed in clause 5, is made to the relevant authority;
b) An application for a noise-sensitive development (in terms of clause 3.16) is made to the relevant authority;
c) An application for a change in land use is made to the relevant authority; or
d) An environmental noise impact investigation is requested by an applicant or any interested or affected party.

5.3.1.1 Clause 4.1 – Ambient indoor noise

This is a critical section, frequently ignored by authorities and even acoustic specialists. This clause provide recommended rating levels ($L_{Req,T}$) for ambient noise for different areas of occupancy during the time periods when the areas are used for their intended purposes and with the building services (e.g. ventilation systems, air-conditioning systems, lifts, plumbing and lighting) under normal operating conditions. The rating levels given in column 2 of the table are design values, while those given in column 3 are the maximum levels beyond which the ambient noise can be considered to be annoying or otherwise intrusive. Note 2 highlights that, where these levels are used as guidance for the design of buildings in non-residential areas where the ambient noise exceeds the typical level for the type of development, the building design should provide sufficient acoustic isolation to result in the occupancy level specified in Table 1 of SANS 10103 (see example for residential use in **Table 5-1**).

Table 5-1: Recommended ambient noise for different areas of occupancy indoors (Table 1 - SANS 10103:2008)

1	2	3
Types of occupancy or activity	**Design equivalent continuous rating level ($L_{Req,T}$)a for ambient noise dBA**	**Maximum equivalent continuous rating level ($L_{Req,T}$)a for ambient noise dBA**
9. Residential buildings		
Living rooms	35	45
Kitchens and service areas	45	55
Bathrooms and toilets	40	55

Bedrooms	30	40

5.3.1.2 Clause 4.2 – Typical noise in various districts

This section covers typical rating levels ($L_{Req,T}$) for ambient noise in different districts in Table 2 (duplicated in **Table 5-2**). This standard recommends that these values not be exceeded, and outdoor ambient noise exceeding these levels will be considered to be annoying to the community. The levels may be used as a guide for zoning purposes and assumes that a building with natural ventilation and open windows will provide sound insulation of about 10 dBA, with the rating levels considering Table 1 rating levels. This standard highlight in note 1 that, where occupancies have to be allowed within areas where the acceptable outdoor values are exceeded for the particular type of occupancy, the sound insulation of the building housing the occupancy should be proven to comply to the indoor levels defined in Table 1 (see example for residential use in **Table 5-1**) of this standard.

Table 5-2: Acceptable Zone Sound Levels for noise in districts (Table 2 - SANS 10103:2008)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req,T}$) for noise dBA**					
	Outdoors			**Indoors, with open windows**		
	Day/night $L_{R,dn}$	**Daytime $L_{Req,d}$**	**Night-time $L_{Req,n}$**	**Day/night $L_{R,dn}$**	**Daytime $L_{Req,d}$**	**Night-time $L_{Req,n}$**
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

It must be noted that SANS 10103:2008 does stipulate *"for industries legitimately operating in an industrial district during the entire 24 h day/night cycle, $L_{Req,d} = L_{Req,n} = 70$ dBA can be considered as typical and normal".*

The recommended noise rating levels are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful per *se*.

5.3.1.3 Clause 4.5 – Assessment of annoyance

This section recommends investigation only when the rating level ($L_{Req,T}$) of the ambient noise exceeds the rating level ($L_{Req,T}$) of the residual noise (ambient sound levels) at the same location during the relevant time period. The ambient indoor or outdoor sound level should be compared with the appropriate level given in Table 1 (see 5.3.1.1) or Table 2 (see 5.3.1.2). This standard state that it is probable that the noise is annoying or otherwise intrusive to the community or to a group of persons if the rating level of the ambient noise under investigation exceeds the applicable of the following:

a) the rating level of the residual noise (determined in the absence of the specific noise under investigation);
b) the maximum rating level for the ambient noise given in table 1 (see example for residential use in **Table 5-1**); or
c) the typical rating level for the ambient noise for the applicable environment given in table 2 (duplicated in **Table 5-2**). The probable community or group response to the excess ($\Delta L_{Req,T}$) is given in **Figure 5-1**.

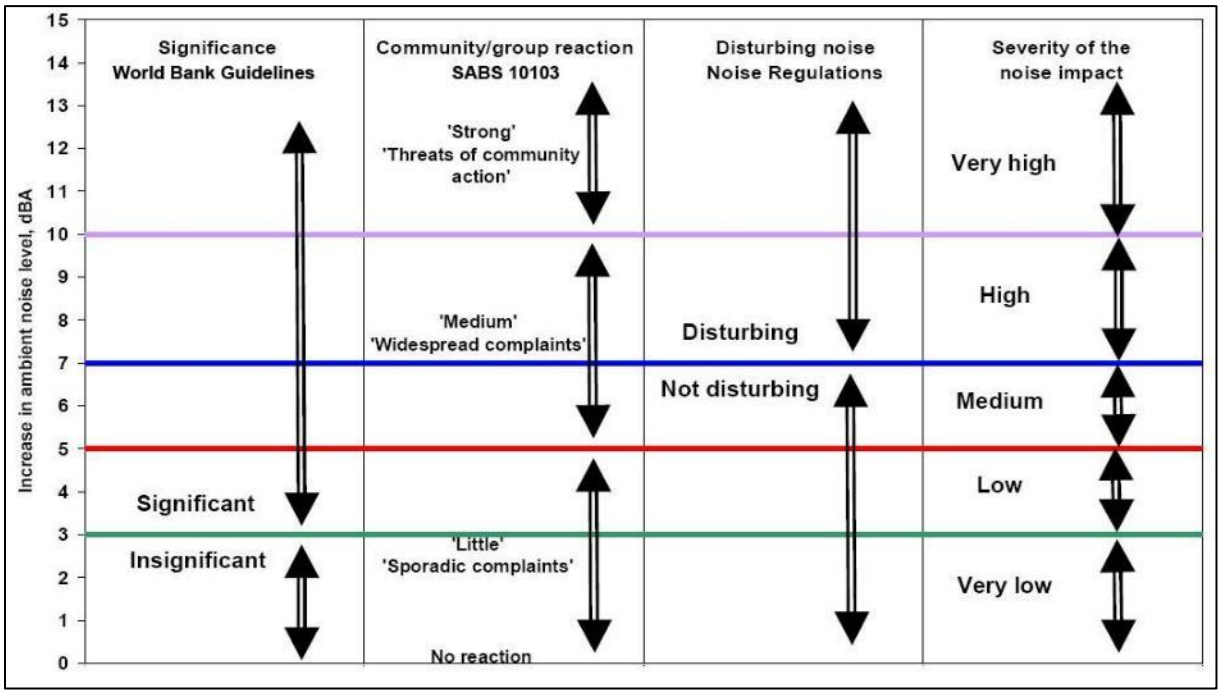


Figure 5-1: Criteria to assess the significance of impacts stemming from noise

5.3.2 SANS 10328:2008

SANS 10328 provide methods for environmental noise impact assessment, with relevant regulations (see **section 5.1.1**) and GNR320 (see **sections 4.6.1** and the checklist in **section 3**) stipulating that this standard be followed when doing a noise specialist study.

SANS 10328 recommends that the procedures given in clause 6 to clause 8 (inclusive) be followed if:

a) an application, in respect of any activities identified in terms of the current relevant legislation are proposed, if noise sources listed in clauses 3.17 and 3.18 (of of SANS 10328) are to be developed, or the issues listed in clause 5 (of SANS 10328) may take place, is made to the relevant authority;
b) an application for a noise-sensitive development (see 3.16 of SANS 10328) is made to the relevant authority;
c) an application for a change in land use is made to the relevant authority; or
d) an environmental noise impact investigation is requested by an applicant or any interested or affected party.

The minimum contents of the noise specialist study are also included in **section 4.6.2** of this report.

5.4 INTERNATIONAL GUIDELINES

While a number of international guidelines and standards exists, those selected below are used by numerous countries for environmental noise management (although they are not necessarily applicable to this Project).

5.4.1 Guidelines for Community Noise (WHO, 1999)

The World Health Organization's (WHO) document on the *Guidelines for Community Noise* is the outcome of the WHO expert task force meeting held in London, United Kingdom, in April 1999. It is based on the document entitled "Community Noise" that was prepared for the World Health Organization and published in 1995 by the Stockholm University and Karolinska Institute.

The scope of WHO's effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments. It discusses the specific effects of noise on communities including:

- Interference with communication, noise-induced hearing impairment, sleep disturbance effects, cardiovascular and psychophysiological effects, mental health effects, effects on performance, annoyance responses and effects on social behaviour.

It further discusses how noise can affect (and propose guideline noise levels) specific environments such as residential dwellings, schools, preschools, hospitals, ceremonies,

festivals and entertainment events, sounds through headphones, impulsive sounds from toys, fireworks and firearms, and parklands and conservation areas.

To protect the majority of people from being affected by noise during the daytime, it proposes that sound levels at outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the day, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}. At night, equivalent sound levels at the outside façades of the living spaces should not exceed 45 dBA and 60 dBA L_{Amax} so that people may sleep with bedroom windows open. It is critical to note that this guideline requires the sound level measuring instrument to be set on the "fast" detection setting.

5.4.2 European Parliament Directive 200/14/EC (2000)

Directive 2000/14/EC relating to the noise emission in the environment by equipment for use outdoors was adopted by the European Parliament and the Council and first published in May 2000 and applied from 3 January 2002. The directive placed sound power limits on equipment to be used outdoors in a suburban or urban setting. Failure to comply with these regulations may result in products being prohibited from being placed on the EU market. Equipment list is vast and includes machinery such as compaction machineries, dozers, dumpers, excavators, etc. Manufacturers as a result started to consider noise emission levels from their products to ensure that their equipment will continue to have a market in most countries.

5.4.3 Equator Principles (2003)

The **Equator Principles** (EPs) are a voluntary set of standards for determining, assessing and managing social and environmental risk in project financing. Equator Principles Financial Institutions (EPFIs) commit to not providing loans to projects where the borrower will not or is unable to comply with their respective social and environmental policies and procedures that implement the EPs.

The EPs were developed by private sector banks and were launched in June 2003. The banks chose to model the EPs on the environmental standards of the World Bank and the social policies of the International Finance Corporation (IFC). As of March 2021, one hundred and sixteen (116) financial institutions (in 37 different countries) have adopted the EPs, which have become the de facto standard for banks and investors on how to assess major development projects around the world. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the IFC Environmental, Health and Safety (EHS) Guidelines.

5.4.4 IFC: General EHS Guidelines – Environmental Noise Management (2007)

These guidelines are applicable to noise created beyond the property boundaries of a development that conforms to the Equator Principles. The environmental standards of the World Bank have been integrated into the social policies of the IFC since April 2007 as the International Finance Corporation Environmental, Health and Safety (EHS) Guidelines.

It states that noise prevention and mitigation measures should be applied where predicted or measured noise impacts from project facilities/operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at source. It goes as far as to propose methods for the prevention and control of noise emissions, including:

- Selecting equipment with lower sound power levels;
- Installing silencers for fans;
- Installing suitable mufflers on engine exhausts and compressor components;
- Installing acoustic enclosures for equipment casing radiating noise;
- Improving the acoustic performance of constructed buildings, apply sound insulation;
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimise the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective;
- Installing vibration isolation for mechanical equipment;
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas;
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding;
- Placement of permanent facilities away from community areas if possible;
- Taking advantage of the natural topography as a noise buffer during facility design;
- Reducing project traffic routing through community areas wherever possible;
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas; and
- Developing a mechanism to record and respond to complaints.

It sets noise level guidelines (see **Table 5-3**) and highlights certain monitoring requirements pre- and post-development. It adds another criterion in that the existing background ambient noise level should not rise by more than 3 dBA. This criterion will effectively sterilize large areas of any development. Therefore, it is EARES's considered opinion that this criterion was introduced to address cases where the existing ambient noise level is already at, or in excess of the recommended limits.

Table 5-3: IFC Table 7.1-Noise Level Guidelines

Receptor type	One hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The document uses the $L_{Aeq,1hr}$ noise descriptors to define noise levels. It does not determine the detection period, but refers to the IEC standards, which requires the fast detector setting on the Sound Level Meter during measurements in Europe.

5.4.5 Night Noise Guidelines for Europe (WHO, 2009)

Refining previous Community Noise Guidelines issued in 1999, and incorporating more recent research, the World Health Organization has released a comprehensive report on the health effects of night time noise, along with new (non-mandatory) guidelines for use in Europe. Rather than a maximum of 30 dB inside at night (which equals 45-50 dB max outside), the WHO now recommends a maximum year-round outside night-time noise average of 40 dB to avoid sleep disturbance and its related health effects. The report notes that only below 30 dB (outside annual average) are "*no significant biological effects observed*," and that between 30 and 40 dB, several effects are observed, with the chronically ill and children being more susceptible; however, "*even in the worst cases the effects seem modest*." Elsewhere, the report states more definitively, "*There is no sufficient evidence that the biological effects observed at the level below 40 dB (night, outside) are harmful to health*." At levels over 40 dB "*Adverse health effects are observed*" and "*many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected*."

The 184-page report offers a comprehensive overview of research into the various effects of noise on sleep quality and health (including the health effects of non-waking sleep arousal), and is recommended reading for anyone working with noise issues. The use of an outdoor noise standard is in part designed to acknowledge that people do prefer to leave windows open when sleeping, though the year-long average may be difficult to obtain (it would require longer-term sound monitoring than is usually budgeted for by either industry or neighbourhood groups).

While recommending the use of the average level, the report notes that some instantaneous effects occur in relation to specific maximum noise levels, but that the health effects of these "cannot be easily established."

5.4.6 Environmental Noise Guidelines for the European Region (WHO, 2018)

This document identifies levels at which noise has significant health impacts and recommends actions to reduce exposure. Compared to previous WHO guidelines on noise, this version contains five significant developments:

- Stronger evidence of the cardiovascular and metabolic effects of environmental noise;
- Inclusion of new noise sources, namely wind turbine noise and leisure noise, in addition to noise from transportation (aircraft, rail, and road traffic);
- Use of a standardized approach to assess the evidence;
- A systematic review of evidence, defining the relationship between noise exposure and risk of adverse health outcomes;
- Use of long-term average noise exposure indicators to better predict adverse health outcomes.

6 CURRENT ENVIRONMENTAL SOUND CHARACTER

6.1 EFFECT OF SEASON ON SOUND LEVELS

Natural sounds are a part of the environmental noise surrounding humans. In rural areas the sounds from insects and birds would dominate the ambient sound character, with noises such as wind flowing through vegetation increasing as wind speed increase. Work by Fégeant (2002) stressed the importance of wind speed and turbulence causing variations in the level of vegetation-generated noise. In addition, factors such as the season (e.g., dry or no leaves versus green leaves), the type of vegetation (e.g., grass, conifers, deciduous), the vegetation density and the total vegetation surface all determine both the sound level as well as spectral characteristics.

Ambient sound levels are significantly affected by the area where the sound measurement location (or a listener) is situated. When the sound measurement location is situated within an urban area, close to industrial plants or areas with a constant sound source (ocean, rivers, etc.), seasons and higher wind speeds may have an insignificant impact on ambient sound levels.

Sound levels in undeveloped rural areas (away from occupied dwellings), however, are impacted by changes in season for a number of complex reasons. The two main reasons are:

- Faunal communication is more significant during the warmer spring and summer months as various species communicate in an effort to find mates. Faunal communication is normally less during the colder months, with ambient sound levels measured during the winter period frequently being very low.
- The occurrence of temperature inversions, see **Sub Section 6.1.1**, and
- Seasonal changes in weather patterns, mainly due to increased wind speeds (also see **Sub Section 6.1.2 6.1.1**below) and potential gustiness of the wind.

For environmental noise, weather plays an important role. The greater the separation distance, the greater the influence of the weather conditions, so, from day to day, a road 1,000 m away can sound very loud or can be completely inaudible. Other, environmental factors that impact on sound propagation includes wind, temperature and humidity, as discussed in the sub-sections below.

Ambient sound levels are generally less during the colder months (due to less faunal communication) and higher during the warmer months.

6.1.1 Effect of Temperature inversions

On a typical sunny afternoon, the air is the hottest near the ground surface and temperature decreases at higher altitudes. This temperature gradient causes sound waves to refract upward, away from the ground and results in lower noise levels being heard at a measurement location. In the evening, this temperature gradient will reverse, but, during certain meteorological conditions, the normal vertical temperature gradient could be inverted so that the air is colder near the surface, with a warmer layer blanketing the lower layer. This is illustrated in **Figure 6-1** below.

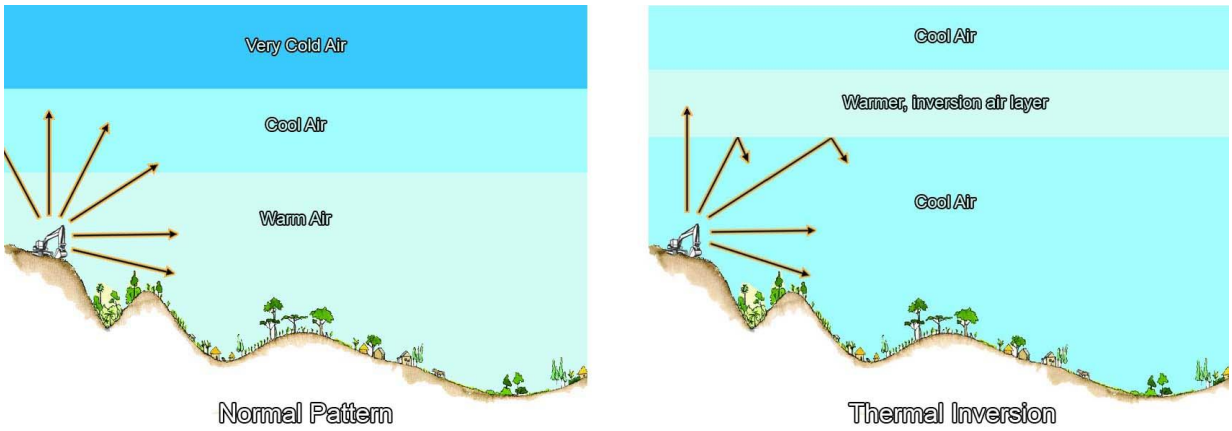


Figure 6-1: Influence of temperature inversions on the propagation of sound

When such an inversion layer is present, some of the sound waves will be refracted[3] by the temperature gradient, with the refracted sound waves returned to the ground. This effect has been noticed near airports and roads, where noises can be heard over greater distances at night than other times of day (Parnell, 2015; Saurenman, 2005; Van der Berg, 2003) for various industries.

Like wind gradients, temperature gradients can influence sound propagation over long distances, complicate sound level measurements as well as propagation modelling.

6.1.2 Effect of Wind

Wind alters sound propagation by the mechanism of refraction, that is, wind bends sound waves. Wind nearer to the ground moves more slowly than wind at higher altitudes, due to surface characteristics such as hills, trees, and man-made structures that interfere with the wind. This wind gradient, with faster wind at higher elevation and slower wind at lower elevation, causes sound waves to bend downward when they are traveling to a location downwind of the source and to bend upward when traveling toward a location upwind of the

[3] Redirecting the wave propagation direction due to a change in the density of the air which influences the speed of sound.

source. Waves bending downward means that a listener standing downwind of the source will hear louder noise levels than the listener standing upwind of the source. This phenomenon can significantly impact sound propagation over long distances and when wind speeds are high. Over short distances wind direction has a small impact on sound propagation as long as wind velocities are reasonably slow, i.e., less than 5 m/s.

Wind speed frequently plays a role in increasing sound levels in natural locations. With no wind, there is little vegetation movement that could generate noises and faunal noises (normally birds and insects) dominate, however, as wind speeds increase, the rustling of leaves increases which subsequently can increase sound levels. This directly depends on the type of vegetation in a certain area. The impact of increased wind speed on sound levels depends on the vegetation type (deciduous versus conifers), the density of vegetation in an area, seasonal changes (in winter deciduous trees are bare) as well as the height of this vegetation. This excludes unanticipated consequences, as suitable vegetation may create suitable habitats and food sources attracting birds and insects (and the subsequent increase in faunal communication).

6.1.3 Effect of Humidity and Temperature

Generally, sound propagates better at lower temperatures (down to 10^{o}C), and with everything being equal, a decrease in temperature from 32^{o}C to 10^{o}C could increase the sound level at a listener 600 m away by ±2.5 dB (at 1,000 Hz).

The effect of humidity on sound propagation is quite complex, but effectively relates to how increased humidity changes the density of air. Lower density translates into faster sound wave travel, so sound waves travel faster at high humidity[4]. With everything being equal, an increase in humidity from 20% to 80% would increase the sound level at a listener 600 m away by ±4 dB (at 1,000 Hz at 20^{o}C).

Together, the impacts of temperature and humidity (together with air pressure - to a minor extent) are complex and highly dependent on the frequency composition of the noise. This is illustrated in **Figure 6-2**.

[4] The addition of water vapor to air (making the air more humid) **reduces the density of the air**. This occurs because the molar mass of water vapor (18 g/mol) is less than the molar mass of dry air (around 29 g/mol).

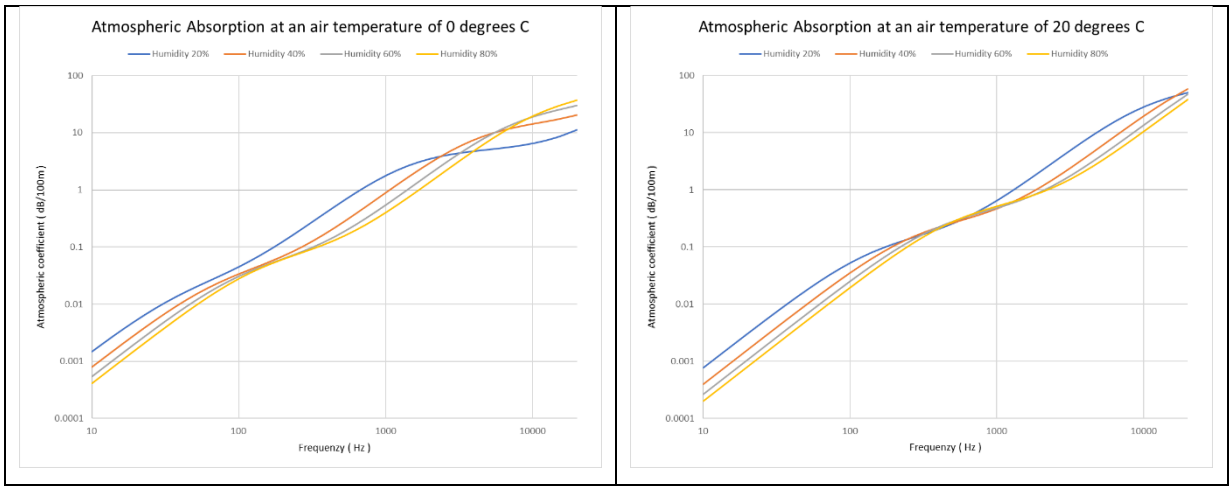


Figure 6-2: Effect of Temperature and Humidity on propagation of Sound

6.2 AMBIENT SOUND LEVEL MEASUREMENTS

Ambient (background) sound levels were measured at three locations during the day, 24 February 2025, repeating the measurements at the same locations during the night of 24/25 and again the night of 25/26 February 2025. All measurements considered the prescribed procedures of GNR320 of 2020 as well as that of SANS 10103:2008 "***The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication***".

The equipment defined in **Table 6-1** was used for the measurements.

Table 6-1: Details of Sound Level Equipment used for measurements

Equipment	Model	Serial no	Calibration Date
Sound Level Meter	SVAN 977	36176	Feb 2024
Pre-amplifier	SV 12L	25685	Feb 2024
Microphone	ACO 7052E	49596	Feb 2024
Calibrator	Quest CA-22	J 2080094	July 2024

The sound measurement locations are illustrated in **Figure 6-3** as blue squares, with the data summarized in **Table 6-2**.

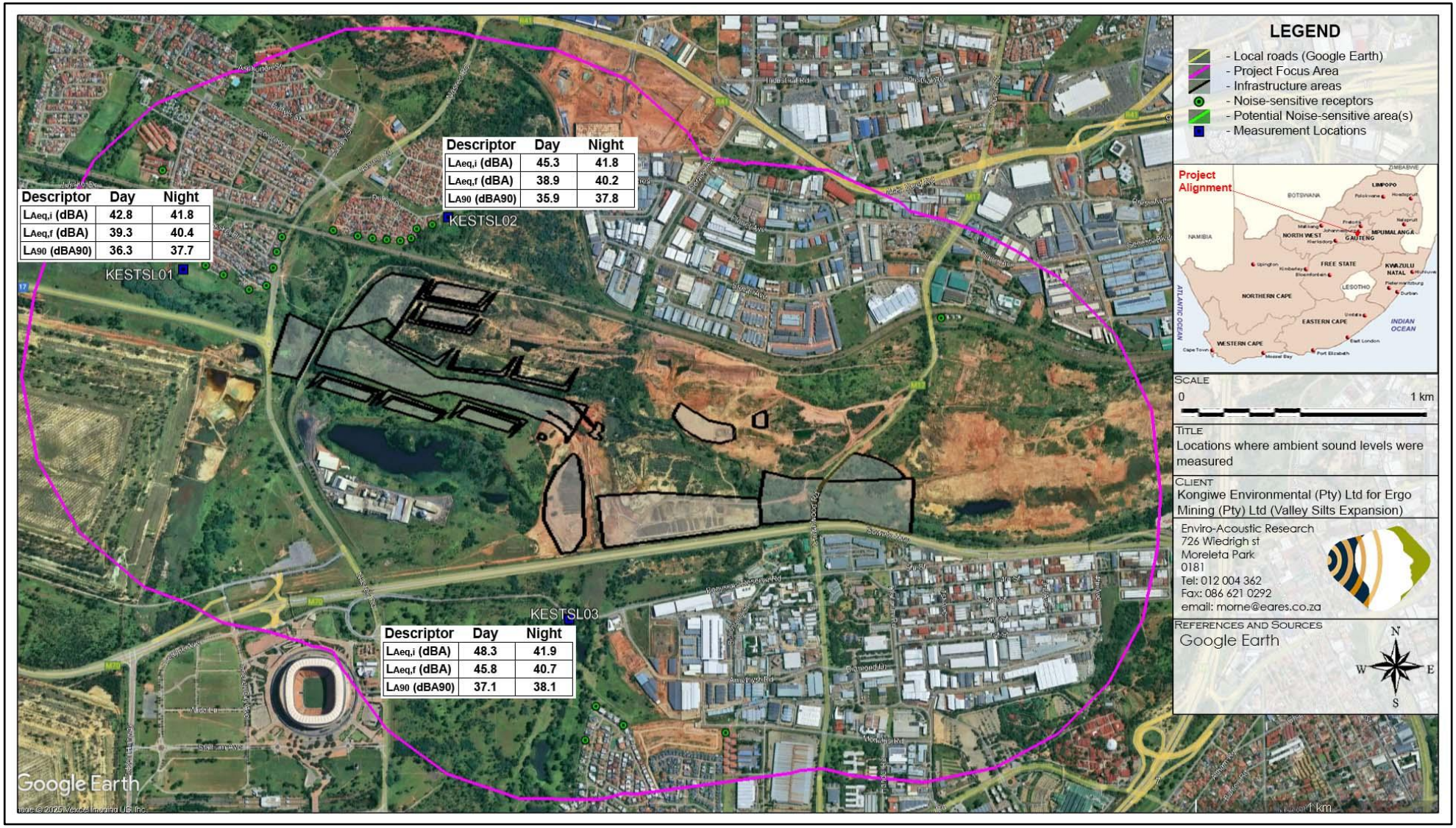


Figure 6-3: Localities where ambient sound levels were measured

Table 6-2: Summary of ambient sound levels measured in the area

Date, Time	$L_{A,Max}$ (dBA)	$L_{A,eq(i)}$ (dBA)	$L_{A,ming}$ (dBA)	$L_{A,eq(f)}$ (dBA)	L_{A90} (dBA)	Temp (°C)	Humid. (%)	Wind (m/s)	Comments
Measurement location: KESTSL01									
2025/02/24 12:50	57.7	42.8	34.1	39.3	36.3	29	47	2.8	Birds. Road traffic audible and constant. Voices.
2025/02/24 22:20	53.6	41.7	34.8	40.4	36.5	22	76	1.6	Birds at times. Insects. Occasional road traffic. Music just audible.
2025/02/25 00:10	58.5	39.7	33.6	37.7	35.5	22	79	1.5	Birds at times. Insects. Occasional road traffic.
2025/02/26 00:30	51.9	43.5	38.2	42.4	39.9	24	75	<1	Birds at times. Insects. Occasional road traffic.
2025/02/26 02:30	46.3	42.0	37.4	41.0	39.0	23	78	<1	Birds at times. Insects. Occasional road traffic.
Measurement location: KESTSL02									
2025/02/24 13:20	60.8	45.3	33.4	38.9	35.9	30	49	2.7	Birds. Water flowing. Reverse alarms.
2025/02/24 22:50	44.5	40.1	34.3	37.7	35.5	23	73	1.4	Water flowing. Insects. Birds. Occasional road traffic (ORT).
2025/02/25 00:40	47.7	41.2	35.0	39.8	36.9	22	84	1.4	Water flowing. Insects. Birds. ORT.
2025/02/26 01:00	47.7	44.0	39.9	42.9	41.2	24	75	<1	Water flowing. Insects. Birds. ORT.
2025/02/26 03:00	50.9	41.7	36.3	40.3	37.6	23	78	<1	Water flowing. Insects. Birds. ORT (very low).
Measurement location: KESTSL03									
2025/02/24 13:50	86.3	48.3	35.5	45.8	37.1	30	47	2.4	Birds. Road traffic constant. Wind noises.
2025/02/24 23:20	48.1	38.8	32.9	37.9	35.0	22	76	1.5	Insects and birds. Low traffic noises.
2025/02/25 01:10	44.6	40.1	34.8	38.8	36.6	23	87	1.5	Insects and birds. Low traffic noises.
2025/02/26 01:30	47.4	45.2	41.7	44.4	43.1	24	65	<1	Insects and birds. Low traffic noises.
2025/02/26 03:30	57.4	43.5	35.9	41.6	37.5	24	68	1.6	Insects and birds. Low traffic noises.

7 POTENTIAL NOISE SOURCES

7.1 POTENTIAL NOISE SOURCES: OPERATIONAL ACTIVITIES

Increased noise levels are directly linked with the various reclamation activities, with the main noise sources being:

- Excavators excavating gold-bearing silt, with the silt deposited in the area for further drying. This silt material is also loaded onto Articulated Dump Trucks (ADTs) for hauling to the drying areas;
- Front End Loaders loading the dryer silt onto road haul trucks;
- ADTs and road trucks moving around onsite;
- A water bowser wetting the area; and
- A maintenance and diesel bowser servicing equipment.

While equipment does work for a few hours at a time in a certain area, none of these activities are stationary (such as a fixed crusher or screen). As such this noise impact assessment considers conceptual scenarios to estimate the potential impact of noise on the surrounding NSR, the conceptual scenarios should not be seen as a reflection of a mining schedule or a specific noise level at receptors at any specific time.

This assessment will focus on three potential location scenarios, with each scenario locating the reclamation activities at different locations on the site. Noise-generating activities include:

- Four excavators operating at four different areas;
- Four front end loaders operating near the excavators, each at a different area;
- Eight trucks (which could include ADT and road trucks) operating near the excavators and front end loaders;
- Eight area noise sources of 500 m^2 each, to account for undefined equipment (such as LDV's, the water bowser or service/diesel bowser) moving around in the area; and
- 30 road haul trucks per hour moving between the active mining area as well as the M17 (Crownwood Road). Considering the high volume of existing road traffic, the addition of the road haul trucks will not influence road traffic noise levels and this was not considered in the noise model.

The main difference between the three scenarios is the location where active reclamation activities will be taking place, with the locations illustrated in **Figure 10-1**, **Figure 10-3** and **Figure 10-5**.

Sound power levels (PWLs) as defined in **Table 7-1** were used in the noise modelling for all scenarios, assuming an acoustical load factor[5] (AL) of 25% for all activities, excluding ADT and haul trucks, where an AL of 10% was used. It was reported that reclamation activities will only take place during the day-time period, and no night-time scenario will be considered.

Table 7-1: Sound power emission levels used for modelling

Equipment	**Sound power level, dB re1 pW, in octave band, Hz**							**SPL**
Process	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**(dBA)**
Point noise sources (dBA re 1 pW)								
Dumper/Haul truck/ADT	102.5	108.6	106.5	105.4	104.5	99.2	97.2	103.0
Excavator	113.8	114.2	110.3	108.3	106.3	103.9	103.7	102.0
Front End Loader ("FEL")	109.0	106.7	107.3	97.9	95.8	92.5	87.6	105.0
Area noise sources (dBA/m^2 re 1 pW)								
General Noise (High-intensity)	95.0	100.0	103.0	105.0	105.0	100.0	100.0	65.0

The noise modelling was also compared with actual noise level measurements done onsite, indicating that the modelling may overpredict the noise levels with 3 – 5 dBA. This is considered acceptable and in line with the precautious principle.

7.2 POTENTIAL NOISE SOURCES: FUTURE DECOMMISSIONING ACTIVITIES

The Decommissioning Phase is considered as the phase which begins after the last silt is removed and rehabilitation activities start. Decommissioning ends when the facility receives a Closure Certificate.

Decommissioning and rehabilitation activities may include the removal of remaining infrastructure, unless it is required for post-mining impact management or for the final end land use. Noise-generating activities may include:

- Removal of all remaining redundant infrastructure;
- Removal of any contaminated soil;
- The rehabilitation of disturbed areas including the necessary ripping of compacted soils and the shaping of rehabilitated areas to ensure free drainage;

[5] Also known as Acoustical Usage Factor, accounts for the percent of time that the equipment is emitting maximum noise levels

- Placement of topsoil on rehabilitated surface areas followed by seeding (if necessary to re-establish vegetation);
- Monitoring and maintenance of the rehabilitated areas; and
- Application for a Closure Certificate for the site.

However, while there are numerous activities that can take place during the decommissioning stage, the potential noise impact will only be discussed in general. This is because the noise impacts associated with the decommissioning phase is normally significantly less than typical operational phases for the following reasons:

- Final decommissioning normally takes place only during the day, a time period when existing ambient sound levels are higher, generally masking most external noises for surrounding receptors; and
- There is a lower urgency of completing this phase and less equipment remains onsite (and fewer are used simultaneously) to affect the noise levels during decommissioning.

8 METHODS: NOISE IMPACT ASSESSMENT AND SIGNIFICANCE

8.1 NOISE IMPACT ON ANIMALS[6]

A significant amount of research was undertaken during the 1960's and 70's on the effects of aircraft noise on animals. While aircraft noise has a specific characteristic that might not be comparable to industrial noise, the findings should be relevant to most noise sources. A general animal behavioural reaction to aircraft noise is the startle response with the strength and length of the startle response to be dependent on the following:

- which species is exposed;
- whether there is one animal or a group of animals, and
- whether there have been some previous exposures.

Overall, the research suggests that species differ in their response to noise depending on the duration, magnitude, characteristics and source of the noise, as well as how accustomed the animals are to the noise (previous exposure).

Extraneous noises impact on animals as it can increase stress levels and even impact on their hearing. Masking sounds may affect their ability to react to threats, compete and seek mates and reproduce, hunt and forage, communicate and generally to survive.

Unfortunately, there are numerous other factors in the faunal environment that also influence the effects of noise. These include predators, weather, changing prey/food base and ground-based disturbance, especially anthropogenic. This hinders the ability to define the real impact of noise on animals.

The only animal species studied in detail are humans, and studies are still continuing in this regard. These studies also indicate that there is considerable variation between individuals, highlighting the loss of sensitivity to higher frequencies as human's age. Sensitivity also varies with frequency with humans. Considering the variation in the sensitivity to frequencies and between individuals, this is likely similar to all faunal species. Some of these studies are repeated on animals, with behavioural hearing tests being able to define the hearing threshold range for some animals as indicated in **Figure 8-1** below.

Only a few faunal (animal) species have been studied in a bit more detail so far, with the potential noise impact on marine animals most likely the most researched subject, with a

[6]Report to Congressional Requesters, 2005; USEPA, 1971; Autumn, 2007; Noise quest, 2010

few studies that discuss behavioural changes in other faunal species due to increased noises. Few studies indicate definitive levels where noises start to impact on animals, with most based on laboratory level research that subject animals to noise levels that are significantly higher than the noise levels these animals may experience in their environment (excluding the rare case where bats and avifauna fly extremely close to an anthropogenic noise, such as from a moving car or the blades of a wind turbine).

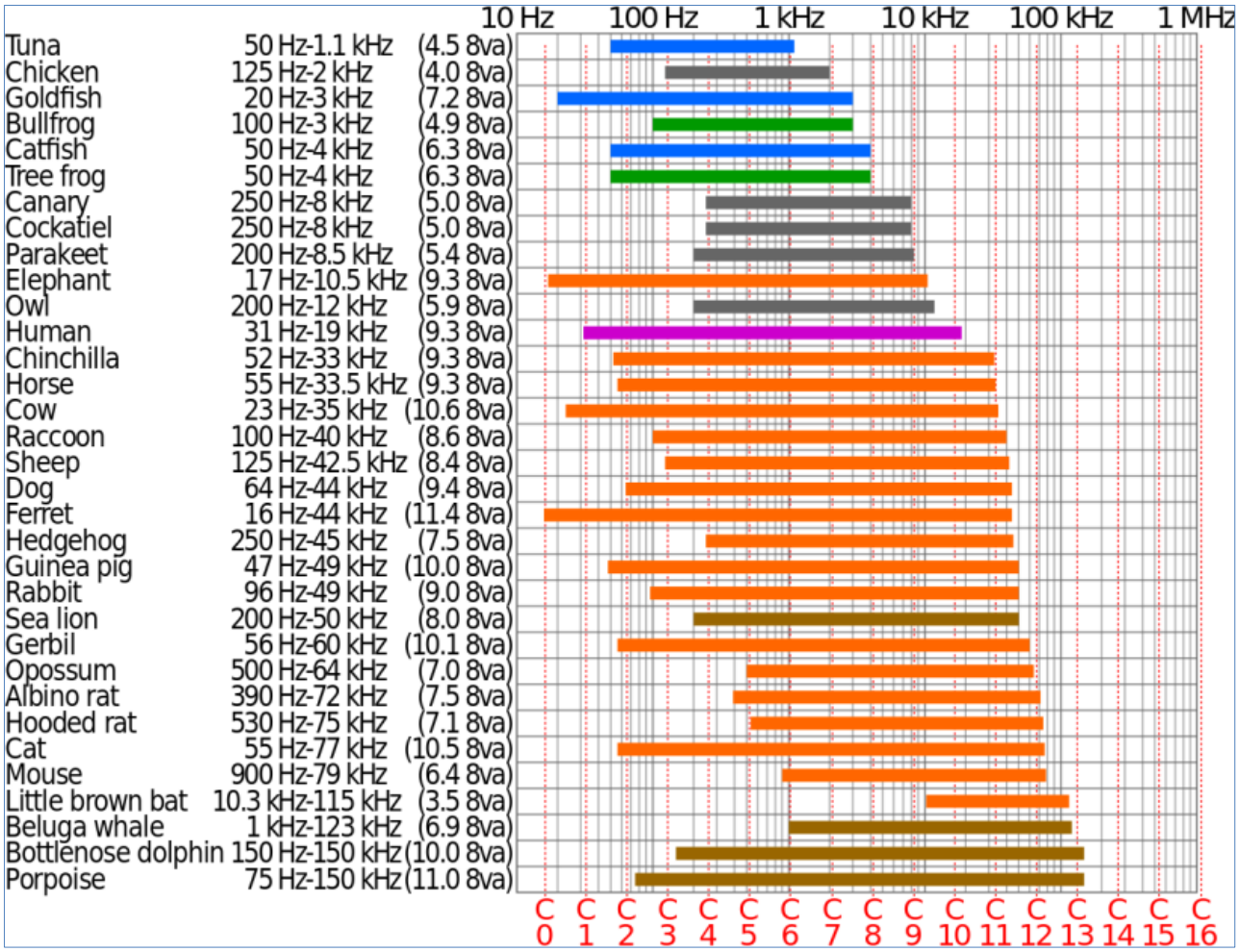


Figure 8-1: Logarithmic Chart of the Hearing Ranges of Some Animals[7]

From these and other studies, the following can be concluded that:

- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running/flying away. If the noises continue, animals would try to relocate (Drooling, 2007).

[7] https://en.wikipedia.org/wiki/Hearing_range

- Animals start to respond to increased noise levels with elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55 to 60 dBA (Baber, 2009).
- Animals of most species exhibit adaptation to noise (Broucek, 2014), including impulsive noises, by changing their behaviour.
- More sensitive species would relocate to a quieter area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate (Drooling, 2007).
- Noises associated with helicopters, motor- and quad bikes do significantly impact on animals. This is due to the sudden and significant increase in noise levels due to these activities.

To date, there are, however, no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals.

8.1.1 Domestic Animals

It may be that domesticated animals are more accustomed to noise sources of an industrial, commercial or other anthropogenic nature, although exposure to high noise levels may still affect domestic animals' well-being. Sound levels in animal shelters can exceed 100 dB, much more than what can be expected at a domestic dwelling from an industrial, commercial or transportation noise source (10-minute equivalent)[8&9]. The high noise levels may see negative influences on animals' cardiovascular systems and behaviour.

According to Šottník, 2011, noise as high as 80 dB had no negative effect on dairy cows. As noise levels increased (up to 105 dB), feed consumption, milk yield and intensity of milk release decreased.

Unexpected high intensity noise (above 110 dB), such as low altitude jet aircraft overflights at milking time could reduce effectiveness of the milk ejection reflex, decrease efficiency of milk removal, increase residual milk, and lead to overall reduction in milk yield. However, a majority of the studies reviewed suggests that there is little or no effect of aircraft noise on cattle. Adverse effects of low-altitude flights have been noted in some studies but have not been uniformly reproduced in other reports (Manci, 1988).

[8]Crista L. Coppola. Noise in the Animal Shelter Environment: Building Design and the Effects of Daily Noise Exposure.
[9] David Key, Essential Kennel Designs.

Domesticated animals may also respond differently to noises than animals in the wild. Domesticated dogs are pack animals and may respond excitedly or vocally to other noises, smells, visual and other stimulants, in contrast to wild animals that may flee due to a slight unfamiliar sound. Animals that are transported at least once in their life (such as pigs to an abattoir) would endure high noise levels for the duration of the delivery period. A change in the heart rate, renal blood flow and blood pressure of study subjects were noted in the above studies. How small changes (in environmental noise levels) may impact on domesticated animals have however not yet been studied.

8.1.2 Wildlife

Many natural based acoustics themselves may be loud or impulsive. Examples include thunder, wind-induced noises that could easily exceed 35 dBA ($L_{A90,fast}$) above wind speeds averaging 6 m/s, noise levels during early morning dawn chorus or loud cicada noises during late evening or early morning.

Potential noise impacts on wildlife are very highly species dependent. Studies showed that most animals adapt to noises and would even return to a site after an initial disturbance, even if the noise continues. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area. Stress levels can increase in animals restricted to areas where the sound levels are impacting on them (due to the level, character or both).

There are a few specific studies discussing the potential impacts of noise on wildlife associated with construction, transportation and industrial facilities. Available information indicates that noises from transportation and industrial sources may mask the sound of a predator approaching; similarly, predators depending on hearing would not be able to locate their prey.

Studies indicated that most animals adapt to noises, and would even return to a site after an initial disturbance, even if the noise is continuous. The more sensitive animals that might be impacted by noise would most likely relocate to a quieter area. Helldin (2012) however highlights that the network of access road could be a significant factor impacting on animals. Noise impacts are therefore very highly species-dependent, but there are also other factors that could impact on animals (such as visibility and increased movement of people and vehicles)[10].

[10] Blickley, 2010; Cummings, 2012; Cummings, 2009; Łopucki, 2016; Noise Quest, 2010; Rabin, 2006

8.1.3 Avifauna[11]

Noise impacts on birds include:

- causing hearing damage (very loud or loud impulsive sounds);
- increasing stress levels (directly and indirectly);
- Masking (directly or indirectly) the sounds of their food, predators or mates;
- Their typical food sources may move;
- Relocation to less suitable habitats; and
- other behavioural reactions.

As with the impact on other wildlife, the impact of noise on avifauna depends on the character of the noise (including the impulsive character), the magnitude or intensity of the noise as well as the familiarity the birds have with the sound.

Similarly, different birds change their response to these sounds differently. Some may not be impacted while other species may:

- avoid noisy areas or completely relocate;
- may start to sing at different times;
- may change the frequency, pitch or character of their calls/singing/signals;
- increase the volume of their calls/singing/signals; or/and
- changes in reproductive success.

As with other animals, there are no guidelines or even studies highlighting acceptable sound levels or other criteria before noise may start to impact on birds.

8.1.4 Laboratory Animal Studies

Although many laboratory animals have wild counterparts (rats, mice) the laboratory test subjects differ in many aspects (genetics, behaviour etc.). Also, noise levels of studies are conducted at generally very high levels at over 100 dB, much more than what would be experienced in environmental settings around industrial, commercial or transportation activities[12] . Other dissimilarities to laboratory tests and a natural environment include the time exposure (duration of noise), the spectral and noise character (impulsive noise vs. constant noise) etc. Although there exist dissimilarities in tests conducted and noise levels around commercial and industrial environments, laboratory rodents exposed to high noise levels did indicate physiological, behavioural changes, hearing loss and other such effects[13].

[11] Autumn, 2007; Brumm, 2004; Cummings, 2009; Dooling, 2007; Francis, 2012; Francis, 2011; Ortega, 2012; Halfwerk, 2011; Parris, 2009, Zwart, 2014.
[12]USEPA, 1971.
[13] Baldwin, 2007.

8.1.5 Concluding Remarks - Noise Impacts on Animals

From these and other studies the following can be concluded:

- To date there are no guidelines or sound limits with regards to noise levels that can be used to estimate the potential significance of noises on animals (Blickley *et al.* 2010).
- Animals respond to impulsive (sudden) noises (higher than 90 dBA) by running away. If the noises continue, animals would try to relocate (Dooling, 2007).
- Terrestrial wildlife responses begin at noise levels of approximately 40 dBA, with 20% of papers documenting impacts below 50 dBA (Shannon *et al.* 2015).
- Animals start to respond to increased noise levels with elevated stress hormone levels and hypertension. These responses begin to appear at exposure levels of 55 to 60 dBA (Baber, 2010), with Helldin *et al.* (2012) reporting that levels of 60–75 dBA have been shown to cause stress, e.g., increased respiration and heart rate, increased vigilance, and decreased time for grazing in domestic animals such as sheep and horses.
- Animals of most species exhibit adaptation with noise (Broucek, 2014), including impulsive noises, by changing their behaviour.
- More sensitive species would relocate to a quieter area, especially species that depend on hearing to hunt or evade prey, or species that makes use of sound/hearing to locate a suitable mate (Dooling, 2007).
- Noises associated with helicopters, motor- and quad bikes significantly impact on animals (startle response). This is due to the sudden and significant increase in noise levels as well as the presence of humans (Autumn, 2007; USEPA, 1971).

8.2 WHY NOISE CONCERNS COMMUNITIES[14]

Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. One can generalise by saying that sound becomes unwanted when it:

- Hinders speech communication;
- Impedes the thinking process;
- Interferes with concentration;
- Obstructs activities (work, leisure and sleeping); and
- Presents a health risk due to hearing damage.

[14]World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009

However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears only music, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases, annoyance is seen as an outcome of disturbances, in other cases, it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered "disturbing". One can refer to a dripping tap in the quiet of the night, or the irritating "thump-thump" of the music from a neighbouring house at night when one would like to sleep.

Severity of the annoyance depends on factors such as:

- Background sound levels, and the background sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological state of the receptor; and
- The attitude of the receptor about the emitter (noise source).

8.2.1 Noise Annoyance

Annoyance is the most widely acknowledged effect of environmental noise exposure, and is considered to be the most widespread. It is estimated that less than a third of the individual noise annoyance is accounted for by acoustic parameters, and that the non-acoustic factors play a major role. Non-acoustic factors that have been identified include age, economic dependence on the noise source, attitude towards the noise source and self-reported noise sensitivity (Bakker *et al.*, 2012; Council of Canadian Academies, 2015; Ellenbogen *et al.*, 2012; Halfwerk *et al*., 2011; Hanning, 2010; Janssen *et al.*, 2011; Knopper *et al.*, 2014; Merlin *et al.*, 2013; Miedema and Vos, 2003; WHO, 2009).

On the basis of a number of studies into noise annoyance, exposure-response relationships were derived for high annoyance from different noise sources. These relationships, illustrated in **Figure 8-2**, are recommended in a European Union position paper published in 2002, stipulating policy regarding the quantification of annoyance. This can be used in environmental health impact assessment and cost-benefit analysis to translate noise maps into overviews of the numbers of persons that may be annoyed, thereby giving insight into

the situation expected in the long-term. It is not applicable to local complaint-type situations or to an assessment of the short-term effects of a change in noise levels.

Severity of the annoyance depends on factors such as:

- Background sound levels and the background sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological and health state of the receptor; and
- The attitude of the receptor about the emitter (noise source).

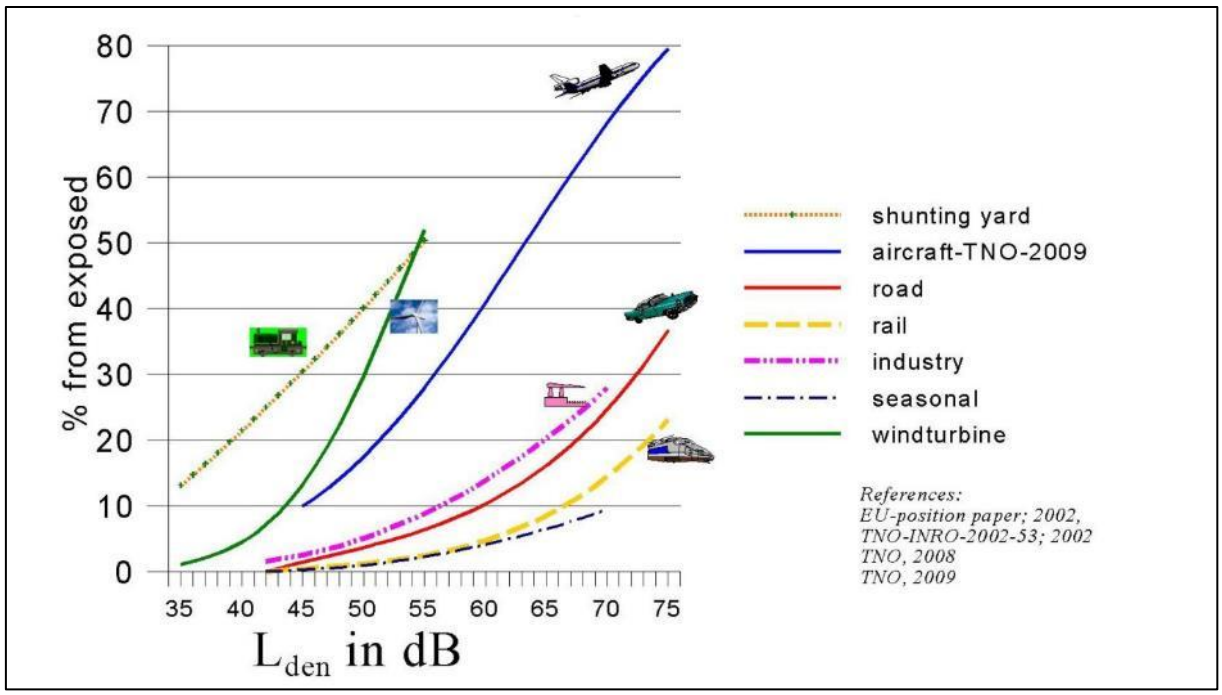


Figure 8-2: Percentage of annoyed persons as a function of the day-evening-night noise exposure at the façade of a dwelling[15]

8.2.1.1 Disturbance to Sleep

Sleep is essential for mental and physical health, and noise is one of the most reported reasons why people may experience sleep interruptions at night. This may be sudden loud noises, with the WHO (2009) reporting that, when maximum noises exceed 60 dBA, with average noise levels exceeding 40 dBA, it may increase the probability of being awakened. People report that quality of life suffer with increased instances of disturbed sleep that may also increase annoyance with a project (Bakker *et al* (2012); Van den Berg *et al* (2014)). It should be noted that Van den Berg *et al* (2008) (see also Van den Berg *et al* - 2014)

[15] Image from https://rigolett.home.xs4all.nl/ENGELS/topic.htm. Wind Turbine Annoyance curve from Pedersen (2007)

showed an indirect effect between sleep disturbances and annoyance, but not between sleep disturbance and the noise level. It is postulated that this is due to increased annoyance due to the visual impact from the project generating the noise.

8.2.1.2 Potential Health Effects from noise

The WHO (2009) does report threshold levels where people may report or experience effects from noise, with these thresholds highlighted in **Table 8-1**. The WHO does use the L_{Amax} and L_{night}[16] descriptors to describe these levels.

Table 8-1: Threshold levels reported by the WHO (2009)

Effect	Indicator	Threshold (dBA)
EEG awakening	$L_{Amax,inside}$	35
Onset of motility	$L_{Amax,inside}$	32
Changes in sleep patterns	$L_{Amax,inside}$	35
Waking up in the night and/or too early in the morning	$L_{Amax,inside}$	42
Increased average motility when sleeping	$L_{night,outside}$	42
Self-reported sleep disturbances	$L_{night,outside}$	42
Environmental insomnia	$L_{night,outside}$	42
Hypertension	$L_{night,outside}$	50
Myocardial infarction	$L_{night,outside}$	50
Psychic disorders	$L_{night,outside}$	60

8.2.1.3 Situational and Personal Factors

There are a few other aspects, collectively referred to as non-acoustical factors that may increase annoyance with a project (Miedema and Vos, 2003; Pedersen *et al.*, 2007). These could include:

- Situational factors (visual issues, attractiveness of area) (Merlin *et al.*, 2014; Michaud *et al.* (2016); Van den Berg *et al*, 2008);
- Socio-economic factors (age, gender, income, level of education) [Miedema and Vos, 2003; Michaud *et al.* (2016)],
- Social factors (attitude towards the applicant/producer/government, media coverage) (Pedersen *et al.*, 2007; Superior Health Council, (2013)),

[16] Refers to the European Union definition in Directive 2002/49/EC – equivalent outdoor sound pressure level associated with a particular type of noise source to which a receptor is exposed to over the 8-hour night-time period, calculated over a period of a year

- Personal factors (fear or worry in relation to noise source, sensitivity to noise, economic benefit from project, existing health condition) (Miedema and Vos, 2003; Taylor *et al* (2013); Van Kamp and Davies (2013)), and
- Attitude towards the project and exposure to negative sentiment (Bernstein *et al* (2024); Crichton *et al*. (2014), Crichton *et al* (2014)).

8.3 IMPACT ASSESSMENT CRITERIA

8.3.1 Overview: The common characteristics

The word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:

- Intensity;
- Loudness;
- Annoyance; and
- Offensiveness.

Of the four common characteristics of sound, the intensity is the only one which is not subjective and can be quantified. Loudness is a subjective measure of the effect sound has on the human ear. As a quantity, it is therefore complicated but has been defined by experimentation on subjects known to have normal hearing.

The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

8.3.2 Noise criteria of concern

The criteria used in this report were drawn from the criteria for the description and assessment of environmental impacts considering the latest EIA Regulations, SANS 10103:2008 as well as guidelines from the World Health Organization.

There are a number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- *Increase in noise levels:* People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of the noise.

With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 5 dBA is considered a disturbing noise. See also **Figure 5-1**.

- *Zone Sound Levels:* Previously referred to as the acceptable rating levels, it sets acceptable noise levels for various areas. See also **Table 5-2**.
- *Absolute or total noise levels:* Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g., 65 dBA. Anything above this level will be considered unacceptable.

In South Africa, the document that addresses the issues concerning environmental noise is SANS 10103:2008. It provides the equivalent ambient noise levels (referred to as Rating Levels), $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively typically associated with such areas. When a noise source is introduced that could change the ambient sound levels, communities may respond as illustrated in **Figure 5-1**.

Considering the average fast-weighted sound level data collected in the area, average:

- daytime fast-weighted sound levels were low, less than the typical rating levels for an urban area. While the ambient sound levels were less than expected, considering the developmental character of the area, this assessment will assume a rating level typical of an urban noise district (55 dBA); and
- night-time fast-weighted sound levels were low and typical of suburban noise district. Considering the developmental character of the area, this assessment will assume a rating level typical of an urban noise district (45 dBA).

Considering the requirements of the GNCR (see **section 5.1.2**), activities relating to the proposed project should not raise ambient sound levels to higher than the typical rating level for the area. Nor should the noise levels exceed the WBG and IFC noise limits (see **section 5.4.4**). Upper noise limits therefore would be:

- 55 dBA for the daytime residential use, typical of an urban noise district; and
- 45 dBA (as recommended by the IFC) for night-time residential use and typical of an urban noise district. It should be noted that the night-time impact will not be assessed, because reclamation activities only take place between 06:00 and 16:00, with no night-time activities to take place.

The Valley Silts operations should also limit the noise level to less than 60 dBA on the boundary (70 dBA during the daytime period, and 60 dBA at night for a 70 dBA day-night noise limit).

SANS 10103:2008 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in sound level, the following criteria are of relevance:

- **Δ ≤ 3 dBA:** An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- **3 < Δ ≤ 5 dBA:** An increase of between 3 dBA and 5 dBA will elicit "little" community response with "sporadic complaints". People will just be able to notice a change in the sound character in the area.
- **5 < Δ ≤ 15 dBA:** An increase of between 5 dBA and 15 dBA will elicit a "medium" community response with "widespread complaints". In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA, the community reaction will be 'strong' with 'threats of community action'.

Note that an increase of more than 7 dBA is defined as a disturbing noise and prohibited (National Noise Control Regulations).

8.3.3 Determining the Significance of the Noise Impact

The level of detail as depicted in the EIA Guidelines (DEAT, 1998) (DEAT, 2002)) was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the Project. This assessment will consider both the EIA assessment criteria defined by the EAP as well as the criteria used by the EARES. The EARES procedures and principles are defined below.

The impact consequence is determined by summing the scores of Magnitude (**Table 8-2**), Duration (**Table 8-3**) and Spatial Extent (**Table** 8-4). The impact significance (see **Sections 8.3.4** and **Section 8.3.5**) is determined by multiplying the Consequence result with the Probability score (**Table 8-5**). An explanation of the impact assessment criteria is defined in the following tables.

Table 8-2: Impact Assessment Criteria – Magnitude

This defines the impact as experienced by any receptor. In this report, the receptor is defined as any resident in the area but excludes faunal species.		
Rating	**Description**	**Score**
Minor	Increase in average sound pressure levels between 0 and 3 dB from the expected ambient sound levels. Ambient sound levels are defined by the average of the measured day- or night-time fast-weighted sound levels during measurement dates. Total projected noise rating level is less than the Zone Sound Level (the rating level) and/or WHO/IFC noise limits in wind-still conditions.	2
Low	Increase in average sound pressure levels between 3 and 5 dB from the expected ambient sound levels. Total projected noise rating level between 3 and 5 above the Zone Sound Level (the rating level) and/or WHO/IFC noise limits (wind-less conditions).	4
Moderate	Increase in average sound pressure levels between 5 and 7 dB from the ambient sound levels. Increase in sound pressure levels between 5 and 7 above the Zone Sound Level (the rating level) and/or WHO/IFC noise limits (wind-less conditions). Sporadic complaints expected.	6
High	Increase in average sound pressure levels between 7 and 10 from the ambient sound level. Total projected noise rating level between 7 and 10 dBA above the Zone Sound Level (the rating level) and/or WHO/IFC noise limits (wind-less condition). Medium to widespread complaints expected.	8
Major	Increase in average ambient sound pressure levels higher than 10 dBA. Total projected noise rating level higher than 10 dB above the Zone Sound Level (the rating level) and/or WHO/IFC noise limits (wind less-conditions). Change of 10 dBA is perceived as 'twice as loud', leading to widespread complaints and even threats of community or group action. Any point where instantaneous noise levels exceed 65 dBA at any receptor.	10

Table 8-3: Impact Assessment Criteria - Duration

The lifetime of the impact that is measured in relation to the lifetime of the proposed development (construction, operational and closure phases). Will the receptors be subjected to increased noise levels for the lifetime duration of the project, or only infrequently.		
Rating	**Description**	**Score**
Temporary	Impacts are predicted to be of short duration (portion of construction period) and intermittent/occasional.	1
Short term	Impacts that are predicted to last only for the duration of the construction period.	2
Medium-term	Impacts predicted to last for a period up to 5 years.	3
Long-term	Impacts that will continue for the life of the Project, but ceases when the Project stops operating.	4
Permanent	Impacts that cause a permanent change in the affected receptor or resource (e.g., removal or destruction of ecological habitat) that endures/last substantially beyond the Project lifetime.	5

Table 8-4: Impact Assessment Criteria – Spatial extent

Classification of the physical and spatial scale of the impact		
Rating	**Description**	**Score**
Site	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.	1
Local	The impact could affect the local area (within 1,000 m from site).	2
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns (further than 1,000 m from site).	3
National	The impact could have an effect that expands throughout the country (South Africa).	4
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.	5

Table 8-5: Impact Assessment Criteria - Probability

This describes the likelihood of the impacts actually occurring, and whether it will impact on an identified receptor. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:		
Rating	**Description**	**Score**
Improbable	Daytime noise levels are less than 50 dBA; Night-time noise levels less than 40 dBA.	1
Possible	Daytime noise levels are less than 55 dBA; Night-time noise levels less than 45 dBA.	2
Likely	Daytime noise levels are less than 60 dBA; Night-time noise levels less than 50 dBA.	3
Highly Likely	Daytime noise levels are less than 65 dBA; Night-time noise levels less than 55 dBA.	4
Definite	Daytime noise levels exceeding 65 dBA; Night-time noise levels higher than 55 dBA.	5

To assess each of these factors for each impact, the following ranking scales as contained in **Table 8-6** were used.

Table 8-6: Assessment Criteria: Ranking Scales

PROBABILITY		MAGNITUDE	
Description / Meaning	**Score**	**Description / Meaning**	**Score**
Definite/don't know	5	Very high/don't know	10
Highly likely	4	High	8
Likely	3	Medium	6
Possible	2	Low Medium	4
Improbable	1	Low	2
DURATION		**SPATIAL SCALE**	
Description / Meaning	**Score**	**Description / Meaning**	**Score**
		International	5
Permanent	5	National	4
Long Term	4	Regional	3
Short term	2	Local	2
Temporary	1	Footprint	1

8.3.4 Defining the Potential Significance without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a Significance Rating (SR) value for each impact (prior to the implementation of mitigation measures).

Significance without mitigation is rated on the following scale:

SR<30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30<**SR** <60	Medium (M)	Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR>60	High (H)	The impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project.

8.3.5 Defining the Potential Significance with Mitigation Measures (WM)

To gain a comprehensive understanding of the overall significance of the impact, after the implementation of the mitigation measures, it was necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale:

SR<30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30<**SR** <60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR>60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded of high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance after mitigation could render the entire development option or entire project proposal unacceptable.

9 ASSUMPTIONS AND LIMITATIONS

9.1 MEASUREMENTS OF AMBIENT SOUND LEVELS

Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that the area is always noisy. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of day, dependant on faunal characteristics (mating season, dawn chorus[17] early hours of the morning, temperature etc.), vegetation in the area and meteorological conditions (especially wind).

Selecting an ideal measurement location could be difficult, with various criteria assessed to identify the viability of a certain location as a point to define ambient sound levels. When selecting a measurement location, the most important criteria would be:

1. Security of the instrument (minimise risk to the technician; prevent theft or sabotage of the equipment);
2. Safety of the equipment (ensure that it does not prevent, interfere or limit typical agricultural or household activities; ensure that the instrument are not in a location where an animal could damage the instrument); and lastly,
3. The suitability of the measurement location to define ambient sound levels (the presence of certain trees or equipment, wetland or other water resources will influence ambient sound level significantly).

As such, after ensuring that the instrument is safe and secure, there are various environmental factors that could influence ambient sound levels measured. These constraints and limitations are discussed below and could include:

- Seasonal changes in the surrounding environment can influence typical ambient sound levels, as many faunal species are more active during warmer periods than the colder periods. As an example, cicada is usually only active during warmer periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals[18];
- In an area with various noise sources (roads, industry, urban development), defining ambient sound levels using the result of one 10-minute measurement may be very

[17] Environ. We Int. Sci. Tech. *Ambient noise levels due to dawn chorus at different habitats in Delhi*. 2001. Pg. 134.
[18] Clyne, D. *"Cicadas: Sound of the Australian Summer, Australian Geographic"* Oct/Dec Vol 56. 1999.

inaccurate (very low confidence level in the results) and measurements over a longer-term period is recommended;

- Some equipment that could influence measurements may be missed when deploying instruments, or, the noise source may not the audible during instrument deployment. This could include equipment such as hidden water pumps and associated pipelines and outflows, Eskom stepdown transformers, hidden compressors, inverters, condensers or other electrical equipment, etc. While not audible during deployment, such equipment may significantly influence ambient sound levels during quiet periods;
- Type, the number and sizes of trees in the vicinity of the instrument, as well as the distances between the microphone and these trees. Certain trees, especially fruiting trees could attract birds and other animals that will significantly impact on ambient sound levels;
- Type and number of animals in the vicinity of the microphone. Dogs, chickens, geese, etc. generate different noises randomly both night and day, and other livestock (sheep, goats, cattle, horses, etc.) kept in enclosures will also raise noise levels, especially if these animals are penned in large numbers;
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. However, when determining the ambient sound levels associated with increased wind speeds, it is desired to measure ambient sound levels at higher wind speeds;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity which can dominate the sound levels around the measurement point (specifically during summertime, rainfall event or during dawn chorus of bird songs). This generally is still considered naturally quiet and accepted as features of the natural environment, and in various cases sought after and pleasing. Ambient sound level data measured in such area however should not be used to develop an opinion in the potential prevailing ambient sound levels in the larger area;
- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation, wetlands and external noise sources will influence measurements. It may determine whether you are measuring anthropogenic sounds from a receptor's dwelling, or environmental ambient baseline contributors of significance (faunal, roads traffic, railway traffic movement etc.); and
- As a residential area develops the presence of people will result in increased dwelling related sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

9.2 CALCULATING NOISE EMISSIONS – ADEQUACY OF PREDICTIVE METHODS

The noise emissions into the environment from the various sources as defined were calculated for the operational phase in detail, using the sound propagation model described in ISO 9613-2.

The following was considered:

- The octave band sound pressure emission levels of processes and equipment;
- The time the activities and equipment are operational and generating the noise rating levels as assumed. For this project a worst-case was assessed, assuming that most equipment (excluding the bulldozer used for clearing of vegetation) would be operating at a 100% load (generating the maximum noise rating levels), 100% of the time. In practice this is inaccurate as no activity or equipment are 100% operational of the time and the assumption will result in an over-estimated noise rating levels;
- The distance of the receiver from the noise sources;
- The impact of atmospheric absorption;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- Topographical layout; and
- Acoustical characteristics of the ground. Fifty per cent (50%) soft ground conditions were modelled, as the area where the mining activity would be taking place is well vegetated and sufficiently uneven to allow the consideration of relatively soft ground conditions. This is because the use of hard ground conditions could represent a too precautionary situation.

The noise emission into the environment due to potential project traffic was calculated using the sound propagation model described in RLS-90 used in Germany. Corrections such as the following were considered:

- Distance of receptor from the road;
- Road construction material;
- Average speeds of travel;
- Types of vehicles used; and
- Ground acoustical conditions.

This noise model generates the potential LA10 noise level, which is used in various countries (such as the United States of America, United Kingdom, Germany, Canada, Australia, New Zeeland, etc.) to define potential road traffic noise analysis (and abatement). In this project, it illustrates the potential extent of the calculated noises (the noise rating level) of the complete project and not noise levels at a specific moment in

time. It is used to define potential issues of concern and not to predict an actual noise level at a potential noise-sensitive receptor. For this, the selected model is internationally recognised and considered adequate. This noise model is recommended for use to calculate potential traffic noises in Germany, Switzerland, Netherlands, United Kingdom, France, Denmark, Italy, Denmark and Austria.

9.3 ADEQUACY OF UNDERLYING ASSUMPTIONS

Noise experienced at a certain location is the cumulative result of innumerable sounds emitted and generated both far and close, each in a different time domain, each having a different spectral character at a different sound level. Each of these sounds is also impacted differently by surrounding vegetation, structures and meteorological conditions that result in a total cumulative noise level represented by a few numbers on a sound level meter.

As previously mentioned, it is not the purpose of noise modelling to accurately determine a likely noise level at a certain receptor but to calculate a noise rating level that is used to identify potential issues of concern.

9.4 UNCERTAINTIES ASSOCIATED WITH MITIGATION MEASURES

Any noise impact can be mitigated to have a low significance; however, the cost of mitigating this impact may be prohibitive, or the measure may not be socially acceptable (such as the relocation of an NSR). These mitigation measures may be engineered, technological or due to management commitment.

For the purpose of the determination of the significance of the noise impact mitigation measures were selected that is feasible, mainly focussing on management of noise impacts using rules, policy and require a management commitment. This, however, does not mean that noise levels cannot be reduced further, only that to reduce the noise levels further may require significant additional costs (whether engineered, technological or management).

It was assumed that any mitigation measures proposed for the construction phase (if any), will be implemented and continued during the operational phase (if required).

9.5 UNCERTAINTIES OF INFORMATION PROVIDED

While it is difficult to define the character of a measured noise in terms of numbers (third octave sound power levels), it is difficult to accurately model noise rating levels at a receptor from any operation. The projected noise rating levels are the output of a numerical model with the accuracy depending on the assumptions made during the setup of the model. The assumptions include the following:

- That octave sound power levels selected for processes and equipment accurately represent the sound character and power levels of these processes and equipment. The determination of octave sound power levels in itself is subject to errors, limitations and assumptions with any potential errors carried over to any model making use of these results;
- Sound power emission levels from processes and equipment changes depending on the load the process and equipment are subject to. While the octave sound power level is the average (equivalent) result of a number of measurements, this measurement relates to a period that the process or equipment was subject to a certain load (work required from the engine or motor to perform action). Normally these measurements are collected when the process or equipment is under high load. The result is that measurements generally represent a worst-case scenario;
- As it is unknown which processes and equipment will be operational (when and for how long), modelling considers a scenario where processes and equipment are under full load for a set time period. Modelling assumptions comply with the precautionary principle and operational time periods are frequently overestimated. The result is that projected noise rating levels would likely be over-estimated;
- Modelling cannot capture the potential impulsive character of a noise that can increase the potential nuisance factor;
- The XYZ topographical information is derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global DEM data, a product of Japan's Ministry of Economy, Trade, and Industry (METI) and the National Aeronautical and Space Administration (NASA). There are known inaccuracies and artefacts in the data set, yet this is still one of the most accurate data sets to obtain 3D-topographical information;
- The impact of atmospheric absorption is simplified and very uniform meteorological conditions are considered. This is an over-simplification and the effect of this in terms of sound propagation modelling is difficult to quantify; and
- Acoustical characteristics of the ground are over-simplified with ground conditions accepted as uniform. Fifty per cent (50%) soft ground conditions will be modelled as the area where the activities are proposed is well vegetated and sufficiently uneven to allow the consideration of medium ground conditions.

9.6 UNCERTAINTY ON HOW NOISE COULD AFFECT PEOPLE

How noise affect communities are discussed in **section 8.2**, with this assessment considering a number of studies and guidelines such as:

- Cooper and Chan (2020), that discuss and present a number of dose-effect relationships as well as summarize a number of international guidelines and standards that can be used to assess noise effects from wind farms;
- Crichton *et al* (2014), that studied how expectations can influence symptom and mood reports in both positive and negative directions;
- Directive 2002/49/EC (2002), directing members of the European Union with a guideline on the assessment and management of environmental noise. This directive recommends the use of dose-effect relationships to assess the effect of noise on populations;
- Miedema and Vos (2013), that integrated the findings from a number of studies on the relationship between noise sensitivities and exposure to noise; and
- SANS 10103 (2008), that can be used to assess how environmental noise can be measured and used to assess annoyance in communities.

It is important to understand that guidelines and dose-effect relationship studies focus on how communities respond to noise and it is difficult to predict or foresee how an individual may respond to noise.

10 PROJECTED NOISE RATING LEVELS

10.1 CONCEPTUAL FUTURE SCENARIOS

Conceptual noise models were developed considering the construction activities as discussed in **Section 7.1** and conceptualised in **Figure 10-1**, **Figure 10-3** and **Figure 10-5**.

The projected noise rating levels are illustrated in:

- **Figure 10-2** and defined in **Appendix C, Table 1** for scenario 1;
- **Figure 10-4** and defined in **Appendix C, Table 2** for scenario 2; and
- **Figure 10-6** and defined in **Appendix C, Table 3** for scenario 3.

10.2 POTENTIAL DECOMMISSIONING AND CLOSURE NOISE LEVELS

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the operational phases. This is because:

1. Decommissioning activities normally are limited to the daytime period, due to the lower urgency to complete this phase; and
2. Decommissioning activities normally use smaller and less equipment, generating less noise than the typical construction or operational phases.

If required, the noise levels for decommissioning can be compared with the daytime operational noise rating levels and the noise impact will be at worse, similar or less.

10.3 POTENTIAL POST-CLOSURE NOISE LEVELS

The potential for a noise impact to occur during the post-closure phase will be minimal and mainly relate to monitoring activities. The noise impact from this phase will not be investigated further.

10.4 EVALUATION OF ALTERNATIVES

10.4.1 Alternative 1: No-go option

The ambient sound levels will remain as is and the area would keep the existing noise character.

10.4.2 Alternative 2: Proposed approval of the mining project

The proposed development will have an insignificant impact on the noise levels at the closest potential noise-sensitive receptors, though noises may be audible at NSR staying within 500 m from the project activities. The impact is considered to be insignificant.

The project however will greatly assist in the economic growth and development challenges South Africa is facing by allowing the mining activity to continue. This will assist in providing employment and other business opportunities for the local communities. Considering only noise[19], people in the area not directly affected by increased noise levels may have a positive perception of the project and could see the need and desirability of the project.

[19] Considering only noise as other factors may affect other NSR



Figure 10-1: Conceptual noise-generating activities considered for operational Scenario 1

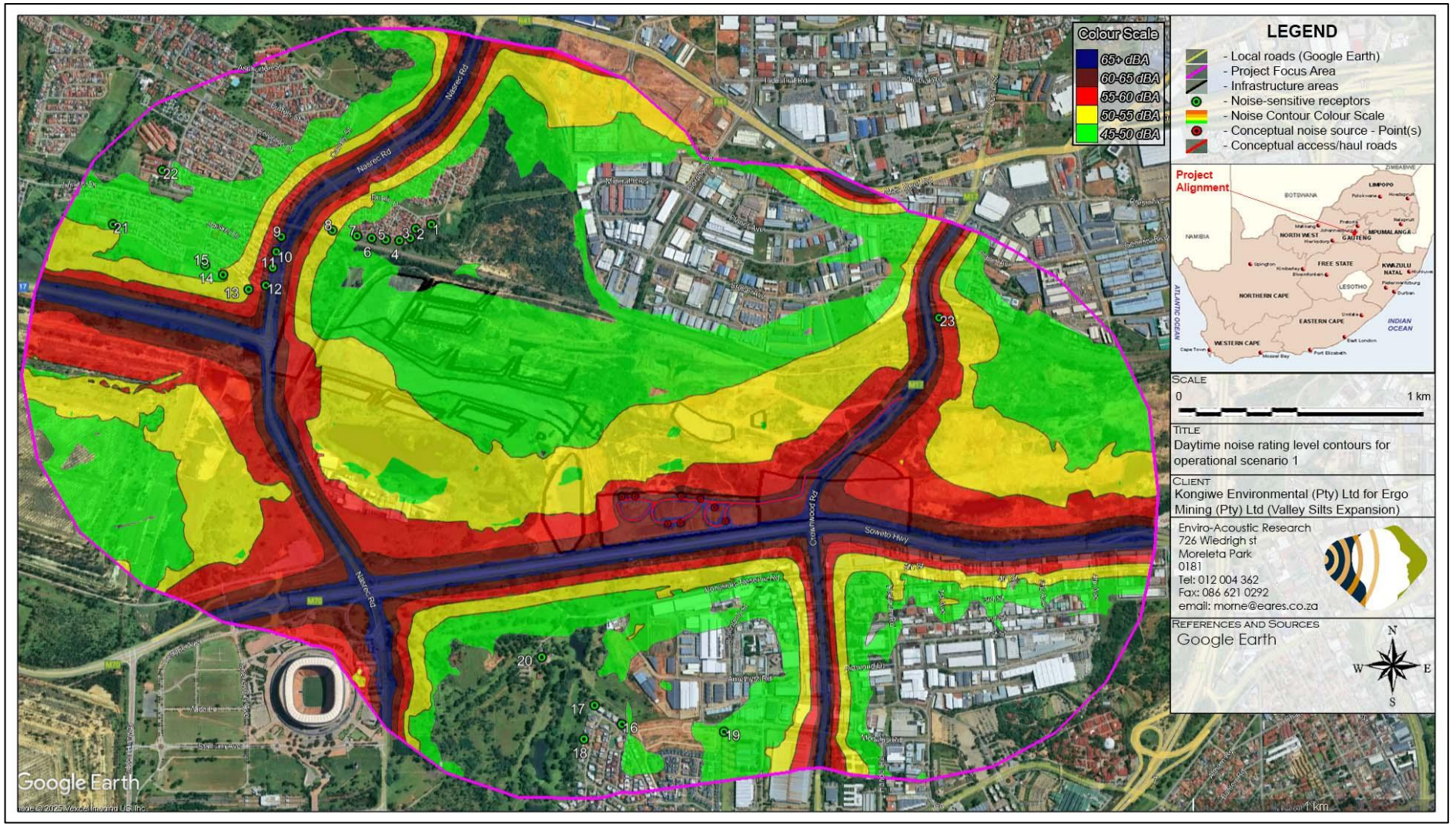


Figure 10-2: Projected daytime noise rating levels relating to operational Scenario 1

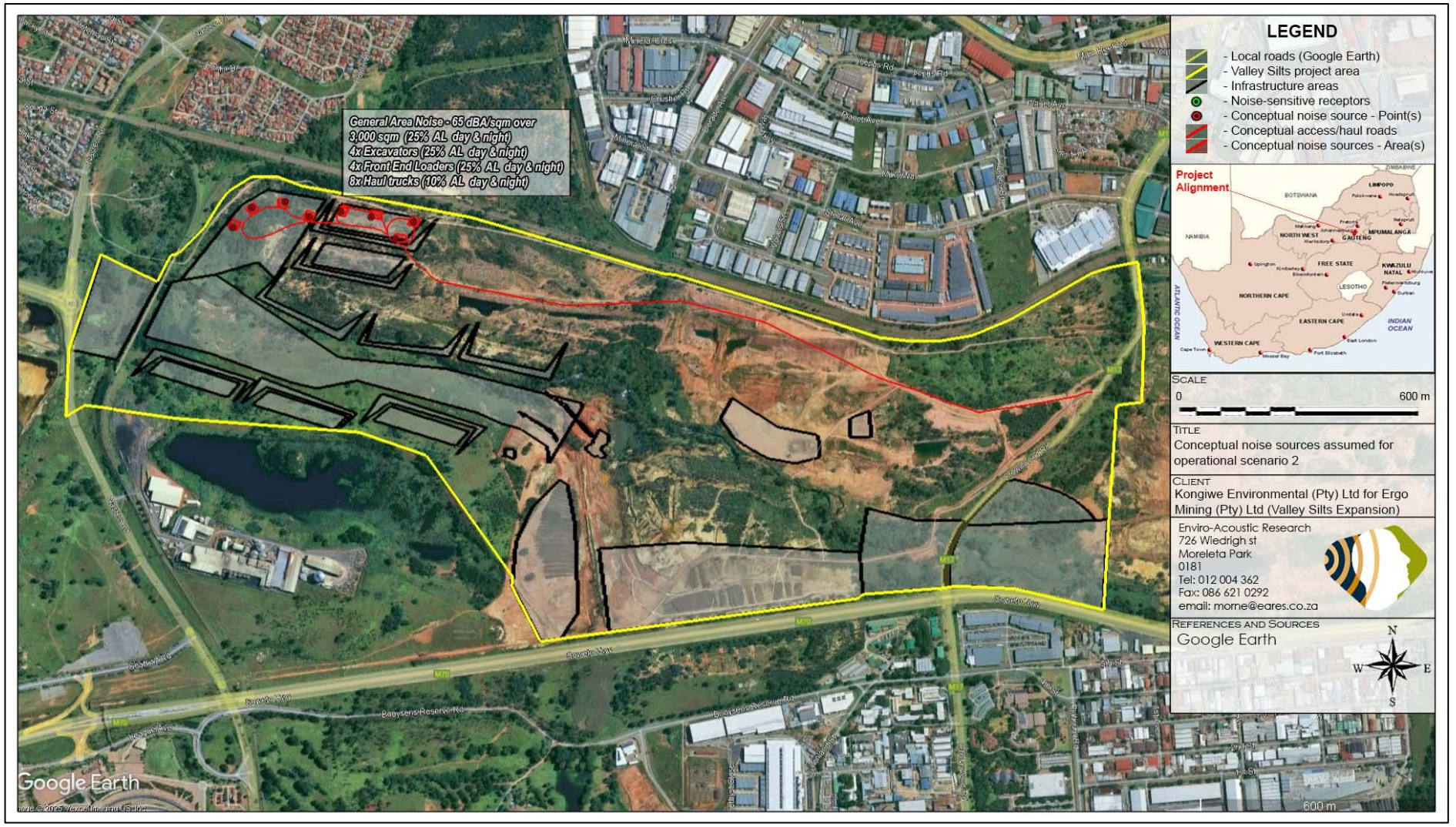


Figure 10-3: Conceptual noise-generating activities considered for operational Scenario 2

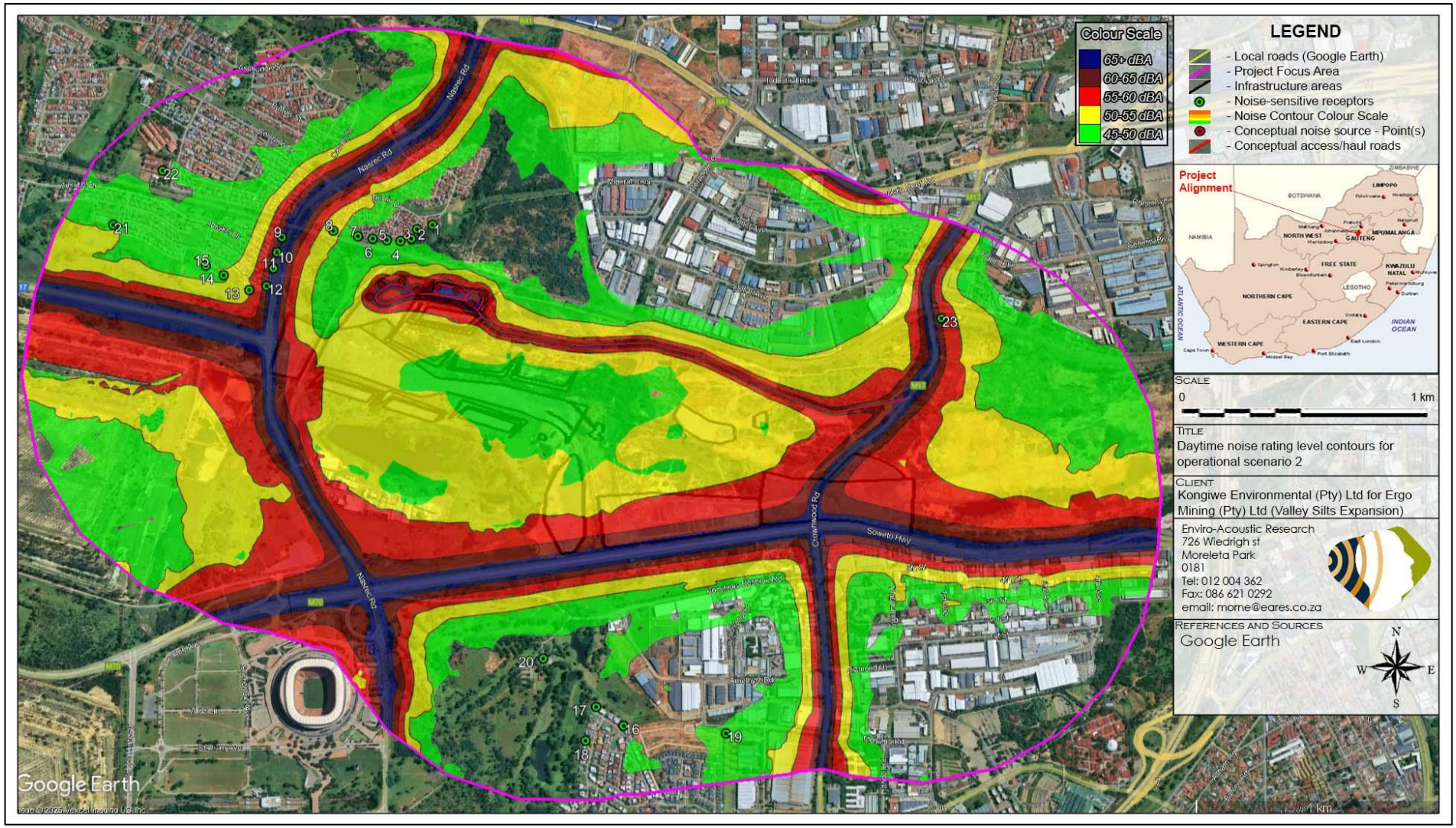


Figure 10-4: Projected daytime noise rating levels – conceptual operational Scenario 2



Figure 10-5: Conceptual noise-generating activities considered for operational Scenario 3

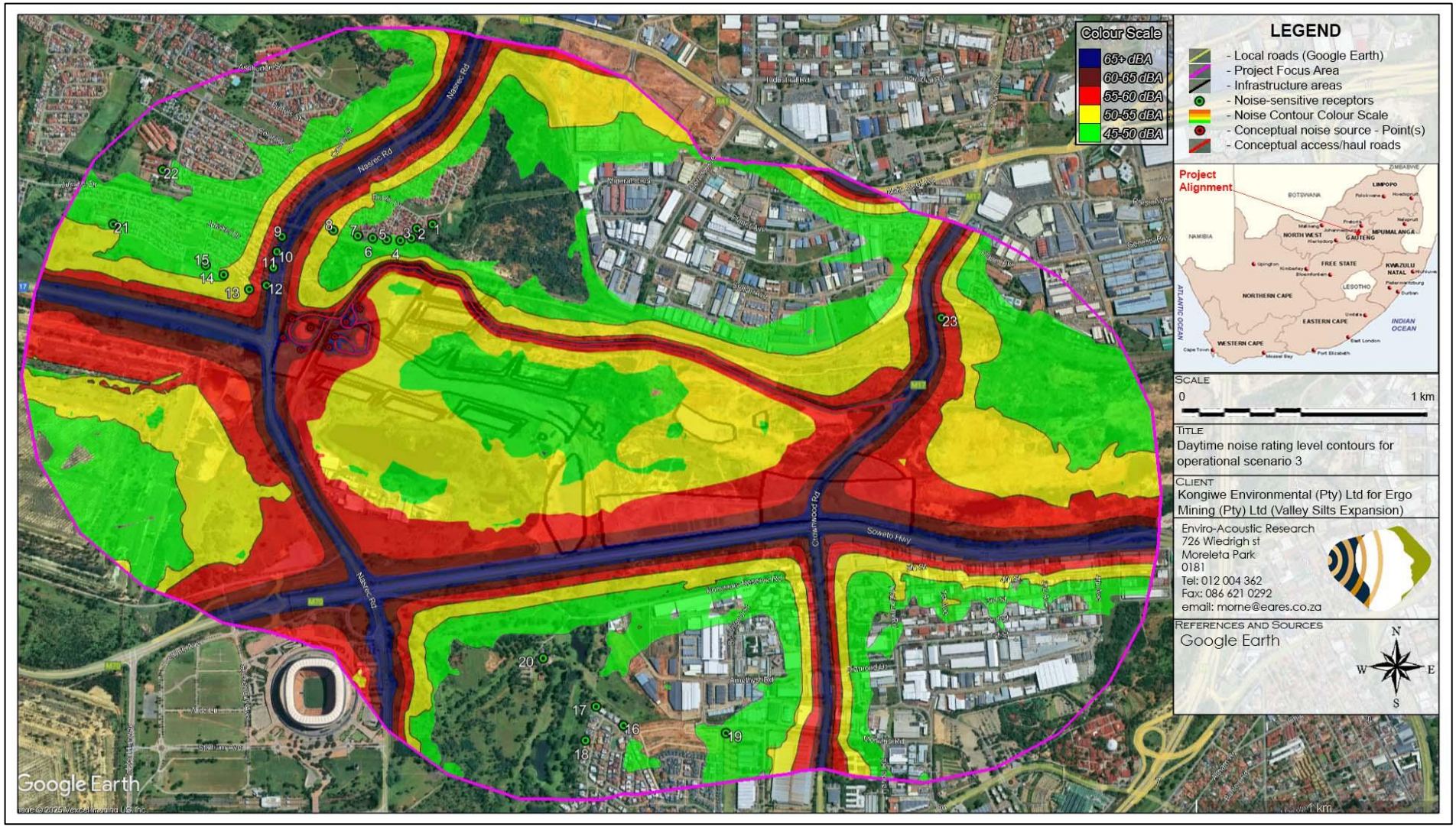


Figure 10-6: Projected daytime noise rating levels – conceptual operational Scenario 2

11 SIGNIFICANCE OF THE NOISE IMPACT

11.1 SIGNIFICANCE OF OPERATIONAL NOISE IMPACT

The various reclamation activities as defined in **section 7.1** was conceptualised (see **Figure 10-1**, **Figure 10-3** and **Figure 10-5**), with potential noise rating levels calculated in **section 10.1** (see **Figure 10-2**, **Figure 10-4** and **Figure 10-6**), with the potential noise rating levels defined per NSR in **Appendix C** (see **Appendix C, Table 1**, **Appendix C, Table 2** and **Appendix C, Table 3**), with the impact summarised for all three scenarios in **Table 11-1**.

Table 11-1: Impact Assessment: Daytime Reclamation Activities

Nature:	***Numerous simultaneous construction activities during the day***	
Acceptable Rating Level	Ambient sound level measurements indicated a quiet area, with an average daytime noise level of 41.3 dBA. Considering the ambient sound levels measured, the developmental character of the area as well as audible observations, the recommended daytime rating level would be 55 dBA. The potential noise rating levels, as well as the significance are defined per NSR in **Appendix C**.	
	Without Mitigation	***With Mitigation***
Magnitude (Table 8-2)	Minor (2)	Very High (10)
Duration (Table 8-3)	Medium-term (3)	Short-term (2)
Extent ($\Delta L_{Aeq,D}$>7dBA) (Table 8-4)	Site (1)	Local (2)
Probability (Table 8-5)	Possible (2) – due to projected existing high noise levels due to road traffic noises	Possible (2)
Significance of Impact	**Low (12) – All NSR**	**Low (28 or less) – All NSR**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No loss of resources.	No loss of resources.
Comments	Worst-case scenario with numerous simultaneous construction activities.	
Degree of Confidence	**High**	
Mitigation:	The potential significance from reclamation noises would be **low** for daytime activities and additional mitigation measures are not required or recommended.	
Cumulative Impacts:	The reclamation activities will not result in a cumulative noise impact.	
Residual Impacts:	This impact will only disappear after decommissioning and closure is completed.	

12 MITIGATION OPTIONS

This study considers the potential noise impact on the surrounding environment due to the construction, operational and future decommissioning activities associated with the extension of the Valley Silts Project. Using conceptual worst-case noise models, it was determined that the potential noise impacts at the project would be of a **low significant** for daytime activities. Due to this low significance, no additional mitigation measures are recommended.

The development of the mining project will slightly increase noise levels at the surrounding communities, though noise complaints could never be excluded. The mine must know that community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon, as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to a perceived noise itself.

At all stages, surrounding receptors should be informed about the project, providing them with factual information without setting unrealistic expectations. It is counterproductive to suggest that the activities will be inaudible due to existing high ambient sound levels, or that noise levels will be low (based on the noise assessment). The magnitude of the sound levels will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the activities, the spectral character and that of the surrounding soundscape (both level and spectral character).

The project applicant must implement a line of communication (i.e., a help line where complaints could be lodged). All potential sensitive receptors should be made aware of these contact numbers. The mine should maintain a commitment to the local community (people staying within 1,000 m from reclamation activities) and respond to noise concerns in an expedient fashion. Sporadic and legitimate noise complaints could be raised. For example, sudden and sharp increases in sound levels could result from mechanical malfunctions or maintenance issues. Problems of this nature can be corrected quickly and it is in the mine's interest to do so.

13 ENVIRONMENTAL MANAGEMENT OBJECTIVES

The DMR guideline for EMP development requires the formulation of Objectives for Mine Closure as influenced by the Environmental Base Line description. This demonstrates the importance of considering the post-closure land use, relative to the pre-mining land use, when formulating the closure objectives.

Environmental Management Objectives are difficult to define for noise because ambient sound levels would slowly increase as development pressures increase in the area. This is due to increased traffic and human habitation and is irrespective of the reclamation activities. The moment reclamation activities stop, noise levels will not change as road traffic noises already dominate in the area.

Based on the low significance for a noise impact to occur, no additional Environmental Management Objectives will be recommended for the project.

14 ENVIRONMENTAL MONITORING PLAN

Environmental Noise Monitoring can be divided into two distinct categories, namely:

- Passive monitoring – the registering of any complaints (reasonable and valid) regarding noise; and
- Active monitoring – the measurement of noise levels at identified locations.

Active environmental noise monitoring is not recommended or required, because the low significance associated with the noise impact.

However, should a valid complaint (from a stakeholder living within 1,000 m from the reclamation activities) be registered, the applicant must investigate this complaint as per the following sections. It is recommended that the noise investigation is done by an independent acoustic consultant.

It should be noted that this noise monitoring programme may be used as a guideline, as site-specific conditions may require that the monitoring locations, frequency or procedure be adapted.

14.1 MEASUREMENT LOCALITIES AND PROCEDURES

14.1.1 Measurement Localities and Frequencies

When investigating a noise complaint, measurements must be conducted at the location of the person that registered a valid and reasonable noise complaint (staying within 2,000 m from the project). A second instrument should be deployed at the mine.

14.1.2 Measurement Procedures

Ambient sound measurements should be collected as defined in SANS 10103:2008 or an acceptable international noise monitoring protocol. When investigating a noise complaint, measurements should be collected during a period or in conditions similar to when the receptor experienced the disturbing noise event.

15 RECOMMENDATIONS AND CONCLUSION

This ENIA covers the proposed expansion at the Valley Silts project, Johannesburg. The potential worst-case noise rating levels were calculated using a sound propagation model using three conceptual scenarios for reclamation activities.

Using conceptual worst-case noise models, it was determined that the potential noise impacts at the project would be of a **low significance** for the reclamation activities.

It is expected that the mining activities may be audible at the closest NSR, though noise impacts will be insignificant for daytime activities. While complaints about noise can never be ruled out, it is highly unlikely that noise complaints with the project will be registered. It is therefore recommended that the Valley Silts Expansion Project be authorized (from a noise impact perspective).

This noise impact assessment is sufficient, and no additional acoustic studies or noise monitoring is required. This assessment is not subject to any conditions.

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APPENDIX A

Glossary of Acoustic Terms, Definitions and General Information

1/3-Octave Band	A filter with a bandwidth of one-third of an octave representing four semitones, or notes on the musical scale. This relationship is applied to both the width of the band, and the centre frequency of the band. See also definition of octave band.
A – Weighting	An internationally standardised frequency weighting that approximates the frequency response of the human ear and gives an objective reading that therefore agrees with the subjective human response to that sound.
Air Absorption	The phenomena of attenuation of sound waves with distance propagated in air, due to dissipative interaction within the gas molecules.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Ambient	The conditions surrounding an organism or area.
Ambient Noise	The all-encompassing sound at a point being composed of sounds from many sources both near and far. It includes the noise from the noise source under investigation.
Ambient Sound	The all-encompassing sound at a point being composite of sounds from near and far.
Ambient Sound Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such a meter was put into operation. In this report the term Background Ambient Sound Level will be used.
Amplitude Modulated Sound	A sound that noticeably fluctuates in loudness over time.
Applicant	Any person who applies for an authorisation to undertake a listed activity or to cause such activity in terms of the relevant environmental legislation.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Attenuation	Term used to indicate reduction of noise or vibration, by whatever method necessary, usually expressed in decibels.
Audible frequency Range	Generally assumed to be the range from about 20 Hz to 20,000 Hz, the range of frequencies that our ears perceive as sound.
Ambient Sound Level	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source or sound generated for test purposes). Ambient sound level as per Noise Control Regulations.
Broadband Noise	Spectrum consisting of a large number of frequency components, none of which is individually dominant.
C-Weighting	This is an international standard filter, which can be applied to a pressure signal or to a *SPL* or *PWL* spectrum, and which is essentially a pass-band filter in the frequency range of approximately 63 to 4000 Hz. This filter provides a more constant, flatter, frequency response, providing significantly less adjustment than the A-scale filter for frequencies less than 1000 Hz.
Controlled area (as per National Noise Control Regulations)	a piece of land designated by a local authority where, in the case of- (a) road transport noise in the vicinity of a road- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period extending from 06:00 to 24:00 while such meter is in operation, exceeds 65dBA; or (ii) the equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2metres, but not more than 1,4 metres, above the ground for a period extending from06:00 to 24:00 as calculated in accordance with SABS 0210-1986, titled: "Code of Practice for calculating and predicting road traffic noise", published under Government Notice No. 358 of 20 February 1987, and projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; (b) aircraft noise in the vicinity of an airfield, the calculated noisiness index, projected for a period of 15 years following the date on which the local authority has made such designation, exceeds 65 dBA; or

	(c) industrial noise in the vicinity of an industry- (i) the reading on an integrating impulse sound level meter, taken outdoors at the end of a period of 24 hours while such meter is in operation, exceeds 61 dBA; or (ii) the calculated outdoor equivalent continuous "A"-weighted sound pressure level at a height of at least 1,2 metres, but not more than 1,4 metres, above the ground for a period of 24 hours, exceeds 61 dBA;
dB(A)	Sound Pressure Level in decibel that has been A-weighted, or filtered, to match the response of the human ear.
Decibel (db)	A logarithmic scale for sound corresponding to a multiple of 10 of the threshold of hearing. Decibels for sound levels in air are referenced to an atmospheric pressure of 20 μ Pa.
Diffraction	The process whereby an acoustic wave is disturbed and its energy redistributed in space as a result of an obstacle in its path, Reflection and refraction are special cases of diffraction.
Direction of Propagation	The direction of flow of energy associated with a wave.
Disturbing noise	Means a noise level that exceeds the zone sound level or, if no zone sound level has been designated, a noise level that exceeds the ambient sound level at the same measuring point by 5 dBA or more.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental Control Officer	Independent Officer employed by the applicant to ensure the implementation of the Environmental Management Plan (EMP) and manages any further environmental issues that may arise.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy that requires authorisation of permission by law and that may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental issue	A concern felt by one or more parties about some existing, potential or perceived environmental impact.
Equivalent continuous A-weighted sound exposure level ($L_{Aeq,T}$)	The value of the average A-weighted sound pressure level measured continuously within a reference time interval *T*, which have the same mean-square sound pressure as a sound under consideration for which the level varies with time.
Equivalent continuous A-weighted rating level ($L_{Req,T}$)	The Equivalent continuous A-weighted sound exposure level *($L_{Aeq,T}$)* to which various adjustments have been added. More commonly used as ($L_{Req,d}$) over a time interval 06:00 – 22:00 (T=16 hours) and ($L_{Req,n}$) over a time interval of 22:00 – 06:00 (T=8 hours). It is a calculated value.
F (fast) time weighting	(1) Averaging detection time used in sound level meters. (2) Fast setting has a time constant of 125 milliseconds and provides a fast reacting display response allowing the user to follow and measure not too rapidly fluctuating sound.
Footprint area	Area to be used for the construction of the proposed development, which does not include the total study area.
Free Field Condition	An environment where there are no reflective surfaces.
Frequency	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kiloHertz (kHz). One hundred Hz is a rate of one hundred times per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a

	relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate.
Greenfield	A parcel of land not previously developed beyond that of agriculture or forestry use; virgin land. The opposite of Greenfield is Brownfield, which is a site previously developed and used by an enterprise, especially for a manufacturing or processing operation. The term Brownfield suggests that an investigation should be made to determine if environmental damage exists.
G-Weighting	An International Standard filter used to represent the infrasonic components of a sound spectrum.
Harmonics	Any of a series of musical tones for which the frequencies are integral multiples of the frequency of a fundamental tone.
I (impulse) time weighting	(1) Averaging detection time used in sound level meters as per South African standards and Regulations. (2) Impulse setting has a time constant of 35 milliseconds when the signal is increasing (sound pressure level rising) and a time constant of 1,500 milliseconds while the signal is decreasing.
Impulsive sound	A sound characterized by brief excursions of sound pressure (transient signal) that significantly exceed the ambient sound level.
Infrasound	Sound with a frequency content below the threshold of hearing, generally held to be about 20 Hz. Infrasonic sound with sufficiently large amplitude can be perceived, and is both heard and felt as vibration. Natural sources of infrasound are waves, thunder and wind.
Integrated Development Plan	A participatory planning process aimed at developing a strategic development plan to guide and inform all planning, budgeting, management and decision-making in a Local Authority, in terms of the requirements of Chapter 5 of the Municipal Systems Act, 2000 (Act 32 of 2000).
Integrated Environmental Management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, workforce, consumers, environmental interest groups and the general public.
Key issue	An issue raised during the Scoping process that has not received an adequate response and that requires further investigation before it can be resolved.
L_{A90}	the sound level exceeded for the 90% of the time under consideration
Listed activities	Development actions that is likely to result in significant environmental impacts as identified by the delegated authority (formerly the Minister of Environmental Affairs and Tourism) in terms of Section 21 of the Environment Conservation Act.
L_{AMin} and L_{AMax}	Is the RMS (root mean squared) minimum or maximum level of a noise source.
Loudness	The attribute of an auditory sensation that describes the listener's ranking of sound in terms of its audibility.
Magnitude of impact	Magnitude of impact means the combination of the intensity, duration and extent of an impact occurring.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
Mitigation	To cause to become less harsh or hostile.
Negative impact	A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Noise	a. Sound that a listener does not wish to hear (unwanted sounds). b. Sound from sources other than the one emitting the sound it is desired to receive, measure or record. c. A class of sound of an erratic, intermittent or statistically random nature.
Noise Level	The term used in lieu of sound level when the sound concerned is being measured or ranked for its undesirability in the contextual circumstances.

Noise-sensitive development	developments that could be influenced by noise such as: a) districts (see table 2 of SANS 10103:2008) 1. rural districts, 2. suburban districts with little road traffic, 3. urban districts, 4. urban districts with some workshops, with business premises, and with main roads, 5. central business districts, and 6. industrial districts; b) educational, residential, office and healthcare buildings and their surroundings; c) churches and their surroundings; d) auditoriums and concert halls and their surroundings; e) recreational areas; and f) nature reserves. In this report, Noise-sensitive developments are also referred to as a Potential Sensitive Receptor
Octave Band	A filter with a bandwidth of one octave, or twelve semi-tones on the musical scale representing a doubling of frequency.
Positive impact	A change that improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and includes an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Reflection	Redirection of sound waves.
Refraction	Change in direction of sound waves caused by changes in the sound wave velocity, typically when sound wave propagates in a medium of different density.
Reverberant Sound	The sound in an enclosure which results from repeated reflections from the boundaries.
Reverberation	The persistence, after emission of a sound, has stopped, of a sound field within an enclosure.
Significant Impact	An impact can be deemed significant if consultation with the relevant authorities and other interested and affected parties, on the context and intensity of its effects, provides reasonable grounds for mitigating measures to be included in the environmental management report. The onus will be on the applicant to include the relevant authorities and other interested and affected parties in the consultation process. Present and potential future, cumulative and synergistic effects should all be taken into account.
S (slow) time weighting	(1) Averaging times used in sound level meters. (2) Time constant of one [1]second that gives a slower response which helps average out the display fluctuations.
Sound Level	The level of the frequency and time-weighted sound pressure as determined by a sound level meter, i.e. A-weighted sound level.
Sound Power	Of a source, the total sound energy radiated per unit time.
Sound Pressure Level (SPL)	Of a sound, 20 times the logarithm to the base 10 of the ratio of the RMS sound pressure level to the reference sound pressure level. International values for the reference sound pressure level are 20 micropascals in air and 100 millipascals in water. SPL is reported as L_p in dB (not weighted) or in various other weightings.
Soundscape	Sound or a combination of sounds that forms or arises from an immersive environment. The study of soundscape is the subject of acoustic ecology. The idea of soundscape refers to both the natural acoustic environment, consisting of natural sounds, including animal vocalizations and, for instance, the sounds of weather and other natural elements; and environmental sounds created by humans, through musical composition, sound design, and other ordinary human activities including conversation, work, and sounds of mechanical origin resulting from use of industrial technology. The disruption of these acoustic environments results in noise pollution.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.

Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs (Brundtland Commission, 1987).
Tread braked	The traditional form of wheel brake consisting of a block of friction material (which could be cast iron, wood or nowadays a composition material) hung from a lever and being pressed against the wheel tread by air pressure (in the air brake) or atmospheric pressure in the case of the vacuum brake.
Zone of Potential Influence	The area defined as the radius about an object, or objects beyond which the noise impact will be insignificant.
Zone Sound Level	Means a derived dBA value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area. This is similar to the Rating Level as defined in SANS10103:2008.

APPENDIX B

Site Sensitivity Verification

SITE SENSITIVITY VERIFICATION (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020

Site sensitivity verification is required for All environmental themes as identified by the online screening tool (whether a protocol has been published or not).

Section 2 of the Noise Protocol in terms of this GNR320 requires that:

2. Prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the screening tool must be confirmed by undertaking a site sensitivity verification.

2.1. The site sensitivity verification must be undertaken by an environmental assessment practitioner (EAP) or a noise specialist, where noise specialist means someone with relevant academic qualifications and with expertise in the domain of acoustic assessments and noise management.

2.2. The site sensitivity verification must be undertaken through the use of:

(a) a desktop analysis, using satellite imagery;

(b) a preliminary on-site inspection; and

(c) any other available and relevant information.

2.3. The outcome of the site sensitivity verification must be recorded in the form of a report that:

(a) confirms or disputes the current use of the land and environmental sensitivity as identified by the screening tool, such as new developments or infrastructure etc.;

(b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and

(c) is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations

The details of the specialist that visited the site are noted below:

Date of Site Visit	24 and 25 February 2025
Specialist Name	Morné de Jager (Site visit and ambient sound level measurements, data processing, modelling, noise report)
Professional Registration Number (if applicable) – M. de Jager	SACNASP (South African Council for Natural Scientific Professions) - 117253 SAIOSH (SA Institute of Occupation Safety & Health) – 72765282
Specialist Affiliation / Company	Enviro-Acoustic Research CC

Output from National Environmental Screening Tool

The site was initially assessed using the National Environmental Screening tool, available at, https://screening.environment.gov.za. The output from the National Online Screening tool indicates that the larger area has a "very high" sensitivity to noise.

This finding is disputed, as most of the area is commercial and industrial, with a large area that could be defined as wilderness (old mining areas). Verified noise-sensitive receptors are illustrated in **Figure C.1**, with the balance of the project area being industrial, commercial and mining areas.

Description on how the site sensitivity verification was undertaken

The site sensitivity was verified using:

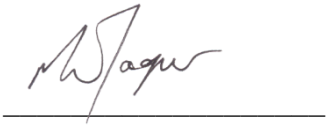
a) *available aerial images (Google Earth®) (See **Figure C.1** for initially identified potential noise-sensitive receptors);*
b) *the statuses of areas that may have a "very high" sensitivity to noise and identified structures were verified during the site visit (February 2025).*

Outcome of the Site Sensitivity Verification

Potential noise-sensitive activities were identified (verified during the site visits) and marked as green dots on **Figure C.1**. There are numerous structures used for residential purposes associated with the areas identified to have a "very high" sensitivity to noise (within the project focus area) and the site sensitivity verification agrees with the findings of the online screening tool.

There are also large areas with no associated noise-sensitive activities, and this assessment dispute this finding.

However, because there are a significant number of potential noise-sensitive receptors within the project focus area, the potential impact of noise from the project is assessed in this Noise Specialist Study.



Signature
Morné de Jager
2025 – 02 – 28

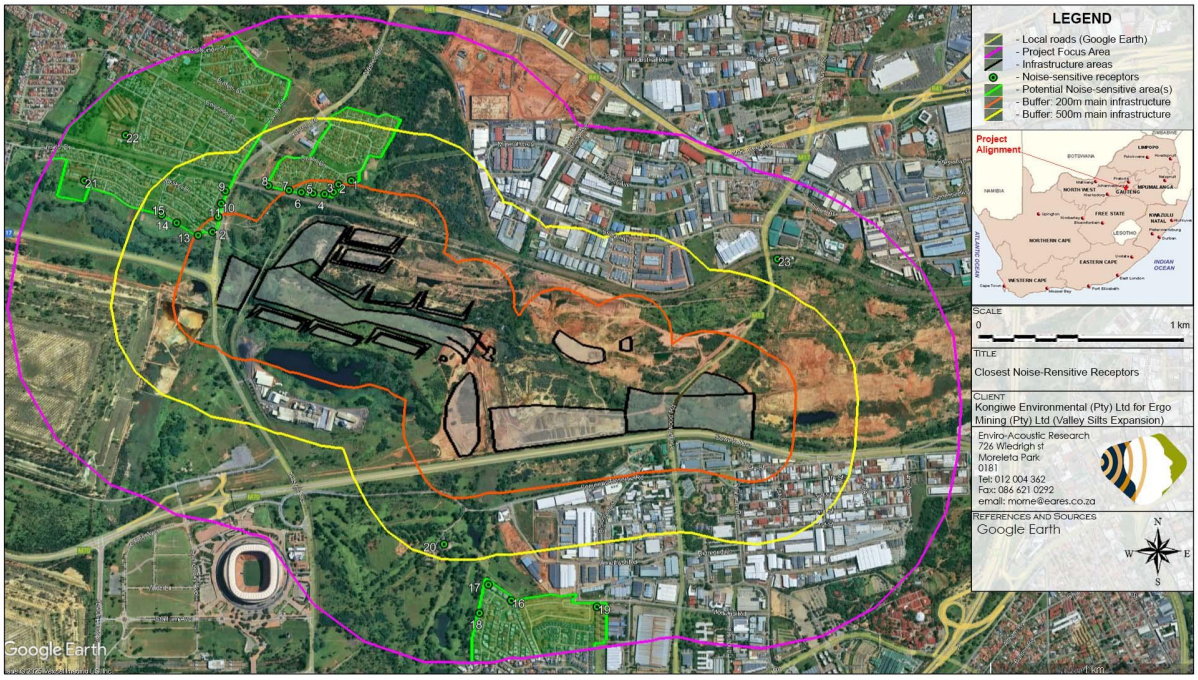


Figure C.2: Sensitive receptors identified in project focus area

APPENDIX C

Calculated conceptual noise rating levels and potential significance

Appendix C, Table 1: Projected worst-case noise rating levels and impact – Conceptual reclamation activities, Scenario 1

Potential Noise-sensitive development / Receptor(s)	Rating level (Urban noise district, based on developmental character)	Recommended noise limit	Potential existing noise levels due to existing traffic (dBA)	Potential Existing Ambient Sound Levels (Average measured onsite)	Projected Noise Level, night-time construction (conceptual, worst-case)	Potential change in rating level, considering either road traffic noise or ambient sound levels	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	55	60	43.5	41.3	43.5	0.0	Minor	Medium-term	Regional	Possible	Low
2	55	60	43.5	41.3	43.5	0.0	Minor	Medium-term	Regional	Possible	Low
3	55	60	43.5	41.3	43.6	0.1	Minor	Medium-term	Regional	Possible	Low
4	55	60	43.8	41.3	43.9	0.1	Minor	Medium-term	Regional	Possible	Low
5	55	60	43.9	41.3	44.0	0.1	Minor	Medium-term	Regional	Possible	Low
6	55	60	43.4	41.3	43.5	0.1	Minor	Medium-term	Regional	Possible	Low
7	55	60	43.5	41.3	43.6	0.1	Minor	Medium-term	Regional	Possible	Low
8	55	60	50.9	41.3	50.9	0.0	Minor	Medium-term	Regional	Possible	Low
9	55	60	67.3	41.3	67.3	0.0	Minor	Medium-term	Regional	Possible	Low
10	55	60	69.1	41.3	69.1	0.0	Minor	Medium-term	Regional	Possible	Low
11	55	60	69.8	41.3	69.8	0.0	Minor	Medium-term	Regional	Possible	Low
12	55	60	64.2	41.3	64.2	0.0	Minor	Medium-term	Regional	Possible	Low
13	55	60	54.5	41.3	54.5	0.0	Minor	Medium-term	Regional	Possible	Low
14	55	60	50	41.3	50.0	0.0	Minor	Medium-term	Regional	Possible	Low
15	55	60	48.7	41.3	48.7	0.0	Minor	Medium-term	Regional	Possible	Low
16	55	60	44.3	41.3	44.6	0.3	Minor	Medium-term	Regional	Possible	Low
17	55	60	41.3	41.3	41.4	0.1	Minor	Medium-term	Regional	Possible	Low
18	55	60	43.4	41.3	43.7	0.3	Minor	Medium-term	Regional	Possible	Low
19	55	60	46	41.3	46.2	0.2	Minor	Medium-term	Regional	Possible	Low
20	55	60	43	41.3	43.2	0.2	Minor	Medium-term	Regional	Possible	Low
21	55	60	49	41.3	49.0	0.0	Minor	Medium-term	Regional	Possible	Low
22	55	60	43.6	41.3	43.6	0.0	Minor	Medium-term	Regional	Possible	Low
23	55	60	59.4	41.3	59.4	0.0	Minor	Medium-term	Regional	Possible	Low

Appendix C, Table 2: Projected worst-case noise rating levels and impact – Conceptual reclamation activities, Scenario 2

Potential Noise-sensitive development / Receptor(s)	Rating level (Urban noise district, based on developmental character)	Recommended noise limit	Potential existing noise levels due to existing traffic (dBA)	Potential Existing Ambient Sound Levels (Average measured onsite)	Projected Noise Level, daytime operation (conceptual, worst-case for Scenario 1)	Potential change in rating level, considering either road traffic noise or ambient sound levels	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	55	60	43.5	41.3	44.0	0.5	Minor	Medium-term	Local	Possible	Low
2	55	60	43.5	41.3	44.2	0.7	Minor	Medium-term	Local	Possible	Low
3	55	60	43.5	41.3	44.5	1.0	Minor	Medium-term	Local	Possible	Low

4	55	60	43.8	41.3	44.7	0.9	Minor	Medium-term	Local	Possible	Low
5	55	60	43.9	41.3	44.7	0.8	Minor	Medium-term	Local	Possible	Low
6	55	60	43.4	41.3	44.1	0.7	Minor	Medium-term	Local	Possible	Low
7	55	60	43.5	41.3	44.1	0.6	Minor	Medium-term	Local	Possible	Low
8	55	60	50.9	41.3	51.0	0.1	Minor	Medium-term	Local	Possible	Low
9	55	60	67.3	41.3	67.3	0.0	Minor	Medium-term	Local	Possible	Low
10	55	60	69.1	41.3	69.1	0.0	Minor	Medium-term	Local	Possible	Low
11	55	60	69.8	41.3	69.8	0.0	Minor	Medium-term	Local	Possible	Low
12	55	60	64.2	41.3	64.2	0.0	Minor	Medium-term	Local	Possible	Low
13	55	60	54.5	41.3	54.5	0.0	Minor	Medium-term	Local	Possible	Low
14	55	60	50	41.3	50.0	0.0	Minor	Medium-term	Local	Possible	Low
15	55	60	48.7	41.3	48.7	0.0	Minor	Medium-term	Local	Possible	Low
16	55	60	44.3	41.3	44.4	0.1	Minor	Medium-term	Local	Possible	Low
17	55	60	41.3	41.3	41.4	0.1	Minor	Medium-term	Local	Possible	Low
18	55	60	43.4	41.3	43.5	0.1	Minor	Medium-term	Local	Possible	Low
19	55	60	46	41.3	46.0	0.0	Minor	Medium-term	Local	Possible	Low
20	55	60	43	41.3	43.1	0.1	Minor	Medium-term	Local	Possible	Low
21	55	60	49	41.3	49.0	0.0	Minor	Medium-term	Local	Possible	Low
22	55	60	43.6	41.3	43.6	0.0	Minor	Medium-term	Local	Possible	Low
23	55	60	59.4	41.3	59.4	0.0	Minor	Medium-term	Local	Possible	Low

Appendix C, Table 3: Projected worst-case noise rating levels and impact – Conceptual reclamation activities, Scenario 3

Potential Noise-sensitive development / Receptor(s)	Rating level (Urban noise district, based on developmental character)	Recommended noise limit	Potential existing noise levels due to existing traffic (dBA)	Potential Existing Ambient Sound Levels (Average measured onsite)	Projected Noise Level, night-time operation (conceptual, worst-case for Scenario 1)	Potential change in rating level, considering either road traffic noise or ambient sound levels	Magnitude / Intensity	Duration	Extent	Probability of Impact Occurring	Significance
1	55	60	43.5	41.3	43.9	0.4	Minor	Medium-term	Regional	Possible	Low
2	55	60	43.5	41.3	44.1	0.6	Minor	Medium-term	Regional	Possible	Low
3	55	60	43.5	41.3	44.6	1.1	Minor	Medium-term	Regional	Possible	Low
4	55	60	43.8	41.3	45.1	1.3	Minor	Medium-term	Regional	Possible	Low
5	55	60	43.9	41.3	45.2	1.3	Minor	Medium-term	Regional	Possible	Low
6	55	60	43.4	41.3	44.5	1.1	Minor	Medium-term	Regional	Possible	Low
7	55	60	43.5	41.3	44.3	0.8	Minor	Medium-term	Regional	Possible	Low
8	55	60	50.9	41.3	51.0	0.1	Minor	Medium-term	Regional	Possible	Low
9	55	60	67.3	41.3	67.3	0.0	Minor	Medium-term	Regional	Possible	Low
10	55	60	69.1	41.3	69.1	0.0	Minor	Medium-term	Regional	Possible	Low
11	55	60	69.8	41.3	69.8	0.0	Minor	Medium-term	Regional	Possible	Low
12	55	60	64.2	41.3	64.2	0.0	Minor	Medium-term	Regional	Possible	Low
13	55	60	54.5	41.3	54.5	0.0	Minor	Medium-term	Regional	Possible	Low
14	55	60	50	41.3	50.1	0.1	Minor	Medium-term	Regional	Possible	Low
15	55	60	48.7	41.3	48.8	0.1	Minor	Medium-term	Regional	Possible	Low
16	55	60	44.3	41.3	44.4	0.1	Minor	Medium-term	Regional	Possible	Low
17	55	60	41.3	41.3	41.4	0.1	Minor	Medium-term	Regional	Possible	Low
18	55	60	43.4	41.3	43.5	0.1	Minor	Medium-term	Regional	Possible	Low

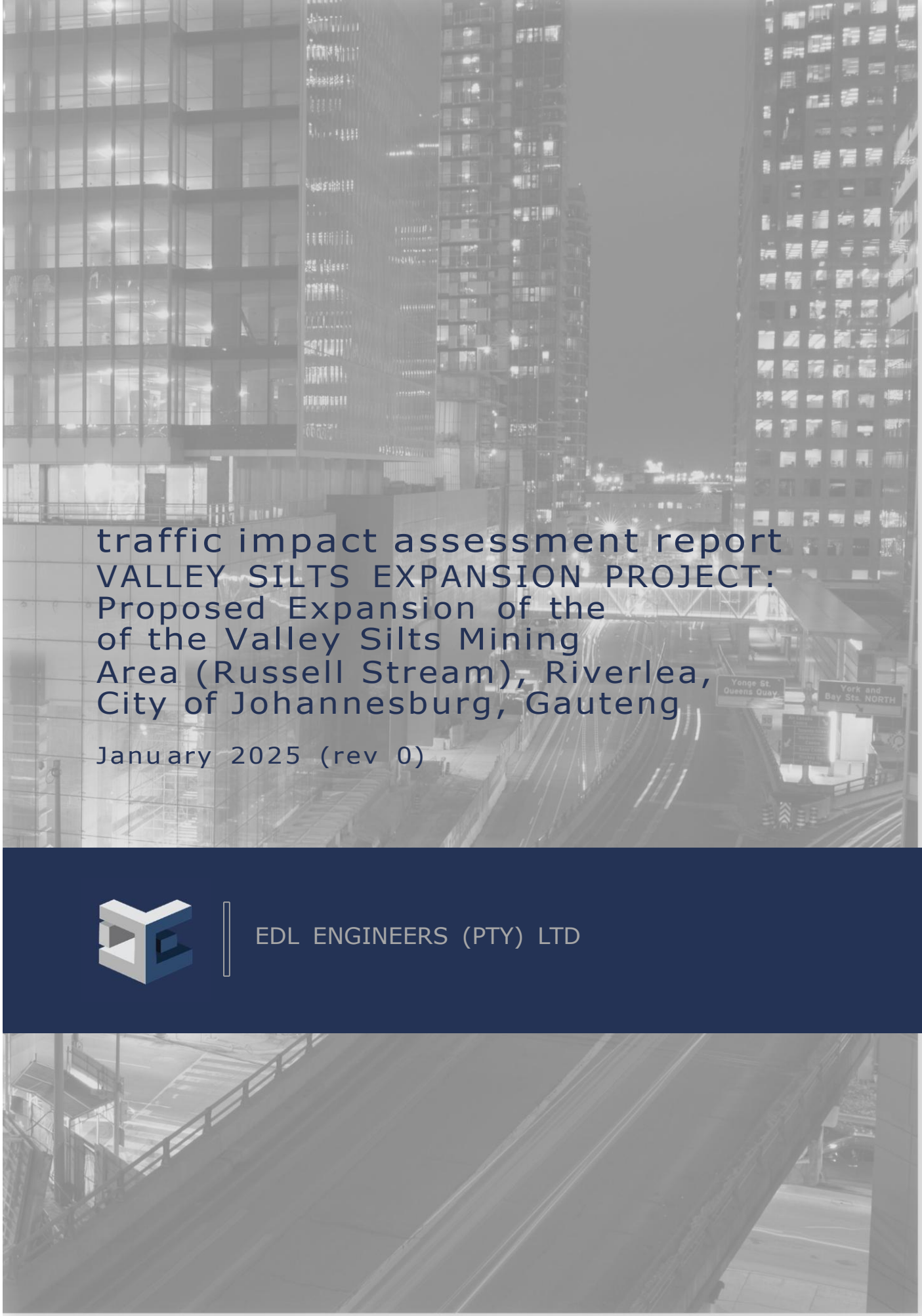
19	55	60	46	41.3	46.0	0.0	Minor	Medium-term	Regional	Possible	Low
20	55	60	43	41.3	43.1	0.1	Minor	Medium-term	Regional	Possible	Low
21	55	60	49	41.3	49.1	0.1	Minor	Medium-term	Regional	Possible	Low
22	55	60	43.6	41.3	43.6	0.0	Minor	Medium-term	Regional	Possible	Low
23	55	60	59.4	41.3	59.4	0.0	Minor	Medium-term	Regional	Possible	Low

End of Report

APPENDIX D:

Specialist Studies

- ❖ Appendix D10 –Traffic Report



traffic impact assessment report

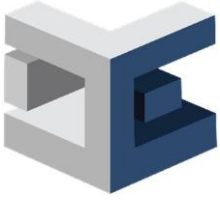
VALLEY SILTS EXPANSION PROJECT: Proposed Expansion of the of the Valley Silts Mining Area (Russell Stream), Riverlea, City of Johannesburg, Gauteng

January 2025 (rev 0)

EDL ENGINEERS (PTY) LTD

Issue/revision	Revision 0	Revision 1	Revision 2	Revision 3
Remarks	Issued for Approval			
Date	January 2025			
Prepared by	J.M. van Rooyen (B. Eng.)			
Checked by	E.D. Kotze (Pr. Tech Eng.)			
Signature				
Project number	24060			
File reference	Z:/PROJECTS/24001-24099/			

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B-BBEE LEVEL2 CONTRIBUTOR

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Annexure A SIDRA Capacity Analysis Results

Abbreviations

- **COTO** Committee of Transport Officials
- **TIA** Traffic Impact Assessment
- **HV** Heavy Vehicles
- **LV** Light Vehicles
- **NMT** Non-motorised Transport
- **PT** Public Transport
- **vph** Vehicles per hour
- **q** Lane Utilisation Factor
- **Qm** Access Utilisation Factor
- **LOS** Level of Service
- **ROW** Right of Way
- **CAGR** Compound Annual Growth Rate

Road Classification

Please note the various Road Classifications of the TRH26 document:

Road Class Number	*TRH26 Classification*
1	Principal Arterial
2	Major Arterial
3	Minor Arterial
4	Collector (Commercial U4a and Residential U4b)
5	Local / Access Road

Level Of Service Classification

The following classification is used when determining the Levels of Service of a road:

Level of Service	*Definition*	*Control Delay Per Vehicle (s/veh)*
A	Free Flow	≤ 10
B	Reasonably Free Flow	> 10 - 20
C	Stable Flow, at or near Free Flow	> 20 - 35
D	Approaching Unstable Flow	> 35 - 55
E	Unstable Flow, Operating at Capacity	> 55 - 80
F	Forced or Breakdown Flow	> 80

1 Introduction

EDL Engineers (Pty) Ltd was appointed to compile a Traffic Impact Assessment for the expansion of the existing Valley Silts Reclamation Project at Russell Stream, north of NASREC near Booysens Reserve in Johannesburg, Gauteng.

The purpose of this Traffic Impact Assessment Report is to investigate the impact of the traffic that will be generated by the proposed expansion of the existing operations, on the existing 2024 (status quo scenario) and Future 2029 Weekday AM (morning) and PM (afternoon) Peak hour traffic. More information regarding the development or activities planned is set out within Chapter 4.1.

The appropriate peak hour trip generation is set out in Chapter 4.2, which is based on the existing trips generated at Valley Silts and the pre-processing operational capacity of the Ergo City Deep Plant (destination for generated trips). Please refer to Chapter 4 for more detailed information.

The classification of the relevant roads and the key intersection(s) are also included in this report, with their characteristics discussed in Chapter 3.

Details of the future background traffic flows (5-year horizon) are discussed in Chapter 3.4. We will also discuss the appropriate Compound Annual Growth Rate (CAGR) for the background traffic in the study area, the population growth rates for the study area, as well as the probability of expansion and densification of the study area in the future. Please also refer to **Figures 3 to 6** for a visual representation of the traffic flow past the subject property.

SIDRA 9™ analyses were undertaken at the relevant key intersection(s) for the Existing 2024 (status quo) and the Future 2029 (5-year horizon) scenarios, to check for possible capacity restraints and required upgrades.

We have included a discussion on the position of the access to and from the proposed development or planned activities, as well as a discussion on future road changes and road master planning which may have an impact on the proposed access arrangements to the subject site in the foreseeable future.

Latent rights developments near the site in question (if any) are investigated / evaluated to determine the overall impact of the collective developments on the surrounding road network and the upgrades that are required for capacity purposes based on the collective impact of their peak hour trips, if required.

The provision of non-motorised transport (NMT) and public transport (PT) services and facilities near the study site area was investigated, evaluated, and discussed within this Traffic Impact Assessment Report, which is based on the previously accepted standards of the old / repealed National Land Transport Transitions Act 22 of 2000, Chapter 29. For more information, please refer to Chapter 8.1 and 8.2.

2 Site Location & Landmarks

2.1 Site Location

As shown in **Figure 1,** the site is located on the following farm portions: Remainder of Portion 3 of the Farm Langlaagte 224-IQ, Remainder of Portion 8 of the Farm Langlaagte 224-IQ, Portion 9 of the Farm Langlaagte 224-IQ, Remainder of Portion 11 of the Farm Langlaagte 224-IQ, Remainder of Portion 13 of the Farm Langlaagte 224-IQ , Portion 381 of the Farm Langlaagte 224-IQ and the Remainder of the Farm Mooifontein 225-IQ.

This site is situated between the areas of Crown (directly to the north), Riverlea (north west of the site) and Booysens Reserve (southeast of the site).

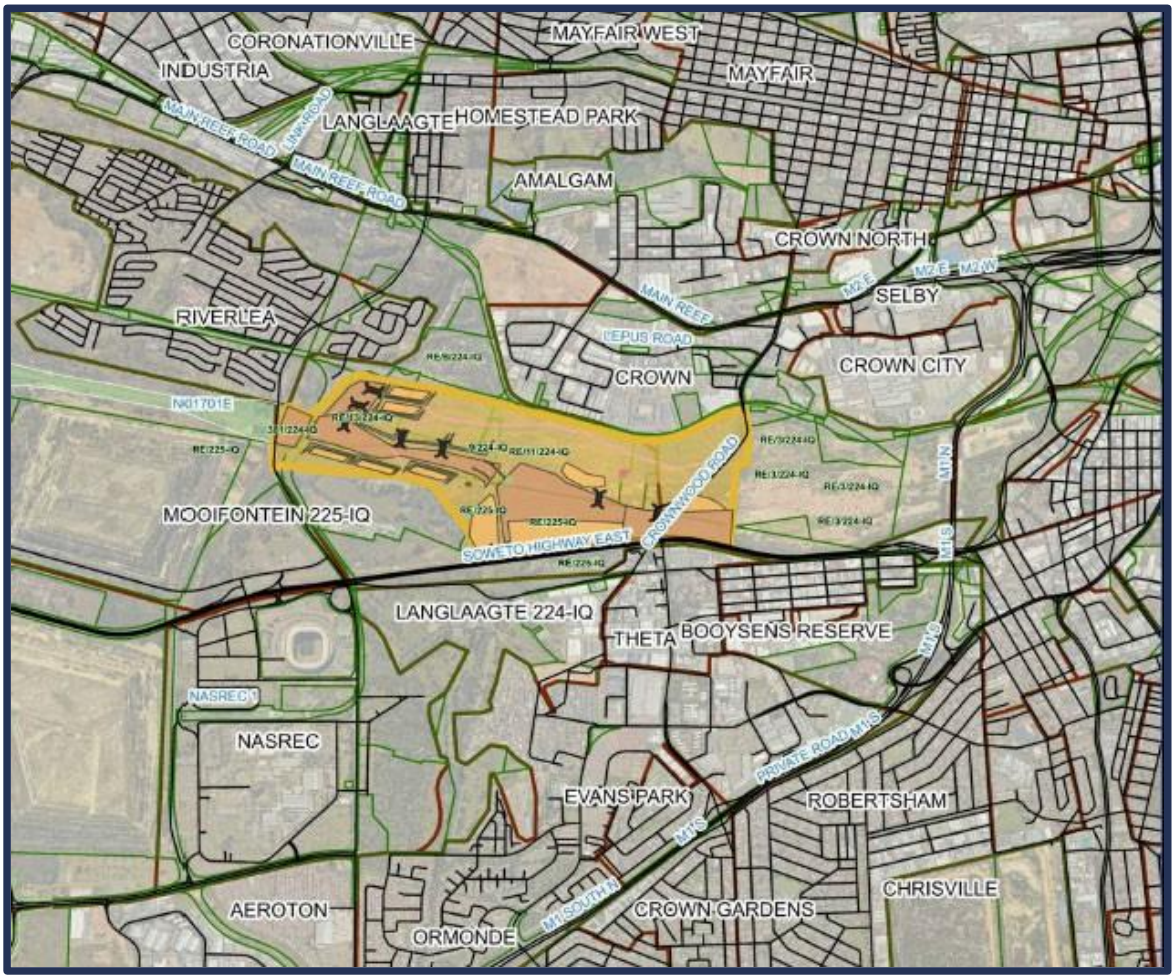
Crownwood Road passes through the site within the eastern portions of the planned activity footprint. Nasrec Road passes to the west of the site.

The site, as can be seen in **Figure 1** (below and attached) is mainly surrounded by commercial / industrial developments to the north and south with some residential areas to the northwest.

Noticeable attractions / destinations near the subject site include the FNB Stadium (Soccer City) approximately 1km to the southwest of the site.

The location of the site can be seen in **Figure 1** below, and near the back of the report.

Figure 1: Locality showing the study site (Also attached at the back of the report)



3 Surrounding Road Network and Traffic Flows

3.1 Surrounding Road Network

The following roads are relevant to the study area.

Crownwood Road: This road, which may be classified as a Class 2 Road, connecting the N12, M1, Soweto Highway and Main Reef Road with Mayfair in Johannesburg Central. It is a surfaced single carriageway road with one (1) through lane per direction. The speed limit on this road is 60km/h near the site. This road has an uphill gradient of ± 2.9% to the north. This road intersects Jupiter Road and Telkom street as a T-Junction, with Crownwood Road having the Right-of-way. This road also has a signalised 4-way intersection with Planet Avenue.

Traffic counts indicate that the Crownwood Road carries traffic volumes between 200vph and 1500vph per direction during the Weekday AM and PM peak hours, depending on location and direction.

Jupiter Road: This road, which may be classified as a Class 5 Road, connecting Crownwood Road to businesses in Crown industrial area. It is a surfaced single carriageway road with one (1) through lane per direction. The speed limit on this road is 60km/h near the site. This road has an uphill gradient of ± 1.6% to the east. This road intersects Crownwood Road as a T-Junction, with Crownwood Road having the Right-of-way.

Traffic counts indicate that the Jupiter Road carries traffic volumes between 150vph and 350vph per direction during the Weekday AM and PM peak hours, depending on location and direction.

Telkom Street: This road, which may be classified as a Class 5 Road, connecting Crownwood Road to Crownwood Business Park (Africa Sunoil). It is a surfaced single carriageway road with one (1) through lane per direction. The speed limit on this road is 60km/h near the site. This road intersects Crownwood Road as a T-Junction (a filling station forms the 4th leg of this intersection), with Crownwood Road having the Right-of-way.

Traffic counts indicate that the Jupiter Road carries traffic volumes between 130vph and 1000vph per direction during the Weekday AM and PM peak hours, depending on location and direction.

Planet Avenue: This road, which may be classified as a Class 4 Road, connecting Crownwood Road to both the Crown and Crown Mines industrial areas. It is a surfaced single carriageway road with one (1) through lane per direction. The speed limit on this road is 60km/h near the site. This road has an uphill gradient of ± 1.5% to the east. This road intersects Crownwood Road as a signalised 4-way intersection.

Traffic counts indicate that the Jupiter Road carries traffic volumes between 150vph and 500vph per direction during the Weekday AM and PM peak hours, depending on location and direction.

3.2 Future Road Network

According to the available information, the following future roads are possible in the study area:

South African National Roads Agency (SANRAL):

Potential extension of the N17 freeway from Nasrec Road to Crownwood Road (M17)

3.3 Existing Traffic Flows

The study area was defined to include two (2) key intersections as required by COTO TMH 16. Friday PM and Saturday AM peak hour Traffic Counts were conducted at these key intersections during March of 2024, by Omega Traffic Data Specialists (Pty) Ltd.

The following intersections were identified as key intersections in this study:

- ☐ Crownwood Road and Planet Avenue
- ☐ Crownwood Road and Telkom Street
- ☐ Crownwood Road and Jupiter Road
- ☐ Crownwood Road and Valley Silts Access

The existing peak hour traffic volumes at the abovementioned key intersections / counted positions are summarised in **Figure 2**.

Please refer to Chapter 7 for more information regarding the key intersections and their respective capacity analyses, as well as possible upgrades (if found to be required).

3.4 Future Traffic Flows

The study site is within the boundaries of Johannesburg Metropolitan Municipality, with Crownwood Road providing access to the study site as well as connecting the N12, M1, Soweto Highway and Main Reef Road with Mayfair in Johannesburg Central.

With reference to census data, it can be established that the population of Johannesburg has seen positive growth over the past two decades, with an average recorded percentage of 2.0% during the years of 2023 and 2024. Therefore, it can be concluded that background traffic growth is expected to stay positive, going forward.

Considering the continued industrialisation and densification of the surrounding areas, we have therefore deemed an average background traffic growth rate of +3.0% per annum (CAGR) appropriate for the background traffic over a 5-year horizon period, from 2024 to 2029, for this study.

Figure 6 shows the Existing 2024 peak hour traffic plus estimated total development traffic, which is the summation of **Figure 2 and Figure 5**.

Figure 8 shows the Future 2029 peak hour traffic plus the estimated total development traffic, which is the summation of **Figures 5 and 7**.

4 Proposed Activities and Trip Generation

The following sub-chapters are relevant with respect to the planned activities of the subject site and its estimated trip generation / attraction during the relevant peak hours.

4.1 Proposed Activities

The gold bearing silts will be mechanically excavated from the project area. The dried tailings/silts will be loaded onto tipper trucks and transported to the City Deep plant for pre-processing. The trucks transporting the material will follow Crownwood Road until they reach Main Reef Road and then join the M2 East. The trucks will then follow the M2 until they reach Heidelberg Road which is followed to the City Deep Plant where the material is offloaded. Please refer to **Table 1** below which shows the extent of the planned activities.

Table 1: Extent of the proposed development/ planned activites

Proposed Use / Activities	Trip Generation Extent
Silt Reclamation and Rehabilitation	3 333 Tons/day Transported from Site

4.2 Estimated Trip Generation

The expected trip generation for the planned activities are discussed below:

Silt Reclamation and Rehabilitation: The expected trips to be generated by the proposed activities were based the maximum processing capacity of the City Deep Plant and COTO TMH17. The document recommends the following splits for Heavy Industry (silt reclamation and rehabilitation) and trips are based on details provided by the client for the construction period. For heavy vehicles a trip distribution of 50/50 during the AM peak period, and 50/50 during the PM peak period was adopted. For light vehicles a trip distribution of 75/25 during the AM peak period, and 25/75 during the PM peak period was adopted.

The expected heavy vehicle traffic was calculated to a rounded approximation of 15 heavy vehicles per hour exiting the site (45 tons silt per vehicle with trailer), in the morning (AM) peak hour, and 15 heavy vehicles per hour exiting the site in the afternoon (PM) peak hour.

We have furthermore added 22 light vehicles per hour (for each peak hour) to account for personnel on site (light vehicles / LDV's).

With reference to the information above, the site is expected to generate / attract **52vph** (total IN and OUT) during the Weekday AM and **52vph** (total IN and OUT) during the Weekday PM peak periods. Please refer to the breakdown in ***Table 2*** on the following page:

Table 2: Estimated trip generation / attraction of the planned activities

Description	Peak Hour	Trip Rate	Split (%)	TRIPS		
				In	Out	Total
Site Personnel (Light Vehicles)	Weekday AM Hour	22vph	75/25	17	5	22
	Weekday PM Hour	22vph	25/75	5	17	22
Silt Transport (Heavy Vehicles)	Weekday AM Hour	45 ton payload	50/50	15	15	30
	Weekday PM Hour	45 ton payload	50/50	15	15	30
Total	**Weekday AM Peak Hour**			**32**	**20**	**52**
	Weekday PM Peak Hour			**20**	**32**	**52**

4.3 Latent Rights Developments

According to the available information, there are no Latent Rights developments in the study area that will need to be considered as part of our traffic impact assessment.

We have furthermore considered a positive average traffic growth rate (CAGR) of 3%/annum for the background traffic (see Chapter 3.4) in the study area, which will account for any unexpected traffic growth on the surrounding road network as a result of any smaller future developments.

5 Queueing Analysis and Site Access

5.1 Queueing Analysis

Calculations for queue lengths that might form at the existing access, were based on a worst-case arrival rate of 32vph, during the peak hours for entering vehicles.

The formula used for the exceedance of 95% is as follows:

$$\frac{\ln(0.05) - \ln(Qm)}{\ln(q)} - 1$$

Where:
Utilization factor (q):

$$\frac{\text{Arrival rate}}{(\text{Number of lanes}) * (\text{Service rate per lane})}$$

And by means of interpolation, Qm is determined by using ***Table 3*** below:

Table 3: Tabled values of the relationship between queue length, number of lanes and utilization factor (Qm)*

Table of Qm Values							
LANES	**1**	**2**	**3**	**4**	**6**	**8**	**10**
0,0	0,0000	0,0000	0,0000	0,0000			
0,1	0,1000	0,0182	0,0037	0,0008	0,0000	0,0000	0,0000
0,2	0,2000	0,0666	0,0247	0,0096	0,0015	0,0002	0,0000
0,3	0,3000	0,1385	0,0700	0,0370	0,0111	0,0036	0,0011
0,4	0,4000	0,2286	0,1411	0,0907	0,0400	0,0185	0,0088
0,5	0,5000	0,3333	0,2368	0,1739	0,0991	0,0591	0,0360
0,6	0,6000	0,4501	0,3548	0,2870	0,1965	0,1395	0,1013
0,7	0,7000	0,5766	0,4923	0,4286	0,3359	0,2706	0,2218
0,8	0,8000	0,7111	0,6472	0,5964	0,5178	0,4576	0,4093
0,9	0,9000	0,8526	0,8172	0,7878	0,7401	0,7014	0,6687
1	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000

Source: Transportation and Land Development (Vergil G Stover / Frank J Koepke)

Considering a scenario with a service rate of 60vph (security checkpoint which takes 60 seconds per vehicle) at the access, the utilization factor equates to 0.533. By then using the table from *Vergil G Stover and Frank J Koepke** above, the exceedance of 95% can be solved by means of interpolation as 0.0.533 as well.

For one (1) entrance lane, a queue length of 3 heavy vehicles may form. A gate offset of 75m is therefore proposed / required, as measured between the road edge of Crownwood Road and the security checkpoint / access-controlled gate.

One (1) entrance lane will be sufficient for the site, and 75m worth of stacking is available at the existing access.

5.2 Site Access

The following is proposed regarding access:

- Access to the site is proposed directly off Crownwood Road at the existing access point. The existing access to the site is approximately 440 m to the south of the intersection with Jupiter Road. The access is 10 m wide, with one lane 'IN' and one lane 'OUT'. Traffic from Crownwood Road (M17) has the right of way and a 'STOP' condition is implemented.

5.3 Sight Distance

Stopping Sight Distance was checked at the full access on Crownwood Road, and the following can be concluded.

Stopping Sight Distance: The existing full access is situated on a road with a speed limit of 60km/h, with no deviation in its vertical alignment near where the access is proposed.

Crownwood Road has an average gradient of +4.4% to the north past the site, and it can therefore be concluded that line of sight will not be impeded by a sag or crest curve in the immediate vicinity of the existing access.

Crownwood Road does have a smaller radius bend in its horizontal alignment, approx. 200m to the north of the access. However, with no visual intrusion (no billboards, large trees or walls obstructing sight distance) obstructing the line of sight to the north, a total sight distance of over 180m will be available to the north of the access, this is more than required stopping sight distance of 125m (80km/h design speed and +3.0% gradient).

6 Trip Distribution

6.1 Trip Distribution

Calculations on the expected trip distribution for the trips generated / attracted by these planned activities were based on the observed trip distributions as part of the traffic counts.

We have however also considered trip attractions such as residential / commercial orientated areas as well as the planned route for heavy vehicles, and higher order roads in the larger study area, during the relevant peak hours for this study.

The expected outbound traffic directional split percentages are shown below for each intersection.

From the access, onto Crownwood Road (Exiting Light Vehicle Traffic):

- An estimated 20% (LV) of the AM Peak Hour traffic will turn left from the site, heading northbound on Crownwood Road towards Jupiter Road.
- An estimated 80% (LV) of the AM Peak Hour traffic will turn right from the site, heading southbound on Crownwood Road towards Booysens Reserve and the M1.

- An estimated 35% (LV) of the PM Peak Hour traffic will turn left from the site, heading northbound on Crownwood Road towards Jupiter Road.
- An estimated 65% (LV) of the AM Peak Hour traffic will turn right from the site, heading southbound on Crownwood Road towards Booysens Reserve and the M1.

From the access, onto Crownwood Road (Exiting Heavy Vehicle Traffic):

- An estimated 100% (HV) of the AM Peak Hour traffic will turn left from the site, heading northbound on Crownwood Road.

- An estimated 100% (HV) of the PM Peak Hour traffic will turn left from the site, heading northbound on Crownwood Road towards Jupiter Road.

From the intersection of Crownwood Road and Jupiter Road (Exiting Light Vehicle Traffic):

- An estimated 100% (LV) of the AM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Telkom Street.

- An estimated 82% (LV) of the PM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Telkom Street.
- An estimated 18% (LV) of the AM Peak Hour traffic will turn left at the intersection of Crownwood Road and Jupiter Road, heading westbound on Jupiter Road into Crown Industrial.

From the intersection of Crownwood Road and Jupiter Road (Exiting Heavy Vehicle Traffic):

- An estimated 100% (HV) of the AM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Telkom Street.

- An estimated 100% (HV) of the PM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Telkom Street.

From the intersection of Crownwood Road and Telkom Street (Exiting Light Vehicle Traffic):

- ☐ An estimated 100% (LV) of the AM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Planet Avenue.

- ☐ An estimated 89% (LV) of the PM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Planet Avenue.
- ☐ An estimated 11% (LV) of the AM Peak Hour traffic will turn right at the intersection of Crownwood Road and Telkom Street, heading eastbound on Telkom Street.

From the intersection of Crownwood Road and Telkom Street (Exiting Heavy Vehicle Traffic):

- ☐ An estimated 100% (HV) of the AM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Planet Avenue.

- ☐ An estimated 100% (HV) of the PM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Planet Avenue.

From the intersection of Crownwood Road and Planet Avenue (Exiting Light Vehicle Traffic):

- ☐ An estimated 100% (LV) of the AM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Main Reef Road.

- ☐ An estimated 12% (LV) of the AM Peak Hour traffic will turn left at the intersection of Crownwood Road and Planet Avenue, heading westbound on Planet Avenue into Crown Industrial.
- ☐ An estimated 63% (LV) of the PM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Main Reef Road.
- ☐ An estimated 25% (LV) of the AM Peak Hour traffic will turn right at the intersection of Crownwood Road and Planet Avenue, heading eastbound on Planet Avenue towards Crown City.

From the intersection of Crownwood Road and Planet Avenue (Exiting Heavy Vehicle Traffic):

- ☐ An estimated 100% (HV) of the AM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Main Reef Road.

- ☐ An estimated 100% (HV) of the PM Peak Hour traffic will continue through the intersection, heading northbound on Crownwood Road towards Main Reef Road.

7 Traffic Impact & Capacity Analyses

To determine the expected traffic impact of the planned activities at the key intersections, capacity analyses were conducted by using SIDRA 9™, a well-known traffic engineering software package. The following intersection was analysed:

Key Intersections:

- ☐ Crownwood Road and Planet Avenue
- ☐ Crownwood Road and Telkom Street
- ☐ Crownwood Road and Jupiter Road
- ☐ Crownwood Road and Valley Silts Access
- ☐

The following scenarios were analysed at the abovementioned key intersections, namely:

- ☐ Existing 2024 Weekday AM and PM peak hour traffic (as per **Figure 2**);
- ☐ Existing 2024 Weekday AM and PM peak hour with development peak hour traffic (as per **Figure 6**);
- ☐ Future 2029 background Weekday AM and PM peak hour traffic (as per **Figure 7**);
- ☐ Future 2029 background Weekday AM and PM peak hour with development peak hour traffic (as per **Figure 8**);

The next sub-chapter illustrates tabled SIDRA 9™ results (of the worst-case approaches) and briefly discusses the results and key conclusion at the analysed intersection, with the details of SIDRA 9™ Intersection Capacity Analyses appended in **Annexure A.**

7.1 Crownwood Road and Planet Avenue

Also refer to **Annexure A:**

Table 4: Results of Sidra Analyses (Crownwood Road and Planet Avenue)

Intersection		**Crownwood Road and Planet Avenue**			
Scenario		Existing 2024	Exist 2024 + Dev	Future 2029	Future 2029 + Dev
Level of Service	Weekday AM	C	C	C	C
	Weekday PM	C	C	C	C
Average Delays	Weekday AM	22.4	22.4	24.9	22.5
	Weekday PM	21.2	21.3	21.7	21.9
Remarks	The intersection operates acceptably. No upgrades are required for capacity purposes at this intersection.				

7.2 Crownwood Road and Telkom Street

Also refer to **Annexure A:**

Table 5: Results of Sidra Analyses (Crownwood Road and Telkom Street)

Intersection		**Crownwood Road and Telkom Street**			
Scenario		Existing 2024	Exist 2024 + Dev	Future 2029	Future 2029 + Dev
Level of Service	Weekday AM	C	C	D	D
	Weekday PM	F	F	F	F
Average Delays	Weekday AM	18.4	18.9	27.0	28.0
	Weekday PM	163.2	208.7	598.0	664.5
Remarks	The intersection has significant delays in the existing scenario, even before the proposed development traffic is added. The problematic leg of this intersection is Telkom Street, providing access to only a small number of businesses (2 farm portions). The proposed development cannot be held responsible for the entrance to a small number of businesses with an already problematic intersection. Therefore, no upgrades are proposed for this development ; **however, we propose flagmen and/ or traffic directing personnel at this intersection in the Weekday AM and Weekday PM Peak hours during operational day**s.				

7.3 Crownwood Road and Jupiter Road

Also refer to **Annexure A:**

Table 6: Results of Sidra Analyses (Crownwood Road and Jupiter Road)

Intersection		**Crownwood Road and Jupiter Road**			
Scenario		Existing 2024	Exist 2024 + Dev	Future 2029	Future 2029 + Dev
Level of Service	Weekday AM	C	C	C	C
	Weekday PM	B	B	B	B
Average Delays	Weekday AM	16.3	16.8	22.8	23.7
	Weekday PM	10.9	11.4	13.9	14.6
Remarks	The intersection operates acceptably. No upgrades are required for capacity purposes at this intersection.				

7.4 Crownwood Road and Valley Silts Access

Also refer to **Annexure A:**

Table 7: Results of Sidra Analyses (Crownwood Road and Valley Silts Access)

Intersection		**Crownwood Road and Valley Silts Access**			
Scenario		Existing 2024	Exist 2024 + Dev	Future 2029	Future 2029 + Dev
Level of Service	Weekday AM	C	C	C	C
	Weekday PM	A	A	A	A
Average Delays	Weekday AM	17.7	18.0	24.0	24.8
	Weekday PM	8.5	8.1	9.0	8.6
Remarks	The intersection operates acceptably. No upgrades are required for capacity purposes at this intersection; **however, we propose flagmen and/ or traffic directing personnel at this intersection in the Weekday AM and Weekday PM Peak hours during operational days**.				

7.5 SIDRA Analyses Conclusions and Access Check

As per the tables in Chapter 7. It can be concluded that with the exception of the intersection of Crownwood Road and Telkom Street, the analysed intersections will operate within acceptable levels of service and average delays within the relevant peak hours. **Significant spare capacity is available at the key intersection under all scenarios. No upgrades are proposed for the key intersection as part of this study. However, we propose flagmen and/ or traffic directing personnel at this intersection in the Weekday AM and Weekday PM Peak hours during operational days.**

Please refer to **Annexure A** for the SIDRA results.

8 Public Transport Assessment

8.1 Pedestrian Facilities / Walkways (NMT)

Because this is not a pedestrian-focused development or activities, and it is not within a comfortable walking distance of any pedestrian generator near / in Crown or Booysens Reserve itself, no pedestrian facilities are proposed or required next to the road.

8.2 Public Transport Facilities (PT)

Chapter 29 of the previous / repealed National Land Transport Transition Act (NLTTA) 22 of 2000 required an assessment of public transportation issues as part of a traffic impact assessment.

The Act required public transportation facilities to be within 1km walking distance of a development in a densely populated area, which is still considered an acceptable standard for developments going forward.

We can therefore conclude that the proposed activities will not be conducted close to any pedestrian generating development (such as a grocery store or other commercial establishments) and will instead be built outside of the highly populated areas.

Because of the planned activities and the expected relatively small number of employees at the site, there may be a slight increase in demand for public transportation during peak hours. However, there is more than enough space on the property for people to easily be dropped off or picked up by public transport vehicles when needed.

In terms of PT facilities, it can be concluded that this development does not warrant the construction of any new PT facilities, as the small increase in demand will be negligible.

9 Conclusions & Recommendations

Based on the contents of this Traffic Impact Assessment report, the following key conclusions and recommendations are relevant:

- This site is situated between the areas of Crown (directly to the north), Riverlea (northwest of the site) and Booysens Reserve (southeast of the site). Crownwood Road pass through the site within the eastern portions of the planned activity footprint. Nasrec Road passes to the west of the site. Locality is shown in **Figure 1**.
- The study area was defined to include four (4) key intersections as required by COTO TMH 16. Weekday AM and PM peak hour traffic counts was conducted at the key intersections, during November of 2024.
- the site is located on the following farm portions: Remainder of Portion 3 of the Farm Langlaagte 224-IQ, Remainder of Portion 8 of the Farm Langlaagte 224-IQ, Portion 9 of the Farm Langlaagte 224-IQ, Remainder of Portion 11 of the Farm Langlaagte 224-IQ, Remainder of Portion 13 of the Farm Langlaagte 224-IQ , Portion 381 of the Farm Langlaagte 224-IQ and the Remainder of the Farm Mooifontein 225-IQ.
- With reference to the information in Chapter 4.2, the planned activities are expected to generate only **52vph (total IN and OUT)** during both the Weekday AM and PM peak periods.
- We have based our queueing analyses on an arrival rate of 32vph, during the Weekday Peak Hours, in front of an access gate that is security controlled. A three (3) heavy vehicles (trucks) queue will form at the access, concluding a required stacking space / gate offset of 75m, already available on site.
- The planned activities will gain access from the existing access position on Crownwood Road.
- Stopping Sight Distance was checked at the existing access, and it can be concluded that the access has sufficient Stopping Sight Distance and was therefore regarded as acceptable from a safety / traffic engineering perspective.
- As per Chapter 7, it can be concluded (following our SIDRA analyses) that the analysed intersections operate within acceptable levels of service and average delays within the relevant peak hours, with significant spare capacity available under all scenarios. The only exception (Crownwood Road and Telkom Street) has existing capacity problems at Telkom Street (short access road)
- **Although no capacity upgrades are proposed, we propose flagmen and/ or traffic directing personnel at this intersection in the Weekday AM and Weekday PM Peak hours during operational days at the Valley Silts Access and the Telkom Street intersection with Crownwood Road.**
- No NMT (non-motorized transport), nor PT (public transport) facilities are proposed externally as part of this development. The planned activities are not seen as a pedestrian generator, and it will have a little impact on the existing PT demand.

It is therefore recommended that the planned activities known as Valley Silts Expansion be supported from a traffic engineering perspective, provided that the proposals regarding access as set out in this report, be implemented as specified and according to the most relevant standards of the Johannesburg Metropolitan Municiaplity.

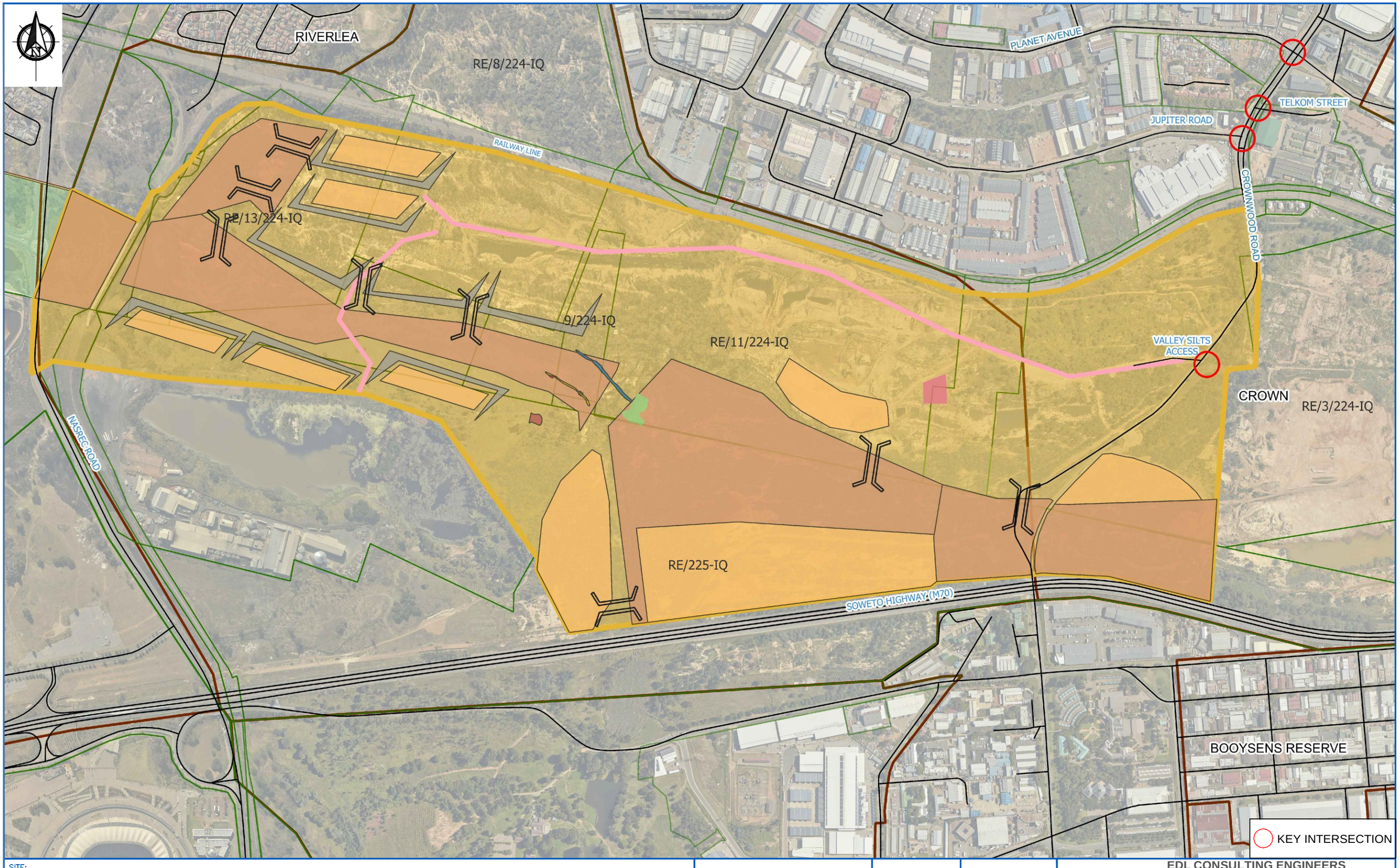
10 Bibliography

The following relevant sources were used in conducting the Traffic Impact Assessment, enabling EDL Engineers (Pty) Ltd to reach the conclusions as per the previous Chapter:

- TMH 16 - Traffic Impact and Site Traffic Assessment Manual. (2012). 1st ed. South African Committee of Transport Officials.
- TMH 17 - South African Trip Data Manual. (2013). South African Committee of Transport Officials.
- TRH 26 - South African Road Classification and Access Management Manual. (2012). 1st ed. South African Committee of Transport Officials.
- National Land Transport Transition Act (NLTTA) 22 of 2000, Chapter 29 (Repealed, but still accepted as acceptable standard).
- South African Road Traffic Signs Manual – Volume 2
- Stover, V. and Koepke, F., 2006. Transportation and land development. (Washington, D.C.): Institute of Transportation Engineers.

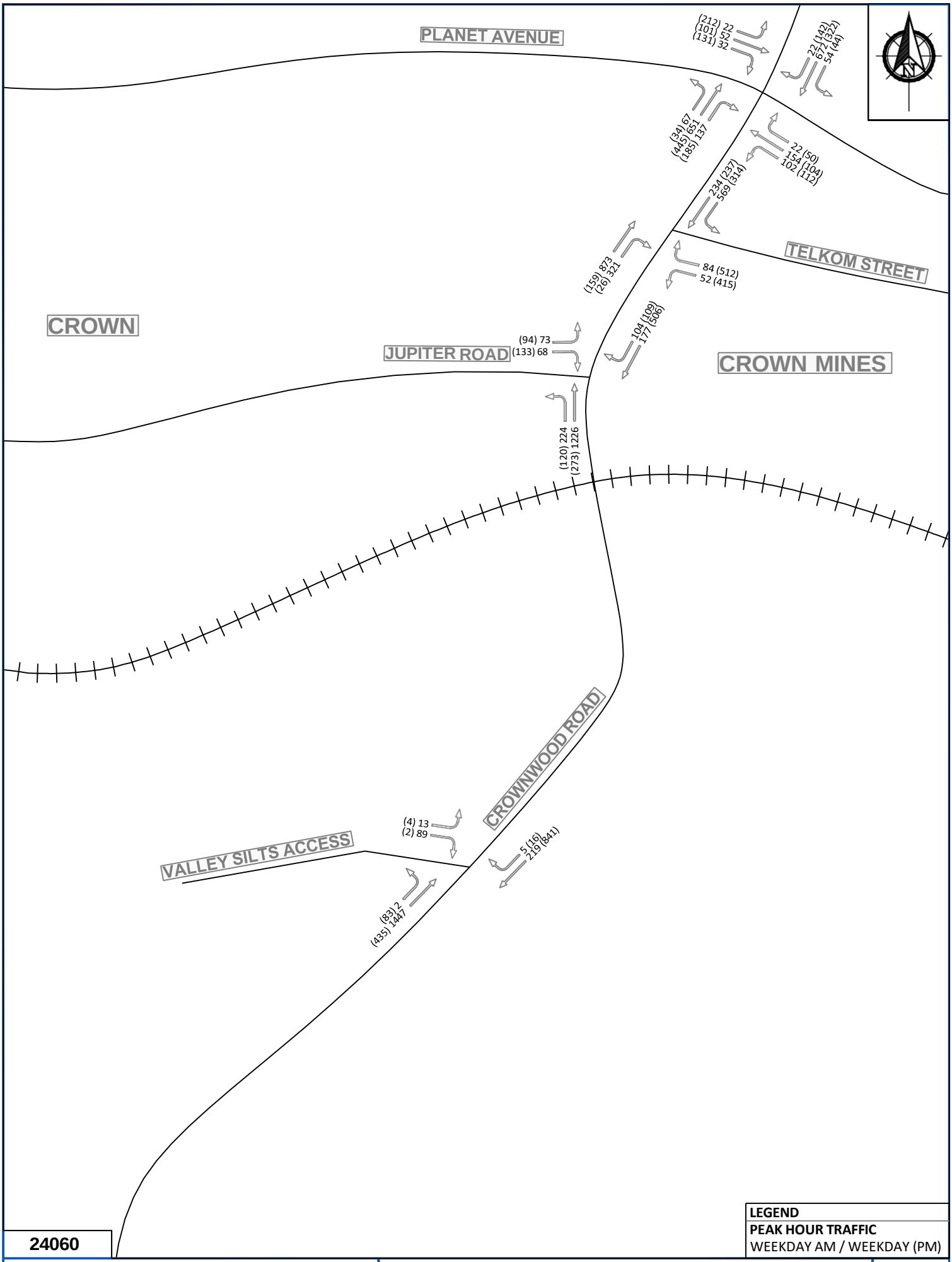
Figure(s)

Figure 1 Locality Plan
Figure 2 Existing 2024 Weekday Peak Hour Traffic
Figure 3 LV Development Weekday Peak Hour Traffic
Figure 4 HV Development Weekday Peak Hour Traffic
Figure 5 Total Development Weekday Peak Hour Traffic
Figure 6 Existing 2024 + Development Weekday Peak Hour Traffic
Figure 7 Future 2029 Weekday Peak Hour Traffic
Figure 8 Future 2029 + Development Weekday Peak Hour Traffic



SITE: **VALLEY SILTS EXPANSION**	**FIGURE 1** DRAWING NO.		**24060** PROJECT NO.	**21/01/2025** DATE.
TITLE: **LOCALITY**	**NTS** SCALE AT A3.	**JMvR** DRAWN.	**ED KOTZE** CHECKED.	**0** REVISION.

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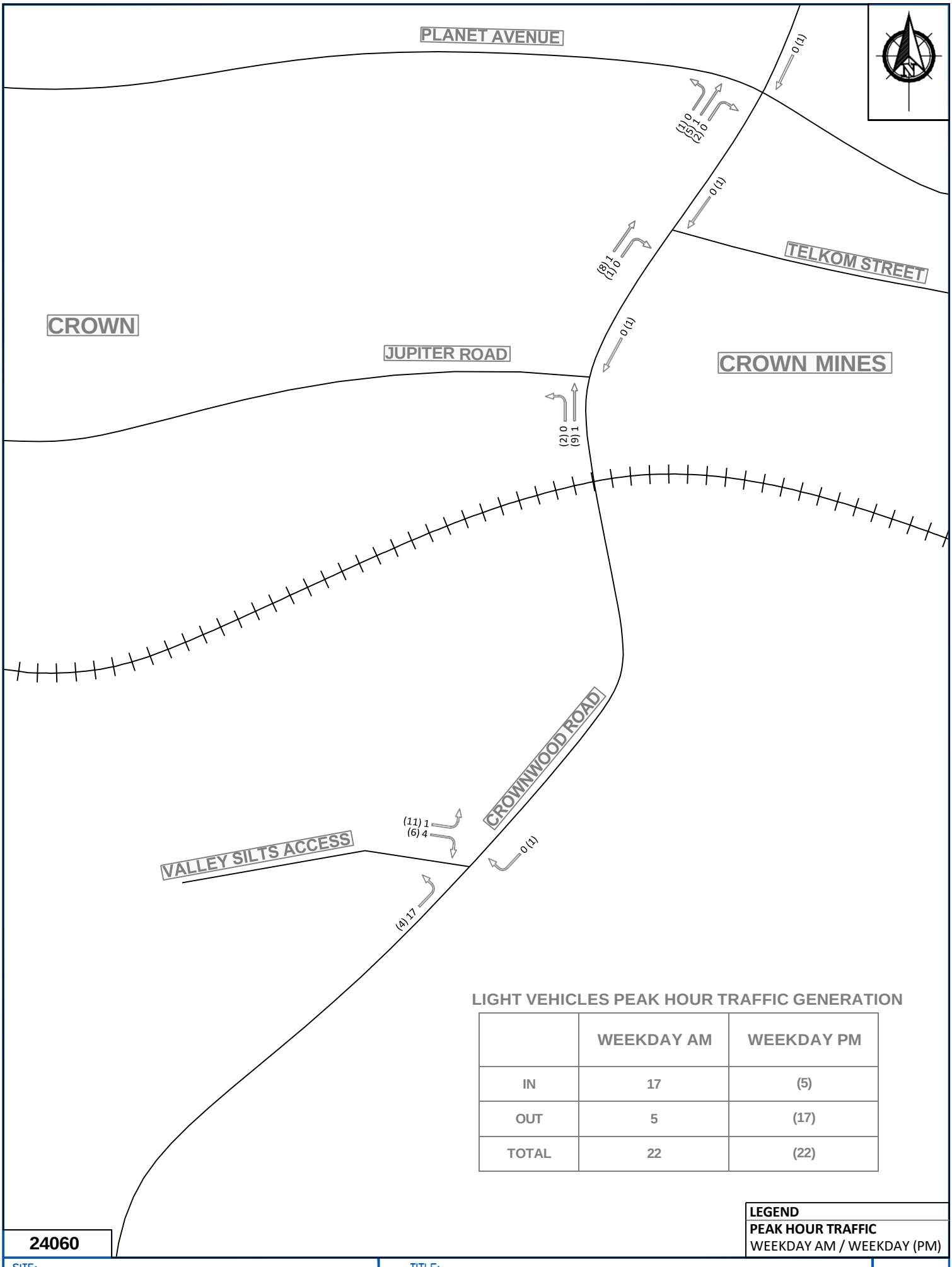
24060

SITE:
VALLEY SILTS EXPANSION

TITLE:
EXISTING 2024 WEEKDAY PEAK HOUR TRAFFIC

FIG 2

EDL ENGINEERS



LIGHT VEHICLES PEAK HOUR TRAFFIC GENERATION

	WEEKDAY AM	WEEKDAY PM
IN	17	(5)
OUT	5	(17)
TOTAL	22	(22)

LEGEND
PEAK HOUR TRAFFIC
WEEKDAY AM / WEEKDAY (PM)

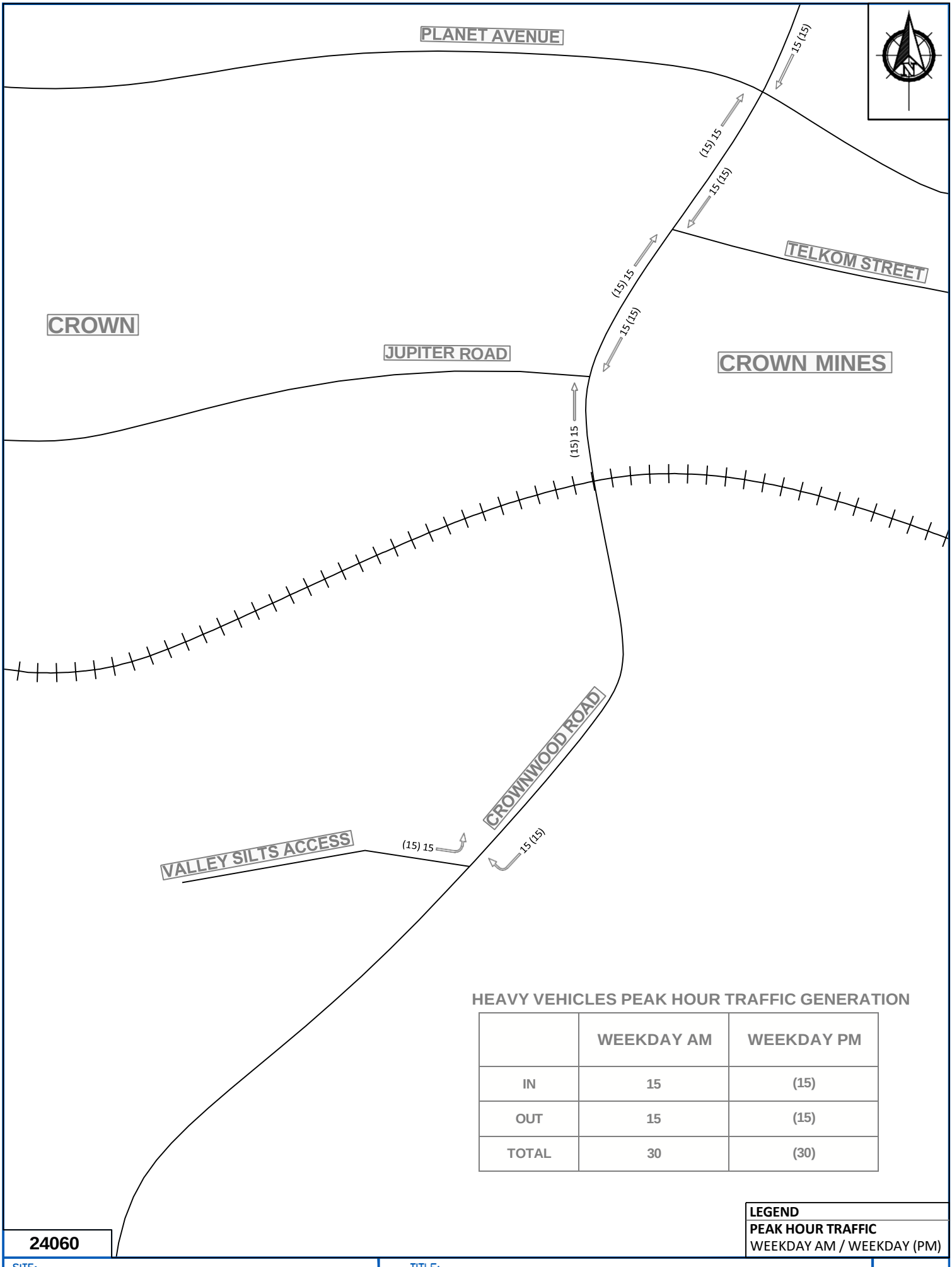
24060

SITE:
VALLEY SILTS EXPANSION

TITLE:
LV DEVELOPMENT WEEKDAY PEAK HOUR TRAFFIC

FIG 3

EDL ENGINEERS



HEAVY VEHICLES PEAK HOUR TRAFFIC GENERATION

	WEEKDAY AM	WEEKDAY PM
IN	15	(15)
OUT	15	(15)
TOTAL	30	(30)

LEGEND
PEAK HOUR TRAFFIC
WEEKDAY AM / WEEKDAY (PM)

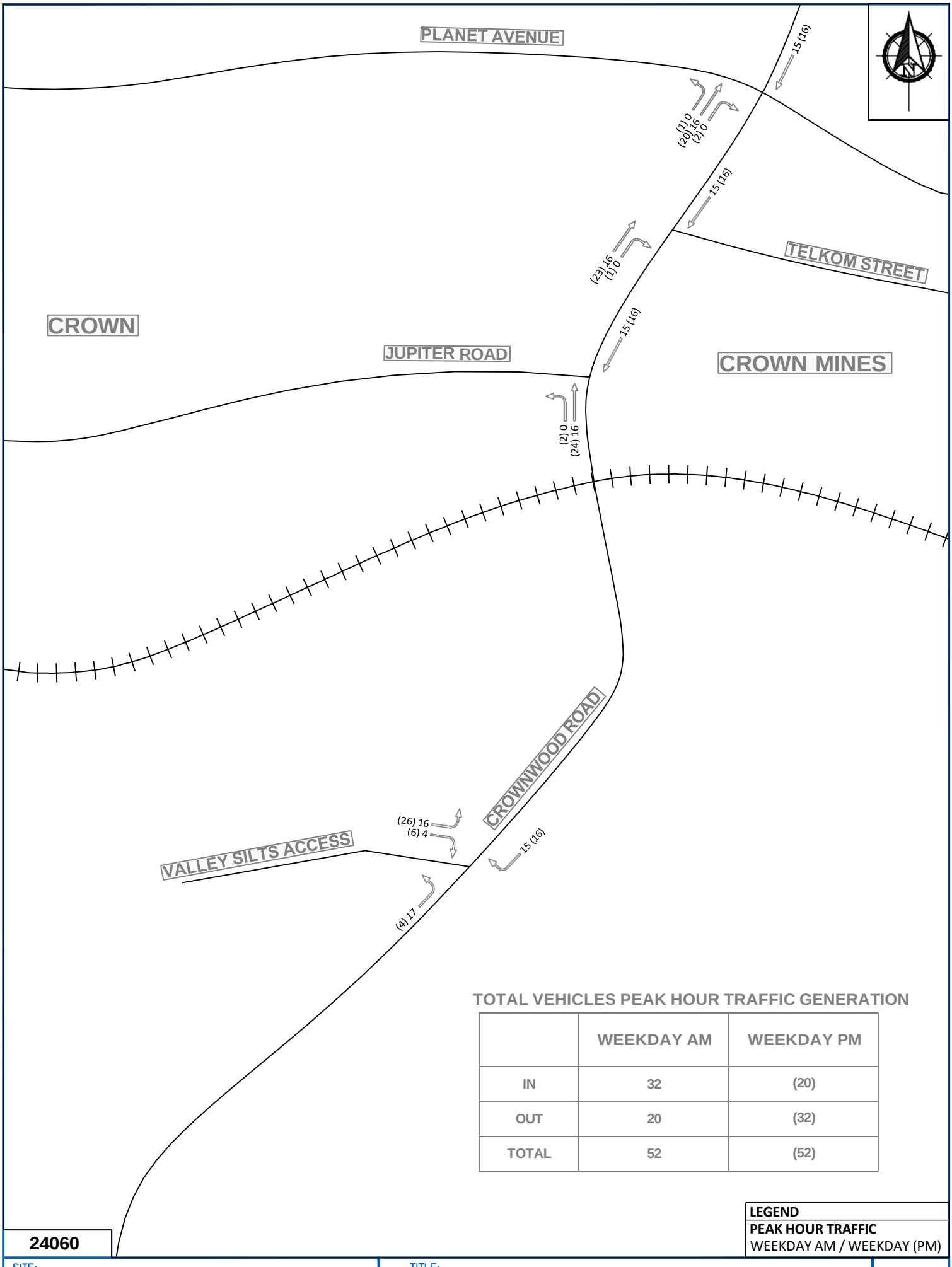
24060

SITE:
VALLEY SILTS EXPANSION

TITLE:
HV DEVELOPMENT WEEKDAY PEAK HOUR TRAFFIC

FIG 4

EDL ENGINEERS



TOTAL VEHICLES PEAK HOUR TRAFFIC GENERATION

	WEEKDAY AM	WEEKDAY PM
IN	32	(20)
OUT	20	(32)
TOTAL	52	(52)

LEGEND
PEAK HOUR TRAFFIC
WEEKDAY AM / WEEKDAY (PM)

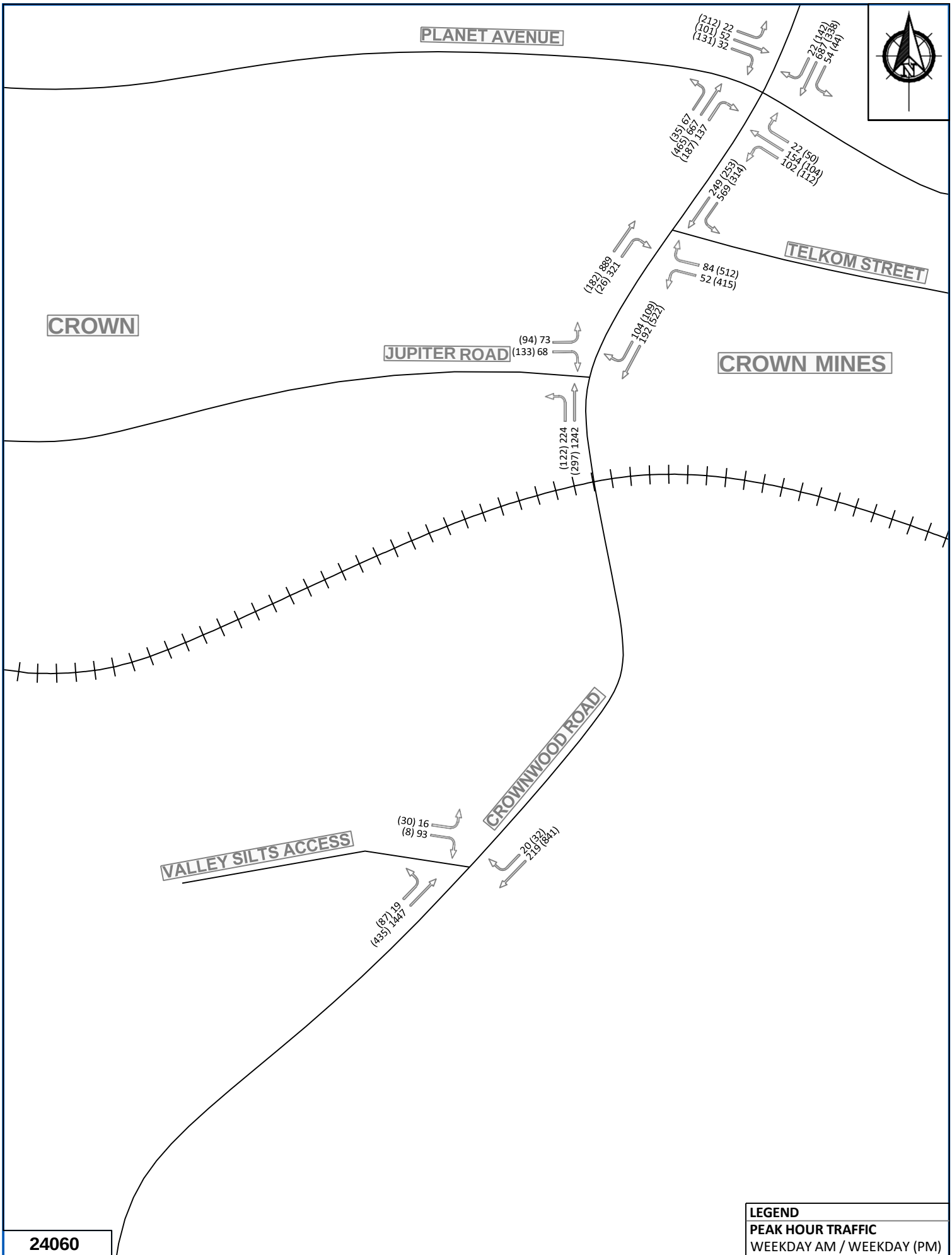
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SITE:
VALLEY SILTS EXPANSION

TITLE:
TOTAL DEVELOPMENT WEEKDAY PEAK HOUR TRAFFIC

FIG 5

EDL ENGINEERS



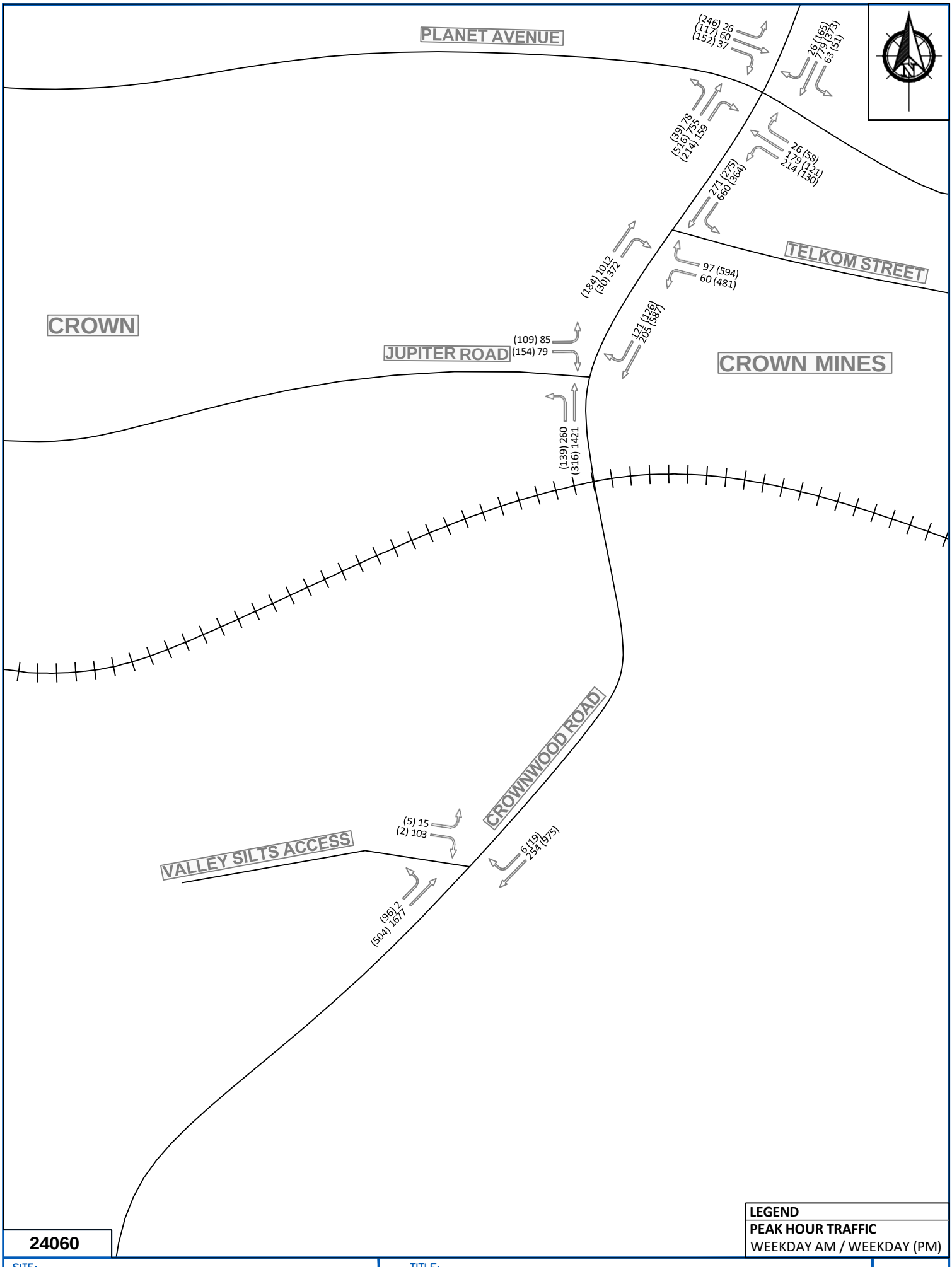
24060

SITE:
VALLEY SILTS EXPANSION

TITLE:
EXISTING 2024 + DEVELOPMENT
WEEKDAY PEAK HOUR TRAFFIC

FIG 6

EDL ENGINEERS



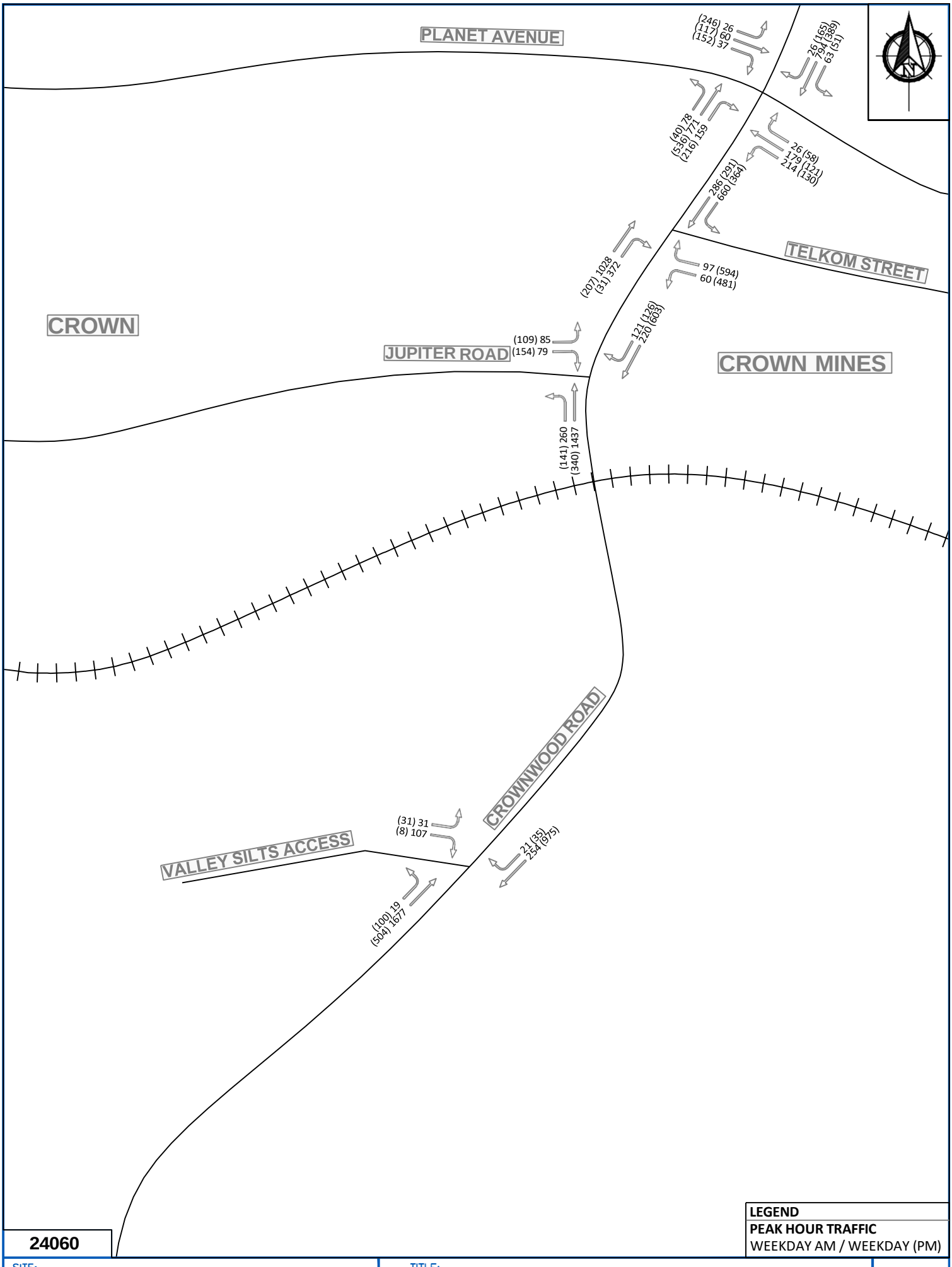
24060

SITE:
VALLEY SILTS EXPANSION

TITLE:
FUTURE 2029 BACKGROUND WEEKDAY PEAK HOUR TRAFFIC

FIG 7

EDL ENGINEERS



24060

SITE:
VALLEY SILTS EXPANSION

TITLE:
FUTURE 2029 BACKGROUND + DEVELOPMENT WEEKDAY PEAK HOUR TRAFFIC

FIG 8

EDL ENGINEERS

Annexure A

SIDRA 9™ Analyses Results:

MOVEMENT SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Ex AM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 Weekday AM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	67	2.0	67	2.0	0.547	25.9	LOS C	10.0	71.5	0.86	0.75	0.86	43.0
2	T1	All MCs	651	2.0	651	2.0	* 0.547	20.4	LOS C	10.1	72.1	0.86	0.74	0.86	44.8
3	R2	All MCs	137	2.0	137	2.0	* 0.369	18.3	LOS B	2.7	19.1	0.81	0.75	0.81	44.9
Approach			855	2.0	855	2.0	0.547	20.5	LOS C	10.1	72.1	0.85	0.75	0.85	44.6
East: Planet Avenue															
4	L2	All MCs	102	2.0	102	2.0	0.056	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	53.4
5	T1	All MCs	154	2.0	154	2.0	* 0.255	19.5	LOS B	4.0	28.3	0.79	0.64	0.79	45.6
6	R2	All MCs	22	2.0	22	2.0	0.055	26.3	LOS C	0.6	4.0	0.77	0.69	0.77	40.9
Approach			278	2.0	278	2.0	0.255	15.0	LOS B	4.0	28.3	0.50	0.60	0.50	47.7
North: Crownwood Road															
7	L2	All MCs	54	2.0	54	2.0	0.086	22.4	LOS C	1.3	8.9	0.71	0.71	0.71	42.5
8	T1	All MCs	672	2.0	672	2.0	0.509	20.0	LOS C	9.3	66.1	0.85	0.72	0.85	45.2
9	R2	All MCs	22	2.0	22	2.0	0.061	17.3	LOS B	0.4	2.8	0.75	0.68	0.75	45.2
Approach			748	2.0	748	2.0	0.509	20.1	LOS C	9.3	66.1	0.83	0.72	0.83	45.0
West: Planet Avenue															
10	L2	All MCs	22	2.0	22	2.0	0.108	24.0	LOS C	1.6	11.1	0.74	0.62	0.74	43.6
11	T1	All MCs	52	2.0	52	2.0	0.108	18.5	LOS B	1.6	11.1	0.75	0.64	0.75	44.5
12	R2	All MCs	32	2.0	32	2.0	0.108	27.5	LOS C	1.1	7.8	0.78	0.69	0.78	41.2
Approach			106	2.0	106	2.0	0.108	22.4	LOS C	1.6	11.1	0.76	0.65	0.76	43.3
All Vehicles			1987	2.0	1987	2.0	0.547	19.7	LOS B	10.1	72.1	0.79	0.71	0.79	45.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Crownwood Road												
P1	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
East: Planet Avenue												

P2	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
North: Crownwood Road												
P3	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
West: Planet Avenue												
P4	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
All Pedestrians		300	300	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Ex PM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 Weekday PM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 62 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	34	2.0	34	2.0	0.484	27.2	LOS C	6.3	45.0	0.90	0.75	0.90	42.5
2	T1	All MCs	445	2.0	445	2.0	* 0.484	21.7	LOS C	6.4	45.3	0.90	0.75	0.90	44.1
3	R2	All MCs	185	2.0	185	2.0	* 0.421	19.0	LOS B	3.7	26.7	0.84	0.77	0.84	44.5
Approach			664	2.0	664	2.0	0.484	21.2	LOS C	6.4	45.3	0.88	0.75	0.88	44.1
East: Planet Avenue															
4	L2	All MCs	112	2.0	112	2.0	0.061	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	53.4
5	T1	All MCs	104	2.0	104	2.0	0.152	14.8	LOS B	2.2	15.4	0.72	0.57	0.72	48.3
6	R2	All MCs	50	2.0	50	2.0	0.151	25.5	LOS C	1.2	8.7	0.81	0.72	0.81	41.3
Approach			266	2.0	266	2.0	0.152	13.0	LOS B	2.2	15.4	0.43	0.58	0.43	48.7
North: Crownwood Road															
7	L2	All MCs	44	2.0	44	2.0	0.093	24.7	LOS C	1.0	7.3	0.79	0.71	0.79	41.4
8	T1	All MCs	322	2.0	322	2.0	0.324	20.6	LOS C	4.1	28.9	0.85	0.69	0.85	44.9
9	R2	All MCs	142	2.0	142	2.0	0.363	19.0	LOS B	2.8	19.9	0.85	0.76	0.85	44.3
Approach			508	2.0	508	2.0	0.363	20.5	LOS C	4.1	28.9	0.85	0.71	0.85	44.4
West: Planet Avenue															
10	L2	All MCs	212	2.0	212	2.0	0.383	22.0	LOS C	5.8	41.1	0.79	0.77	0.79	43.2
11	T1	All MCs	101	2.0	101	2.0	* 0.383	16.3	LOS B	5.8	41.1	0.80	0.75	0.80	44.6
12	R2	All MCs	131	2.0	131	2.0	0.383	23.4	LOS C	4.6	32.6	0.80	0.74	0.80	43.3
Approach			444	2.0	444	2.0	0.383	21.1	LOS C	5.8	41.1	0.80	0.76	0.80	43.5
All Vehicles			1882	2.0	1882	2.0	0.484	19.8	LOS B	6.4	45.3	0.79	0.72	0.79	44.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Crownwood Road												
P1	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
East: Planet Avenue												

P2	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
North: Crownwood Road												
P3	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
West: Planet Avenue												
P4	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
All Pedestrians		300	300	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Ex + Dev AM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	67	2.0	67	2.0	0.559	26.0	LOS C	10.3	73.5	0.87	0.76	0.87	43.0
2	T1	All MCs	667	2.0	667	2.0	* 0.559	20.5	LOS C	10.4	74.1	0.87	0.75	0.87	44.7
3	R2	All MCs	137	2.0	137	2.0	* 0.374	18.3	LOS B	2.7	19.1	0.81	0.75	0.81	44.9
Approach			871	2.0	871	2.0	0.559	20.6	LOS C	10.4	74.1	0.86	0.75	0.86	44.6
East: Planet Avenue															
4	L2	All MCs	102	2.0	102	2.0	0.056	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	53.4
5	T1	All MCs	154	2.0	154	2.0	* 0.255	19.5	LOS B	4.0	28.3	0.79	0.64	0.79	45.6
6	R2	All MCs	22	2.0	22	2.0	0.055	26.3	LOS C	0.6	4.0	0.77	0.69	0.77	40.9
Approach			278	2.0	278	2.0	0.255	15.0	LOS B	4.0	28.3	0.50	0.60	0.50	47.7
North: Crownwood Road															
7	L2	All MCs	54	2.0	54	2.0	0.086	22.4	LOS C	1.3	8.9	0.71	0.71	0.71	42.5
8	T1	All MCs	687	2.0	687	2.0	0.520	20.1	LOS C	9.5	67.9	0.85	0.73	0.85	45.1
9	R2	All MCs	22	2.0	22	2.0	0.062	17.3	LOS B	0.4	2.8	0.75	0.68	0.75	45.2
Approach			763	2.0	763	2.0	0.520	20.2	LOS C	9.5	67.9	0.84	0.72	0.84	45.0
West: Planet Avenue															
10	L2	All MCs	22	2.0	22	2.0	0.108	24.0	LOS C	1.6	11.1	0.74	0.62	0.74	43.6
11	T1	All MCs	52	2.0	52	2.0	0.108	18.5	LOS B	1.6	11.1	0.75	0.64	0.75	44.5
12	R2	All MCs	32	2.0	32	2.0	0.108	27.5	LOS C	1.1	7.8	0.78	0.69	0.78	41.2
Approach			106	2.0	106	2.0	0.108	22.4	LOS C	1.6	11.1	0.76	0.65	0.76	43.3
All Vehicles			2018	2.0	2018	2.0	0.559	19.7	LOS B	10.4	74.1	0.79	0.71	0.79	45.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Crownwood Road												
P1	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
East: Planet Avenue												

P2	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
North: Crownwood Road												
P3	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
West: Planet Avenue												
P4	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
All Pedestrians		300	300	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Ex + Dev PM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 62 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	35	2.0	35	2.0	0.505	27.4	LOS C	6.6	47.3	0.90	0.76	0.90	42.4
2	T1	All MCs	465	2.0	465	2.0	* 0.505	21.8	LOS C	6.7	47.6	0.90	0.75	0.90	44.0
3	R2	All MCs	187	2.0	187	2.0	* 0.431	19.0	LOS B	3.8	27.0	0.84	0.77	0.84	44.5
Approach			687	2.0	687	2.0	0.505	21.3	LOS C	6.7	47.6	0.89	0.76	0.89	44.1
East: Planet Avenue															
4	L2	All MCs	112	2.0	112	2.0	0.061	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	53.4
5	T1	All MCs	104	2.0	104	2.0	0.152	14.8	LOS B	2.2	15.4	0.72	0.57	0.72	48.3
6	R2	All MCs	50	2.0	50	2.0	0.151	25.5	LOS C	1.2	8.7	0.81	0.72	0.81	41.3
Approach			266	2.0	266	2.0	0.152	13.0	LOS B	2.2	15.4	0.43	0.58	0.43	48.7
North: Crownwood Road															
7	L2	All MCs	44	2.0	44	2.0	0.093	24.7	LOS C	1.0	7.3	0.79	0.71	0.79	41.4
8	T1	All MCs	338	2.0	338	2.0	0.340	20.7	LOS C	4.3	30.5	0.86	0.70	0.86	44.8
9	R2	All MCs	142	2.0	142	2.0	0.369	19.0	LOS B	2.8	19.9	0.85	0.76	0.85	44.3
Approach			524	2.0	524	2.0	0.369	20.6	LOS C	4.3	30.5	0.85	0.71	0.85	44.4
West: Planet Avenue															
10	L2	All MCs	212	2.0	212	2.0	0.383	22.0	LOS C	5.8	41.1	0.79	0.77	0.79	43.2
11	T1	All MCs	101	2.0	101	2.0	* 0.383	16.3	LOS B	5.8	41.1	0.80	0.75	0.80	44.6
12	R2	All MCs	131	2.0	131	2.0	0.383	23.4	LOS C	4.6	32.6	0.80	0.74	0.80	43.3
Approach			444	2.0	444	2.0	0.383	21.1	LOS C	5.8	41.1	0.80	0.76	0.80	43.5
All Vehicles			1921	2.0	1921	2.0	0.505	19.9	LOS B	6.7	47.6	0.79	0.72	0.79	44.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Crownwood Road												
P1	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
East: Planet Avenue												

P2	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
North: Crownwood Road												
P3	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
West: Planet Avenue												
P4	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
All Pedestrians		300	300	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Fut AM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background Weekday AM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	78	2.0	78	2.0	0.725	31.0	LOS C	13.4	95.7	0.95	0.87	1.02	40.6
2	T1	All MCs	755	2.0	755	2.0	* 0.725	25.4	LOS C	13.6	96.6	0.95	0.86	1.02	42.2
3	R2	All MCs	159	2.0	159	2.0	* 0.407	19.2	LOS B	3.1	21.9	0.87	0.77	0.87	44.4
Approach			992	2.0	992	2.0	0.725	24.9	LOS C	13.6	96.6	0.94	0.85	0.99	42.4
East: Planet Avenue															
4	L2	All MCs	214	2.0	214	2.0	0.117	5.7	LOS A	0.0	0.0	0.00	0.53	0.00	53.4
5	T1	All MCs	179	2.0	179	2.0	* 0.296	19.8	LOS B	4.7	33.4	0.80	0.65	0.80	45.4
6	R2	All MCs	26	2.0	26	2.0	0.066	26.4	LOS C	0.7	4.8	0.77	0.69	0.77	40.9
Approach			419	2.0	419	2.0	0.296	13.0	LOS B	4.7	33.4	0.39	0.59	0.39	48.8
North: Crownwood Road															
7	L2	All MCs	63	2.0	63	2.0	0.115	24.9	LOS C	1.6	11.2	0.76	0.72	0.76	41.3
8	T1	All MCs	779	2.0	779	2.0	0.674	24.0	LOS C	12.1	86.0	0.93	0.81	0.95	43.1
9	R2	All MCs	26	2.0	26	2.0	0.068	18.0	LOS B	0.5	3.2	0.80	0.69	0.80	44.8
Approach			868	2.0	868	2.0	0.674	23.9	LOS C	12.1	86.0	0.92	0.80	0.93	43.0
West: Planet Avenue															
10	L2	All MCs	26	2.0	26	2.0	0.128	24.2	LOS C	1.9	13.3	0.75	0.63	0.75	43.5
11	T1	All MCs	60	2.0	60	2.0	0.128	18.6	LOS B	1.9	13.3	0.75	0.64	0.75	44.5
12	R2	All MCs	37	2.0	37	2.0	0.128	27.6	LOS C	1.3	8.9	0.79	0.70	0.79	41.1
Approach			123	2.0	123	2.0	0.128	22.5	LOS C	1.9	13.3	0.76	0.66	0.76	43.2
All Vehicles			2402	2.0	2402	2.0	0.725	22.3	LOS C	13.6	96.6	0.83	0.78	0.85	43.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Crownwood Road												
P1	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
East: Planet Avenue												

P2	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
North: Crownwood Road												
P3	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
West: Planet Avenue												
P4	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
All Pedestrians		300	300	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Fut PM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background Weekday PM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 62 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	39	2.0	39	2.0	0.561	27.8	LOS C	7.5	53.4	0.92	0.78	0.92	42.2
2	T1	All MCs	516	2.0	516	2.0	* 0.561	22.2	LOS C	7.6	53.8	0.92	0.77	0.92	43.8
3	R2	All MCs	214	2.0	214	2.0	* 0.508	19.3	LOS B	4.4	31.5	0.86	0.78	0.86	44.3
Approach			769	2.0	769	2.0	0.561	21.7	LOS C	7.6	53.8	0.90	0.77	0.90	43.9
East: Planet Avenue															
4	L2	All MCs	130	2.0	130	2.0	0.071	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	53.4
5	T1	All MCs	121	2.0	121	2.0	0.177	15.0	LOS B	2.5	18.1	0.72	0.58	0.72	48.2
6	R2	All MCs	58	2.0	58	2.0	0.193	26.7	LOS C	1.5	10.4	0.83	0.74	0.83	40.7
Approach			309	2.0	309	2.0	0.193	13.3	LOS B	2.5	18.1	0.44	0.59	0.44	48.5
North: Crownwood Road															
7	L2	All MCs	51	2.0	51	2.0	0.108	24.8	LOS C	1.2	8.6	0.80	0.72	0.80	41.3
8	T1	All MCs	373	2.0	373	2.0	0.375	20.9	LOS C	4.8	34.0	0.87	0.71	0.87	44.7
9	R2	All MCs	165	2.0	165	2.0	0.448	19.5	LOS B	3.3	23.5	0.88	0.77	0.88	44.0
Approach			589	2.0	589	2.0	0.448	20.9	LOS C	4.8	34.0	0.87	0.73	0.87	44.2
West: Planet Avenue															
10	L2	All MCs	246	2.0	246	2.0	0.449	22.4	LOS C	7.0	49.7	0.81	0.78	0.81	42.9
11	T1	All MCs	117	2.0	117	2.0	* 0.449	16.7	LOS B	7.0	49.7	0.82	0.77	0.82	44.3
12	R2	All MCs	152	2.0	152	2.0	0.449	23.9	LOS C	5.4	38.4	0.83	0.76	0.83	43.0
Approach			515	2.0	515	2.0	0.449	21.6	LOS C	7.0	49.7	0.82	0.77	0.82	43.3
All Vehicles			2182	2.0	2182	2.0	0.561	20.2	LOS C	7.6	53.8	0.81	0.73	0.81	44.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Crownwood Road												
P1	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
East: Planet Avenue												

P2	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
North: Crownwood Road												
P3	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
West: Planet Avenue												
P4	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
All Pedestrians		300	300	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Fut + Dev AM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	78	2.0	78	2.0	0.646	26.9	LOS C	12.4	88.4	0.90	0.79	0.90	42.6
2	T1	All MCs	771	2.0	771	2.0	* 0.646	21.3	LOS C	12.5	89.2	0.90	0.78	0.90	44.3
3	R2	All MCs	159	2.0	159	2.0	* 0.470	19.2	LOS B	3.2	22.5	0.86	0.77	0.86	44.4
Approach			1008	2.0	1008	2.0	0.646	21.4	LOS C	12.5	89.2	0.89	0.78	0.89	44.1
East: Planet Avenue															
4	L2	All MCs	214	2.0	214	2.0	0.117	5.7	LOS A	0.0	0.0	0.00	0.53	0.00	53.4
5	T1	All MCs	179	2.0	179	2.0	* 0.296	19.8	LOS B	4.7	33.4	0.80	0.65	0.80	45.4
6	R2	All MCs	26	2.0	26	2.0	0.066	26.4	LOS C	0.7	4.8	0.77	0.69	0.77	40.9
Approach			419	2.0	419	2.0	0.296	13.0	LOS B	4.7	33.4	0.39	0.59	0.39	48.8
North: Crownwood Road															
7	L2	All MCs	63	2.0	63	2.0	0.100	22.5	LOS C	1.5	10.5	0.71	0.72	0.71	42.4
8	T1	All MCs	794	2.0	794	2.0	0.602	20.9	LOS C	11.4	81.3	0.88	0.76	0.88	44.7
9	R2	All MCs	26	2.0	26	2.0	0.079	18.3	LOS B	0.5	3.3	0.80	0.69	0.80	44.7
Approach			883	2.0	883	2.0	0.602	20.9	LOS C	11.4	81.3	0.87	0.76	0.87	44.6
West: Planet Avenue															
10	L2	All MCs	26	2.0	26	2.0	0.128	24.2	LOS C	1.9	13.3	0.75	0.63	0.75	43.5
11	T1	All MCs	60	2.0	60	2.0	0.128	18.6	LOS B	1.9	13.3	0.75	0.64	0.75	44.5
12	R2	All MCs	37	2.0	37	2.0	0.128	27.6	LOS C	1.3	8.9	0.79	0.70	0.79	41.1
Approach			123	2.0	123	2.0	0.128	22.5	LOS C	1.9	13.3	0.76	0.66	0.76	43.2
All Vehicles			2433	2.0	2433	2.0	0.646	19.8	LOS B	12.5	89.2	0.79	0.73	0.79	45.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Crownwood Road												
P1	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
East: Planet Avenue												

P2	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
North: Crownwood Road												
P3	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
West: Planet Avenue												
P4	Full	75	75	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09
All Pedestrians		300	300	29.3	LOS C	0.1	0.1	0.92	0.92	183.2	200.0	1.09

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Fut + Dev PM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 62 seconds (Site Optimum Cycle Time - Minimum Delay)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	40	2.0	40	2.0	0.582	27.9	LOS C	7.8	55.8	0.92	0.78	0.92	42.2
2	T1	All MCs	536	2.0	536	2.0	* 0.582	22.4	LOS C	7.9	56.2	0.92	0.78	0.92	43.8
3	R2	All MCs	216	2.0	216	2.0	* 0.520	19.5	LOS B	4.5	31.8	0.88	0.78	0.88	44.2
Approach			792	2.0	792	2.0	0.582	21.9	LOS C	7.9	56.2	0.91	0.78	0.91	43.8
East: Planet Avenue															
4	L2	All MCs	130	2.0	130	2.0	0.071	5.6	LOS A	0.0	0.0	0.00	0.53	0.00	53.4
5	T1	All MCs	121	2.0	121	2.0	0.177	15.0	LOS B	2.5	18.1	0.72	0.58	0.72	48.2
6	R2	All MCs	58	2.0	58	2.0	0.193	26.7	LOS C	1.5	10.4	0.83	0.74	0.83	40.7
Approach			309	2.0	309	2.0	0.193	13.3	LOS B	2.5	18.1	0.44	0.59	0.44	48.5
North: Crownwood Road															
7	L2	All MCs	51	2.0	51	2.0	0.108	24.8	LOS C	1.2	8.6	0.80	0.72	0.80	41.3
8	T1	All MCs	389	2.0	389	2.0	0.392	21.0	LOS C	5.0	35.6	0.87	0.71	0.87	44.6
9	R2	All MCs	165	2.0	165	2.0	0.455	19.8	LOS B	3.3	23.5	0.90	0.78	0.90	43.9
Approach			605	2.0	605	2.0	0.455	21.0	LOS C	5.0	35.6	0.87	0.73	0.87	44.1
West: Planet Avenue															
10	L2	All MCs	246	2.0	246	2.0	0.449	22.4	LOS C	7.0	49.7	0.81	0.78	0.81	42.9
11	T1	All MCs	117	2.0	117	2.0	* 0.449	16.7	LOS B	7.0	49.7	0.82	0.77	0.82	44.3
12	R2	All MCs	152	2.0	152	2.0	0.449	23.9	LOS C	5.4	38.4	0.83	0.76	0.83	43.0
Approach			515	2.0	515	2.0	0.449	21.6	LOS C	7.0	49.7	0.82	0.77	0.82	43.3
All Vehicles			2221	2.0	2221	2.0	0.582	20.4	LOS C	7.9	56.2	0.81	0.74	0.81	44.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Eff. Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Crownwood Road												
P1	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
East: Planet Avenue												

P2	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
North: Crownwood Road												
P3	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
West: Planet Avenue												
P4	Full	75	75	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12
All Pedestrians		300	300	25.4	LOS C	0.1	0.1	0.91	0.91	179.2	200.0	1.12

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Fut + Dev PM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 62 seconds (Site Optimum Cycle Time - Minimum Delay)

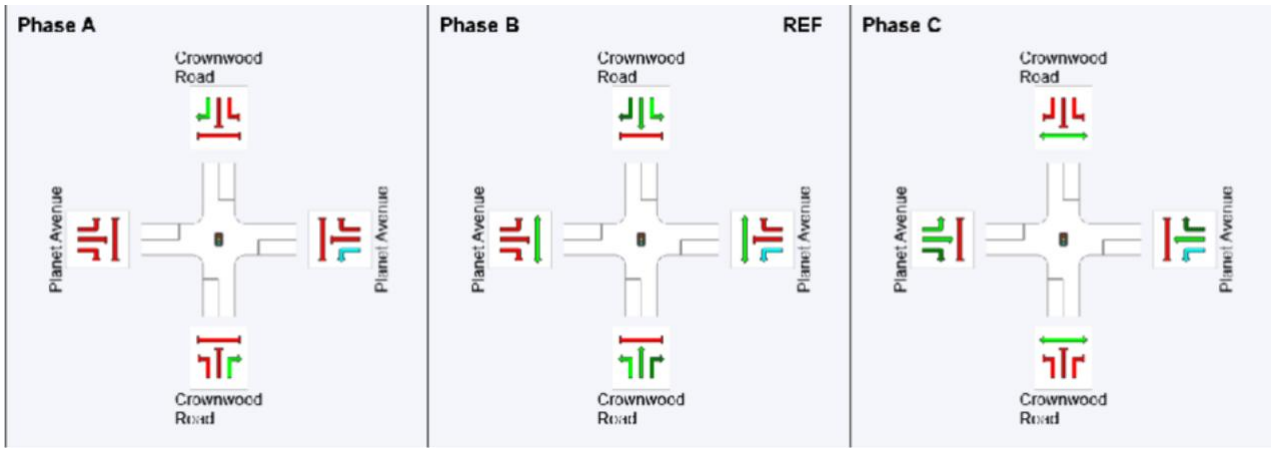
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Four-Phase Leading Right Turns
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C
Reference Phase: Phase B

Phase Timing Summary

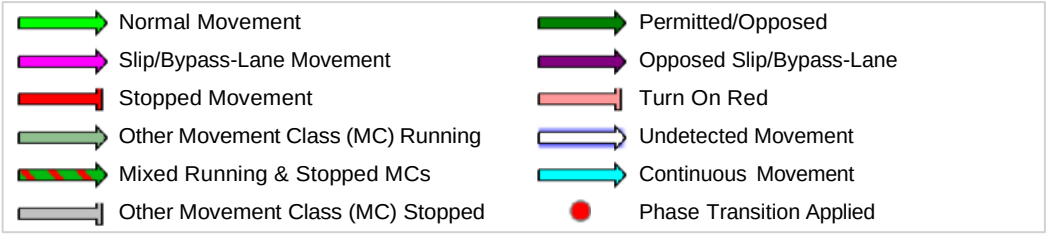
Phase	A	B	C
Phase Change Time (sec)	50	0	22
Green Time (sec)	6	16	22
Phase Time (sec)	12	22	28
Phase Split	19%	35%	45%
Phase Frequency (%)	100.0	100.0	100.0

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



PHASING SUMMARY

Site: 4 [Crownwood Road & Planet Avenue - Fut + Dev AM (Site Folder: Crownwood Rd & Planet Ave)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

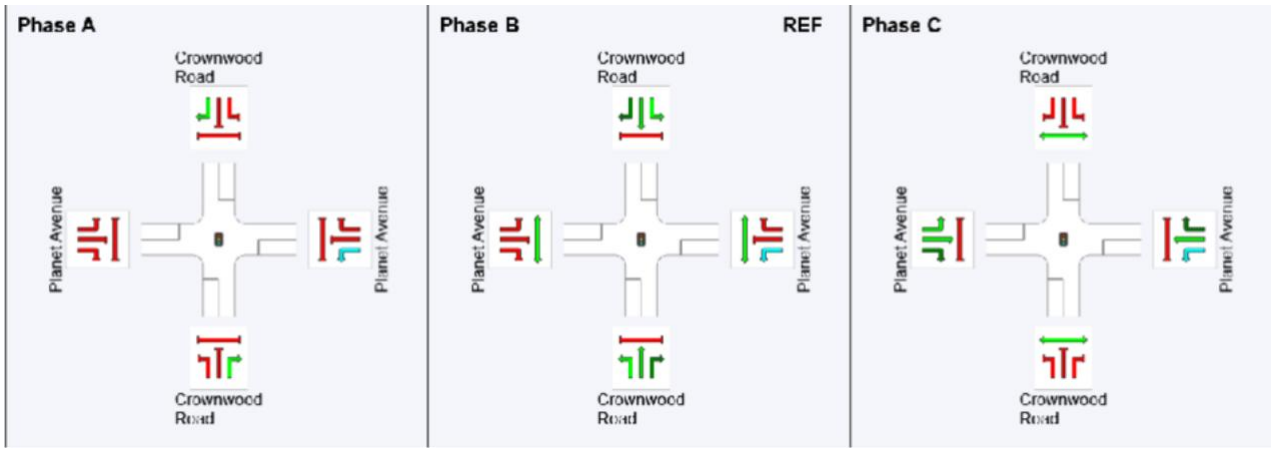
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Four-Phase Leading Right Turns
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C
Reference Phase: Phase B

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	58	0	30
Green Time (sec)	6	24	22
Phase Time (sec)	12	30	28
Phase Split	17%	43%	40%
Phase Frequency (%)	100.0	100.0	100.0

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 3 [Crownwood Road & Telkom Street - Ex AM (Site Folder: Crownwood Rd & Telkom St)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	10	2.0	10	2.0	0.005	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	873	2.0	873	2.0	0.227	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	All MCs	321	2.0	321	2.0	0.608	12.8	LOS B	3.1	21.8	0.70	1.02	1.19	47.8
Approach			1204	2.0	1204	2.0	0.608	3.5	NA	3.1	21.8	0.19	0.28	0.32	56.0
East: Telkom Street															
4	L2	All MCs	52	2.0	52	2.0	0.433	7.8	LOS A	1.9	13.6	0.76	0.84	1.11	44.6
5	T1	All MCs	10	2.0	10	2.0	0.433	19.0	LOS C	1.9	13.6	0.76	0.84	1.11	44.9
6	R2	All MCs	84	2.0	84	2.0	0.433	24.8	LOS C	1.9	13.6	0.76	0.84	1.11	44.8
Approach			146	2.0	146	2.0	0.433	18.4	LOS C	1.9	13.6	0.76	0.84	1.11	44.7
North: Crownwood Road															
7	L2	All MCs	569	2.0	569	2.0	0.311	5.6	LOS A	0.0	0.0	0.00	0.57	0.00	52.7
8	T1	All MCs	234	2.0	234	2.0	0.081	0.6	LOS A	0.3	2.1	0.11	0.12	0.11	58.9
9	R2	All MCs	21	2.0	21	2.0	0.081	9.7	LOS A	0.3	2.1	0.33	0.37	0.33	54.6
Approach			824	2.0	824	2.0	0.311	4.3	NA	0.3	2.1	0.04	0.44	0.04	54.4
West: Filling Station															
10	L2	All MCs	23	0.0	23	0.0	0.017	6.0	LOS A	0.0	0.2	0.22	0.58	0.22	52.2
11	T1	All MCs	12	0.0	12	0.0	0.064	16.0	LOS C	0.2	1.1	0.77	0.90	0.77	46.6
12	R2	All MCs	5	0.0	5	0.0	0.064	14.5	LOS B	0.2	1.1	0.77	0.90	0.77	46.5
Approach			40	0.0	40	0.0	0.064	10.1	LOS B	0.2	1.1	0.45	0.72	0.45	49.6
All Vehicles			2214	2.0	2214	2.0	0.608	4.9	NA	3.1	21.8	0.17	0.38	0.27	54.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 3 [Crownwood Road & Telkom Street - Ex PM (Site Folder: Crownwood Rd & Telkom St)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	10	2.0	10	2.0	0.005	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	159	2.0	159	2.0	0.041	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
3	R2	All MCs	26	2.0	26	2.0	0.040	7.7	LOS A	0.1	0.7	0.39	0.68	0.39	51.2
Approach			195	2.0	195	2.0	0.041	1.3	NA	0.1	0.7	0.05	0.12	0.05	58.2
East: Telkom Street															
4	L2	All MCs	415	2.0	415	2.0	1.074	155.0	LOS F	123.1	876.1	1.00	4.22	9.67	16.2
5	T1	All MCs	11	2.0	11	2.0	1.074	165.1	LOS F	123.1	876.1	1.00	4.22	9.67	16.2
6	R2	All MCs	512	2.0	512	2.0	1.074	169.7	LOS F	123.1	876.1	1.00	4.22	9.67	16.2
Approach			938	2.0	938	2.0	1.074	163.2	LOS F	123.1	876.1	1.00	4.22	9.67	16.2
North: Crownwood Road															
7	L2	All MCs	314	2.0	314	2.0	0.171	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
8	T1	All MCs	237	2.0	237	2.0	0.073	0.1	LOS A	0.1	0.9	0.04	0.06	0.04	59.4
9	R2	All MCs	21	2.0	21	2.0	0.073	6.2	LOS A	0.1	0.9	0.10	0.14	0.10	56.3
Approach			572	2.0	572	2.0	0.171	3.3	NA	0.1	0.9	0.02	0.35	0.02	55.5
West: Filling Station															
10	L2	All MCs	23	0.0	23	0.0	0.015	5.6	LOS A	0.0	0.2	0.08	0.56	0.08	52.7
11	T1	All MCs	12	0.0	12	0.0	0.027	7.8	LOS A	0.1	0.5	0.45	0.70	0.45	51.4
12	R2	All MCs	5	0.0	5	0.0	0.027	9.4	LOS A	0.1	0.5	0.45	0.70	0.45	51.2
Approach			40	0.0	40	0.0	0.027	6.7	LOS A	0.1	0.5	0.24	0.62	0.24	52.1
All Vehicles			1745	2.0	1745	2.0	1.074	89.1	NA	123.1	876.1	0.56	2.41	5.22	24.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 3 [Crownwood Road & Telkom Street - Ex + Dev AM (Site Folder: Crownwood Rd & Telkom St)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	10	2.0	10	2.0	0.005	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	889	2.0	889	2.0	0.231	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	All MCs	321	2.0	321	2.0	0.616	13.0	LOS B	3.1	22.2	0.71	1.03	1.22	47.7
Approach			1220	2.0	1220	2.0	0.616	3.5	NA	3.1	22.2	0.19	0.27	0.32	56.0
East: Telkom Street															
4	L2	All MCs	52	2.0	52	2.0	0.445	8.0	LOS A	2.0	14.0	0.77	0.86	1.14	44.3
5	T1	All MCs	10	2.0	10	2.0	0.445	19.5	LOS C	2.0	14.0	0.77	0.86	1.14	44.6
6	R2	All MCs	84	2.0	84	2.0	0.445	25.6	LOS D	2.0	14.0	0.77	0.86	1.14	44.5
Approach			146	2.0	146	2.0	0.445	18.9	LOS C	2.0	14.0	0.77	0.86	1.14	44.4
North: Crownwood Road															
7	L2	All MCs	569	2.0	569	2.0	0.311	5.6	LOS A	0.0	0.0	0.00	0.57	0.00	52.7
8	T1	All MCs	249	2.0	249	2.0	0.085	0.6	LOS A	0.3	2.1	0.11	0.12	0.11	58.9
9	R2	All MCs	21	2.0	21	2.0	0.085	9.8	LOS A	0.3	2.1	0.32	0.36	0.32	54.7
Approach			839	2.0	839	2.0	0.311	4.3	NA	0.3	2.1	0.04	0.44	0.04	54.4
West: Filling Station															
10	L2	All MCs	23	0.0	23	0.0	0.017	6.0	LOS A	0.0	0.2	0.22	0.59	0.22	52.2
11	T1	All MCs	12	0.0	12	0.0	0.066	16.4	LOS C	0.2	1.2	0.78	0.90	0.78	46.4
12	R2	All MCs	5	0.0	5	0.0	0.066	14.9	LOS B	0.2	1.2	0.78	0.90	0.78	46.3
Approach			40	0.0	40	0.0	0.066	10.2	LOS B	0.2	1.2	0.46	0.72	0.46	49.5
All Vehicles			2245	2.0	2245	2.0	0.616	4.9	NA	3.1	22.2	0.17	0.38	0.27	54.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 3 [Crownwood Road & Telkom Street - Ex + Dev PM (Site Folder: Crownwood Rd & Telkom St)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	10	2.0	10	2.0	0.005	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	182	2.0	182	2.0	0.047	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
3	R2	All MCs	26	2.0	26	2.0	0.040	7.8	LOS A	0.1	0.7	0.39	0.69	0.39	51.2
Approach			218	2.0	218	2.0	0.047	1.2	NA	0.1	0.7	0.05	0.11	0.05	58.4
East: Telkom Street															
4	L2	All MCs	415	2.0	415	2.0	1.101	200.4	LOS F	143.0	1018.2	1.00	4.98	11.82	13.5
5	T1	All MCs	10	2.0	10	2.0	1.101	210.6	LOS F	143.0	1018.2	1.00	4.98	11.82	13.5
6	R2	All MCs	512	2.0	512	2.0	1.101	215.3	LOS F	143.0	1018.2	1.00	4.98	11.82	13.5
Approach			937	2.0	937	2.0	1.101	208.7	LOS F	143.0	1018.2	1.00	4.98	11.82	13.5
North: Crownwood Road															
7	L2	All MCs	314	2.0	314	2.0	0.171	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
8	T1	All MCs	253	2.0	253	2.0	0.078	0.1	LOS A	0.1	1.0	0.04	0.06	0.04	59.4
9	R2	All MCs	21	2.0	21	2.0	0.078	6.3	LOS A	0.1	1.0	0.10	0.14	0.10	56.3
Approach			588	2.0	588	2.0	0.171	3.3	NA	0.1	1.0	0.02	0.34	0.02	55.6
West: Filling Station															
10	L2	All MCs	23	0.0	23	0.0	0.015	5.6	LOS A	0.0	0.2	0.09	0.56	0.09	52.6
11	T1	All MCs	12	0.0	12	0.0	0.028	7.9	LOS A	0.1	0.5	0.47	0.71	0.47	51.2
12	R2	All MCs	5	0.0	5	0.0	0.028	9.6	LOS A	0.1	0.5	0.47	0.71	0.47	51.1
Approach			40	0.0	40	0.0	0.028	6.8	LOS A	0.1	0.5	0.25	0.62	0.25	52.0
All Vehicles			1783	2.0	1783	2.0	1.101	111.0	NA	143.0	1018.2	0.54	2.75	6.23	21.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 3 [Crownwood Road & Telkom Street - Fut AM (Site Folder: Crownwood Rd & Telkom St)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	10	2.0	10	2.0	0.005	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	1012	2.0	1012	2.0	0.322	0.5	LOS A	1.9	13.4	0.24	0.09	0.24	58.8
3	R2	All MCs	372	2.0	372	2.0	0.787	17.6	LOS C	5.3	37.5	0.84	1.26	2.01	45.0
Approach			1394	2.0	1394	2.0	0.787	5.1	NA	5.3	37.5	0.40	0.41	0.71	54.3
East: Telkom Street															
4	L2	All MCs	60	2.0	60	2.0	0.633	11.5	LOS B	3.4	24.0	0.93	1.05	1.73	40.4
5	T1	All MCs	10	2.0	10	2.0	0.633	27.6	LOS D	3.4	24.0	0.93	1.05	1.73	40.6
6	R2	All MCs	97	2.0	97	2.0	0.633	36.4	LOS E	3.4	24.0	0.93	1.05	1.73	40.5
Approach			167	2.0	167	2.0	0.633	27.0	LOS D	3.4	24.0	0.93	1.05	1.73	40.5
North: Crownwood Road															
7	L2	All MCs	660	2.0	660	2.0	0.360	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	52.7
8	T1	All MCs	271	2.0	271	2.0	0.094	0.7	LOS A	0.4	2.5	0.11	0.13	0.11	58.8
9	R2	All MCs	21	2.0	21	2.0	0.094	10.7	LOS B	0.4	2.5	0.33	0.38	0.33	54.3
Approach			952	2.0	952	2.0	0.360	4.4	NA	0.4	2.5	0.04	0.44	0.04	54.3
West: Filling Station															
10	L2	All MCs	23	0.0	23	0.0	0.018	6.2	LOS A	0.0	0.3	0.26	0.61	0.26	52.1
11	T1	All MCs	12	0.0	12	0.0	0.082	19.8	LOS C	0.2	1.4	0.83	0.92	0.83	44.6
12	R2	All MCs	5	0.0	5	0.0	0.082	17.3	LOS C	0.2	1.4	0.83	0.92	0.83	44.5
Approach			40	0.0	40	0.0	0.082	11.6	LOS B	0.2	1.4	0.50	0.74	0.50	48.6
All Vehicles			2553	2.0	2553	2.0	0.787	6.4	NA	5.3	37.5	0.30	0.47	0.52	53.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 3 [Crownwood Road & Telkom Street - Fut PM (Site Folder: Crownwood Rd & Telkom St)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	10	2.0	10	2.0	0.005	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	184	2.0	184	2.0	0.048	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
3	R2	All MCs	30	2.0	30	2.0	0.049	8.1	LOS A	0.1	0.9	0.42	0.72	0.42	50.9
Approach			224	2.0	224	2.0	0.049	1.3	NA	0.1	0.9	0.06	0.12	0.06	58.2
East: Telkom Street															
4	L2	All MCs	481	2.0	481	2.0	1.322	589.6	LOS F	349.2	2486.5	1.00	10.23	26.39	5.5
5	T1	All MCs	10	2.0	10	2.0	1.322	600.0	LOS F	349.2	2486.5	1.00	10.23	26.39	5.5
6	R2	All MCs	594	2.0	594	2.0	1.322	604.7	LOS F	349.2	2486.5	1.00	10.23	26.39	5.5
Approach			1085	2.0	1085	2.0	1.322	598.0	LOS F	349.2	2486.5	1.00	10.23	26.39	5.5
North: Crownwood Road															
7	L2	All MCs	364	2.0	364	2.0	0.199	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.7
8	T1	All MCs	275	2.0	275	2.0	0.083	0.1	LOS A	0.1	1.0	0.04	0.06	0.04	59.4
9	R2	All MCs	21	2.0	21	2.0	0.083	6.3	LOS A	0.1	1.0	0.10	0.13	0.10	56.4
Approach			660	2.0	660	2.0	0.199	3.3	NA	0.1	1.0	0.02	0.34	0.02	55.5
West: Filling Station															
10	L2	All MCs	23	0.0	23	0.0	0.015	5.6	LOS A	0.0	0.2	0.09	0.56	0.09	52.6
11	T1	All MCs	12	0.0	12	0.0	0.030	8.2	LOS A	0.1	0.5	0.50	0.74	0.50	51.0
12	R2	All MCs	5	0.0	5	0.0	0.030	10.2	LOS B	0.1	0.5	0.50	0.74	0.50	50.8
Approach			40	0.0	40	0.0	0.030	7.0	LOS A	0.1	0.5	0.26	0.63	0.26	51.9
All Vehicles			2009	2.0	2009	2.0	1.322	324.3	NA	349.2	2486.5	0.56	5.66	14.27	9.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 3 [Crownwood Road & Telkom Street - Fut + Dev AM (Site Folder: Crownwood Rd & Telkom St)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	10	2.0	10	2.0	0.005	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	1028	2.0	1028	2.0	0.328	0.5	LOS A	1.9	13.9	0.24	0.10	0.25	58.8
3	R2	All MCs	372	2.0	372	2.0	0.797	18.2	LOS C	5.4	38.7	0.85	1.28	2.09	44.7
Approach			1410	2.0	1410	2.0	0.797	5.2	NA	5.4	38.7	0.40	0.41	0.73	54.2
East: Telkom Street															
4	L2	All MCs	60	2.0	60	2.0	0.651	12.1	LOS B	3.5	24.8	0.94	1.08	1.79	39.9
5	T1	All MCs	10	2.0	10	2.0	0.651	28.6	LOS D	3.5	24.8	0.94	1.08	1.79	40.2
6	R2	All MCs	97	2.0	97	2.0	0.651	37.8	LOS E	3.5	24.8	0.94	1.08	1.79	40.0
Approach			167	2.0	167	2.0	0.651	28.0	LOS D	3.5	24.8	0.94	1.08	1.79	40.0
North: Crownwood Road															
7	L2	All MCs	660	2.0	660	2.0	0.360	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	52.7
8	T1	All MCs	286	2.0	286	2.0	0.099	0.7	LOS A	0.4	2.6	0.11	0.12	0.11	58.8
9	R2	All MCs	21	2.0	21	2.0	0.099	10.9	LOS B	0.4	2.6	0.32	0.37	0.32	54.4
Approach			967	2.0	967	2.0	0.360	4.3	NA	0.4	2.6	0.04	0.44	0.04	54.4
West: Filling Station															
10	L2	All MCs	23	0.0	23	0.0	0.018	6.2	LOS A	0.0	0.3	0.27	0.61	0.27	52.1
11	T1	All MCs	12	0.0	12	0.0	0.084	20.2	LOS C	0.2	1.5	0.83	0.92	0.83	44.4
12	R2	All MCs	5	0.0	5	0.0	0.084	17.7	LOS C	0.2	1.5	0.83	0.92	0.83	44.3
Approach			40	0.0	40	0.0	0.084	11.8	LOS B	0.2	1.5	0.51	0.74	0.51	48.5
All Vehicles			2584	2.0	2584	2.0	0.797	6.4	NA	5.4	38.7	0.30	0.47	0.54	53.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 3 [Crownwood Road & Telkom Street - Fut + Dev PM (Site Folder: Crownwood Rd & Telkom St)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	10	2.0	10	2.0	0.005	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	207	2.0	207	2.0	0.054	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
3	R2	All MCs	31	2.0	31	2.0	0.052	8.2	LOS A	0.1	0.9	0.42	0.72	0.42	50.8
Approach			248	2.0	248	2.0	0.054	1.3	NA	0.1	0.9	0.05	0.11	0.05	58.3
East: Telkom Street															
4	L2	All MCs	481	2.0	481	2.0	1.359	656.0	LOS F	375.2	2671.8	1.00	11.18	29.25	5.0
5	T1	All MCs	10	2.0	10	2.0	1.359	666.5	LOS F	375.2	2671.8	1.00	11.18	29.25	5.0
6	R2	All MCs	594	2.0	594	2.0	1.359	671.3	LOS F	375.2	2671.8	1.00	11.18	29.25	5.0
Approach			1085	2.0	1085	2.0	1.359	664.5	LOS F	375.2	2671.8	1.00	11.18	29.25	5.0
North: Crownwood Road															
7	L2	All MCs	364	2.0	364	2.0	0.199	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.7
8	T1	All MCs	291	2.0	291	2.0	0.088	0.1	LOS A	0.1	1.0	0.04	0.06	0.04	59.5
9	R2	All MCs	21	2.0	21	2.0	0.088	6.4	LOS A	0.1	1.0	0.10	0.13	0.10	56.4
Approach			676	2.0	676	2.0	0.199	3.3	NA	0.1	1.0	0.02	0.34	0.02	55.6
West: Filling Station															
10	L2	All MCs	23	0.0	23	0.0	0.015	5.6	LOS A	0.0	0.2	0.09	0.56	0.09	52.6
11	T1	All MCs	12	0.0	12	0.0	0.031	8.4	LOS A	0.1	0.6	0.52	0.75	0.52	50.8
12	R2	All MCs	5	0.0	5	0.0	0.031	10.5	LOS B	0.1	0.6	0.52	0.75	0.52	50.7
Approach			40	0.0	40	0.0	0.031	7.1	LOS A	0.1	0.6	0.27	0.64	0.27	51.8
All Vehicles			2049	2.0	2049	2.0	1.359	353.2	NA	375.2	2671.8	0.55	6.06	15.51	8.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

MOVEMENT SUMMARY

Site: 2 [Crownwood Road & Jupiter Road - Ex AM (Site Folder: Crownwood Rd & Jupiter Rd)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	224	2.0	224	2.0	0.121	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	1226	2.0	1226	2.0	0.315	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.8
Approach			1450	2.0	1450	2.0	0.315	0.9	NA	0.0	0.0	0.00	0.09	0.00	58.6
North: Crownwood Road															
8	T1	All MCs	177	2.0	177	2.0	0.046	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	All MCs	104	2.0	104	2.0	0.349	16.5	LOS C	1.1	7.6	0.78	0.95	0.97	45.6
Approach			281	2.0	281	2.0	0.349	6.1	NA	1.1	7.6	0.29	0.35	0.36	53.7
West: Jupiter Road															
10	L2	All MCs	73	5.0	73	5.0	0.369	8.8	LOS A	1.5	10.9	0.74	0.96	0.98	45.7
12	R2	All MCs	68	5.0	68	5.0	0.369	24.3	LOS C	1.5	10.9	0.74	0.96	0.98	45.9
Approach			141	5.0	141	5.0	0.369	16.3	LOS C	1.5	10.9	0.74	0.96	0.98	45.8
All Vehicles			1872	2.2	1872	2.2	0.369	2.9	NA	1.5	10.9	0.10	0.19	0.13	56.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 2 [Crownwood Road & Jupiter Road - Ex PM (Site Folder: Crownwood Rd & Jupiter Rd)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	120	2.0	120	2.0	0.065	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	273	2.0	273	2.0	0.070	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach			393	2.0	393	2.0	0.070	1.7	NA	0.0	0.0	0.00	0.18	0.00	57.6
North: Crownwood Road															
8	T1	All MCs	506	2.0	506	2.0	0.130	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
9	R2	All MCs	109	2.0	109	2.0	0.147	7.2	LOS A	0.4	2.9	0.35	0.67	0.35	51.6
Approach			615	2.0	615	2.0	0.147	1.3	NA	0.4	2.9	0.06	0.12	0.06	58.3
West: Jupiter Road															
10	L2	All MCs	94	5.0	94	5.0	0.345	6.5	LOS A	1.8	12.8	0.57	0.66	0.66	49.0
12	R2	All MCs	133	5.0	133	5.0	0.345	14.0	LOS B	1.8	12.8	0.57	0.66	0.66	49.3
Approach			227	5.0	227	5.0	0.345	10.9	LOS B	1.8	12.8	0.57	0.66	0.66	49.2
All Vehicles			1235	2.6	1235	2.6	0.345	3.2	NA	1.8	12.8	0.14	0.24	0.15	56.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 2 [Crownwood Road & Jupiter Road - Ex + Dev AM (Site Folder: Crownwood Rd & Jupiter Rd)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	224	2.0	224	2.0	0.121	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	1242	2.0	1242	2.0	0.319	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.8
Approach			1466	2.0	1466	2.0	0.319	0.9	NA	0.0	0.0	0.00	0.09	0.00	58.6
North: Crownwood Road															
8	T1	All MCs	192	2.0	192	2.0	0.049	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	All MCs	104	2.0	104	2.0	0.354	16.8	LOS C	1.1	7.7	0.79	0.96	0.98	45.5
Approach			296	2.0	296	2.0	0.354	5.9	NA	1.1	7.7	0.28	0.34	0.35	53.9
West: Jupiter Road															
10	L2	All MCs	73	5.0	73	5.0	0.380	9.0	LOS A	1.5	11.2	0.75	0.97	1.01	45.4
12	R2	All MCs	68	5.0	68	5.0	0.380	25.1	LOS D	1.5	11.2	0.75	0.97	1.01	45.7
Approach			141	5.0	141	5.0	0.380	16.8	LOS C	1.5	11.2	0.75	0.97	1.01	45.5
All Vehicles			1903	2.2	1903	2.2	0.380	2.9	NA	1.5	11.2	0.10	0.19	0.13	56.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 2 [Crownwood Road & Jupiter Road - Ex + Dev PM (Site Folder: Crownwood Rd & Jupiter Rd)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	122	2.0	122	2.0	0.066	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	297	2.0	297	2.0	0.076	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach			419	2.0	419	2.0	0.076	1.6	NA	0.0	0.0	0.00	0.17	0.00	57.7
North: Crownwood Road															
8	T1	All MCs	522	2.0	522	2.0	0.134	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
9	R2	All MCs	109	2.0	109	2.0	0.150	7.3	LOS A	0.4	2.9	0.37	0.68	0.37	51.5
Approach			631	2.0	631	2.0	0.150	1.3	NA	0.4	2.9	0.06	0.12	0.06	58.3
West: Jupiter Road															
10	L2	All MCs	94	5.0	94	5.0	0.358	6.7	LOS A	1.9	13.9	0.60	0.68	0.72	48.7
12	R2	All MCs	133	5.0	133	5.0	0.358	14.7	LOS B	1.9	13.9	0.60	0.68	0.72	48.9
Approach			227	5.0	227	5.0	0.358	11.4	LOS B	1.9	13.9	0.60	0.68	0.72	48.8
All Vehicles			1277	2.5	1277	2.5	0.358	3.2	NA	1.9	13.9	0.14	0.23	0.16	56.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 2 [Crownwood Road & Jupiter Road - Fut AM (Site Folder: Crownwood Rd & Jupiter Rd)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	260	2.0	260	2.0	0.141	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	1421	2.0	1421	2.0	0.365	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.8
Approach			1681	2.0	1681	2.0	0.365	1.0	NA	0.0	0.0	0.00	0.09	0.00	58.6
North: Crownwood Road															
8	T1	All MCs	205	2.0	205	2.0	0.053	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	All MCs	121	2.0	121	2.0	0.503	21.8	LOS C	1.6	11.7	0.86	1.03	1.22	42.8
Approach			326	2.0	326	2.0	0.503	8.1	NA	1.6	11.7	0.32	0.38	0.45	52.2
West: Jupiter Road															
10	L2	All MCs	85	5.0	85	5.0	0.553	12.0	LOS B	2.4	17.8	0.84	1.09	1.38	42.3
12	R2	All MCs	79	5.0	79	5.0	0.553	34.5	LOS D	2.4	17.8	0.84	1.09	1.38	42.5
Approach			164	5.0	164	5.0	0.553	22.8	LOS C	2.4	17.8	0.84	1.09	1.38	42.4
All Vehicles			2171	2.2	2171	2.2	0.553	3.7	NA	2.4	17.8	0.11	0.21	0.17	55.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 2 [Crownwood Road & Jupiter Road - Fut PM (Site Folder: Crownwood Rd & Jupiter Rd)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	139	2.0	139	2.0	0.075	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	316	2.0	316	2.0	0.081	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach			455	2.0	455	2.0	0.081	1.7	NA	0.0	0.0	0.00	0.18	0.00	57.6
North: Crownwood Road															
8	T1	All MCs	587	2.0	587	2.0	0.151	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
9	R2	All MCs	126	2.0	126	2.0	0.178	7.5	LOS A	0.5	3.6	0.39	0.70	0.39	51.4
Approach			713	2.0	713	2.0	0.178	1.4	NA	0.5	3.6	0.07	0.12	0.07	58.2
West: Jupiter Road															
10	L2	All MCs	109	5.0	109	5.0	0.457	7.9	LOS A	3.1	22.5	0.70	0.78	1.01	47.1
12	R2	All MCs	154	5.0	154	5.0	0.457	18.2	LOS C	3.1	22.5	0.70	0.78	1.01	47.3
Approach			263	5.0	263	5.0	0.457	13.9	LOS B	3.1	22.5	0.70	0.78	1.01	47.2
All Vehicles			1431	2.6	1431	2.6	0.457	3.8	NA	3.1	22.5	0.16	0.26	0.22	55.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 2 [Crownwood Road & Jupiter Road - Fut + Dev AM (Site Folder: Crownwood Rd & Jupiter Rd)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	260	2.0	260	2.0	0.141	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	1437	2.0	1437	2.0	0.369	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.8
Approach			1697	2.0	1697	2.0	0.369	1.0	NA	0.0	0.0	0.00	0.09	0.00	58.6
North: Crownwood Road															
8	T1	All MCs	220	2.0	220	2.0	0.057	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
9	R2	All MCs	121	2.0	121	2.0	0.510	22.2	LOS C	1.7	11.9	0.87	1.03	1.23	42.6
Approach			341	2.0	341	2.0	0.510	7.9	NA	1.7	11.9	0.31	0.37	0.44	52.4
West: Jupiter Road															
10	L2	All MCs	85	5.0	85	5.0	0.570	12.4	LOS B	2.5	18.5	0.85	1.11	1.42	41.8
12	R2	All MCs	79	5.0	79	5.0	0.570	35.9	LOS E	2.5	18.5	0.85	1.11	1.42	42.0
Approach			164	5.0	164	5.0	0.570	23.7	LOS C	2.5	18.5	0.85	1.11	1.42	41.9
All Vehicles			2202	2.2	2202	2.2	0.570	3.7	NA	2.5	18.5	0.11	0.21	0.17	55.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 2 [Crownwood Road & Jupiter Road - Fut + Dev PM (Site Folder: Crownwood Rd & Jupiter Rd)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Crownwood Road															
1	L2	All MCs	141	2.0	141	2.0	0.076	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	52.8
2	T1	All MCs	340	2.0	340	2.0	0.087	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach			481	2.0	481	2.0	0.087	1.6	NA	0.0	0.0	0.00	0.17	0.00	57.7
North: Crownwood Road															
8	T1	All MCs	603	2.0	603	2.0	0.155	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
9	R2	All MCs	126	2.0	126	2.0	0.182	7.7	LOS A	0.5	3.6	0.40	0.71	0.40	51.3
Approach			729	2.0	729	2.0	0.182	1.4	NA	0.5	3.6	0.07	0.12	0.07	58.2
West: Jupiter Road															
10	L2	All MCs	109	5.0	109	5.0	0.475	8.2	LOS A	3.2	23.6	0.72	0.81	1.09	46.7
12	R2	All MCs	154	5.0	154	5.0	0.475	19.1	LOS C	3.2	23.6	0.72	0.81	1.09	46.9
Approach			263	5.0	263	5.0	0.475	14.6	LOS B	3.2	23.6	0.72	0.81	1.09	46.8
All Vehicles			1473	2.5	1473	2.5	0.475	3.8	NA	3.2	23.6	0.16	0.26	0.23	55.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 1 [Crownwood Road & Valley Silts Access - Ex AM (Site Folder: Crownwood Rd & Valley Silts Access)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
NorthEast: Crownwood Road															
8	T1	All MCs	219	2.0	219	2.0	0.124	0.5	LOS A	0.1	1.0	0.06	0.07	0.06	59.3
9	R2	All MCs	5	2.0	5	2.0	0.124	12.8	LOS B	0.1	1.0	0.06	0.07	0.06	57.4
Approach			224	2.0	224	2.0	0.124	0.7	NA	0.1	1.0	0.06	0.07	0.06	59.3
NorthWest: Valley Sitls Access															
10	L2	All MCs	13	2.0	13	2.0	0.329	14.3	LOS B	1.1	8.0	0.82	0.96	1.00	45.1
12	R2	All MCs	89	2.0	89	2.0	0.329	18.2	LOS C	1.1	8.0	0.82	0.96	1.00	45.5
Approach			102	2.0	102	2.0	0.329	17.7	LOS C	1.1	8.0	0.82	0.96	1.00	45.4
SouthWest: Crownwood Road															
1	L2	All MCs	2	2.0	2	2.0	0.753	6.1	LOS A	0.0	0.0	0.00	0.00	0.00	56.4
2	T1	All MCs	1447	2.0	1447	2.0	0.753	0.7	LOS A	0.0	0.0	0.00	0.00	0.00	58.8
Approach			1449	2.0	1449	2.0	0.753	0.7	NA	0.0	0.0	0.00	0.00	0.00	58.8
All Vehicles			1775	2.0	1775	2.0	0.753	1.7	NA	1.1	8.0	0.06	0.07	0.07	57.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 1 [Crownwood Road & Valley Silts Access - Ex PM (Site Folder: Crownwood Rd & Valley Silts Access)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
NorthEast: Crownwood Road															
8	T1	All MCs	841	2.0	841	2.0	0.450	0.1	LOS A	0.2	1.8	0.03	0.03	0.03	59.7
9	R2	All MCs	16	2.0	16	2.0	0.450	7.2	LOS A	0.2	1.8	0.03	0.03	0.03	57.8
Approach			857	2.0	857	2.0	0.450	0.2	NA	0.2	1.8	0.03	0.03	0.03	59.7
NorthWest: Valley Sitls Access															
10	L2	All MCs	4	2.0	4	2.0	0.008	6.8	LOS A	0.0	0.2	0.50	0.60	0.50	50.7
12	R2	All MCs	2	2.0	2	2.0	0.008	12.0	LOS B	0.0	0.2	0.50	0.60	0.50	51.1
Approach			6	2.0	6	2.0	0.008	8.5	LOS A	0.0	0.2	0.50	0.60	0.50	50.8
SouthWest: Crownwood Road															
1	L2	All MCs	83	2.0	83	2.0	0.271	5.6	LOS A	0.0	0.0	0.00	0.10	0.00	56.5
2	T1	All MCs	435	2.0	435	2.0	0.271	0.1	LOS A	0.0	0.0	0.00	0.10	0.00	59.0
Approach			518	2.0	518	2.0	0.271	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.6
All Vehicles			1381	2.0	1381	2.0	0.450	0.5	NA	0.2	1.8	0.02	0.06	0.02	59.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 1 [Crownwood Road & Valley Silts Access - Ex + Dev AM (Site Folder: Crownwood Rd & Valley Silts Access)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
NorthEast: Crownwood Road															
8	T1	All MCs	219	2.0	219	2.0	0.154	1.7	LOS A	0.5	3.8	0.22	0.26	0.22	57.6
9	R2	All MCs	20	2.0	20	2.0	0.154	12.9	LOS B	0.5	3.8	0.22	0.26	0.22	55.8
Approach			239	2.0	239	2.0	0.154	2.6	NA	0.5	3.8	0.22	0.26	0.22	57.4
NorthWest: Valley Sitls Access															
10	L2	All MCs	16	2.0	16	2.0	0.351	14.5	LOS B	1.2	8.7	0.83	0.97	1.03	44.9
12	R2	All MCs	93	2.0	93	2.0	0.351	18.6	LOS C	1.2	8.7	0.83	0.97	1.03	45.3
Approach			109	2.0	109	2.0	0.351	18.0	LOS C	1.2	8.7	0.83	0.97	1.03	45.2
SouthWest: Crownwood Road															
1	L2	All MCs	19	2.0	19	2.0	0.762	6.1	LOS A	0.0	0.0	0.00	0.01	0.00	56.3
2	T1	All MCs	1447	2.0	1447	2.0	0.762	0.7	LOS A	0.0	0.0	0.00	0.01	0.00	58.7
Approach			1466	2.0	1466	2.0	0.762	0.8	NA	0.0	0.0	0.00	0.01	0.00	58.6
All Vehicles			1814	2.0	1814	2.0	0.762	2.0	NA	1.2	8.7	0.08	0.10	0.09	57.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 1 [Crownwood Road & Valley Silts Access - Ex + Dev PM (Site Folder: Crownwood Rd & Valley Silts Access)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Existing 2024 + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
NorthEast: Crownwood Road															
8	T1	All MCs	841	2.0	841	2.0	0.464	0.2	LOS A	0.5	3.8	0.06	0.06	0.07	59.5
9	R2	All MCs	32	2.0	32	2.0	0.464	7.8	LOS A	0.5	3.8	0.06	0.06	0.07	57.6
Approach			873	2.0	873	2.0	0.464	0.4	NA	0.5	3.8	0.06	0.06	0.07	59.4
NorthWest: Valley Sitls Access															
10	L2	All MCs	30	2.0	30	2.0	0.046	6.9	LOS A	0.2	1.2	0.48	0.65	0.48	51.0
12	R2	All MCs	8	2.0	8	2.0	0.046	12.4	LOS B	0.2	1.2	0.48	0.65	0.48	51.5
Approach			38	2.0	38	2.0	0.046	8.1	LOS A	0.2	1.2	0.48	0.65	0.48	51.1
SouthWest: Crownwood Road															
1	L2	All MCs	87	2.0	87	2.0	0.273	5.6	LOS A	0.0	0.0	0.00	0.10	0.00	56.5
2	T1	All MCs	435	2.0	435	2.0	0.273	0.1	LOS A	0.0	0.0	0.00	0.10	0.00	59.0
Approach			522	2.0	522	2.0	0.273	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.5
All Vehicles			1433	2.0	1433	2.0	0.464	0.9	NA	0.5	3.8	0.05	0.09	0.06	58.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 1 [Crownwood Road & Valley Silts Access - Fut AM (Site Folder: Crownwood Rd & Valley Silts Access)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
NorthEast: Crownwood Road															
8	T1	All MCs	254	2.0	254	2.0	0.147	0.7	LOS A	0.2	1.6	0.08	0.09	0.08	59.0
9	R2	All MCs	6	2.0	6	2.0	0.147	15.0	LOS B	0.2	1.6	0.08	0.09	0.08	57.1
Approach			260	2.0	260	2.0	0.147	1.0	NA	0.2	1.6	0.08	0.09	0.08	59.0
NorthWest: Valley Sitls Access															
10	L2	All MCs	15	2.0	15	2.0	0.486	19.1	LOS C	1.8	12.5	0.89	1.03	1.23	41.9
12	R2	All MCs	103	2.0	103	2.0	0.486	24.7	LOS C	1.8	12.5	0.89	1.03	1.23	42.2
Approach			118	2.0	118	2.0	0.486	24.0	LOS C	1.8	12.5	0.89	1.03	1.23	42.1
SouthWest: Crownwood Road															
1	L2	All MCs	2	2.0	2	2.0	0.872	6.8	LOS A	0.0	0.0	0.00	0.00	0.00	55.2
2	T1	All MCs	1677	2.0	1677	2.0	0.872	1.5	LOS A	0.0	0.0	0.00	0.00	0.00	57.4
Approach			1679	2.0	1679	2.0	0.872	1.5	NA	0.0	0.0	0.00	0.00	0.00	57.4
All Vehicles			2057	2.0	2057	2.0	0.872	2.7	NA	1.8	12.5	0.06	0.07	0.08	56.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 1 [Crownwood Road & Valley Silts Access - Fut PM (Site Folder: Crownwood Rd & Valley Silts Access)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
NorthEast: Crownwood Road															
8	T1	All MCs	975	2.0	975	2.0	0.523	0.1	LOS A	0.4	3.2	0.04	0.04	0.05	59.7
9	R2	All MCs	19	2.0	19	2.0	0.523	8.0	LOS A	0.4	3.2	0.04	0.04	0.05	57.8
Approach			994	2.0	994	2.0	0.523	0.3	NA	0.4	3.2	0.04	0.04	0.05	59.7
NorthWest: Valley Sitls Access															
10	L2	All MCs	5	2.0	5	2.0	0.011	7.0	LOS A	0.0	0.2	0.53	0.63	0.53	50.4
12	R2	All MCs	2	2.0	2	2.0	0.011	13.9	LOS B	0.0	0.2	0.53	0.63	0.53	50.8
Approach			7	2.0	7	2.0	0.011	9.0	LOS A	0.0	0.2	0.53	0.63	0.53	50.5
SouthWest: Crownwood Road															
1	L2	All MCs	96	2.0	96	2.0	0.314	5.6	LOS A	0.0	0.0	0.00	0.10	0.00	56.5
2	T1	All MCs	504	2.0	504	2.0	0.314	0.1	LOS A	0.0	0.0	0.00	0.10	0.00	59.0
Approach			600	2.0	600	2.0	0.314	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.6
All Vehicles			1601	2.0	1601	2.0	0.523	0.6	NA	0.4	3.2	0.02	0.06	0.03	59.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 1 [Crownwood Road & Valley Silts Access - Fut + Dev AM (Site Folder: Crownwood Rd & Valley Silts Access)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday AM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
NorthEast: Crownwood Road															
8	T1	All MCs	254	2.0	254	2.0	0.184	2.2	LOS A	0.7	5.2	0.24	0.27	0.24	57.0
9	R2	All MCs	21	2.0	21	2.0	0.184	15.1	LOS C	0.7	5.2	0.24	0.27	0.24	55.3
Approach			275	2.0	275	2.0	0.184	3.2	NA	0.7	5.2	0.24	0.27	0.24	56.9
NorthWest: Valley Sitls Access															
10	L2	All MCs	31	2.0	31	2.0	0.549	20.3	LOS C	2.1	15.0	0.90	1.06	1.34	41.5
12	R2	All MCs	107	2.0	107	2.0	0.549	26.2	LOS D	2.1	15.0	0.90	1.06	1.34	41.8
Approach			138	2.0	138	2.0	0.549	24.8	LOS C	2.1	15.0	0.90	1.06	1.34	41.7
SouthWest: Crownwood Road															
1	L2	All MCs	19	2.0	19	2.0	0.882	6.9	LOS A	0.0	0.0	0.00	0.01	0.00	55.0
2	T1	All MCs	1677	2.0	1677	2.0	0.882	1.6	LOS A	0.0	0.0	0.00	0.01	0.00	57.1
Approach			1696	2.0	1696	2.0	0.882	1.6	NA	0.0	0.0	0.00	0.01	0.00	57.1
All Vehicles			2109	2.0	2109	2.0	0.882	3.4	NA	2.1	15.0	0.09	0.11	0.12	55.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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MOVEMENT SUMMARY

Site: 1 [Crownwood Road & Valley Silts Access - Fut + Dev PM (Site Folder: Crownwood Rd & Valley Silts Access)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

Future 2029 Background + Development Weekday PM Peak Hour Traffic
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
NorthEast: Crownwood Road															
8	T1	All MCs	975	2.0	975	2.0	0.538	0.3	LOS A	0.9	6.2	0.07	0.07	0.10	59.5
9	R2	All MCs	35	2.0	35	2.0	0.538	8.4	LOS A	0.9	6.2	0.07	0.07	0.10	57.5
Approach			1010	2.0	1010	2.0	0.538	0.6	NA	0.9	6.2	0.07	0.07	0.10	59.4
NorthWest: Valley Sitls Access															
10	L2	All MCs	31	2.0	31	2.0	0.053	7.1	LOS A	0.2	1.3	0.52	0.68	0.52	50.6
12	R2	All MCs	8	2.0	8	2.0	0.053	14.4	LOS B	0.2	1.3	0.52	0.68	0.52	51.1
Approach			39	2.0	39	2.0	0.053	8.6	LOS A	0.2	1.3	0.52	0.68	0.52	50.7
SouthWest: Crownwood Road															
1	L2	All MCs	100	2.0	100	2.0	0.316	5.6	LOS A	0.0	0.0	0.00	0.10	0.00	56.5
2	T1	All MCs	504	2.0	504	2.0	0.316	0.1	LOS A	0.0	0.0	0.00	0.10	0.00	58.9
Approach			604	2.0	604	2.0	0.316	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.5
All Vehicles			1653	2.0	1653	2.0	0.538	0.9	NA	0.9	6.2	0.05	0.09	0.07	58.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

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CURRICULUM VITAE: EBEN KOTZE, Managing Director



Years with the firm

2½ years

Years in total

27 years

Areas of practice

Traffic impact assessments

Access studies

Feasibility studies

Parking relaxation studies

Traffic signal designs

Civil services reports

Road rehabilitation

Filling Stations

Shopping Centres

Big Box Rentals

Warehouses

Hardware/Builders

Stormwater Design

Bulk earthworks

Road geometric design

Intersection Upgrades

Road widening

Languages

English

Afrikaans

CAREER SUMMARY

I am a registered professional and director, with more than 27 years' experience in Traffic & Transportation, Project Management and Civil Engineering disciplines, working in the commercial, residential, hospitality, mining and retail fuel sectors.

I have successfully completed personally and overseen or lead the preparation of over 950 Traffic Impact Studies, more than 200 Feasibility Studies (Filling Stations) and hundreds of other traffic related reports over 22 years from 1998 to 2020.

In the beginning of 2018, I founded a new consultancy company (EDL Engineers), where I am employed as the Managing Director. I have extensive knowledge in traffic & transportation planning for development nodes and urban areas in the afore mentioned sectors that I have gained over more than two decades. I have also gained valuable civil engineering experience over the past 27 years in the various sectors mentioned above. I started my career in KZN in 1993 working for Consulting Engineers Theron Prinsloo GrimsehI & Pullen and Dept of Roads as a technician and moved to Gauteng in mid-1998 to join Brian Roberts & Associates as a project manager where I started working on and producing traffic & transportation studies and also gained valuable experience on engineering projects (and have since been involved in both the traffic & transportation and civil engineering disciplines). I became a director and partner in the beginning of 2006 at Infragen Consultants, which was bought by the WSP Group in September 2008. After leaving WSP in the beginning of 2018, I have founded a new company known as EDL Engineers. As the Managing Director I focus mainly on traffic and transportation projects, with some of these projects leading to civil engineering appointments for various developments, including filling stations, shopping centres and a wide variety of infrastructure projects.

Countries of work experience include South Africa, Swaziland and Mozambique.

EDUCATION

Construction Regulations 2014 Training Course, EOH Legal Services	2015
Certificate in JBCC, FIDIC, and Procsa Contracts, i-Sizeze Consulting & Training	2014
B.Tech Business Administration, University of South Africa	2007
B.Tech Civil Engineering (Construction Management), Technikon Witwatersrand	1999
T4 Higher National Diploma Civil Engineering, Technikon Natal	1993

PROFESSIONAL MEMBERSHIPS

SARF - South African Road Federation – Member (K91)

ECSA - Engineering Council of South Africa – Pr Tech Eng (200370133)

SAICE - South African Institute of Civil Engineers – Member (202000557)

REFERENCES

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AfriPlan	Jaco Le Roux	Senior Prof. Town Planner	Tel: 013 282 8035 072 391 2604 jaco@afriplan.com
SANRAL (SA National Roads Agency Ltd)	Izak Van der Linde / Klaus Schmid	Planning Manager	+27 (0)83 459 9574 +27 (12) 426 6213 +27 (0) 83 275 0010 VDLindeI@nra.co.za SchmidK@nra.co.za
J Paul Van Wyk Planners	Paul Van Wykr	Director / Prof. Town Planner	+27 (0)82893 7370/ 012 996 0097 airtaxi@mweb.co.za
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Philo Environmental Management	Sindiswa Sethlodi	Director	+27 (0)61 419 6464/ 083 525 6988 sindiswa@philoenviro.co.za

CONTACT DETAILS

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Cell : +27 (0)83 564 1563
Tel : +27 (0)87 897 5074 /5/6

The specialist declaration:

I, Eben Daniël Kotzé declare that -- General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist: 

Name of company (if applicable): **EDL ENGINEERS (PTY) LTD**

Date: 3 JUNE 2025

APPENDIX D:

Specialist Studies

- ❖ Appendix D11 - Closure and Rehabilitation Report

Ergo Mining: Valley Silts Expansion Project

FINAL CLOSURE AND REHABILITATION REPORT

DMRE REFERENCE NUMBER: GP 184 MR

Report Information

Project:	Ergo Mining: Valley Silts Expansion Project
Report Title:	Final Rehabilitation and Closure Report
DMR Reference No:	GP 184 MR
Client:	Ergo Mining (Pty) Ltd
Project No:	DRDG#052
Compilation Date:	March 2025
Status of Report:	Final
Actions:	Intrenal review

Verification	Capacity	Name	Signature	Date
By Author	EAP	Gerlinde Wilreker		31 March 2025
Reviewed by:	Review	Michael Hennessy		31 March 2025
Authorised by	Chief Executive	Bradly Thornton		16 April 2025

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Executive Summary

Introduction and Project Background

Ergo Mining (Pty) Ltd (Ergo), a subsidiary of DRDGOLD Limited, intends to expand its Valley Silts reclamation operation (the Valley Silts Expansion Project). The expansion involves mechanically excavating gold-bearing silts from the Russell Stream valley, stretching from the old dam wall to Nasrec Road (Blocks N1 to N20), situated immediately west of the authorised and existing Valley Silts reclamation project area and the remaining Blocks (N21 and N22) being located either side of Crownwood Road, near Booysens Reserve and Riverlea, Johannesburg.

Ergo obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section near the Russell Stream north of NASREC near Booysens Reserve, in Johannesburg. The reclamation authorisation for the removal of silts, falls within Mining Right GP 184 MR. Further to this, Ergo holds various Mining Rights (MR) in respect of slimes dams and sand dumps extending 65 km from Western Johannesburg to Eastern Ekurhuleni with most activities occurring on the central and eastern sections of the Witwatersrand mining belt.

The removal of silts within the already authorised Valley Silts Project area has been ongoing since May 2023. The construction and site establishment began in October 2022 and has been an ongoing operation for a period of time, and as such, to maintain an efficient mining operation, as well as a sustainable feed source to the process plant, it is necessary to prepare for the recovery of the remaining silts in the Russell Stream.

The Valley Silts resource has three primary sectors. The current approved reclamation area is Sector 1 and extends from the dam wall to the end of the stockpile area near Crownwood Road. The site is already established with fully fenced hard park facilities, solar powered security lights, well maintained haul roads, and site offices. Access is fully controlled by security for all vehicles.

The Expansion Phase of the project will consist of Sector 2 and Sector 3.

Sector 2 will extend from the old dam wall to Nasrec Road (Blocks N1 to N20), with the remaining Blocks (Sector 3: N21 and N22) being located either side of Crownwood Road. As reclamation exceeds the delivery rate, stockpile areas are therefore required for temporary storage. Stockpiled silts are moved in a sequential manner due to the moisture content, the drying process, as well as oxidation.

The detailed plans are based on a 1:1000 scale survey plan and all blocks are based on a delivery rate required by Ergo. Individual blocks will be removed in sequence.

Prospecting trenching will determine the depositional flank extents, and all material will be removed from the natural flow path as well as the flanks. Paddocks and storm water controls are required to protect the stream from any extraneous ingress and these will be installed. The current infrastructure at the Valley Silts Project area will be utilised for the Expansion project. Hard Park, cut off trenches and stormwater collection points (sumps) are pre-installed and appropriate for further use. The proposed reclamation will

employ a methodology consistent with previous practices specifically through mechanical excavation techniques.

Project Rehabilitation and Future Land use

The primary aim of rehabilitation, in the context of this document, is to:

- Reduce the actual or potential environmental threat.
- Reduce the potential risks so that unacceptable risks identified in the EIA are reduced to acceptable levels.
- Protect the future liability of the land.

Once the gold-bearing silts have been removed from the targeted areas, decommissioning will commence with the removal of all associated vehicles and infrastructure from the site as well as the removal of berms, paddocks, diversion trenches, infrastructure and anything else installed during construction and operations.

Regarding the safety of both the public and the employees, Ergo has completed a workers' safety assessment as well as a public safety assessment. The public safety assessment for all the proposed operations of Ergo are currently being updated. This is being done in relation to the requirements of the National Nuclear Regulator (NNR).

Rehabilitation will take place as and when excavation progresses along areas of the mining blocks. Care will be taken to ensure that the material and excavated soil required for backfilling are free of contamination from hydrocarbons. Ergo aims to rehabilitate the Valley Silts area by shaping the areas where silts were removed and make the area free draining. Thereafter, appropriate species will be planted to stabilise the soil.

Post-decommissioning activities will entail the assessment of rehabilitation and will address any further rehabilitation requirements. Monitoring must occur for at least five years after decommissioning and rehabilitation, or until satisfactory results are achieved.

Maintenance will specifically need to focus on the rehabilitated areas in accordance with the approved EMPr. Continuous erosion monitoring of rehabilitated areas and slopes should be undertaken and zones with excessive erosion should be identified. The cause of the erosion should be identified and rectified. Zones with erosion will need to be repaired with topsoil.

Above all, Ergo aim to remove the silts from the valley in specific target areas, thereby improving the water flow dynamics and assisting in ameliorating current flooding issues experienced in the area of Riverlea. The proposed rehabilitation, extent and viability will be evaluated through specialist studies during the EIA phase, in consultation with the landowner (iProp), the City of Johannesburg and Department of Water and Sanitation (DWS).

Purpose of the Report

The Valley Silts Expansion Project forms part of the Mining Right GP 184 MR and is therefore governed by the Mineral and Petroleum Resources Development Act, 2002 Act No 12 of 2002) (MPRDA). Ergo will therefore need to comply with the provisions of the MPRDA, the National Environmental Management Act, 1998 (Act No 107 of 1998) (NEMA), the Environmental Impact Assessment Regulations, as amended in 2017 and 2021 (EIA 2014 Regulations) and in particular, with the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GNR. 1147 of 2015, as amended) (the Financial Provision Regulations), published in accordance with NEMA. This report serves accordingly to meet the Financial Provision Regulations, which requires that a final rehabilitation, decommissioning and closure plan is developed which includes the determination of financial provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts of mining. This Report presents the conceptual rehabilitation, decommissioning and closure plan for the proposed Valley Silts Expansion Project.

The rehabilitation, decommissioning and closure plan must be updated and amended annually to comply with legislation. During this process, changes in baseline information, legislation amendments, spatial developments and any other changes which may impact the closure of the operation must be incorporated to ensure that the plan remains current and implementable.

The focus of this report is on areas associated with surface infrastructure and laydown areas for the Project. It is anticipated that the Project will be active for a total life of mine (LoM) of 5 years. A 3 year Life of Operation where active excavation would take place, and 2 years to rehabilitate the site.

The closure calculation has been based as follows:

- Unplanned closure cost after Year 1 of operation;
- Closure cost after Year 5 of operation.

Table A details the closure costs (excl. VAT)

Table A: Closure Costs

	Unplanned closure (year 1)	Planned Closure (year 5)
Valley Silts Expansion	R1 700 709.77	R1 623 003.74

According to Regulation 7 of the NEMA Financial Provisioning Regulations, 2015, the applicant or holder of a right or permit must ensure that the financial provision is, at any given time, equal to the sum of the actual costs of implementing the rehabilitation for a period of at least 10 years forthwith. Although the date of compliance with the Regulations has been extended (GN R 4296, 1 February 2024), it is considered best practice to provide provision for the 10 year period. Therefore Ergo will need to provide a guarantee of R1 623 003.74..

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Abbreviations

Abbreviation	Description
ARPs	Annual Rehabilitation Plans
CBAs	Critical Biodiversity Areas
DFFE	Department of Forestry, Fisheries and the Environment
DMR	Department of Mineral Resources
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme Report
ERA	Environmental Risk Assessment
Ergo	Ergo Mining (Pty) Ltd
Kongiwe	Kongiwe Environmental (Pty) Ltd
MHSA	Mine Health and Safety Act, 1996 (No. 29 of 1996)
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act, 1998 (No. 107 of 1998)
NEM:AQA	National Environmental Management Air Quality Act, 2004 (No. 39 of 2004)
NEM:BA	National Environmental Management Biodiversity Act, 2004 (No. 10 of 2004)
NEM:LAA	National Environmental Management Laws Amendment Act, 2014 (No. 25 of 2014)
NEM:WA	National Environmental Management Waste Act, 2008 (No. 59 of 2008)
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PAOI	Project Area of Influence
PM	Particulate matter
SEI	Site Ecological Importance

1 INTRODUCTION

Ergo Mining (Pty) Ltd (Ergo), a subsidiary of DRDGOLD Limited, intends to expand its Valley Silts reclamation operation (the Valley Silts Expansion Project). The expansion involves mechanically excavating gold-bearing silts from the Russell Stream, stretching from the old dam wall to Nasrec Road (Blocks N1 to N20), situated immediately west of the authorised and existing Valley Silts reclamation project area and the remaining Blocks (N21 and N22) being located either side of Crownwood Road, near Booysens Reserve and Riverlea, Johannesburg.

The Department of Environmental Affairs (now the Department of Forestry, Fisheries and the Environment (DFFE)), in consultation with the Department of Mineral Resources and Energy (now the Department of Mineral Resources (DMR)) identified the need for the alignment of EAs and promulgated a single environmental system under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) whereby the DMR has become the competent authority for the authorisation of mining-related projects under the Environmental Impact Assessment Regulations, 2014, as amended in 2017 and 2021 (the EIA 2014 Regulations). This has resulted in simultaneous decisions in terms of NEMA, the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA) and other specific environmental management Acts.

The NEMA Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GN R1147 of 2015) (the Financial Provision Regulations) require that a final rehabilitation, decommission and] closure plan is developed which includes the determination of financial provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts of mining. This report presents the final rehabilitation, decommission and closure plan for the proposed project.

The focus of this report is based on areas associated with surface infrastructure and the expansion of the Valley Silts Project.

This plan covers the proposed activities associated with the Valley Silts Expansion Project. The perimeter for this plan is the outer extent of the areas associated with the infrastructure and activities relating to the Project.

2 REHABILITATION, DECOMMISSIONING AND CLOSURE PLAN

2.1 Purpose of the Report

The purpose of this document is to provide a plan that is measurable and auditable to the DMRE that takes into consideration the proposed post-mining end land use of the affected area. It must be stated from the outset that to comply with current legislation, this rehabilitation, decommissioning and closure plan must be reviewed, updated and revised annually. During this process, changes in baseline information, legislative amendments, spatial developments and any other changes which may impact the closure of the project must be incorporated to ensure the plan remains current and implementable.

This report encompasses information as per the guideline document pertaining to the Financial Provision Regulations, and therefore includes the definition of the closure vision, objectives and design and relinquishment criteria, indicating infrastructure and activities which will ultimately be decommissioned, closed, removed and remediated.

The risk drivers determine actions, which specify how the closure activities will be implemented to achieve the closure relinquishment criteria as required by the DMR as well as indicating monitoring, auditing and reporting requirements.

2.2 Terms of Reference

Section 41 (1) of Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) has been repealed and replaced by the provisions of Section 24PA in the NEMA, as amended, which provides that the holder of a Mining Right must make financial provision for rehabilitation of negative environmental impacts. The financial provision must guarantee the availability of sufficient funds to undertake the:

- Rehabilitation of the adverse environmental impacts of the listed or specified activities;
- Rehabilitation of the impacts of the prospecting, exploration, mining or production activities, including the pumping and treatment of polluted or extraneous water;
- Decommissioning and closure of the operations;
- Remediation of latent or residual environmental impacts which become known in the future;
- Removal of building structures and other objects; and/ or
- Remediation of any other negative environmental impacts.

In addition to Section 24PA, as mentioned above, the Financial Provision Regulations apply to the Valley Silts Expansion Project. Various Draft Regulations dealing with financial provisioning for mines have been published for comment, most recently in 2024, but it is not clear when these will be promulgated. In light of this uncertainty, this report is prepared under the current regulatory regime at date of finalisation.

Regulation 6 of the Financial Provision Regulations requires a holder of a Mining Right to determine the quantum of the financial provision through detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for:

- Annual rehabilitation, as reflected in Annual Rehabilitation Plans (ARPs);
- Final rehabilitation, decommissioning and closure of the mining operations which includes the findings of the Environmental Risk Assessment (ERA); and
- Remediation of latent or residual environmental impacts as identified in the ERA.

It must be noted that exemption from compiling an ARP is being requested as it is expected that no annual rehabilitation will be undertaken in the initial construction and operational phases. The need for an Annual Rehabilitation Plan will be reassessed annually as part of the financial provision update.

2.3 Objectives

The objective of the rehabilitation, decommissioning and closure plan, which must be measurable and auditable, is to identify a post-mining land use that is feasible through:

- Providing the vision, objectives, targets and criteria for final rehabilitation, decommissioning and closure of the Project;
- Outlining the design principles for closure;
- Explaining the risk assessment approach and outcomes and link closure activities to risk rehabilitation;
- Detailing the closure actions that clearly indicate the measures that will be taken to mitigate and/ or manage identified risks and describes the nature of residual risks that will need to be monitored and managed post closure;
- Committing to a schedule, budget, roles and responsibilities for final rehabilitation, decommissioning and closure of each relevant activity or item of infrastructure;
- Identifying knowledge gaps and how these will be addressed and filled;
- Detailing the full closure costs for the life of project at increasing levels of accuracy as the project develops and approaches closure in line with the final land use proposed; and
- Outlining monitoring, auditing and reporting requirements.

2.4 Statutory Requirements

There are a number of legal and regulatory frameworks with which the project must comply, which could materially affect rehabilitation and closure:

- Constitution of the Republic of South Africa, 1996;
- NEMA;
- National Environmental Management Laws Amendment Act (Act No. 25 of 2014) (NEM:LAA);
- The Financial Provision Regulations, which replaces the equivalent provisions in the MPRDA – closure and financial provision elements repealed;
- MPRDA as it pertains to the Mining Work Programme and the Social and Labour Plan;
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) and supporting regulations (NEM:WA);
- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA);

- National Water Act, 1998 (Act No. 36 of 1998) (NWA); and
- Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA).

Although legislation influencing closure is varied, all statutes require that the impacts of the operation on the environment need to be mitigated and the solutions implemented are required to be sustainable. Table 2-1 details required legislation and its impact on closure.

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Table 2-1: Legislation Summary

Applicable Section of the Legislation	Impact on Closure
The Constitution of the Republic of South Africa, 1996 In terms of Section 24 of the Constitution "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."	Constitutional requirement to ensure that the Plan includes measures that protect the rights of people to an environment that is not harmful to health or well-being post closure.
National Environment Management Act, 1998 Sections 28 (1) and (3) of NEMA set out the duty of care principle, which is applicable to all types of pollution and must be taken into account in considering any aspects of potential environmental degradation. Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment. Section 24PA provides that the holder of an environmental authorisation for a mining activity must maintain and retain a financial provision until a closure certificate is issued and review and adjust the environmental liability from time to time. That holder must also annually undertake the prescribed mitigation and rehabilitation measures.	The measures required in terms of subsection (1) may include measures to - Investigate, assess and evaluate the impact on the environment; Inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed to avoid causing significant pollution or degradation of the environment; Cease, modify or control any act, activity or process causing the pollution or degradation; Contain or prevent the movement of pollutants or the causes of degradation; Eliminate any source of the pollution or degradation; or Remedy the effects of the pollution or degradation. The financial provision must be calculated by an independent party and be subject to audit. These provisions are amplified in the Financial Provision Regulations.
Environmental Impact Assessment Regulations, 2014, as amended in 2017 and 2021 These regulations were developed for the preparation, evaluation, submission, processing and consideration of, and decision on, applications for environmental authorisations.	Any new EIAs or Basic Assessments (BAs) for the project will be required to consider closure during planning and to include a closure plan and closure estimate to support an authorisation application.
National Environment Management: Waste Act , 2008	

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Applicable Section of the Legislation	Impact on Closure
Part 8 of Chapter 4 of the Act indicates the requirement to identify the status and risk of contaminated sites and provides a legal mechanism for remediation activities to be instigated and controlled	Contamination resulting from operational activities will require remediation, with the final soil quality meeting requirements as specified in the Acts and Regulations.
Waste Classification and Management Regulations The Waste Classification and Management Regulations require that (Chapter 2, 4(2)) all waste generators must ensure that the waste they generate is classified in accordance with SANS 10234 within 180 days of generation and if the waste is to be disposed of to landfill that the waste is assessed in accordance with the Norms and Standards for Assessment of Waste for Landfill Disposal (Chapter 2 (8)1) (a)).	The Waste Classification and Management Regulations and the supporting Norms and Standards as well as Regulations regarding the Planning and Management of Residue Deposits and Residue Stockpile do not contain specifications around closure, other than the requirements in Regulations regarding the Planning and Management of Residue Deposits and Residue Stockpile that stockpiles and deposits be closed according to the relevant provisions in the environmental authorisations, an EMPr and any other applicable legislation.
Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits The regulations specify design approach and considerations for Residue Stockpiles and Residue Deposit (RSRD), but more importantly specify that these facilities must comply with the Norms and Standards.	
Regulations pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations The purpose of these Regulations is to regulate the determine and making of financial provision as contemplated in the Act for the costs associated with the undertaking of management, rehabilitation and remediation of environmental impacts from prospecting, exploration, mining or production operations through the lifespan of such operations and latent or residual environmental impacts that may become known in the future. The Regulations also include detailed descriptions of the wording required in the documentation to support the provisioning for liability using Bank Guarantees and Trust Funds. Finally, the legislation also provides detail on the information to be contained in the following plans: Annual rehabilitation plan Final rehabilitation, decommissioning and mine closure plan Environmental risk assessment report Care and maintenance plan.	Closure planning process will need to be expanded to include Annual rehabilitation plan, Final rehabilitation, decommissioning and closure plan, Environmental risk assessment report and Care and Maintenance Plan.

Applicable Section of the Legislation	Impact on Closure
The National Environment Management: Air Quality Act, 2004 This Act regulates atmospheric pollution and repealed the Atmospheric Pollution Prevention Act. The Act came into full effect on 1 April 2010 and entrusts the Department of Environmental Affairs with the task of preventing pollution and ecological degradation, while at the same time promoting justifiable economic and social development. Metropolitan and District Municipalities are charged with issuing atmospheric emission licenses for certain listed activities. It must be shown that the best practical means are being employed to limit air pollution before these certificates will be issued. Penalties and criminal sanctions are imposed for noncompliance with the National Management: Air Quality Act. On 1 April 2010, the Department of Environmental Affairs established a list of activities which require atmospheric emission licenses. The Department has published the minimum emission standards resulting from these listed activities. These include the permissible amount, volume, emission rate or concentration of that substance or mixture of substances that may be emitted into the atmosphere and the manner in which measurements of such emissions must be carried out. The consequences of the listing of these activities is that no person may, without a provisional atmospheric emission licence or an atmospheric emission license, conduct an activity listed on the list anywhere in the Republic or listed on the list applicable in a province anywhere in that province.	Other aspects of the NEM:AQA such as monitoring and application of management/ mitigation measures may apply during closure.
The National Environmental Management: Biodiversity Act, 2004 The Act seeks amongst other things, to manage and conserve biological diversity, to protect certain species and ecosystems, to ensure the sustainable use of biological resources and to promote the fair and equitable sharing of benefits arising from bio-prospecting involving those resources. The NEMBA includes a Regulation related to the management of threatened and protected species. A similar Regulation is applied to	If relevant species or threatened ecosystems are present, a management plan must be developed in alignment with these norms and standards.

Applicable Section of the Legislation	Impact on Closure
Threatened Ecosystems. NEMBA has a set of norms and standards for the development of management plans for both species (e.g. Threatened or Migratory Species) and ecosystems (Endangered or Critically Endangered). The National Environmental Management: Protected Areas Act, 2003: Protected areas such as nature reserves and special nature reserves are declared and managed in terms of this Act. Depending on the nature of the protected area, certain activities (such as mining) may require Ministerial consent or be prohibited outright. The Act also aims to promote the sustainable use of protected areas and the participation of local communities in such areas. In addition, it provides for the continued existence of the South African National Parks.	
Mineral and Petroleum Resources Development Act , 2002 The MPRDA makes provision for equitable access to and sustainable development of South Africa's mineral resources. The MPRDA requires that the environmental management principles set out in NEMA shall apply to all mining operations and serves as a guideline for the interpretation, administration and implementation of the environmental requirements of NEMA.	Historically requirements relating to closure planning and provisioning were included in the MPRDA. These have now been replaced by those in the Financial Provision Regulations under NEMA.
National Water Act, 1998 Section 19 of the NWA sets out the principles for "an owner of land, a person in control of land or a person who occupies or uses land" to: • Cease, modify or control any act or process causing pollution; • Comply with any prescribed waste standard or management practice; Contain or prevent the movement of pollutants; • Eliminate any source of pollution;	This places the obligation to mitigate any aspects that cause or have caused pollution as well as to remediate any residual contaminated water at closure.

Applicable Section of the Legislation	Impact on Closure
• Remedy the effects of the pollution; and • Remedy the effects of any disturbance to the bed and banks of a watercourse. It also describes the actions that can be taken by the catchment management agency to enforce the requirements of the NWA.	
Mine Health and Safety Act, 1996 This Act deals with the protection of the health and safety of persons in the mining industry but has some implications for environmental issues due to the need for environmental monitoring within mine operations and maintenance of mine residue deposits.	All closure activities will have to be undertaken in a safe manner where the Health and Safety of all workers involved in closure activities is protected.

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3 LIMITATIONS

This document was compiled based on the following assumptions and limitations:

- Current information available to Kongiwe was used in developing the rehabilitation, decommissioning and closure plan;
- The information contained within this report is based on current layout plans provided;
- Information, mitigation measures and recommendations given are based on the specialist studies that have been conducted in support of the application process;
- The report has been compiled utilising current legislation pertaining to closure and rehabilitation. Amended regulations, at the time of compiling this document, have not yet been promulgated; and
- This report must be considered as a living document and will be updated as additional information becomes available, new legislation and regulations are promulgated and as monitoring and rehabilitation progresses.

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4 PROJECT DESCRIPTION

4.1 Project Location

The Proposed Project is located within the Russell Stream valley, near Booysens Reserve. The project area stretches from New Canada Road, following the valley southeast, past the Nasrec Road bridge and past Crownwood Road until the stream meets the M1.

The Proposed Project is situated in the City of Johannesburg Metropolitan Municipality (CoJMM). The Russell Stream (also referred to as the Klipspruit) is surrounded by industrial, commercial, residential and undeveloped land. The closest residential area to the project is Riverlea, the outskirt of the suburb is situated approximately 120m from the Valley silts project area.

The following infrastructure is encountered in the area (Figure 4-1 and Figure 4-2):

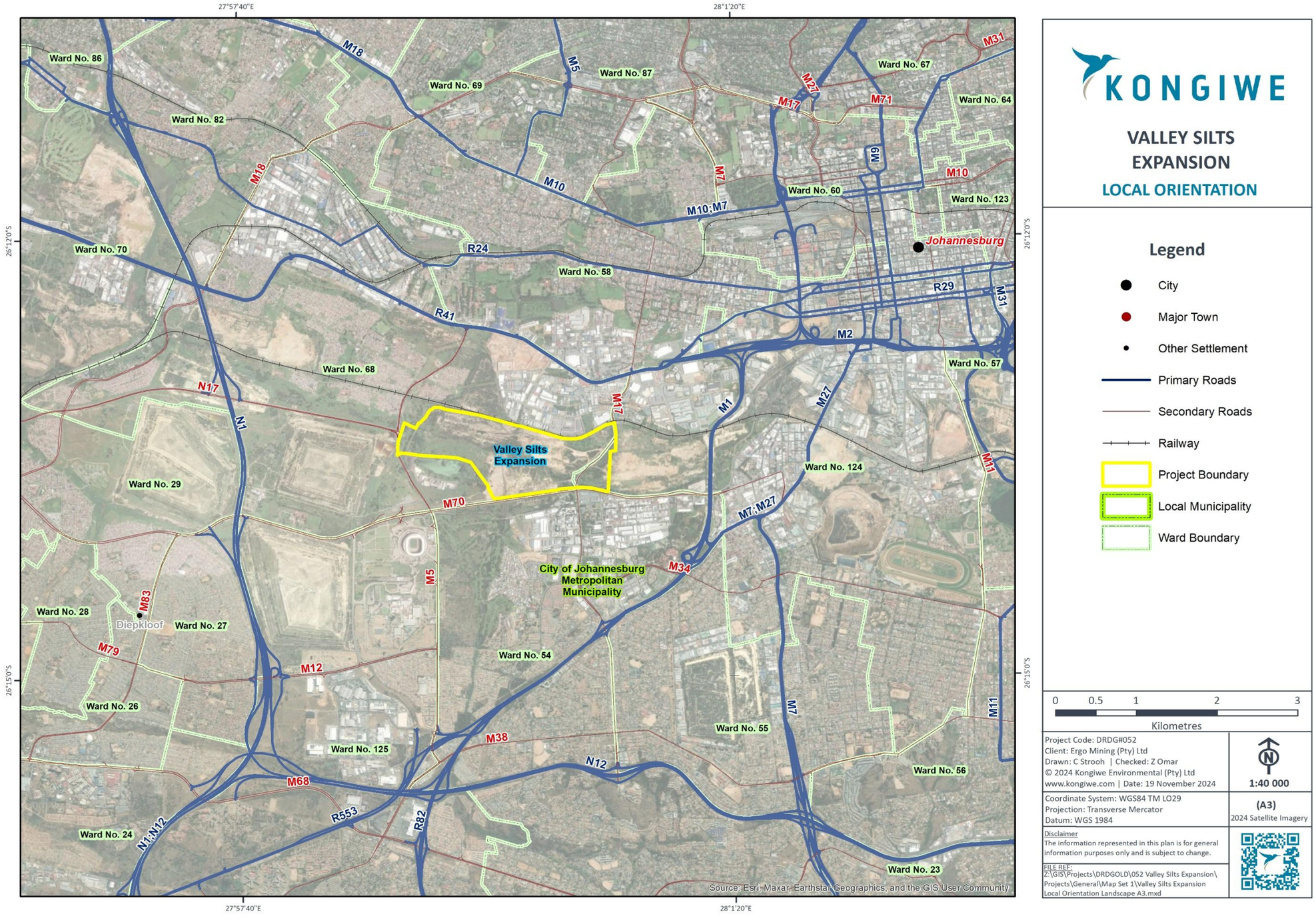
- National and provincial roads (M70, M17, N17, N1);
- Residential and commercial properties:
- Industrial properties;
- FNB Soccer City Sports Centre;
- Power lines;
- Sewer lines;
- Railway line;
- Water reticulation systems; and
- Historic Mine Dumps.



Figure 4-1: Infrastructure found in the project area including pipelines and powerlines.



Figure 4-2: FNB Stadium (Soccer City)



KONGIWE

VALLEY SILTS EXPANSION

LOCAL ORIENTATION

Legend

- City
- Major Town
- Other Settlement
- Primary Roads
- Secondary Roads
- Railway
- Project Boundary
- Local Municipality
- Ward Boundary

0 0.5 1 2 3

Kilometres

Project Code: DRDG#052
Client: Ergo Mining (Pty) Ltd
Drawn: C Strooh | Checked: Z Omar
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www.kongiwe.com | Date: 19 November 2024

1:40 000

Coordinate System: WGS84 TM LO29
Projection: Transverse Mercator
Datum: WGS 1984

(A3)
2024 Satellite Imagery

Disclaimer
The information represented in this plan is for general information purposes only and is subject to change.

FILE REF:
Z:\GIS\Projects\DRDGOLD\052 Valley Silts Expansion\Projects\General\Map Set 1\Valley Silts Expansion Local Orientation Landscape A3.mxd

Figure 4-3: Locality Map illustrating the location of the proposed project

4.2 Activity Description

Ergo intend to expand its Valley Silts reclamation operation. The expansion involves mechanically excavating gold-bearing silts from the dam wall to Nasrec Road (Blocks N1 to N20), situated immediately west of the authorised Valley Silts project area and the remaining Blocks (N21 and N22) being located either side of Crownwood Road.

The removal of silts within the already authorised Valley Silts Project area has been ongoing since May 2023. The construction and site establishment began in October 2022 and as such, the requirement to prepare for the Valley Eastern Expansion, Southern Expansion, and Valley Expansion Northwest is now necessary to maintain an ongoing operation, as well as a sustainable feed source to the process plant.

The Valley Silts resource has three primary sectors. The current approved reclamation area is Sector 1 and extends from the dam wall to the end of the stockpile area near Crownwood Road. The site is already established with fully fenced hard park facilities, solar powered security lights, well maintained haul roads, and site offices. Access is fully controlled by security for all vehicles.

Sector 2 will extend from the dam wall to Nasrec Road (Blocks N1 to N20), with the remaining Blocks (Sector 3: N21 and N22) being located either side of Crownwood Road. Section 2 and 3 falls within the proposed Valley Silts Expansion Project, as depicted in Figure 4-4 below.

The Valley Silts reclamation exceeds the delivery rate; therefore, stockpile areas are required for temporary storage on site. Stockpiled silts are moved in a sequential manner due to the moisture content, the drying process, as well as oxidation.

As it stands, the Russell Stream is highly polluted and heavily silted and given the current status quo, Ergo will aim to rehabilitate the Valley Silts area to an appropriate and functioning ecological state.

The proposed reclamation will employ a methodology consistent with previous practices, specifically through mechanical excavation techniques. In terms of project logistics, the gold bearing silts will be mechanically excavated from Valley Silts Expansion project area and then temporarily stockpiled and dried in the stockpile areas directly north and south of Blocks N1 to N18. The dried silts will then be loaded onto dump trucks and transported to the City Deep Plant for preprocessing. The trucks transporting the material follow Crownwood Road until they reach Main Reef Road and then join the M2 East. The trucks then follow the M2 until they reach Heidelberg Road which is followed to the City Deep Plant where it will be offloaded.

The City Deep Plant is an authorised site which falls under the City Deep Mining Right: GP 185 MR and it is ideally suited for the project.

The Valley Silts Project site is already established with fully fenced hard park facilities, solar powered security lights, well maintained haul roads, and site offices. Access is fully controlled by security for all vehicles.

4.3 Infrastructure intended for the Project

Existing infrastructure to be utilised at stages during the project includes:

- City Deep Plant;
- Stockpile area;
- Main haul roads;
- Existing site access roads;
- Electricity reticulation for domestic purposes;
- Hauling road: access roads and main roads,
- Administration buildings, including change houses and ablution facilities,
- Mechanical excavation equipment (Backhoes or Excavators);
- 30 ton Articulated Dump Trucks (ADT's);
- 30 ton Dump Trucks;

The following infrastructure is not existing and will be utilised on site:

- Drying stockpiles (8 locations);
- Stormwater control berms/paddocks;
- Culverts (8); and
- Additional site access roads;

Regarding the safety of both the public and the employees, Ergo has completed a workers safety assessment as well as a public safety assessment for the Valley Silts Mining Project. The public safety assessment in connection with the proposed expansion operations will be updated.

Above all, the aim of the expansion project is to remove the gold bearing silts from the Russell stream, this will aid in the rehabilitation of the Russell Stream as well as alleviate some environmental and social issues for the surrounding communities.

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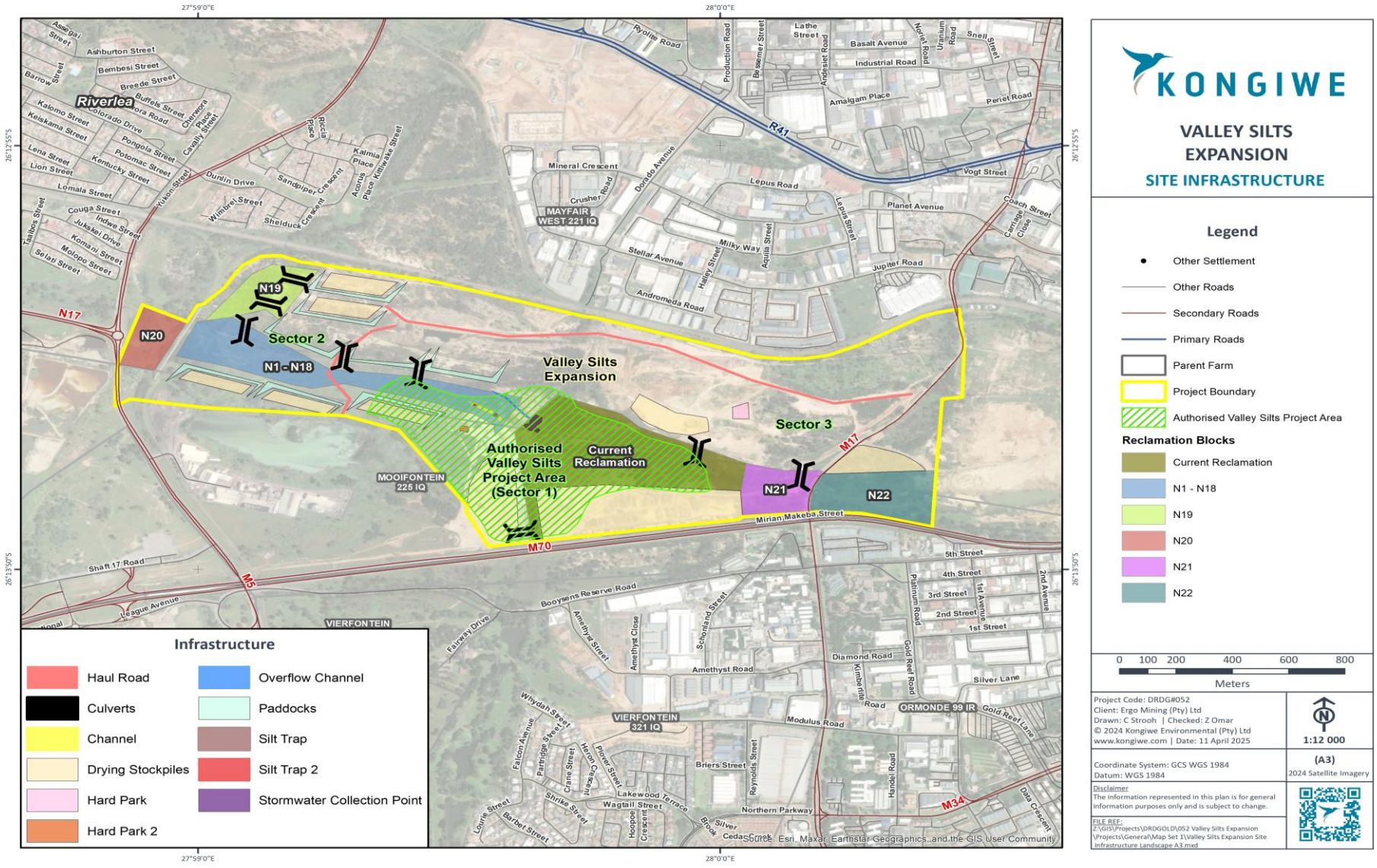


Figure 4-4: Silts Expansion Infrastructure Map.

4.4 Rehabilitation

It is important to take note of that the Proposed Project is both a reclamation and rehabilitation project.

Presently, the removal of silts within the already authorised Valley Silts Project area has been ongoing since May 2023. The construction and site establishment began in October 2022 and as such, the requirement to prepare for the Valley Eastern Expansion, Southern Expansion, and Valley Expansion Northwest is now necessary to maintain an efficient reclamation operation, as well as a sustainable feed source to the process plant whilst potentially improving the water flow dynamics within the Russell stream, which could assist in ameliorating current flooding issues experienced in the area of Riverlea and the surroundings. The gold-bearing silts will be removed. After removal of the silts from the target areas, Ergo aims to rehabilitate the Valley Silts area within the Russell Stream by shaping the areas where silts were removed and make the area free draining. Thereafter, appropriate species will be planted to stabilise the soil.

Once the silts have been removed from the targeted areas, decommissioning will commence with the removal of all associated vehicles and infrastructure from the site as well as the removal of berms, paddocks, diversion trenches, infrastructure, and anything else installed during construction and operations.

Care will be taken to ensure that the material and excavated soil required for backfilling are free of contamination from hydrocarbons.

Post-decommissioning activities will entail the assessment of rehabilitation and will address any further rehabilitation requirements. Monitoring must occur for at least five years after decommissioning and rehabilitation, or until satisfactory results are achieved.

Maintenance will specifically need to focus on the rehabilitated areas in accordance with the approved EMPr. Continuous erosion monitoring of rehabilitated areas and slopes should be undertaken and zones with excessive erosion should be identified. The cause of the erosion should be identified, and rectified. Zones with erosion will need to be repaired with topsoil.

After the proposed operation, decommissioning and rehabilitation, the land will be returned to the landowner (iProp). The proposed project area is earmarked for development by the landowner, with plans for light industrial development, as set out in Figure 4-5 below. Additionally, there are plans to expand the N17 within the proposed project area, from Crownwood to Nasrec Road.

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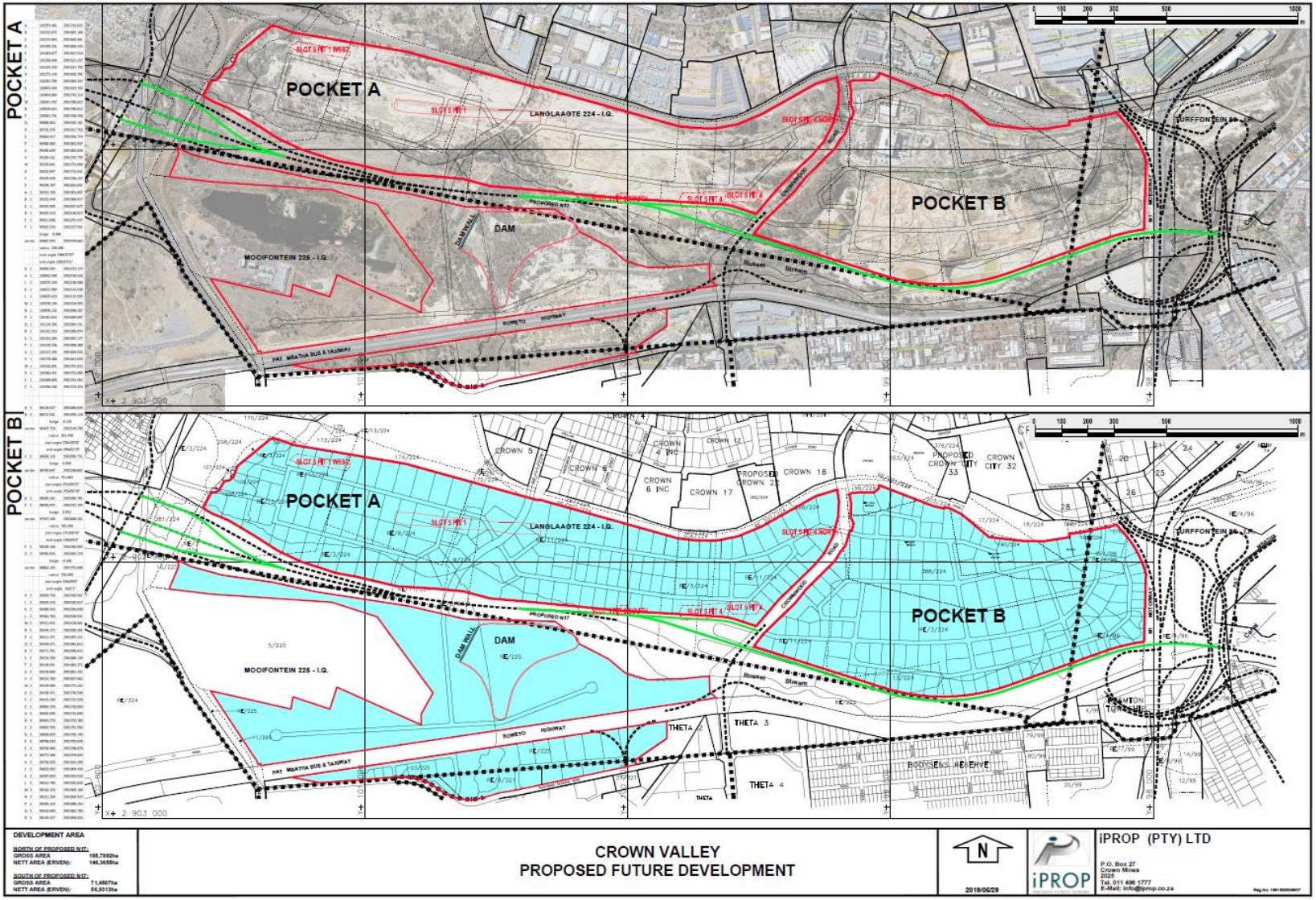


Figure 4-5: Crown Valley Proposed Future Development

4.5 Works Schedule and Life-cycle of the Project

The anticipated life span of the project is approximately **5 years**. A 3-year Life of Operation where active excavation would take place, and 2 years to rehabilitate the Valley Silts target sites. It is envisioned that clearance will be obtained once the operation, decommissioning and rehabilitation has been completed.

5 ENVIRONMENTAL CONTEXT

Baseline biophysical and socio-economic information was obtained from Kongiwe's EIA Report as well as from a number of specialist studies that were conducted as a result of the Project.

5.1 Air Quality

Dispersion simulations were undertaken to determine ambient concentrations of $PM_{2.5}$ and PM_{10} resulting from the Valley Silts Expansion project. The dispersion of particulate matter was modelled up to 5 km from the centre of the project area.

The isopleths of the modelling results for $PM_{2.5}$ and PM_{10} are given in Figure 5-1 to Figure 5-8 below. The red isopleths represent the National Ambient Air Quality Standard (NAAQS), therefore, all areas on the maps that lie within the red coloured isopleth can be expected to experience exceedances of the relevant NAAQS.

The following scenarios were simulated:

- Drying area 1 used for drying. Northern access road used between the drying area and Crownwood Road.
- Drying area 2 used for drying. Northern access road used between the drying area and Crownwood Road.
- Drying area 2 used for drying. Southern access road used between the drying area and Crownwood Road.
- Drying area 3 used for drying. Southern access road used between the drying area and Crownwood Road.

Exceedances of the PM_{10} and $PM_{2.5}$ 24-hour NAAQS can be expected beyond the Valley Silts Expansion footprint under worst-case meteorological conditions. The areas exposed to exceedances, however, are not expected to extend as far as sensitive receptors. Increases in ambient concentrations of particulate matter mostly affects the closest residents of Riverlea situated to the east of Nasrec Road, and to a lesser extent the Crown industrial area to the north and the Theta industrial area to the south of the project area. Although the maximum modelled concentrations for these receptors are less than 50% of the NAAQS, additional care should be taken in drying area 1 and drying area 3.

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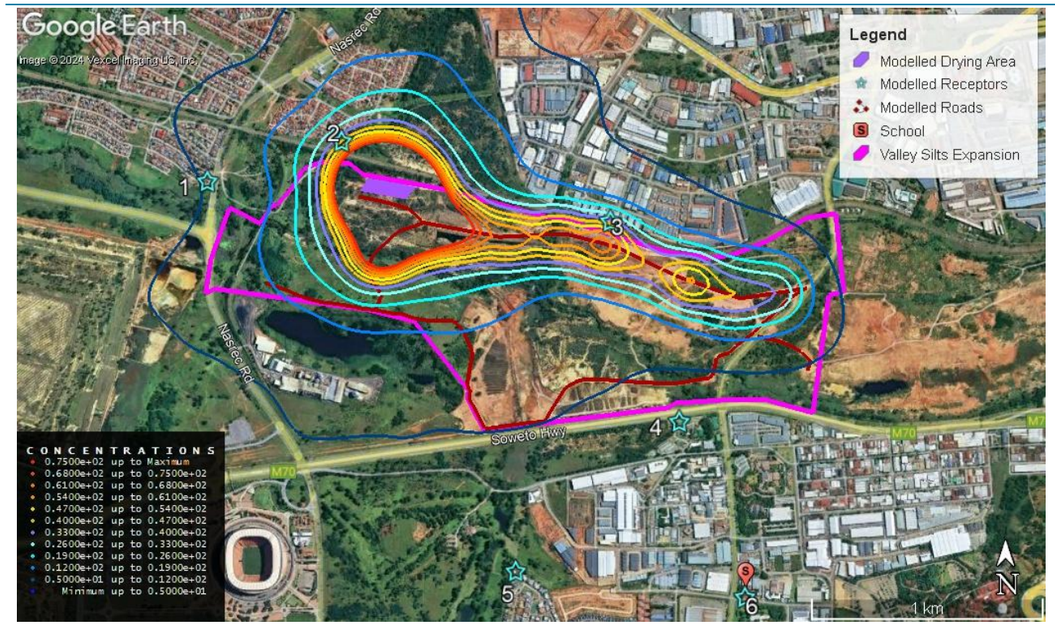


Figure 5-1: Modelled prediction of highest 24-hour average PM_{10} concentrations resulting from drying area 1 and associated hauling.

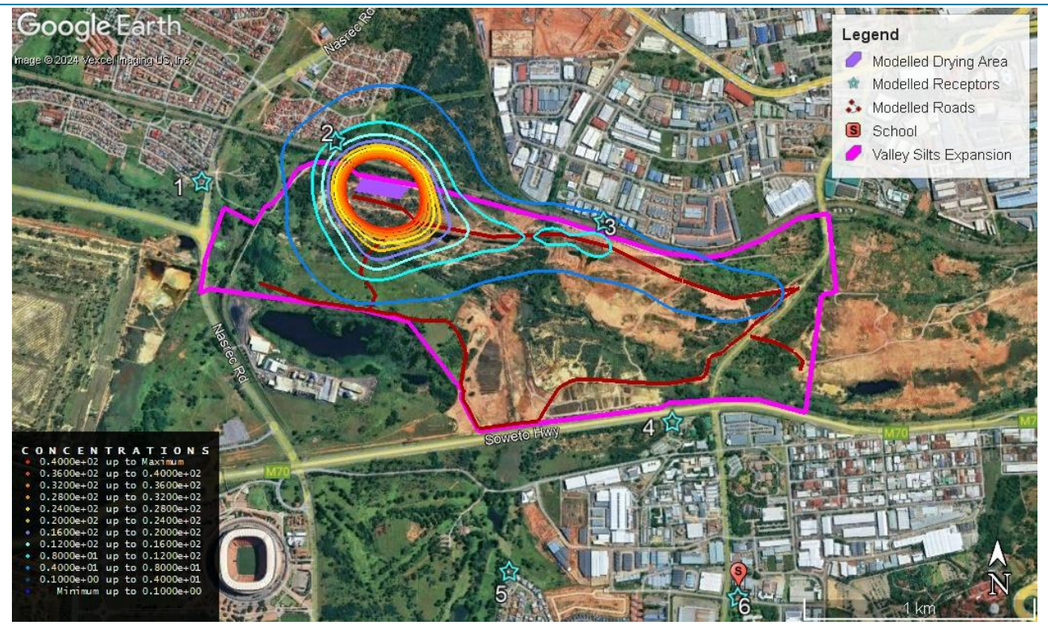


Figure 5-2: Modelled prediction of highest 24-hour average $PM_{2.5}$ concentrations resulting from drying area 1 and associated haulin

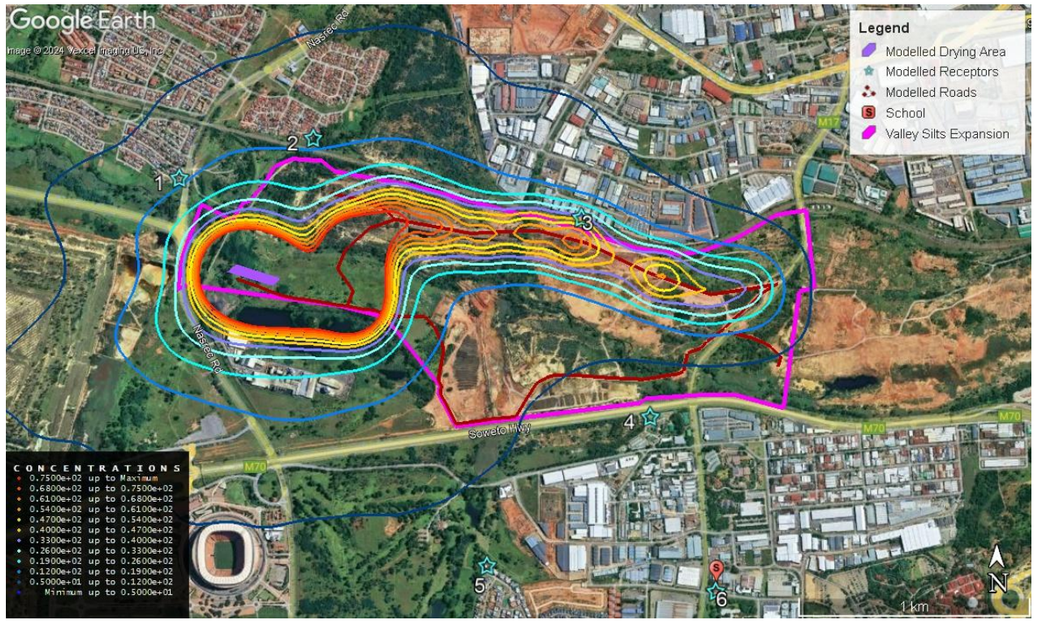


Figure 5-3: Modelled prediction of highest 24-hour average PM_{10} concentrations resulting from drying area 2 and associated hauling using the northern access road.

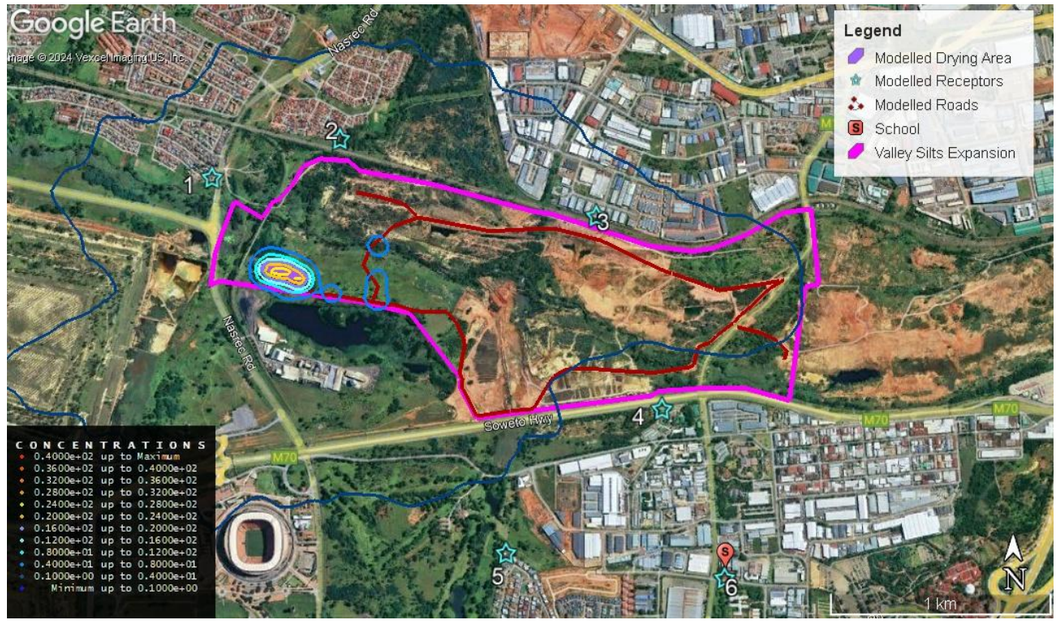


Figure 5-4: Modelled prediction of highest 24-hour average $PM_{2.5}$ concentrations resulting from drying area 2 and associated hauling using the northern access road.

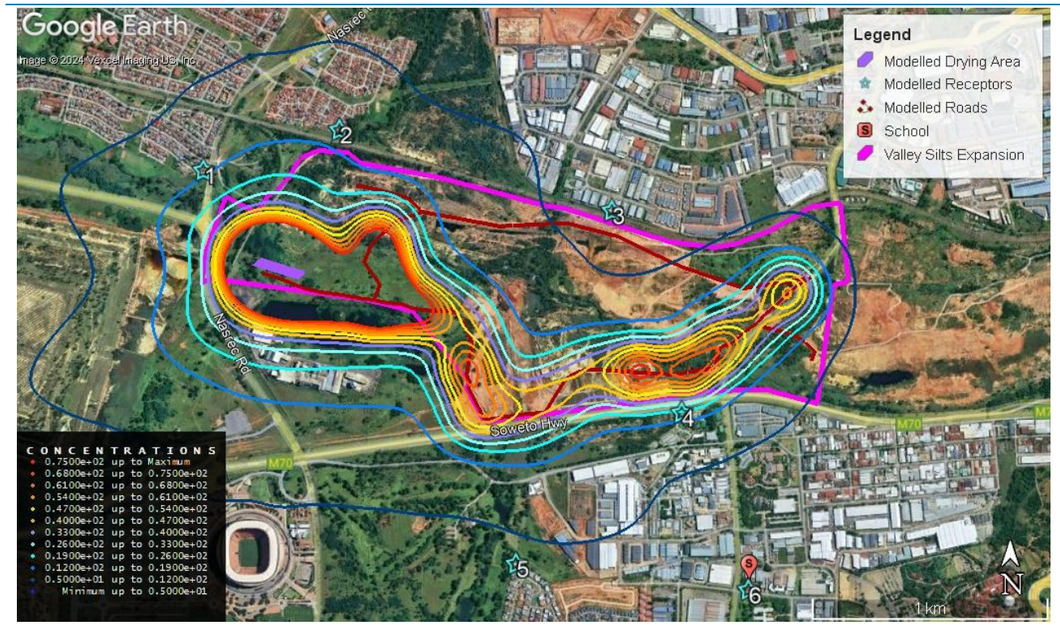


Figure 5-5: Modelled prediction of highest 24-hour average PM_{10} concentrations resulting from drying area 2 and associated hauling using the southern access road.

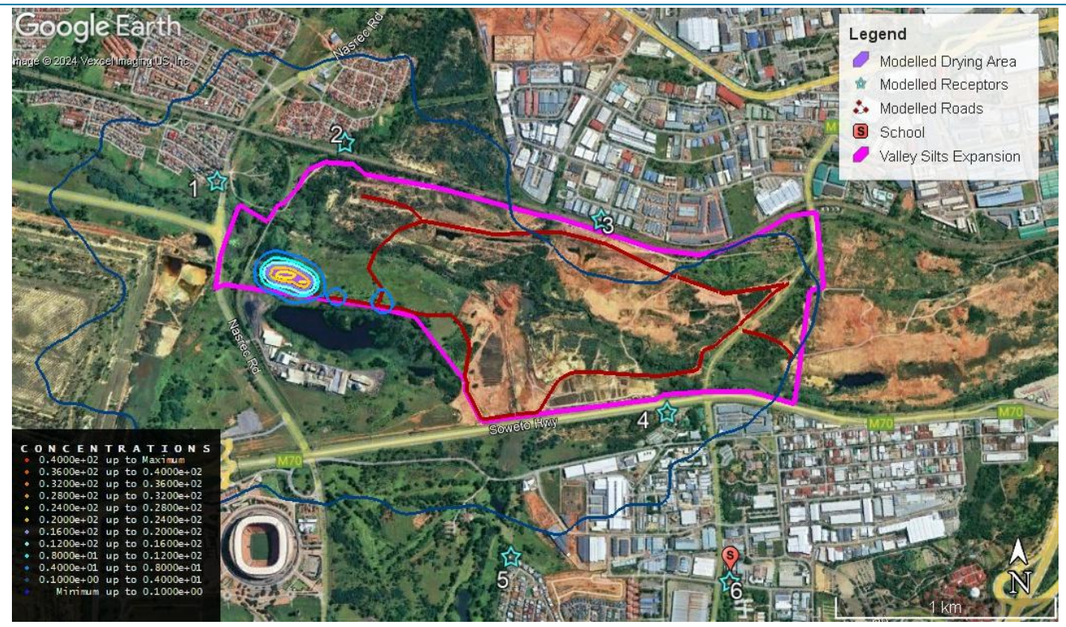


Figure 5-6: Modelled prediction of highest 24-hour average $PM_{2.5}$ concentrations resulting from drying area 2 and associated hauling using the southern access road.

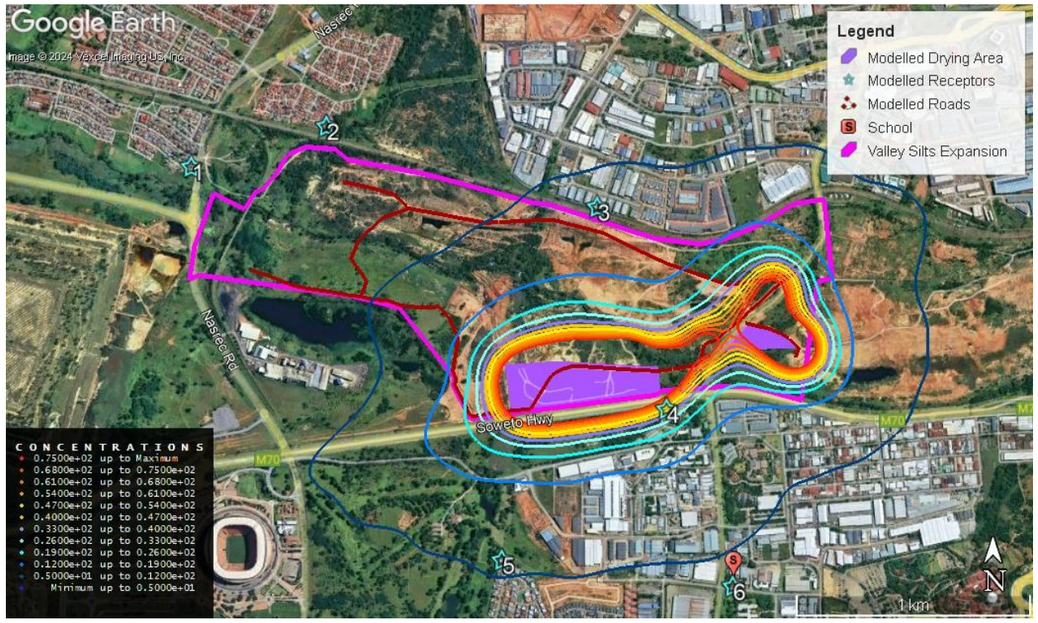


Figure 5-7: Modelled prediction of highest 24-hour average PM_{10} concentrations resulting from drying area 3 and associated hauling using the southern access road.

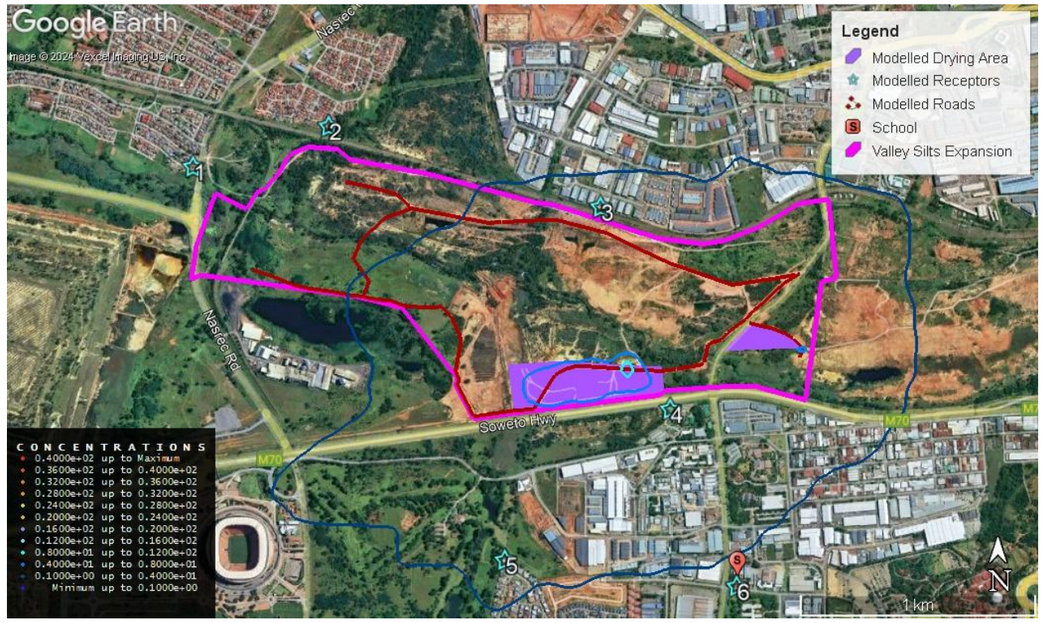


Figure 5-8: Modelled prediction of highest 24-hour average $PM_{2.5}$ concentrations resulting from drying area 3 and associated hauling using the southern access road.

5.2 Biodiversity

5.2.1 Terrestrial Biodiversity

Three (3) main habitat types were identified across the Project Area of Influence (PAOI) and include:

- Modified;
- Water Resource; and
- Artificial Water Resource.

The habitat units for the PAOI can be seen delineated in Figure 5-9 and descriptions of the habitat units can be found in Table 5-1.

Table 5-1: Table providing descriptions of the habitat types delineated for the PAOI

Habitat	Description and Condition
Modified	This habitat unit includes all areas that maintain little to no native vegetation and/or where anthropogenic activity has substantially modified an area's primary ecological functions and species composition. Within the PAOI, these areas are mostly comprised of roads, mining areas, and other construction activities. These areas include very few, if any, indigenous species and are associated with alien and invasive plant species. No fauna or flora SCC were observed, and none are expected for the habitat unit.
Water Resource	This is a non-terrestrial habitat made up of wetlands and drainage features within the PAOI. Vegetation associated with this habitat unit includes hydrophytes. No fauna or flora SCC were observed, and none are expected for the habitat unit. Additional information regarding this habitat unit may be found in the accompanying wetland assessment (TBC, 2024).
Artificial Water Resource	This is a non-terrestrial habitat made up of artificial wetlands and water features within the PAOI. No fauna or flora SCC were observed, and none are expected for the habitat unit. Additional information regarding this habitat unit may be found in the accompanying wetland assessment (TBC, 2024).

The allocated sensitivities for each of the relevant themes are either disputed or validated for the overall PAOI in Table 5-2 below. A summative explanation for each result is provided as relevant. The specialist-assigned sensitivity ratings are based largely on the SEI process followed in the previous section, and consideration is given to any observed or likely presence of SCC or protected species. A map illustrating the overall SEI allocations for the PAOI can be seen in Figure 5-10.

Table 5-2: Summary of the screening tool vs specialist assigned sensitivities

Screening Tool Theme	Screening Tool	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Animal Theme	Medium	Low	Disputed – Habitat exists in a largely degraded or modified state with high levels of anthropogenic disturbance, particularly those associated with the mining activities on site. No SCC observed and unlikely to occur.
Plant Theme	Medium	Low	Disputed – Habitat exists in a largely degraded or modified state with high levels of anthropogenic disturbance, particularly those associated with the mining activities on site. High numbers of alien and invasive plants. No SCC observed and unlikely to occur.
Terrestrial Theme	Very High	Low	Disputed – Habitat exists in a largely degraded or modified state with high levels of anthropogenic disturbance, particularly those associated with the mining activities on site, and has therefore lost much of its ecosystem functionality. Habitat will not recover without human intervention and will continue to degrade over time without rehabilitation. No longer representative of a CBA or ESA. No SCC observed and unlikely to occur

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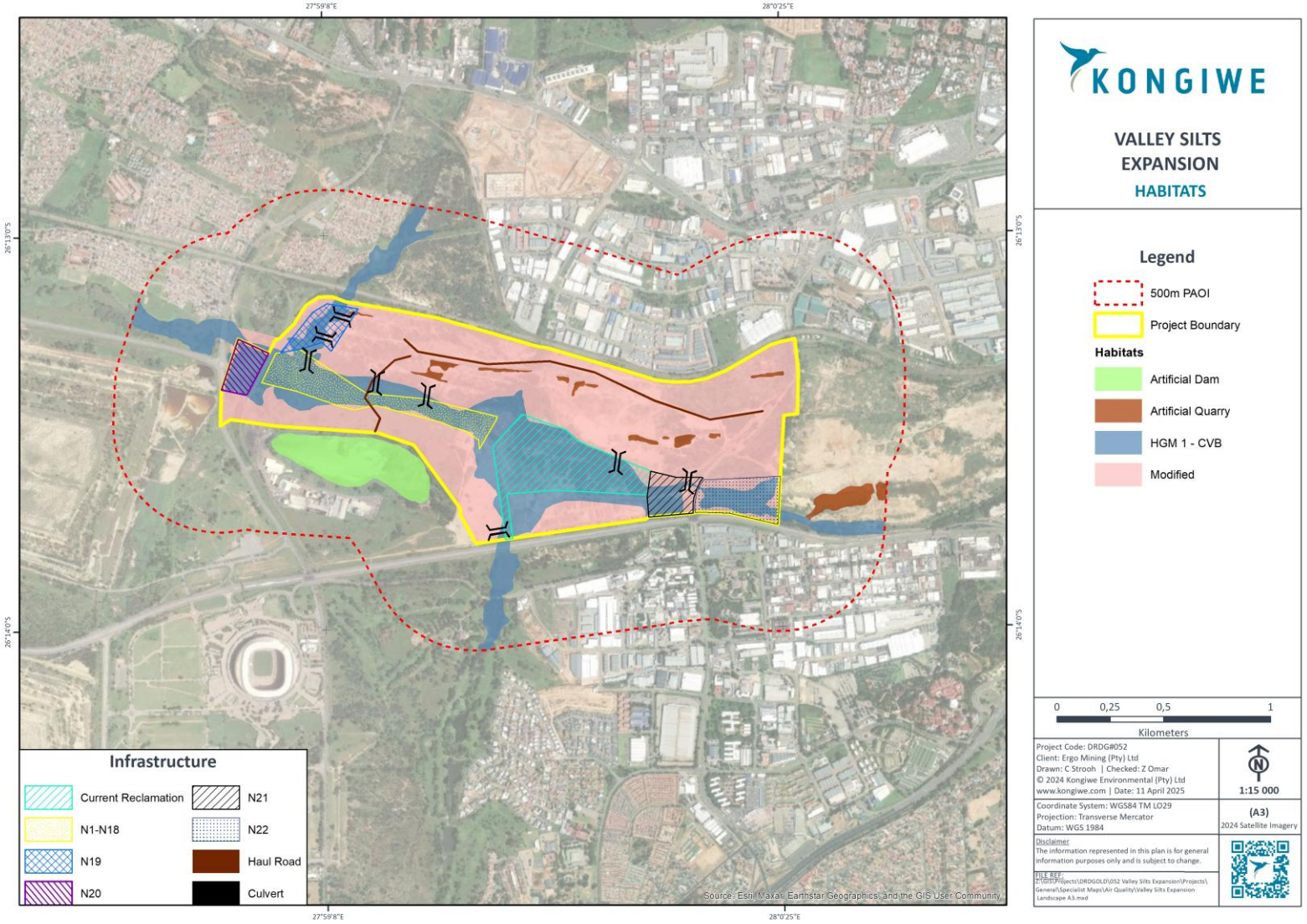


Figure 5-9: Habitats identified within the PAOI

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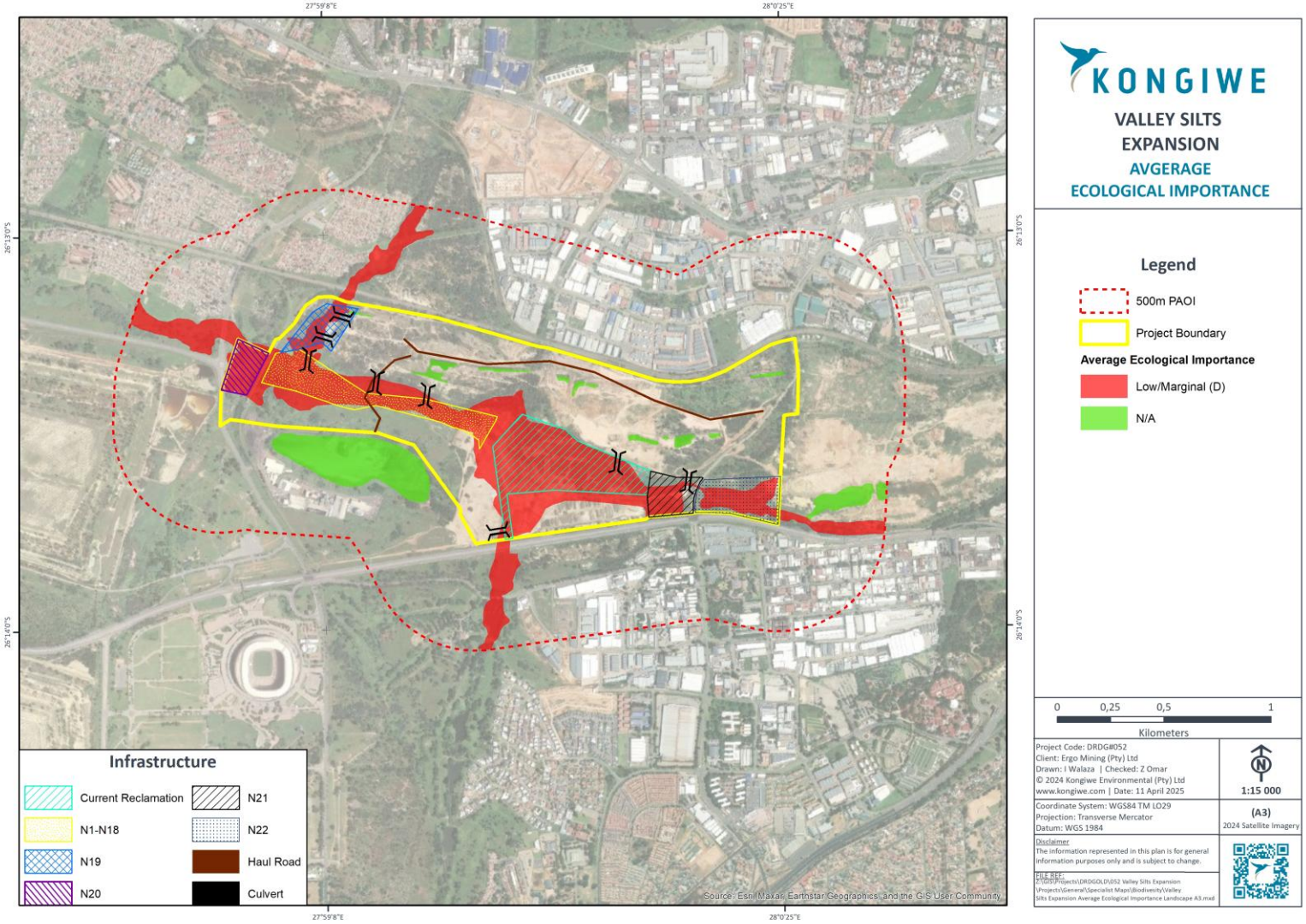


Figure 5-10: Map illustrating the site ecological importance for the PAOI

5.2.2 Wetlands

One wetland type, consisting of one hydrogeomorphic (HGM) unit, has been identified in relation to the proposed project site and its respective PAOI (Figure 5-12 and Figure 5-11). This wetland type has been classified as a channelled valley-bottom (CVB; HGM 1). Wetland functional assessment has only been conducted for natural wetlands.

HGM 1 has been identified to be within the proposed Valley Silts Expansion project area (Figure 5-12). The CVB has been critically modified for a considerable time and has received mine water discharge as well as tailings sediments and the contaminants that accompany it.

Apart from these features, several artificial quarries (as a result of historical mining activities) and one artificial dam were identified within the PAOI and project footprints (Figure 5-12).



Figure 5-11: Examples of the watercourses delineated within the project area. A & B) Artificial Quarries, C and D) Channelled valley-bottom (HGM 1)

The allocated sensitivities for each of the relevant themes are either disputed or validated for the assessed areas in Table 5-3 below. A summative explanation for each result is provided as relevant. The specialist-assigned sensitivity ratings are based largely on the PES and EIS assessment processes followed in the previous section, and consideration is given to any observed or likely presence of sensitive fauna and flora. A map highlighting the Freshwater Sensitivities for the PAOI is depicted in Figure 5-13.

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Table 5-3: Summary of the screening tool vs specialist assigned sensitivities

Features	Screening Tool Theme	Environmental Screening Tool Sensitivity	Specialist Sensitivity	Tool Validated or Disputed by Specialist - Reasoning
HGM 1	Aquatic Biodiversity Theme	Low	High	Screening Tool Sensitivity Disputed. Rationale for the specialist assigned 'High' rating: The wetland system has experienced historical impact related to mining as well as from the surrounding developments in the catchment. The wetland is perceived to be seasonal as surface water was observed in the wetland. Wetland vegetation within the system was abundant. The ecosystem services these wetlands provide together with the PES and EIS have contributed towards determining the sensitivity rating. The wetland has therefore been assigned a 'High' sensitivity rating.
Artificial watercourses	Aquatic Biodiversity Theme	Low	Low	Screening Tool Sensitivity Validated. Rationale for the specialist assigned 'Low' rating: These watercourses were all artificially created through mining activities and other developments such as the Gauteng Oil and Cake Milll. Therefore, a "Low" sensitivity has been assigned for these areas in relation to freshwater biodiversity.
Remaining Area	Aquatic Biodiversity Theme	Low	Low	Screening Tool Sensitivity Validated. Rationale for the specialist assigned 'Low' rating: Much of the area has been historically modified through mining and other developments. The proposed activities are not anticipated to significantly modify the hydrological characteristics of the entire area; therefore a "Low" sensitivity has been assigned for these areas in relation to freshwater biodiversity.

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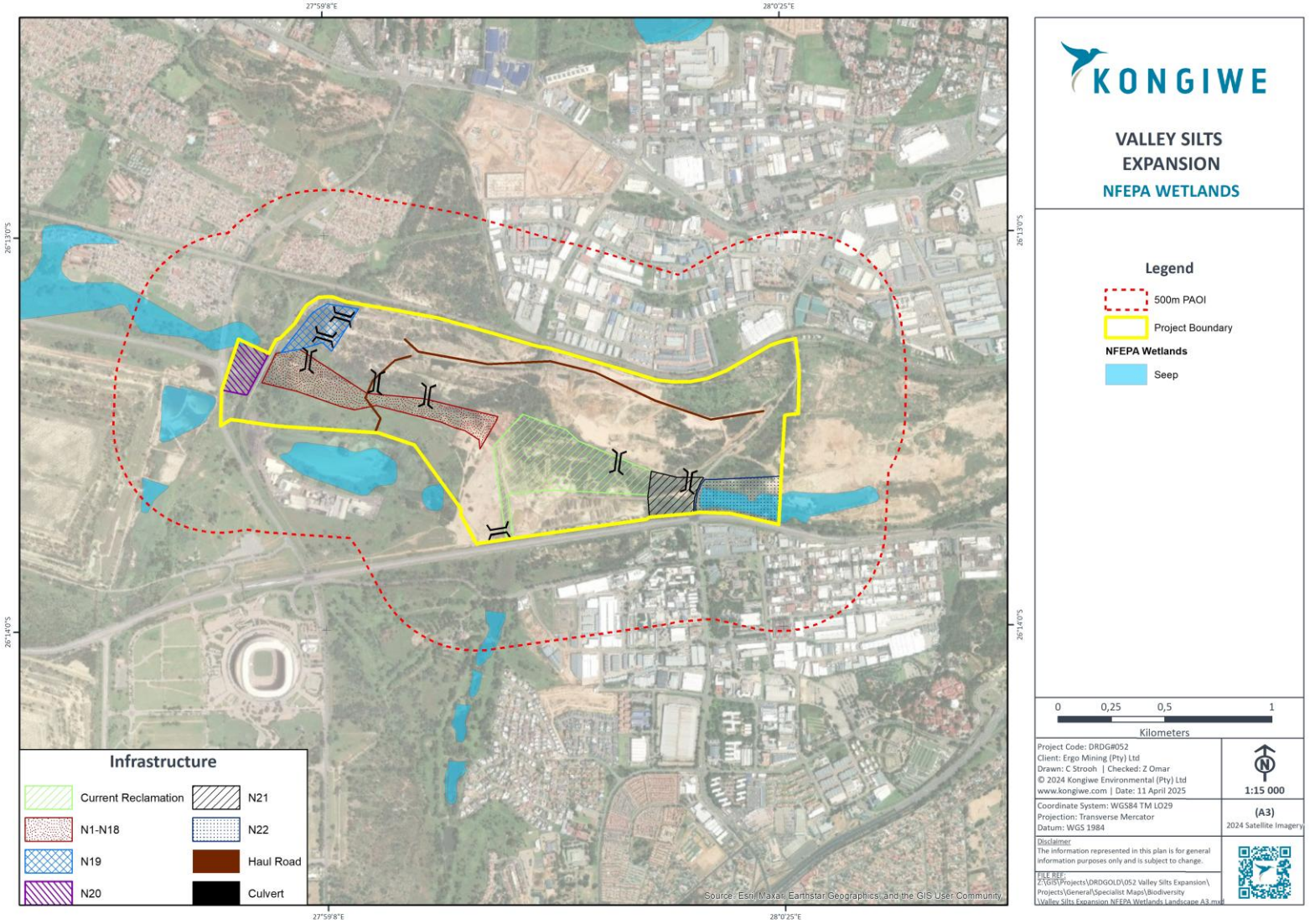


Figure 5-12: Delineation of wetland features within the Proposed Site and Project Area of Influence

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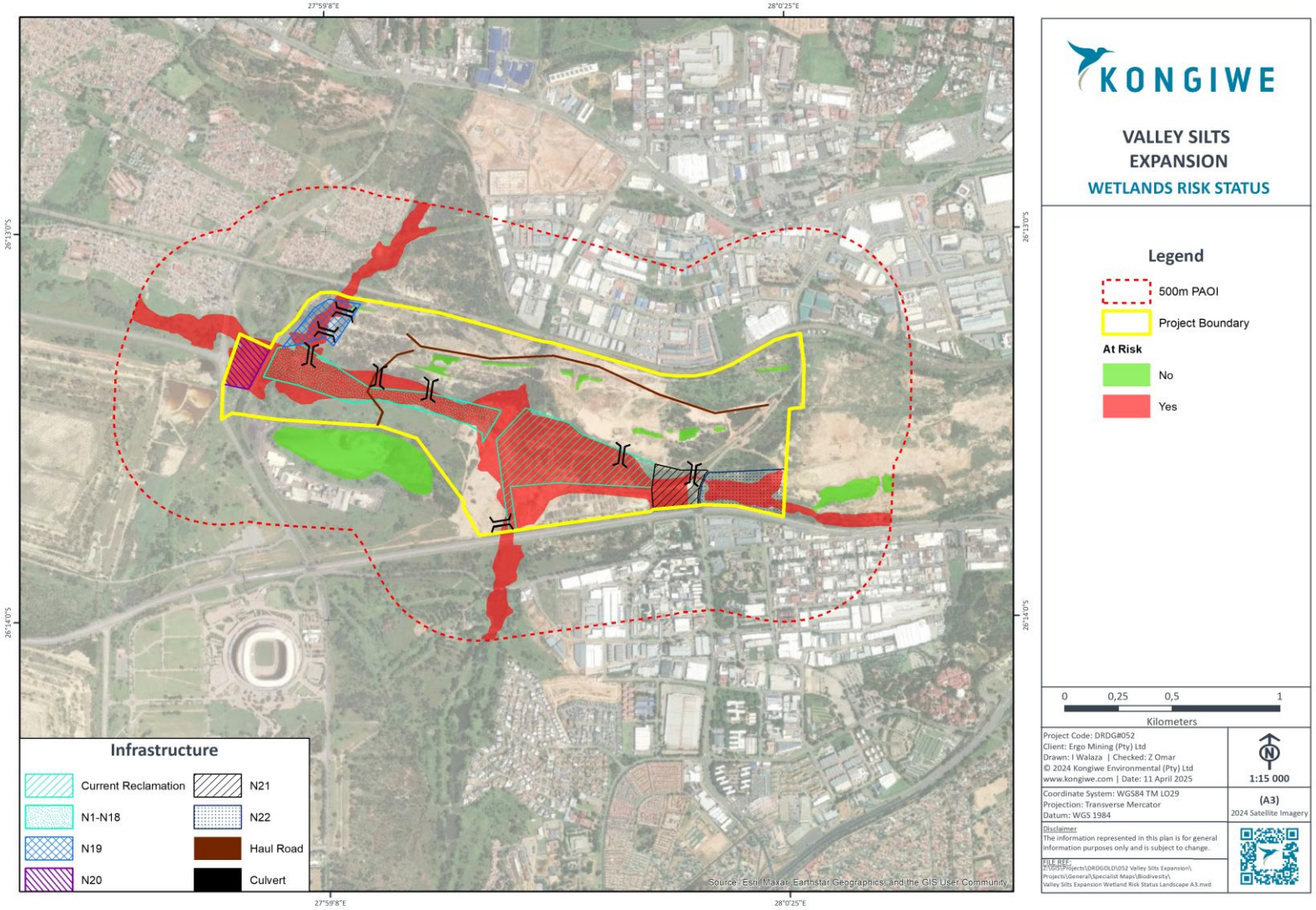


Figure 5-13: Sensitivity Map for the project area of interest

5.3 Groundwater

The Valley Silts Project is located on the Central Rand Group, of the Witwatersrand Supergroup. The Witwatersrand Supergroup is a sequence of conglomerate, shale and quartzite, ranging in age from 2.7 Ga for the Hospital Hill Subgroup to 2.4 Ga for the Turffontein Subgroup. The Lower Witwatersrand is composed mainly of argillaceous clays and shale, with occasional banded ironstone, tillite and intercalated lava flow, while the Upper Witwatersrand consists almost entirely of quartzite and conglomerate (Groundwater Abstract, 2025).

5.3.1 Groundwater Quality

No historical, long-term groundwater quality information could be sourced for the project area. Three groundwater samples were collected from the Valley Silts Extension project area during the hydrocensus, and four water samples were also collected from the newly drilled boreholes.

The water samples were submitted to Aquatico Laboratories for analysis. Aquatico is a SANAS accredited laboratory (South African National Accreditation System). The water samples were analysed for basic inorganic parameters (Table 5-5 and Table 5-6) and the results were compared against the SANS 241:2015 Drinking Water Standards.

The water quality results for the Valley Silts project area are presented in Table 5-4 to Table 5-6. Table 5-4 presents the water quality data for the Valley Silts area during the 2019 groundwater study. Table 5-5 and Table 5-6 present the groundwater qualities during the 2025 hydrocensus and the 2025 aquifer testing programs respectively. The laboratory certificates are attached in Appendix D of the Valley Silts Expansion Project Groundwater Report.

The groundwater in the project area represents a Calcium/ Magnesium-Sulphate water, indicating contaminated water. Only borehole VAL4 (Abraham Kriel Bambanani borehole approx. 1.6 km north of the Russell Stream) presents a Calcium/Magnesium-Bicarbonate water, indicating recent recharge water.

Based on the 2025 groundwater quality results (Table 5-5 and Table 5-6), the following conclusions were drawn:

- Health impact:
    - **Iron** – An elevated iron concentration was measured for all 7 boreholes (hydrocensus and newly drilled) sampled during the 2025 fieldwork program, with Iron concentrations varying between 4.59 mg/L (borehole VAL4) and 441 mg/L (borehole VS-BH1s), versus the maximum allowable concentration of 2 mg/L. The concentration of dissolved Iron in the 4 newly drilled boreholes, adjacent to the Russell Stream vary varies between 72.7 mg/L and 441 mg/L, with lower concentrations measured for the two downgradient boreholes (VS-BH2s and d).

      The concentration of dissolved Iron in water is dependent on the occurrence of other

heavy metals, such as manganese, and the pH of the water.

- **Manganese** – Manganese is a relatively abundant element, constituting approximately 0.1% of the earth's crust. Six of the 7 boreholes sampled during the 2025 study measured a Manganese concentration that exceeds the health impact limit. The measured Mangansee concentration for borehole VAL4 (Abraham Kriel Bambanani borehole) exceeds the Aesthetic Limit of 0.1 mg/L, but is below the Health Impact limit of 0.4 mg/L.

  Manganese concentrations vary between 5.45 mg/L (borehole VAL1) and 74.3 mg/L (borehole VS-BH2d), versus the maximum allowable concentration of 0.4 mg/L. The concentration of dissolved Manganese in the 4 newly drilled boreholes, adjacent to the Russell Stream varies between 34.7 mg/L and 74.3 mg/L, with lower concentrations measured for the 2 upstream boreholes (VS-BH1s and d).

  Manganese tends to precipitate out of solution to form a black hydrated oxide which is responsible for staining problems.

- **Cadmium** – The 4 newly drilled boreholes measured a Cadmium concentration that could result in chronic health effects (0.008 to 0.117 mg/L). The health impact limit is set at 0.003mg/L. Elevated Cadmium concentrations were not measured for the 3 hydrocensus boreholes.

  Cadmium has a low solubility under conditions of neutral or alkaline pH and is highly soluble under acidic conditions, where toxic concentrations can easily arise from the dissolution of cadmium from cadmium-plated materials. Cadmium sulphide, carbonate and hydroxide salts are insoluble in water, whereas cadmium chloride, nitrate and sulphate salts are highly soluble in water. Cadmium is not usually found in water at concentrations greater than 0.001 mg/L, unless the water has been subject to pollution from cadmium containing industrial effluents. Cadmium is used in electroplating, in alloys, in certain solders and in nickel-cadmium batteries. Salts of cadmium are used in photography, pottery, the electronics industry and as pigments in many different applications (DWAF, 1996).

- **Nickel** – An elevated dissolved Nickel concentration was measured at the 4 newly drilled boreholes, plus hydrocensus borehole VAL2. Nickel may be present in groundwater because of dissolution from nickel ore-bearing rocks.

  There are many anthropogenic sources of these chemicals. Industrial uses include alloys, paints, pigments, electroplating, batteries, automotive parts, coatings and electrical wiring.

- **Sulphate** – Sulphate forms salts with various cations such as potassium, sodium, calcium, magnesium, barium, lead and ammonium (DWAF, 1996). Sulphate is a common constituent of water and arises from the dissolution of mineral sulphates in soil and rock.

Since most sulphates are soluble in water it tends to accumulate to progressively increasing concentrations. Contamination by sulphate is to be expected in waters contaminated by Witwatersrand mining activities, due to the oxidation of sulphides in the ores and wastes.

Sulphate concentrations were elevated in 6 of the 7 boreholes sampled during the 2025 study. It was only borehole VAL4 where the measured Sulphate concentration was within acceptable health and aesthetic limits.

The elevated Sulphate concentrations vary between 1125 mg/L (borehole VAL1) and 3126 mg/L (borehole VS-BH1d), versus the maximum allowable concentration of 500 mg/L. The concentration of Sulphate in the 4 newly drilled boreholes, adjacent to the Russell Stream vary between 2011 mg/L and 3126 mg/L, with lower concentrations measured for the two downstream boreholes (VS-BH2s and d).

- **Lead** – An elevated Lead concentration was measured for borehole VS-BH2d (0.012mg/L) and borehole VAL2 (0.012 mg/L), with the health limit defined as 0.01mg/L. The Lead concentration in all other boreholes were below the detection limit.

  The occurrence of Lead in its elemental state is rare. Lead tends to accumulate in sediments and soils in the environment. Lead has many industrial applications which can give rise to sources of Lead contamination in water. Lead is used in batteries, in domestic water distribution pipes, in paints and as an organic lead compound, alkyl lead, in gasoline.

- **Total Organic Carbon** – High TOC values (between 11.2 and 19.1 mg/L) were measured for boreholes VAL1, VAL2, VS-BH2s and VS-BH2d. In groundwater, the main natural sources of organic matter include buried peat, kerogen and coal; soil and sediment organic matter; and organic matter present in water infiltrating into the subsurface from rivers or dams/ pans.
- **E. coli** – borehole VAL4 produced a measurable E. coli count – 7 counts per 100 ml; the count must be zero. E. coli is a type of faecal coliform bacteria commonly found in the intestines of animals and humans. Of the five general groups of bacteria that comprise the total coliforms, only E. coli is generally not found growing and reproducing in the environment. Consequently, E. coli is the species of coliform bacteria that is the best indicator of faecal pollution and the possible presence of pathogens.

  Borehole VAL4 is in an old residential and industrial area, and it has been assumed that leaking sewer lines are possibly contaminating the groundwater around this borehole.

- Aesthetic effects:

  - **Aluminium** – The aluminium concentration for boreholes VS-BH1s and VS-BH1d (25.1mg/L and 2.07 mg/L respectively) exceed the SANS241:2015 guideline value of 0.3 mg/L. Aesthetic effects (discolouration) occur in the presence of iron or manganese. Aluminium is the most common metal in the earth's crust. Aluminium does not occur in the elemental form, but its minerals, particularly the silicates of aluminium (clay minerals), are widespread. The sampled groundwater from the BH1 cluster set was very muddy during the sampling process and this could have contributed to the elevated Aluminium concentrations.
  - Zinc – The Zinc concentration for borehole VS-BH1s (7.99 mg/L) exceeds the SANS241:2015 guideline value of 5 mg/L. The measured Zinc concentrations for the other 3 newly drilled boreholes were below the aesthetic impact limit.

    Zinc is an essential nutritional trace element for plants and animals. Humans have a high tolerance level to elevated Zinc concentrations, while fish are highly susceptible to poisoning.

    The most common mineral form of Zinc is the sulphide (sphalerite). Zinc is also found as a carbonate, oxide or silicate and may occur in association with many other metal ores such as Copper and Arsenic. The Chloride, Sulphate and Nitrate salts of Zinc are highly soluble in water, but at neutral and alkaline pH they hydrolyse to form relatively insoluble hydroxides which tend to be associated with sediments. On acidification of the water, the insoluble hydroxides are released back into solution. If the water is acidic, Zinc leaching caused by dissolution of the protective zinc hydroxide layer of galvanised piping can give rise to relatively high concentrations of Zinc in solution.

    Zinc and zinc salts are used in many industrial processes. Zinc itself is extensively used in galvanising processes and in alloys (DWAF, 1996).

    Ammonium – The chemistry of ammonia is very complex, especially where transition metals are present in water, and while ammonia itself is of relatively low toxicity, this is not necessarily the case for some of its organometallic complexes. Taste and odour complaints.

  - are likely to occur if the ammonia concentration exceeds 1.5 mg/L. High concentrations of ammonia can also give rise to Nitrite. The Ammonium concentration for borehole VAL1 exceeds the aesthetic limit for drinking water (14.6mg/L). The aesthetic limit set at 1.5 mg/L. The ammonia concentrations in the other boreholes vary between 0.19 and 0.88 mg/L.
  - **Sodium** – Sodium is abundant in the environment and usually occurs as sodium chloride, but sometimes as sodium sulphate, bicarbonate or even nitrate (DWAF, 1996). Sodium is highly soluble in water and does not precipitate when water evaporates, unless saturation occurs. The measured Sodium concentration for borehole VS-BH1d (210 mg/L)

exceeds the aesthetic limits for drinking water (200mg/L). With the re-use or recycling of water, the Sodium concentration will tend to increase with each cycle or addition of Sodium to the water. For this reason, Sodium concentrations are elevated in runoffs or leachates.

- **Turbidity** – Turbidity is indicative of the concentration of suspended matter in water and is also related to clarity, a measure of the transparency of water and settleable material. Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles, and organic matter. The latter can be both living matter such as micro-organisms and non-living matter such as dead algal cells. Turbidity was high in all boreholes with units varying between 42.5 NTUs and 730 NTUs.
- **Calcium** – The measured Calcium concentration was elevated for all sampled boreholes, with concentrations varying between 37.5 mg/L and 493 mg/L. Calcium is an alkaline earth metal and exists as the doubly positively-charged ion, Ca(II) (DWAF, 1996). Calcium occurs naturally in varying concentrations in most waters and, together with magnesium, is one of the main components of water hardness. Soft waters contain low, while hard waters contain high concentrations of Calcium; see Total Hardness. Calcium is an essential element for all living organisms and is an important constituent of the bony skeleton of mammals, which consists of phosphates of calcium. Mineral deposits of calcium are common, usually as calcium carbonate, phosphate or sulphate (DWAF, 1996).
- **Magnesium** – Magnesium is an alkaline earth metal which reacts with oxygen and water to form magnesium oxide and magnesium hydroxide, respectively. Magnesium is a common constituent of water, and the solubility is governed by the carbonate/bicarbonate equilibrium and the pH. Magnesium, together with calcium, is responsible for the hardness of water. High Magnesium concentrations were measured in 5 of the 7 boreholes and were thus in acceptable limits for boreholes VAL1 and VAL4.
- **Total Hardness** – The Total hardness value was elevated for all boreholes except borehole VAL4, indicating very hard water. Water hardness is influenced by the presence of calcium and magnesium salts. Other metals such as strontium, iron, aluminium, zinc and manganese may occasionally contribute to the hardness of water, but the calcium and magnesium hardness usually predominates. Temporary hardness is due to the presence of bicarbonates of calcium and magnesium and can be removed by boiling, whereas permanent hardness is attributed to other salts such as sulphate and chloride salts, which cannot be removed by boiling. Excessive hardness of water can give rise to scaling in plumbing and household heating appliances.

Total Coliform – Total coliform bacteria are common in the environment (soil or vegetation) and are generally harmless. The total coliform count was elevated for borehole VAL4 (40 counts per 100 ml) and for borehole VS-BH1d (20 counts per 100 ml). The operational limit is set at 10 counts per 100 millilitres (ml).

Total coliform bacteria are frequently used to assess the general hygienic quality of water and to evaluate the efficiency of drinking water treatment and the integrity of the

distribution system. They should not be detectable in treated water supplies. If found, they suggest inadequate treatment, post-treatment contamination and/or aftergrowth or an excessive concentration of nutrients. In some instances, they may indicate the presence of pathogens. Some bacteria classified as coliforms are not of faecal origin. Total coliforms include bacteria that are found in the soil, in water that has been influenced by surface water, and in human or animal waste.

- **pH** – the pH value for the two newly drilled upstream boreholes (VS-BH1s and VS-BH1d) (4.87 and 4.52 respectively) is below the SANS guideline limit of 5.

  The mobility of trace elements is dependent on several parameters, including pH. All the trace elements examined are most mobile when the pH <4.5, and least mobile when the pH > 6. The pH for the two downstream groundwater samples was 5.6 and 6.2.

- The SANS 241 guideline limits for Electrical Conductivity (EC) and Total Dissolved Salts (TDS) were exceeded for all sampled sites, except for borehole VAL4. EC level varied between 222 and 403 mS/m. TDS varied between 1756 and 4134 mg/L.

The chemicals of concern for the Valley Silts project area are pH, Iron, Manganese, Sulphate, Cadmium, Lead, Nickel and Total Organic Carbon (Table 5-5 and Table 5-6). Parameters exceeding aesthetic limits include Ammonium, Aluminium, Chloride, Calcium, Magnesium, Sodium, Zinc and Total Hardness and Turbidity. Most of these are elevated in the four newly drilled boreholes. Based on the SANS241 drinking water guidelines and on the sampled water results, the sampled water is not fit for human consumption (unless treated).

Groundwater near tailings dams is affected by salt loads. The groundwater quality improved with increasing distance down gradient from the pollution source, mainly because of dilution and solid speciation. Once contaminants have migrated through the unsaturated zone, into the groundwater zone, the rate of lateral movement increases by orders of magnitude. The implication of this is that although there is a dilution effect because of contact with groundwater, the potential impact on the environment is extended in a spatial and temporal sense.

The gold containing silt in Russell Stream and the adjacent TSF and sand dump facilities can potentially add sulphate, iron, chloride, calcium, magnesium, manganese and aluminium to the local groundwater system, if the management of contaminated water on site is not effective, but also through seepage from the adjacent dumps. This has been confirmed by the 2019 and the 2025 water sampling results (Table 5-4 to Table 5-6). Metals like cobalt, copper, nickel and zinc can also be elevated. In general, sulphate concentrations around the tailings complexes south and west of Johannesburg vary between 417 and 4700 mg/L.

The pyrite present in the silt and sand material is oxidised in the presence of oxygen and water to form ferrous sulphate and sulphuric acid. Both reactions result in an acidic pH, and high sulphate and metal concentrations, leading to Acid Mine Drainage (AMD); often measured in leachate from these dumps. Pyrite was also noted in the drill samples from borehole VS-BH2d.

The rate at which pyrite oxidation takes place within the surrounding dumps varies and decreases with depth. The addition of lime during the gold recovery process raises the pH to neutral conditions when tailings are deposited on the facilities. Negative quality impacts are expected when the silts are excavated and exposed to oxygen and water.

The Valley Silts Project area is surrounded by residential and industrial areas. Many pollution sources (industrial discharge, mining activities and poor waste and sanitation management) do exist that can contribute to groundwater contamination. It will be difficult to define the contaminants and concentration at all point sources in the area.

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Table 5-4: Hydrocensus groundwater quality – October 2019

Parameter	Unit	SANS241 Standard Limits		DWS Drinking Standards	B15	Storm 1	Val 1
Ammonium	mg N/ℓ	Aesthetic ≤1.5			0,451	0,202	3,61
Chloride	mg Cl/ℓ	Aesthetic ≤300			145	118	43,1
Aluminium	mg Al/ℓ	≤0.3			-0,002	19	-0,002
Cadmium	mg Cd/ℓ		Chronic health ≤0.003		-0,002	-0,002	-0,002
Calcium	mg Ca/ℓ			No health. Scaling intensifies from 32mg/L	330	577	76,4
Copper	mg Cu/ℓ		Chronic health ≤2		-0,002	-0,002	-0,002
Iron	mg Fe/ℓ	Aesthetic ≤0.3	Chronic health ≤2		-0,004	342	-0,004
Lead	mg Pb/ℓ		Chronic health ≤0.01		-0,004	-0,004	-0,004
Magnesium	mg Mg/ℓ			Diarrhoea and scaling issues from 70mg/L	249	93,6	37,7
Manganese	mg Mn/ℓ	Aesthetic ≤0.1	Chronic health ≤0.4		4,74	28,1	0,705
Nickel	mg Ni/ℓ		Chronic health ≤0.07		-0,002	-0,002	-0,002
Zinc	mg Zn/ℓ	Aesthetic ≤5			0,07	0,6	-0,002
Electrical Conductivity at 25°C	mS/m	Aesthetic ≤170			316	460	95,6
Fluoride	mg/ℓ		Chronic health ≤1.5		-0,263	0,615	-0,263
Nitrate	mg/ℓ		Acute health ≤11		0,303	-0,194	0,509
pH at 25°C		≥5 - ≤9.7			6,16	4,13	7,41
Potassium	mg K/ℓ			No aesthetic or health effects below 50mg/L	3,21	59,7	6,72
Sodium	mg Na/ℓ	Aesthetic ≤200			202	219	65,1
Sulphate	mg SO4/ℓ	Aesthetic ≤250	Acute health ≤500		1843	3208	417
Total Alkalinity	mg CaCO3/ℓ				55,4	13,1	39,2
Total Dissolved Solids	mg/ℓ	Aesthetic ≤1200			2807	4285	677
Total Hardness	mg CaCO3/ℓ	60–120 mg/l, moderately hard	120–180 mg/l, hard	more than 180 mg/l, very hard	1848	1826	346
Orthophosphate (PO4) as P	mg/ℓ				-0,005	-0,005	-0,005
Cobalt	mg/ℓ				0,208	0,945	0,041
Turbidity	NTU	Aesthetic ≤5			93	38,2	3,41
TOC			Chronic health ≤10		2,75	13,3	1,99

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Table 5-5: Hydrocensus groundwater quality – February 2025

Parameter	Unit	SANS241 Standard Limits		DWS Drinking Standards	Val 1	Val 2	Val 4
Ammonium	mg N/ℓ	Aesthetic ≤1.5			14,6	0,887	0,229
Chloride	mg Cl/ℓ	Aesthetic ≤300			81,9	145	25,6
Aluminium	mg Al/ℓ	≤0.3			-0,002	-0,002	-0,002
Cadmium	mg Cd/ℓ		Chronic health ≤0.003		0,003	0,003	-0,002
Calcium	mg Ca/ℓ			No health. Scaling intensifies from 32mg/L	232	376	37,5
Copper	mg Cu/ℓ		Chronic health ≤2		0,015	0,016	-0,002
Iron	mg Fe/ℓ	Aesthetic ≤0.3	Chronic health ≤2		11,7	18,3	4,59
Lead	mg Pb/ℓ		Chronic health ≤0.01		-0,004	0,012	-0,004
Acid Soluble Chromium	mg Cr/ℓ		Chronic health ≤0.05		-0,003	-0,003	-0,003
Magnesium	mg Mg/ℓ			Diarrhoea and scaling issues from 70mg/L	66,9	82,1	16,8
Manganese	mg Mn/ℓ	Aesthetic ≤0.1	Chronic health ≤0.4		5,45	53	0,294
Nickel	mg Ni/ℓ		Chronic health ≤0.07		-0,002	0,123	-0,002
Zinc	mg Zn/ℓ	Aesthetic ≤5			-0,002	-0,002	-0,002
Electrical Conductivity at 25°C	mS/m	Aesthetic ≤170			222	271	31,9
Fluoride	mg/ℓ		Chronic health ≤1.5		-0,263	-0,263	-0,263
Nitrate	mg/ℓ		Acute health ≤11		0,269	-0,194	4,19
TON	mg/ℓ				0,269	-0,194	4,19
pH at 25°C		≥5 - ≤9.7			7,49	7,55	8,17
Potassium	mg K/ℓ			No aesthetic or health effects below 50mg/L	28,2	12,9	1,28
Sodium	mg Na/ℓ	Aesthetic ≤200			164	92,3	5,78
Sulphate	mg SO4/ℓ	Aesthetic ≤250	Acute health ≤500		1125	1388	23,5
Total Alkalinity	mg CaCO3/ℓ				62,8	48	97,7
Total Dissolved Solids	mg/ℓ	Aesthetic ≤1200			1756	2127	189
Total Hardness	mg CaCO3/ℓ	60–120 mg/l, moderately hard	120–180 mg/l, hard	more than 180 mg/l, very hard	855	1278	163
E.coli	CFU/100ml		Not detected		-1	-1	7
Total Coliforms	CFU/100ml	≤ 10			5	-1	40
Turbidity	NTU	Aesthetic ≤5			302	317	42,5
TOC	mg/ℓ		Chronic health ≤10		18,9	11,2	2,18
Langelier Saturation Index	LSI	A negative Langelier index indicates a scale-dissolving tendency, with the possibility of corrosion			-0,39	-0,24	-0,21

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Table 5-6: Aquifer testing groundwater quality – March 2025

Parameter	Unit	SANS241 Standard Limits		DWS Drinking Standards	VSBH-1d	VSBH-1s	VSBH-2s	VSBH-2d
Ammonium	mg N/ℓ	Aesthetic ≤1.5			0,263	0,758	0,328	0,196
Chloride	mg Cl/ℓ	Aesthetic ≤300			31.0	59.0	77,2	78,1
Aluminium	mg Al/ℓ	≤0.3			2,07	25,10	0,023	0,071
Cadmium	mg Cd/ℓ		Chronic health ≤0.003		0,063	0,117	0,012	0,008
Calcium	mg Ca/ℓ			No health. Scaling intensifies from 32mg/L	493	341	334	414
Copper	mg Cu/ℓ		Chronic health ≤2		0,043	0,077	0,019	0,022
Iron	mg Fe/ℓ	Aesthetic ≤0.3	Chronic health ≤2		296	441	83,5	72,7
Lead	mg Pb/ℓ		Chronic health ≤0.01		-0,004	-0,004	-0,004	0,012
Acid Soluble Chromium	mg Cr/ℓ		Chronic health ≤0.05		-0,003	-0,003	-0,003	0,017
Magnesium	mg Mg/ℓ			Diarrhoea and scaling issues from 70mg/L	246	96,6	168	149
Manganese	mg Mn/ℓ	Aesthetic ≤0.1	Chronic health ≤0.4		38,2	34,7	68,3	74,3
Nickel	mg Ni/ℓ		Chronic health ≤0.07		5,21	10,2	1,4	5,83
Zinc	mg Zn/ℓ	Aesthetic ≤5			2,19	7,99	0,036	0,391
Electrical Conductivity at 25°C	mS/m	Aesthetic ≤170			403	317	299	341
Fluoride	mg/ℓ		Chronic health ≤1.5		-0,263	-0,263	-0,263	-0,263
Nitrate	mg/ℓ		Acute health ≤11		1,49	1,01	-0,194	-0,194
TON	mg/ℓ				1,49	1,01	-0,194	-0,194
pH at 25°C		≥5 - ≤9.7			4,52	4,87	6,22	5,69
Potassium	mg K/ℓ			No aesthetic or health effects below 50mg/L	9,09	6,94	18,50	26,90
Sodium	mg Na/ℓ	Aesthetic ≤200			210	77,7	121	145
Sulphate	mg SO4/ℓ	Aesthetic ≤250	Acute health ≤500		3126	2395	2011	2246
Total Alkalinity	mg CaCO3/ℓ				21,3	14,5	43,5	41,4
Total Dissolved Solids	mg/ℓ	Aesthetic ≤1200			4134	2991	2757	3085
Total Hardness	mg CaCO3/ℓ	60–120 mg/l, moderately hard	120–180 mg/l, hard	more than 180 mg/l, very hard	2243	1249	1525	1650
E.coli	CFU/100ml		Not detected		-1	-1	-1	-1
Total Coliforms	CFU/100ml	≤ 10			20	5	-1	-1
Turbidity	NTU	Aesthetic ≤5			626	730	566	133
TOC	mg/ℓ		Chronic health ≤10		4,18	5,42	19,1	12,3
Langelier Saturation Index	LSI	A negative Langelier index indicates a scale-dissolving tendency, with the possibility of corrosion			-3,51	-3,48	-1,69	-2,16

5.4 Surface Water

The Project is located in the Vaal WMA, within quaternary catchment C22A in the Klip River Catchment. A number of small tributaries drain the surrounding suburbs, industrial areas and the western portion of the Johannesburg CBD into the Russell Stream. The Russell Stream flows through the Project area in a north-westerly direction and is a tributary of the Klip River, which flows into the Vaal River above the Vaal Barrage, near the town of Vereeniging. The accumulation of sediment over years has resulted in the Russell Stream being deflected to the north of its original course. Furthermore, the large amount of sediment that has accumulated in the Russell Stream valley has resulted in regular flooding, particularly at the suburb of Riverlea.

5.4.1 Water Quality

Water quality results from 4 locations were analysed. CR1 and CR4 are directly upstream and CR7and CR11 are downstream of the project. The water quality monitoring results are presented in Table 5-7 to

Table 5-9, with trends in selected parameters shown in Figure 5-14.

The following provides a summary of the water quality:

- pH was within limits at all monitoring locations;
- Electrical Conductivity (EC) and Total Dissolved Solids (TDS), which provides an indication of the dissolved salts in water, were within acceptable limits at all monitoring locations;
- Nutrients (Ammonia, Nitrate and Phosphate), E.coli and Chemical Oxygen Demand (COD), were regularly elevated at DWS1, indicating sewage contamination of the Russell Stream;
- Elevated levels of heavy metal concentrations for Iron, Manganese, Aluminium, Nickel and Arsenic were recorded at most of the monitoring locations. This has been occurring since before the current mining operation at Sector 1 commenced in May 2023;
- Uranium was within limits at all of the Ergo monitoring locations; and
- Suspended Solids (SS) was regularly elevated above unacceptable limits at all monitoring locations. A comparison between the upstream (CR1 and CR4) and downstream (CR7) monitoring locations showed no significant increase in SS as a result of the current mining operation.

The water quality of the Russell Stream has a neutral pH of approximately 7.2, dissolved salts within the ideal range of the Klip River catchment guideline limits, high nutrient and E.coli levels, elevated Suspended Solids, as well as at times elevated metals in terms of Iron, Manganese, Aluminium, Nickel and Arsenic. Uranium was found to be within limits.

Based on the current water quality available, it appears that the current mining operation at Sector 1 is not having a significant impact on the water quality of the Russell Stream. This is likely due to current measures that are implemented onsite, such as berms that contain runoff from dirty areas, as well as silt traps that settle out silt.

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Table 5-7: Ergo water quality results – August 2023 to December 2023

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits		August 2023				September 2023				October 2023				November 2023				December 2023			
		Tolerable	Unacceptable	Risk	Limit	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7	---	6.30	7.20	---	7.30	7.40	7.30	7.30	---	7.20	7.30	---	---	7.80	7.60	---	6.80	7.10	7.10	7.60
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170	---	52.60	66.60	---	62.50	53.90	67.40	67.80	---	48.50	70.00	---	---	64.40	65.30	---	64.00	56.30	57.10	78.30
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200	---	278.00	328.00	---	282.00	270.00	340.00	348.00	---	272.00	364.00	---	---	400.00	444.00	---	476.00	280.00	332.00	406.00
Total Acidity as CaCO3	mg/ℓ	---	---	---	---	---	16.00	<5	---	<5	<5	<5	<5	---	<5	<5	---	---	<5	<5	---	12.00	8.00	12.00	<5
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300	---	36.00	44.00	---	39.00	32.00	41.00	43.00	---	31.00	53.00	---	---	44.00	42.00	---	74.00	38.00	38.00	61.00
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500	---	51.00	84.00	---	56.00	67.00	112.00	115.00	---	79.00	119.00	---	---	50.00	116.00	---	<2	49.00	109.00	<2
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5	---	0.20	0.20	---	0.20	0.20	0.20	0.20	---	<0.2	0.20	---	---	0.20	0.20	---	0.20	<0.2	<0.2	0.20
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	0.10	---	0.10	0.10	---	---	0.10	0.20	---	<0.1	<0.1	<0.1	<0.1
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9	---	0.06	0.07	---	<0.05	<0.05	<0.05	0.05	---	<0.05	<0.05	---	---	<0.05	<0.05	---	<0.05	<0.05	<0.05	<0.05
Bromide as Br	mg/ℓ	---	---	---	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1
Ortho Phosphate as P	mg/ℓ	---	---	---	---	---	0.10	0.30	---	1.90	0.90	0.50	0.40	---	0.20	0.20	---	---	0.20	<0.1	---	0.70	1.10	0.20	1.00
Total Cyanide as CN	mg/ℓ	---	---	---	---	---	<0.07	<0.07	---	<0.07	<0.07	<0.07	<0.07	---	---	---	---	---	<0.07	<0.07	---	<0.07	<0.07	<0.07	<0.07
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---	---	10.00	19.00	---	23.00	13.00	17.00	17.00	---	11.00	24.00	---	---	12.00	10.00	---	7.20	18.00	12.00	22.00
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200	---	30.00	41.00	---	43.00	33.00	47.00	42.00	---	28.00	42.00	---	---	55.00	43.00	---	89.00	40.00	44.00	59.00
Potassium as K	mg/ℓ	---	---	---	---	---	7.50	11.00	---	11.90	8.10	10.70	10.50	---	9.00	13.10	---	---	10.40	10.60	---	14.90	11.20	10.50	15.70
Calcium as Ca	mg/ℓ	---	---	---	---	---	34.00	33.00	---	29.00	31.00	34.00	39.00	---	33.00	36.00	---	---	33.00	37.00	---	35.00	38.00	46.00	56.00
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---	---	12.00	15.00	---	13.00	12.00	16.00	17.00	---	13.00	16.00	---	---	11.00	14.00	---	18.00	14.00	18.00	21.00
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3	---	<0.100	<0.100	---	<0.100	<0.100	<0.100	<0.100	---	<0.100	<0.100	---	---	<0.100	<0.100	---	<0.100	<0.100	<0.100	0.11
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02	---	<0.001	<0.001	---	0.00	<0.001	0.00	0.00	---	0.00	0.00	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	0.00
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	---	0.005	0.002	---	<0.001	0.003	0.003	0.004	---	0.006	0.006	---	---	0.008	0.002	---	0.001	0.002	0.002	0.006
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7	---	0.05	0.04	---	0.04	0.04	0.04	0.03	---	0.04	0.03	---	---	0.04	0.04	---	0.07	0.04	0.04	0.04
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	0.20	0.17	0.17	0.14	---	0.07	0.07	---	---	0.22	0.18	---	0.14	0.04	0.07	0.07
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4	---	0.03	0.04	---	<0.025	<0.025	0.03	0.03	---	0.03	0.05	---	---	<0.025	<0.025	---	0.04	0.05	0.04	0.06
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05	---	0.01	<0.010	---	<0.010	<0.010	<0.010	<0.010	---	<0.010	<0.010	---	---	0.02	0.01	---	0.01	<0.010	<0.010	<0.010
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	0.05	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	0.05	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2	---	<0.010	<0.010	---	<0.010	<0.010	<0.010	<0.010	---	<0.010	<0.010	---	---	<0.010	<0.010	---	0.02	0.02	0.02	0.02
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2	---	<0.025	<0.025	---	0.38	0.76	0.44	0.42	---	0.86	1.85	---	---	0.38	0.37	---	0.14	0.11	0.68	0.04
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	0.05	0.04	0.03	0.03	---	0.12	0.34	---	---	0.18	0.14	---	0.06	0.03	<0.025	<0.025
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	0.34	0.72	0.40	0.39	---	0.74	1.52	---	---	0.20	0.23	---	0.08	0.08	0.65	0.03
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	---	0.00	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	0.00	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4	---	0.70	1.96	---	0.12	0.52	1.31	1.48	---	0.88	1.76	---	---	0.89	2.10	---	1.81	0.67	2.21	2.61
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006	---	<0.001	0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07	---	<0.025	0.05	---	<0.025	<0.025	0.03	0.03	---	<0.025	0.06	---	---	<0.025	0.03	---	<0.025	<0.025	0.04	<0.025
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---	---	0.36	0.89	---	3.82	1.85	1.43	0.55	---	0.61	1.58	---	---	0.73	0.18	---	0.98	1.34	0.35	1.17
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04	---	<0.001	<0.001	---	<0.001	<0.001	0.00	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	0.00	<0.001
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---	---	8.40	8.40	---	10.50	8.50	9.60	8.80	---	8.90	8.70	---	---	8.10	8.50	---	9.30	7.60	8.30	9.00
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---	---	0.14	0.14	---	0.13	0.12	0.13	0.13	---	0.15	0.15	---	---	0.12	0.14	---	0.16	0.16	0.18	0.18
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	0.00	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	0.01	0.01	0.02	0.02
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03	---	0.001	0.002	---	<0.001	0.001	0.003	0.004	---	0.002	0.004	---	---	0.001	0.002	---	<0.001	0.001	0.001	0.003
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5	---	<0.025	<0.025	---	0.04	0.03	0.03	0.03	---	0.04	0.03	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001

Suspended Solids	mg/ℓ	30 - 55	> 55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	456	---	---	---	37	---	---
Turbidity	NTU	---	---	Aesthetic	≤ 5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	139	---	---	---	14	---	---

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Table 5-8: Ergo water quality results – January 2024 to August 2024

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits		January 2024				February 2024				March 2024				June 2024				August 2024			
		Tolerable	Unacceptable	Risk	Limit	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7	---	6.80	7.00	---	---	7.30	7.20	---	7.10	6.90	7.10	7.10	6.80	7.00	7.20	7.10	---	7.10	7.00	---
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170	---	57.30	66.90	---	---	52.00	62.20	---	116.00	64.30	68.10	79.20	59.20	59.80	77.30	76.70	---	48.20	79.10	---
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200	---	420.00	474.00	---	---	264.00	322.00	---	578.00	344.00	410.00	410.00	302.00	318.00	394.00	424.00	---	274.00	388.00	---
Total Acidity as CaCO3	mg/ℓ	---	---	---	---	---	28.00	20.00	---	---	<5	<5	---	<5	<5	<5	<5	12.00	<5	<5	<5	---	24.00	173.00	---
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300	---	35.00	37.00	---	---	29.00	34.00	---	121.00	42.00	45.00	53.00	47.00	35.00	46.00	44.00	---	30.00	47.00	---
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500	---	113.00	158.00	---	---	58.00	92.00	---	40.00	42.00	61.00	79.00	50.00	57.00	79.00	102.00	---	45.00	48.00	---
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5	---	0.30	0.30	---	---	0.30	0.30	---	0.40	0.30	0.30	0.30	0.40	0.20	0.20	0.30	---	<0.2	<0.2	---
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11	---	<0.1	<0.1	---	---	<0.1	0.20	---	0.70	0.30	0.30	0.30	<0.1	2.10	2.00	2.00	---	<0.1	<0.1	---
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9	---	<0.05	<0.05	---	---	0.10	<0.05	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	---	0.05	<0.05	---
Bromide as Br	mg/ℓ	---	---	---	---	---	<0.1	<0.1	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---
Ortho Phosphate as P	mg/ℓ	---	---	---	---	---	<0.1	<0.1	---	---	0.40	0.40	---	0.80	0.40	0.40	0.60	<0.1	0.40	0.50	0.50	---	0.40	1.20	---
Total Cyanide as CN	mg/ℓ	---	---	---	---	---	<0.07	<0.07	---	---	<0.07	<0.07	---	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	---	<0.07	<0.07	---
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---	---	4.80	9.90	---	---	14.00	15.00	---	35.00	15.00	14.00	20.00	6.50	11.00	19.00	14.00	---	8.70	25.00	---
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200	---	34.00	38.00	---	---	26.00	38.00	---	95.00	38.00	48.00	58.00	35.00	36.00	47.00	51.00	---	27.00	54.00	---
Potassium as K	mg/ℓ	---	---	---	---	---	9.10	9.30	---	---	7.50	9.20	---	50.00	12.30	15.70	21.00	12.30	9.40	11.60	11.50	---	9.20	15.60	---
Calcium as Ca	mg/ℓ	---	---	---	---	---	46.00	50.00	---	---	31.00	34.00	---	35.00	28.00	35.00	41.00	37.00	35.00	37.00	40.00	---	34.00	41.00	---
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---	---	15.00	18.00	---	---	16.00	19.00	---	14.00	10.00	13.00	16.00	15.00	14.00	18.00	19.00	---	12.00	16.00	---
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3	---	<0.100	<0.100	---	---	<0.100	<0.100	---	0.13	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	---	<0.100	<0.100	---
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02	---	<0.001	<0.001	---	---	0.00	0.00	---	<0.001	<0.001	<0.001	<0.001	0.00	0.00	0.00	<0.001	---	0.00	0.00	---
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	---	0.001	0.001	---	---	0.002	0.003	---	0.004	0.005	0.002	0.005	0.002	0.003	0.003	0.003	---	0.006	0.005	---
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7	---	0.06	0.04	---	---	<0.025	<0.025	---	0.04	0.04	0.04	0.03	0.06	0.04	0.03	<0.025	---	0.03	0.04	---
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	0.03	0.03	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	0.04	---
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4	---	0.06	0.06	---	---	0.03	0.04	---	0.10	<0.025	<0.025	0.03	0.05	<0.025	0.03	0.04	---	<0.025	<0.025	---
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05	---	<0.010	<0.010	---	---	<0.010	0.02	---	<0.010	<0.010	<0.010	<0.010	0.01	0.01	0.02	0.02	---	<0.010	0.03	---
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---	---	0.04	0.07	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.03	---	<0.025	<0.025	---
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2	---	<0.010	<0.010	---	---	<0.010	<0.010	---	0.01	<0.010	<0.010	<0.010	<0.010	0.02	0.02	0.02	---	<0.010	<0.010	---
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2	---	0.37	<0.025	---	---	0.03	0.24	---	0.38	0.26	0.28	0.35	0.56	0.33	0.23	0.32	---	0.56	0.49	---
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	0.06	0.07	0.07		0.09	0.13	0.07	---	0.09	0.18	---
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---	---	0.37	<0.025	---	---	0.03	0.24	---	0.38	0.20	0.21	0.28		0.24	0.10	0.24	---	0.47	0.31	---
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4	---	1.70	3.91	---	---	<0.025	1.51	---	0.70	0.67	1.49	1.80	0.77	0.48	2.36	2.50	---	0.12	1.76	---
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	0.04	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07	---	0.05	0.11	---	---	<0.025	0.03	---	0.03	<0.025	0.03	0.03	<0.025	<0.025	0.04	0.03	---	<0.025	0.03	---
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---	---	0.01	0.02	---	---	0.05	0.07	---	1.07	1.07	0.77	1.15	0.42	0.22	0.39	0.14	---	8.41	2.51	---
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---	---	5.30	5.30	---	---	5.50	6.00	---	6.10	5.80	6.00	6.20	4.80	5.90	5.60	5.80	---	5.00	5.40	---
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---	---	0.16	0.16	---	---	0.14	0.14	---	0.17	0.13	0.16	0.17	0.18	0.15	0.15	0.15	---	0.15	0.17	---
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	0.00	<0.001	<0.001	<0.001	---	0.00	0.00	---
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03	---	0.003	0.005	---	---	0.004	0.005	---	0.002	<0.001	0.001	0.002	0.001	<0.001	0.001	0.001	---	0.001	0.001	---
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5	---	<0.025	<0.025	---	---	<0.025	<0.025	---	0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---

Suspended Solids	mg/ℓ	30 - 55	> 55	---	---	---	33	---	---	---	31	---	---	---	71	---	---	---	---	---	---	---	95	125	---
Turbidity	NTU	---	---	Aesthetic	≤ 5	---	43	---	---	---	20	---	---	---	24	---	---	---	---	---	---	---	58	28	---

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Table 5-9: Ergo water quality results – September 2024 to January 2025

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits		September 2024				October 2024				November 2024				December 2024				January 2025			
		Tolerable	Unacceptable	Risk	Limit	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11	CR1	CR4	CR7	CR11
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7	7.30	7.30	7.20	7.20	---	7.20	7.20	---	---	7.10	7.10	---	7.20	7.10	7.20	7.10	---	6.00	6.80	---
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170	70.20	65.50	70.50	74.40	---	50.40	78.80	---	---	64.10	84.50	---	68.70	50.60	78.90	72.80	---	119.00	104.00	---
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200	328.00	439.00	472.00	499.00	---	272.00	354.00	---	---	294.00	358.00	---	284.00	284.00	412.00	378.00	---	802.00	646.00	---
Total Acidity as CaCO3	mg/ℓ	---	---	---	---	8.00	8.00	396.00	8.00	---	20.00	207.00	---	---	12.00	166.00	---	20.00	24.00	259.00	56.00	---	24.00	47.00	---
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300	50.00	33.00	46.00	44.00	---	31.00	55.00	---	---	40.00	53.00	---	40.00	35.00	52.00	47.00	---	42.00	40.00	---
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500	47.00	43.00	69.00	73.00	---	44.00	47.00	---	---	44.00	50.00	---	27.00	40.00	53.00	41.00	---	473.00	333.00	---
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5	0.20	0.40	0.30	0.20	---	0.20	0.20	---	---	0.20	0.30	---	<0.2	<0.2	<0.2	<0.2	---	<0.2	<0.2	---
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11	1.40	1.00	1.50	1.10	---	0.80	0.80	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1	---	0.10	<0.1	---
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9	<0.05	0.10	0.20	0.20	---	<0.05	<0.05	---	---	<0.05	<0.05	---	<0.05	<0.05	<0.05	<0.05	---	<0.05	<0.05	---
Bromide as Br	mg/ℓ	---	---	---	---	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---	---	<0.1	<0.1	---	<0.1	<0.1	<0.1	<0.1	---	<0.1	<0.1	---
Ortho Phosphate as P	mg/ℓ	---	---	---	---	2.20	2.00	1.30	2.70	---	0.60	2.10	---	---	0.70	1.80	---	2.20	0.20	1.00	3.20	---	<0.1	<0.1	---
Total Cyanide as CN	mg/ℓ	---	---	---	---	<0.35	<0.35	<0.35	<0.35	---	<0.07	<0.07	---	---	<0.07	<0.07	---	0.12	<0.07	<0.07	<0.07	---	0.27	0.10	---
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---	22.00	26.00	19.00	24.00	---	9.30	27.00	---	---	13.00	26.00	---	30.00	9.40	27.00	18.00	---	16.00	17.00	---
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200	48.00	37.00	52.00	45.00	---	31.00	54.00	---	---	37.00	50.00	---	35.00	28.00	48.00	54.00	---	51.00	46.00	---
Potassium as K	mg/ℓ	---	---	---	---	12.20	11.10	11.70	11.50	---	10.10	17.10	---	---	10.50	13.30	---	10.30	9.00	13.60	12.70	---	11.00	10.10	---
Calcium as Ca	mg/ℓ	---	---	---	---	34.00	31.00	33.00	33.00	---	34.00	35.00	---	---	35.00	31.00	---	33.00	34.00	36.00	35.00	---	126.00	97.00	---
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---	13.00	12.00	14.00	15.00	---	13.00	14.00	---	---	12.00	13.00	---	12.00	12.00	14.00	14.00	---	31.00	28.00	---
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3	<0.100	<0.100	<0.100	<0.100	---	0.49	0.74	---	---	<0.100	<0.100	---	0.19	<0.100	<0.100	<0.100	---	<0.100	<0.100	---
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02	0.00	0.00	0.00	<0.001	---	<0.001	<0.001	---	---	0.00	<0.001	---	0.00	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	0.021	0.010	0.016	0.005	---	0.007	0.007	---	---	0.017	0.007	---	0.012	0.003	0.009	0.018	---	0.002	0.001	---
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7	0.04	0.03	0.03	<0.025	---	0.06	0.06	---	---	0.03	0.03	---	0.04	0.04	0.03	<0.025	---	<0.025	<0.025	---
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---	0.03	0.04	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4	0.24	0.15	0.09	0.09	---	<0.025	<0.025	---	---	<0.025	0.04	---	0.43	0.17	<0.025	0.05	---	0.10	0.09	---
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05	0.02	0.01	0.02	0.01	---	<0.010	<0.010	---	---	<0.010	0.02	---	0.02	0.01	0.02	0.02	---	<0.010	<0.010	---
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	0.31	0.25	---
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2	<0.010	<0.010	<0.010	<0.010	---	<0.010	0.02	---	---	<0.010	<0.010	---	<0.010	<0.010	<0.010	<0.010	---	0.01	<0.010	---
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2	0.53	0.56	0.57	0.52	---	2.13	3.12	---	---	0.23	0.21	---	1.34	0.69	0.57	0.35	---	0.94	0.03	---
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---	0.27	0.05	0.10	<0.025	---	<0.025	0.12	---	---	0.05	0.10	---	<0.025	0.03	0.03	<0.025	---	<0.025	<0.025	---
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---	0.27	0.51	0.47	0.52	---	2.12	3.00	---	---	0.18	0.11	---	1.33	0.65	0.54	0.33	---	0.94	0.03	---
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01	0.02	0.01	0.00	<0.001	---	0.07	0.03	---	---	<0.001	<0.001	---	0.04	0.00	0.00	0.00	---	<0.001	<0.001	---
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4	0.28	0.35	0.97	1.27	---	0.44	1.07	---	---	0.41	0.92	---	0.33	0.50	1.64	1.34	---	6.33	5.56	---
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07	<0.025	<0.025	0.03	<0.025	---	<0.025	0.05	---	---	0.09	0.10	---	<0.025	<0.025	0.03	<0.025	---	0.41	0.33	---
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---	1.54	1.55	0.96	2.90	---	0.39	1.51	---	---	1.19	2.87	---	3.36	0.65	1.80	4.23	---	0.04	0.03	---
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04	<0.001	<0.001	<0.001	<0.001	---	0.00	0.00	---	---	<0.001	<0.001	---	<0.001	0.00	0.00	<0.001	---	<0.001	<0.001	---
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---	5.60	4.20	4.80	4.20	---	5.30	5.80	---	---	5.00	4.70	---	5.50	4.00	4.20	4.30	---	3.10	3.60	---
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---	0.16	0.14	0.14	0.13	---	0.15	0.13	---	---	0.15	0.13	---	0.15	0.14	0.14	0.12	---	0.26	0.22	---
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	<0.001	<0.001	---	<0.001	<0.001	---
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	0.04	---	---	<0.025	<0.025	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	0.00	<0.001	0.00	<0.001	---	<0.001	<0.001	---
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03	0.002	0.002	0.003	0.001	---	0.002	0.002	---	---	0.002	0.001	---	0.001	0.001	0.002	0.002	---	0.002	0.003	---
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---	---	<0.025	0.03	---	<0.025	<0.025	<0.025	<0.025	---	<0.025	<0.025	---
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5	<0.025	<0.025	<0.025	<0.025	---	0.07	0.10	---	---	<0.025	<0.025	---	0.05	<0.025	<0.025	<0.025	---	0.25	<0.025	---
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---	---	<0.001	<0.001	---	<0.001	<0.001	<0.001	<0.001	---	<0.001	<0.001	---

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Suspended Solids	mg/ℓ	30 - 55	> 55	---	---	172	113	136	136	---	385	92	---	---	717	56	---	1373	74	46	548	---	41	28	---
Turbidity	NTU	---	---	Aesthetic	≤ 5	104	48	8	53	---	70	20	---	---	55	16	---	160	12	16	54	---	127	24	---

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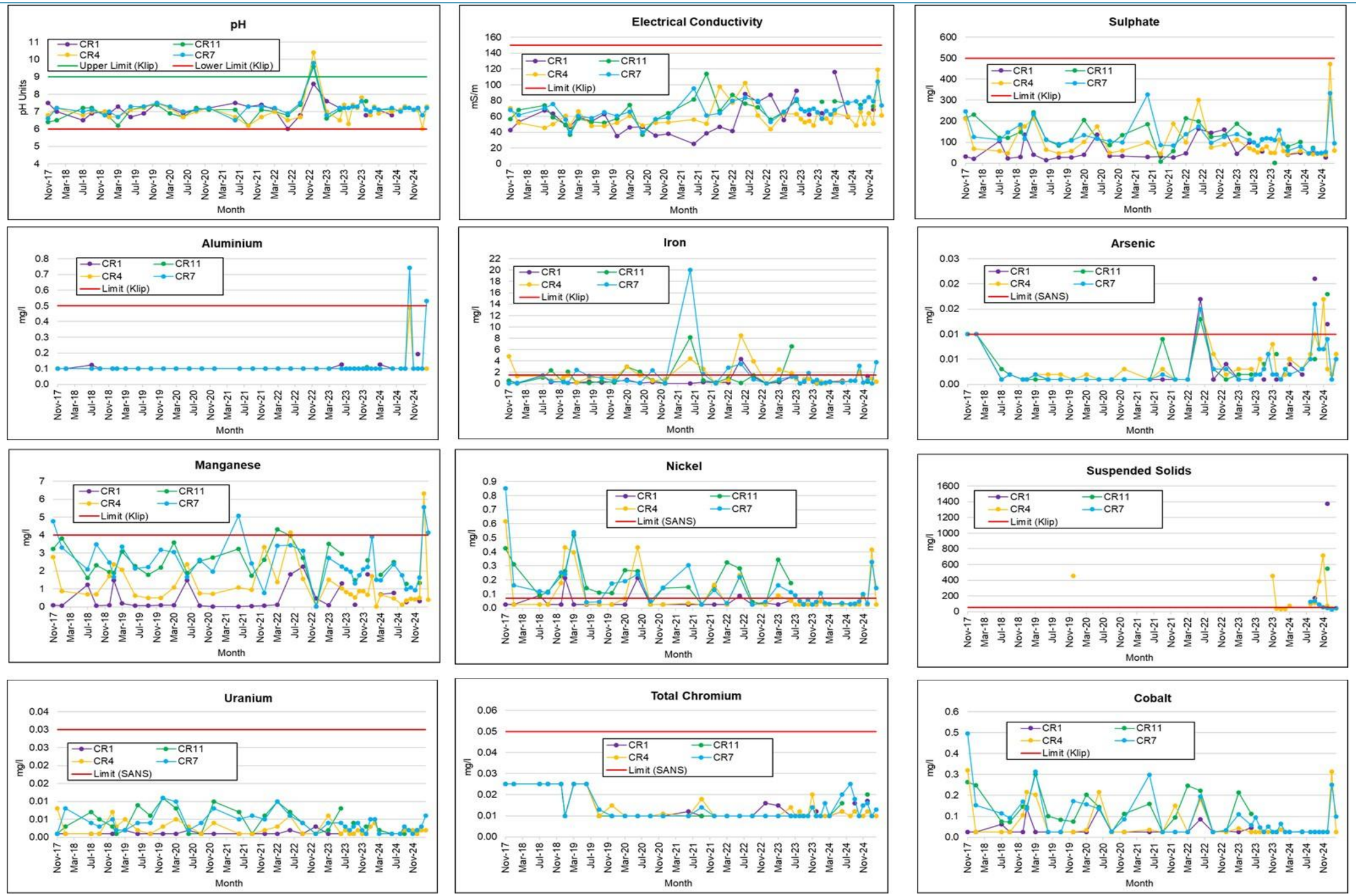


Figure 5-14: Trends in the Ergo water quality results for selected parameters

5.5 Noise

Ambient (background) sound levels were measured at three locations during the day, 24 February 2025, repeating the measurements at the same locations during the night of 24/25 and again the night of 25/26 February 2025. All measurements considered the prescribed procedures of GNR320 of 2020 as well as that of SANS 10103:2008.

Increased noise levels are directly linked with the various reclamation activities, with the main noise sources being:

- Excavators excavating gold-bearing silt, with the silt deposited in the area for further drying. Though not observed during the site visit, it was reported that this silt material is also loaded onto Articulated Dump Trucks (ADTs) for hauling to the drying areas;
- Front End Loaders loading the dryer silt onto road haul trucks;
- ADTs and road trucks moving around onsite;
- A water bowser wetting the area; and
- A maintenance and diesel bowser servicing equipment.

The proposed development will have an insignificant impact on the noise levels at the closest potential noise-sensitive receptors, though noises may be audible at NSR staying within 500 m from the project activities. The impact is considered to be insignificant.

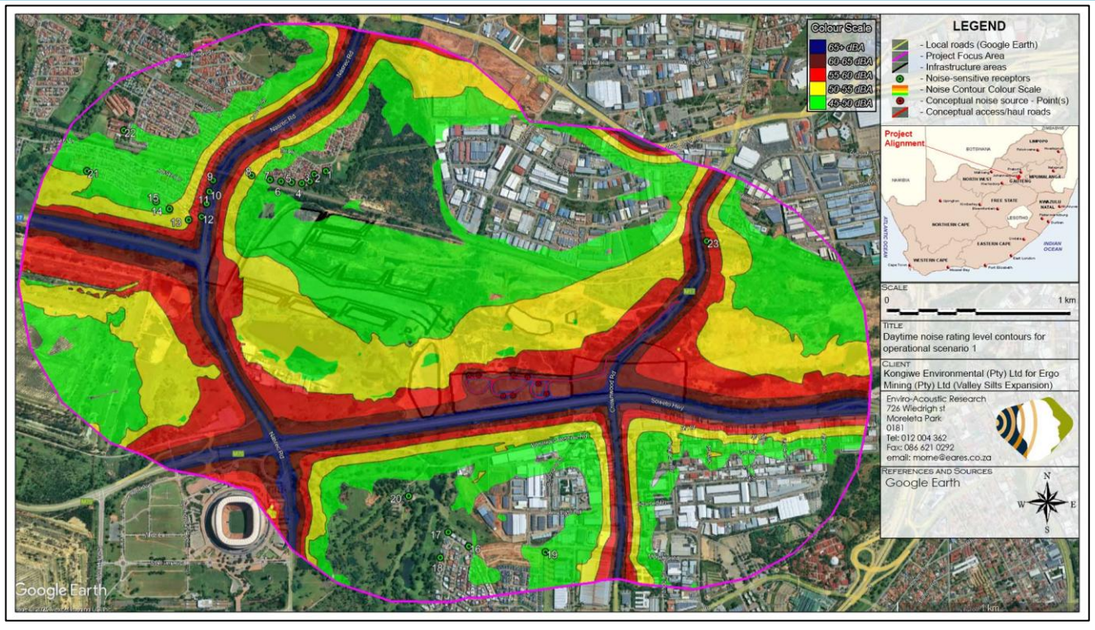


Figure 5-15: Projected daytime noise rating levels relating to operational Scenario 1

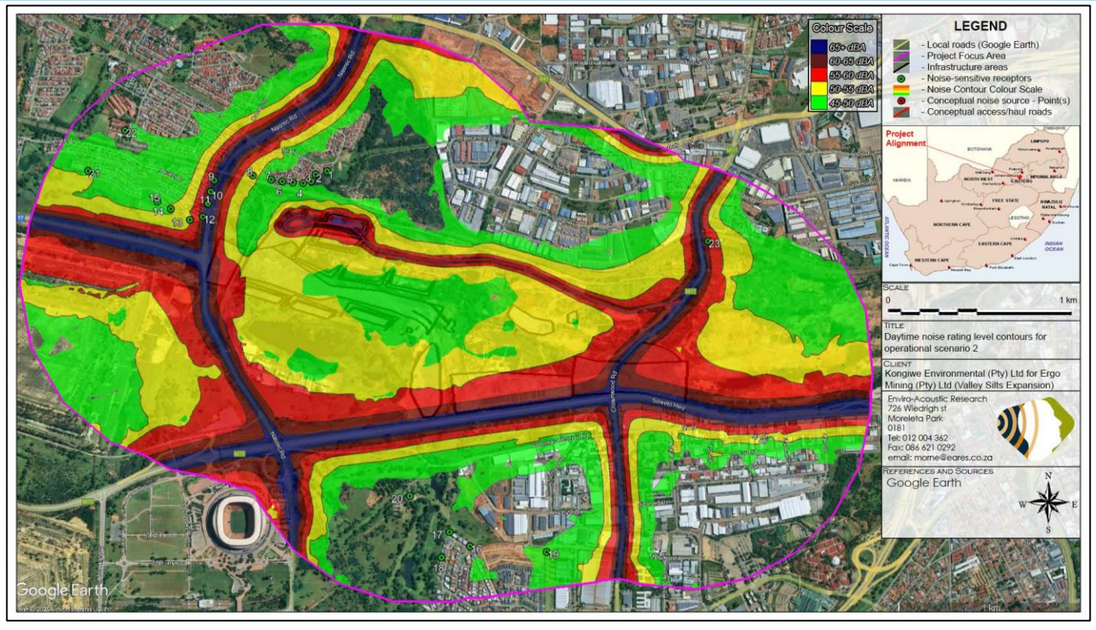


Figure 5-16: Projected daytime noise rating levels – conceptual operational Scenario 2

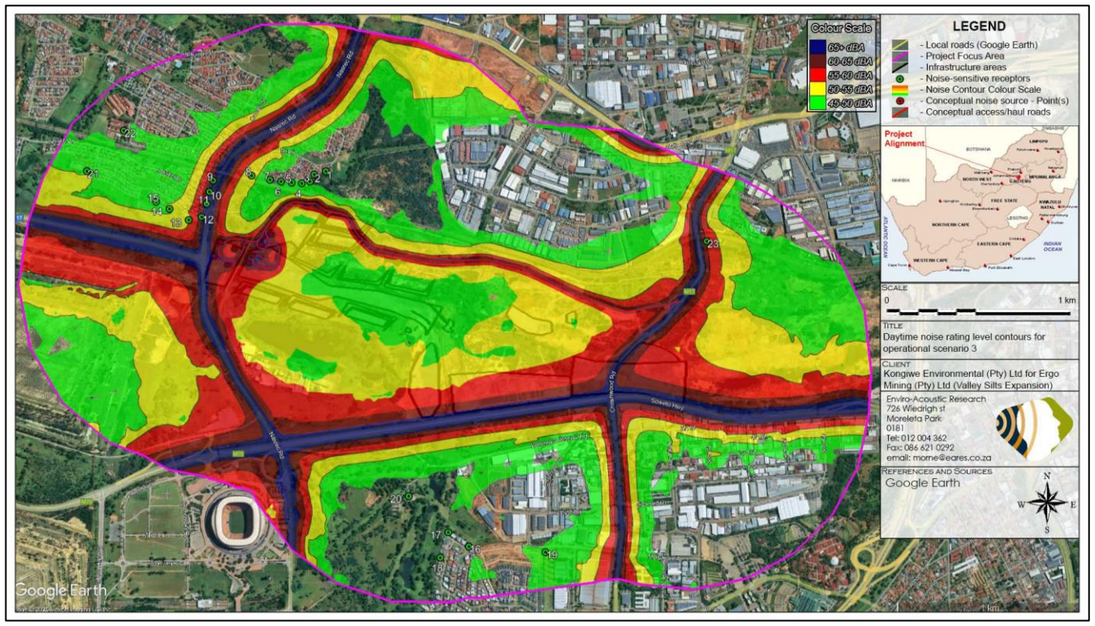


Figure 5-17: Projected daytime noise rating levels – conceptual operational Scenario 3

5.6 Socio-economic

The project is situated in Gauteng in the central parts of the City of Johannesburg (CoJ) about 7km south of the Central Business District (CBD). The Ward is situated in CoJ Ward 68 with Wards 54 (south); 124 (east) and 125 (south west) surrounding the project area. The main socio-economic characteristics of the local environment can be summarised as follows:

- Valley Silts is situated in an urban and industrial area of Johannesburg surrounded by industrial and business parks to the north and south east of the project area;
- Riverlea, the closest residential area to the project's north west. The other residential area is located in Ormonde to the south of the project area;
- The CoJ experienced relatively low population growth since 2011 signifying some exodes from the city to the other urban centres such as Ekurhuleni and the City of Pretoria;
- Compared to population growth m household growth remained high in the CoJ, possibly also due to the relative high number of low-cost housing programmes being rolled-out by CoJ the past decade;
- The relatively low female ratios and high ratios of economically active population in wards 124 and 125 close to the project area signifies to the presence of single male workers that have migrated to these areas in search of work;
- CoJ on average experienced lower municipal service backlogs in 2022 compared to provincial and national averages. The wards around the project area experienced lower municipal service backlogs compared to CoJ averages apart from the relatively high sanitation backlogs in Ward 68 (Riverlea). The lack of maintenance of municipal services in Riverlea furthermore poses a potential health and safety risks to the community.
- The education levels of the adult population are in higher in Gauteng and the CoJ than nationally. That is also the case in the project wards around the project area. The education levels of the population in Ward 68 are lower than in the other wards with 46% being unskilled (without matric) and only 8% with tertiary qualifications.
- There is a potential shortage in primary and secondary schools as well as educators in the CoJ The lack of schools and educators are also more pronounced in the Riverlea area;
- Apart from the possible shortage in public health facilities, other health challenges that the local community face include the compromised surface water quality in the local area, the lack of maintenance of municipal infrastructure and illegal dumping activities;
- The proximity of old gold tailings facilities in the area increases the exposure risk to elevated levels of Uranium (U) deposited within the gold tailings. Based on tests done in the Valley Silts area it was however found that the material in the area is not radioactive;
- Per capita crime rates are higher in CoJ than nationally and in particular high in the Riverlea area. The high crime levels in the Riverlea area could partially be ascribed the high levels of illegal mining in the surrounding areas;
- The finance and sectors are dominant sectors in CoJ in terms of output and employment. Sectors that made a relatively smaller contribution compared to their national contribution include the primary sectors (agriculture and mining) as well as manufacturing, utilities and transport;

- The mining and industrial sectors play a relatively large role in the project area with current Ergo reclamation activities as well as the industrial and warehouse activities taking place in the business and industrial zones adjacent to the project area;
- CoJ experienced low growth in employment and output with the mining sector in particular showing a steep decline the past decade;
- Low economic growth resulted in rising unemployment and poverty in CoJ in general and in particular in Ward 68 where the project is situated;
- Gauteng provincial development priorities revolve around output and employment growth and skills development. On a spatial level, focus areas include increasing available land from mine dumps to be used for other purposes, in line with government priorities;
- The Joburg Spatial Develop framework prioritises the rehabilitation and development of land in the mining belt area to unlock land for mixed use developments that could bridge the historic spatial divide between the developed north, and southern areas such as Soweto.

6 STAKEHOLDER PARTICIPATION

Stakeholder engagement was undertaken during the Scoping Phase of the EIA/EMPr. The following key issues have been raised by Interested and Affected Parties (I&APs) thus far:

- Dust impacts from silt removal and stockpiles;
- Impacts on surface water and groundwater quality;
- Security on site during operations, especially around illegal miners;
- Rehabilitation and end land use;
- Surface water management on site; and
- Economic aspects of the project and how the communities will benefit.

The stakeholder issues or comments have informed this Rehabilitation, Decommissioning and Closure Plan at this stage. Results from the draft EIA comment period will be incorporated into the finalised report, once comments have been received.

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7 DESIGN PRINCIPLES

7.1 Closure Vision and Objectives

The closure vision for the Project is intended to inform the closure objectives. The closure objectives set as part of the projects's closure planning process aims to ensure that the final land use is achieved and that the area is sustainable in the long-term from an environmental and social point of view. The objective is to

Rehabilitate impacted areas so that have a sustainable land use

Closure and rehabilitation is a continuous series of activities that begin with planning prior to the Project's design and construction, and end with achievement of long-term site stability and the establishment of a self-sustaining ecosystem. Not only will the implementation of this concept result in a more satisfactory environmental conclusion, but it will also reduce the financial burden of closure and rehabilitation The vision is underpinned by the objectives listed below:

- Adhere to all statutory and other legal requirements (National, Provincial and Local);
- Implement progressive rehabilitation measures where possible to ensure protection of the local environment;
- Create a safe, physically stable rehabilitated landscape that limits long-term erosion potential and environmental degradation;
- Focus on establishing a functional post-mining landscape;
- Utilise closure strategies that promote a self-sustaining condition with little or no need for ongoing care and maintenance; and
- Create opportunities for alternative post-mining livelihoods by aligning to Integrated Development Plans, Spatial Development Frameworks and other developmental initiatives.

Rehabilitation and closure objectives have been tailored to the project at hand. This Rehabilitation, Decommissioning and Closure Plan aims to assist Ergo in carrying out successful rehabilitation for the Project.

7.2 Closure and Post-Closure Options

The main vision of closure is to prevent or minimise adverse long-term socio-economic and environmental impacts, and to create a self- sustaining natural ecosystem or alternative land use based on an agreed set of objectives. Thus noting that set objectives need to be agreed upon it is important that all role players involved are engaged regarding closure and rehabilitation objectives, specifically related to long term impacts and end land use.

The objectives that should be considered are the following:

- To encourage the development of a comprehensive closure plan that returns the site to a viable, and wherever practicable, self-sustaining ecosystem, and that this plan is adequately financed, implemented and monitored within all jurisdictions;

- To manage closure in an integrated and sustainable manner;
- To promote a strategic approach to managing water so that water in more efficiently managed and valued;
- Set out the strategic issues that operations needs to consider for sustainable closure in an area in order to manage risks and identify opportunities for continuous improvement; and
- Provide high-level guidance on issues that should be addressed in developing a post- closure water strategy for an area.

Thus it is important that closure and rehabilitation for this proposed project considers the above objectives where practical and possible.

7.3 Closure and Post Closure Period

Once closure activities have been implemented, Ergo will commence with its closure monitoring period. During this time, erosion repair, vegetation establishment and groundwater and surface water remediation activities will be undertaken and monitoring activities will be conducted. At this stage, biological processes should have become established, leading to stable vegetation cover and heathier functioning ecosystems. Data would be collected to demonstrate that the closure is sustainable and that there is no unmitigated impacts to the receiving environment. Overall the relinquishment criteria and other statutory requirements would be achieved.

7.4 Closure Options Research

During the operational phase, it is advised that continual monitoring of surface and groundwater is conducted. This information needs to be collected and used to update specific water models to monitor and evaluate the impact of the operation. Additionally, it would be advisable to conduct monthly dust fall monitoring to evaluate the ongoing and probable air pollution. This will allow Ergo to establish the best practicable option to ensure that the minimal impacts occur.

The final rehabilitation, decommissioning and closure plan is a living document and will be reviewed and amended through the life of the project, any changes due to new research will be incorporated into these amendments.

Ongoing research and investigations for closure options and current best practice will be focussed on during the LoM. The final rehabilitation, decommissioning and closure plan is a living document and will be reviewed and amended through the life of the project, any changes due to new research will be incorporated into these amendments.

7.5 Closure Assumptions

Information currently available may need to be supplemented during the operational phase of the Project. As additional information will be collected during operations and these assumptions will need to be reviewed and revised.

The assumptions used to prepare this report are the following:

- The Valley Silts Expansion Project site is a brownfields site;
- The closure period will commence once the silts have been removed completely;
- The life of the operations is estimated at 5 years;
- At closure, the area will be sloped and revegetated;
- The mine plan, design and layout have been adhered to;
- There are limited opportunities for post-closure infrastructure for community uses. Therefore all structures will be demolished/removed;
- All hazardous and domestic waste will be transported offsite for disposal in licenced landfills; and
- Access roads to the site required for the new land use will not be closed as part of normal closure actions.

8 RISK ASSESSMENT FINDINGS

The objective of the risk assessment is outlined in the Financial Provisioning Regulations. The objective is to:

- Ensure timeous risk reduction through appropriate interventions;
- Identify and quantify the potential latent environmental risks related to post closure;
- Detail the approach to managing the risks;
- Quantify the potential liabilities associated with the management of the risks; and
- Outline monitoring, auditing and reporting requirements.

8.1 Methodology

A desktop risk assessment for the project was undertaken utilising a risk assessment process. During this desktop assessment, the risks associated with the Project were described and a determination was taken to assess the nature of the risk. Subject to the nature of the risk, it is ranked according to predetermined criteria for probability and consequence. Five categories are considered to describe the nature of the risk, these categories include:

- Health and Safety;
- Environment;
- Financial;
- Legal and Regulatory Obligations; and
- Reputational, Social or Community.

Once the risks had been captured, the probability of the risk occurring as well as the consequence of the risk transpiring were rated according to the criteria presented below.

Table 8-1: Consequence Rating Definitions

	Consequence Category				
	1 - Insignificant	**2 - Minor**	**3 - Moderate**	**4 - Major**	**5 - Catastrophic**
Safety and Health	**First Aid Case**	**Minor Injury,** Medical Treatment Case with/or Restricted Work Case.	**Serious Injury** or Lost Work Case	**Major or Multiple Injuries** - permanent injury or disability	**Single or Multiple Fatalities**
Environment	**No impact** on baseline environment. Localized to point source.	**Localized** within site boundaries. Recovery measurable within 1 month of impact	**Moderate** harm with possible wider effect. Recovery in 1 year	**Significant** harm with local effect. Recovery	**Significant** harm with widespread effect. Recovery

	Consequence Category				
	1 - Insignificant	2 - Minor	3 - Moderate	4 - Major	5 - Catastrophic
	No recovery required			longer than 1 year.	longer than 1 year. Limited prospect of full recovery
Financial	< R100k	R100k - R500k	R500k - R5M	R5M - R10M	>R10M
Reputational, Social or Community	**Minor impact**; awareness/ concern from specific individuals/ Minor disturbance of culture/ social structures	**Limited impact**; concern/ complaints from certain groups/ organizations (e.g. NGOs) / Some impacts on local population, mostly repairable. Single stakeholder complaint in reporting period	**Local impact**; public concern/ adverse publicity localised within neighbouring communities / On-going social issues. Isolated complaints from community members/ stakeholders	**Suspected reputational damage**; local/ regional public concern and reactions / Significant social impacts. Organized community protests threatening continuity of operations	**Noticeable reputational damage**; national/ international public attention and repercussions/ Major widespread social impacts. Community reaction affecting business continuity. "Licence to operate" under jeopardy
Legal & Regulatory Obligations	Technical non-compliance. No warning received; no regulatory reporting required	Breach of regulatory requirements; report/involvement of authority. Attracts administrative fine	Minor breach of law; report/investigation by authority. Attracts compensation/ penalties/ enforcement action	Breach of the law; may attract criminal prosecution, penalties/ enforcement action. Individual licence temporarily revoked	Significant breach of the law. Individual or company law suits; permit to operate substantially modified or withdrawn

Table 8-2: Probability Rating Definitions

Probability Category				
1 - Rare	**2 - Unlikely**	**3 - Moderate**	**4 - Likely**	**5 - Almost Certain**
Highly unlikely to occur on this project	Given current practices and procedures, this incident is unlikely to occur on this project	Incident has occurred on a similar project	Incident is likely to occur on this project	Incident is very likely to occur on this project, possibly several times

Ergo considers that the Health, Safety and Environmental risks typically represent external risks to the biophysical and socio-economic environment that may exist at closure, and the financial, legal and reputational risks are internal risks and present how risks at closure influence the Project.

A matrix listing the probability and consequence is then used numerically to rank the risk and determine whether the risk level is:

- **High** (H);
- **Significant** (S);
- **Medium** (M); or
- **Low** (L).

Table 8-3: Significance Rating Methodology

Probability (of exposure to impacts)	Consequence				
	1 - Insignificant	**2 - Minor**	**3 - Moderate**	**4 - Major**	**5 - Catastrophic**
5 - Definite	6	7	8	9	10
4 - Likely	5	6	7	8	9
3 - Moderate	4	5	6	7	8
2 - Unlikely	3	4	5	6	7
1 -Rare	2	3	4	5	6

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8.2 Results of Risk Assessment

The risk assessment is detailed inTable 8-4.

Table 8-4: Risk Assessment

Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy														
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
Health and Safety	Unauthorised access gained to site may lead to health and safety risk	2	1	L													The Group's security service provider and in-house security managers increase staff complements as required. Surveillance equipment allows for continuous monitoring of properties by security personnel. The areas shall also be fenced off during the closure and rehabilitation phases.	1	1	L													
	Seepage of pollutants into the environment may lead to potential health and safety hazard	4	2	M													Hydrocarbon spillages should be contained and cleaned up immediately. Other pollution/waste potential activities will occur in bunded areas. Ergo has the required rehabilitation and mitigation measures set in place to mitigate these issues.	2	2	L													

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Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy														
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
	Inadequate removal of contaminated materials and infrastructure may pose a potential risk to individual health and safety	4	3	S													Following the closure and rehabilitation plan will ensure that all infrastructure and equipment are adequately removed. Ergo has the required rehabilitation and mitigation measures set in place to mitigate these issues.	1	2	L													
	The amount of illegal activities may increase or remain the same if the site is not completely rehabilitated	4	3	S													The presence of the activity and the rehabilitation will add a management factor to the area which will help minimise the crime factor. The Group's security service provider and in-house security managers increase staff complements as required.	2	2	L													
Environment	Exposure of silts to oxygen during the reclamation process may lead to acid and metalliferous drainage this may find its way into the groundwater				4	5	H										Ensure that hazardous waste is disposed of in the appropriate manner. Hydrocarbon spillages should				2	3	M									

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Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy												
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
	and surface water leading to contamination.																be contained and remediated immediately. The active site of reclamation must have the required stormwater management plan in place to ensure that no contamination of clean surface water occurs. Continual monitoring should occur to ensure for compliance, until the surrounding water sources has recovered to specific objectives.																	
	Contaminated soil may be washed down slope into the surrounding surface water, impacting surface water quality and eventually groundwater.				4	4	H										Ensure that hazardous waste is disposed of in the appropriate manner. Hydrocarbon spillages should be contained and remediated immediately. The active site of reclamation must have the required				2	3	M										

Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy												
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
																	stormwater management plan in place to ensure that no contamination of clean surface water occurs. Continual monitoring should occur to ensure for compliance, until the surrounding water sources has recovered to specific objectives.																
	Encroachment of alien invasive plant species.				4	2	S										Ensure that the site is monitored during the duration of the closure period and ensure that the continual removal of alien vegetation occurs.				3	1	L									
	Dust dispersal during removal of infrastructure from trucks and soil erosion				3	2	M										Ensure the roads and site is kept dowsed and wet to minimise dust from transportation. The re-established vegetation will prevent soil erosion.				1	2	L									
	Sedimentation of watercourses				3	3	M										The required stormwater management system as well as vegetation should help prevent further siltation of the stream				1	3	L									

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Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy												
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
	A failure to rehabilitate the site fully may lead to the remobilisation of contaminated silts and other contaminated material.				3	4	S										Ensure that the entire site is completely rehabilitated and all the contaminated materials are removed. Ensure that the area has been revegetated, this will create new habitat for fauna and thus they species shall move back.				1	3	L									
	Possible radioactivity presence on site may pose a risk				3	3	M										Ensure that the correct monitoring and mitigation plans are set in place and followed, and that the required closure certificate has been received from the NNR.				2	2	L									
	Groundwater quality impacts once the silts have been removed				3	3	M										The complete removal of all the silts from the stream will have a positive impact on the quality of the ground water in the long term.				2	2	L									
	Erosion and consequent deterioration of water quality in the Russel Stream				3	3	M										Ensure that the revegetation on site is successful. This will minimise erosion as well as the amount of silt and soil contamination of the Russel stream				2	2	L									
	Possible displacement due to habitat disturbance				3	3	M										Ensure removal of silts and that the sites are revegetated with indigenous vegetation.				2	2	L									

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Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy												
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
	Unidentified impacts that occur that are not mitigated that occur during the closure phase				3	2	M										Ensure that mitigation plans are up to date and continually reviewed to ensure that any issues that may arise are compensated for.				2	2	L									
	Possible environmental legislation, regulatory authorities and changes.							4	3	S							The Group has funds invested and financial guarantees in place to fund its rehabilitation obligations adequately.							4	1	L						
	Volatile commodity prices and foreign exchange fluctuations.							4	4	H							Key gold price trends and market indicators are constantly monitored to ensure an effective response to commodity price and exchange rate fluctuations.							4	2	M						
	Financial constraints or operational cost increases due to labour and other socio-economic issues.							3	4	S							The Group has funds invested and financial guarantees in place to fund its rehabilitation obligations adequately .							3	2	M						
Financial	Reliance on Eskom for power supply.							4	1	M							Ensure that emergency plans are in place for areas of the operation where electricity is required/							3	1	L						

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Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy														
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
Legal and Regulatory Obligations	The operation will not be able to demonstrate that all of the relinquishment criteria have been achieved, resulting in closure not being granted.										3	4	S				The closure actions have been developed to achieve the relinquishment criteria and appropriate monitoring activities have been identified to assist with demonstrating that relinquishment criteria have been achieved. Plans will be adapted to meet changing legislative and environmental pressures.										2	3	M			
	Social licence to operate.										3	4	S				Ergo has an ongoing commitment to improving engagement with their employees and surrounding communities. The strategic objective to support the neighbouring communities by improving quality of life, poverty alleviation and youth education helps mitigate the risk.										2	3	M			

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Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy														
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
	Unforeseen changes to legislation and regulatory authorities.										4	4	H				Ergo monitors changes and engages with government and regulators to ensure compliance. The Group also maintains close relationships with authorities at regional and national level so that any issues can be addressed speedily.										3	3	M			
	Undetermined land-owner issues.										3	4	S				Ensure that all of the attempts to find any and all land owners have been documented and archived.										2	2	L			
Reputational, Social or Community	Increased levels of crime and gold theft.													4	4	H	Ergo maintains close relationships with leaders in the communities surrounding our operations. The Group's security service provider and in-house security managers increase staff complements as required. Surveillance equipment allows for continuous monitoring of properties by security personnel													4	3	S
	Degradation of relationship with the surrounding I&AP's													4	4	H	Ergo has an ongoing commitment to improving engagement with their employees and surrounding													2	2	L

Risk Log		Risk at Closure															Closure Strategy	Risk after Implementation of Closure Strategy														
		Health and Safety			Environment			Financial			Legal			Reputational & Social				Health and Safety			Environment			Financial			Legal			Reputational & Social		
		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank		Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank	Prob	Cons	Rank
																	communities. Their strategic objective to support the neighbouring communities by improving quality of life, poverty alleviation and youth education helps mitigate the risk.														

9 PROPOSED POST-MINING LAND USE

It is proposed that before the decommissioning phase of the Project starts , Ergo should establish a Closure Forum. This Closure forum will encompass the following:

- Discuss and develop joint action plans and strategies with key stakeholders to achieve sustainable closure;
- Identification and analysis of problems and challenges impacting the operations during the closure phase of the Project;
- Accountability for the implementation of action plans and strategies;
- Review of current economic trends and programmes within the province to ensure that the strategies in place are best suited;
- Generating awareness around the decommissioning and closure of the project; and
- Alignment with the SLP.

Post-closure land-use is determined in consultation with stakeholders so that the use meets the requirements of all the participants.

Once all of the silts have been successfully reclaimed and all the existing equipment and infrastructure has been removed, Ergo intends to shape the project area and to revegetate it with adequate and viable indigenous vegetation, to assist with the stabilisation of the soil. The drying areas will be worked down to red earth, to ensure that all contaminated soils have been removed. All existing infrastructure and equipment will be removed, and the footprints will be scarified. This area will then be levelled to provide for free drainage and ensure it is adequately revegetated. Haul roads and access infrastructure will be scarified and returned to their previous status. Once the site has been successfully rehabilitated a Post-mining Management Plan will need to be in place to ensure the complete rehabilitation.

After the proposed operation, decommissioning and rehabilitation, the land will be returned to the landowner (iProp). The proposed project area is earmarked for development by the landowner, with plans for light industrial development. Additionally, there are plans to expand the N17 within the proposed project area, from Crownwood to Nasrec Road.

10 REHABILITATION PLAN

The main aim in developing the Rehabilitation, Decommissioning and Closure Plan is to minimise and mitigate the impacts caused by mining and industrial activities and to restore land back to a satisfactory standard. It is best practice to develop the Plan as early as possible so as to ensure the optimal management of rehabilitation and closure issues that may arise. It is critical that a Rehabilitation, Decommissioning and Closure Plan is defined and understood from before mining progresses and is complimentary to the objectives and goals set. Rehabilitation and closure objectives need to be tailored to the project at hand and be aligned with the Environmental Management Plan Report (EMPr).

The Rehabilitation, Decommissioning and Closure Plan aims to inform on the actions required to rehabilitate the project to ensure that the area is socially and environmentally safely and sustainably closed. Importantly, the Rehabilitation Plan consists of direct activities associated with rehabilitation of various infrastructure components.

This Plan should inform how the infrastructure is removed from site. During the operational phase, it is recommended that an assessment be undertaken of the infrastructure to determine if some of the infrastructure can be utilised post closure.

The rehabilitation and closure actions for the particular infrastructure are detailed below and separated into phases.

10.1 Rehabilitation Activities

Limited surface infrastructure will be established to support the mining activities for the Project and this infrastructure footprint will need to be rehabilitated. The primary structures proposed for the project include:

- Building infrastructure which includes:
  - Temporary administration buildings and contractor's construction yards; and
  - Bridges.
- Stormwater system.

The rehabilitation plan is comprised of these stages:

1. Removal of existing infrastructure;
2. Re-shaping of the landforms;
3. Re-vegetation of the landscape; and
4. Monitoring and maintenance.

10.1.1 Building Infrastructure

Infrastructure, including foundation should be removed. The following steps should be followed:

- The re-usable items should be removed from the site;
- Remaining structures should be demolished to 1 m below surface and the demolition rubble removed;
- Soil should be tested for contamination. If contamination is discovered, this soil should be removed and disposed of in the appropriate waste disposal facility;
- Once the site has been cleared of all infrastructure and rubble and no contamination is present, the exposed underlying materials should be reshaped to create a gently sloping, free-draining topography. Re-instate natural drainage lines to limit erosion and sediment build up within local river courses;
- Remove alien invasive plants;
- Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land; and
- Ensure that robust care and maintenance plans are in place.

10.1.2 Access and Service Roads

Roads that can and will be used for rehabilitation/ monitoring or by other users post-closure should be left *in situ* provided this is agreed upon by all parties concerned. If there is no future use for roads onsite, they will require the following actions:

- Soil should be tested for contamination. If contamination is discovered, this soil should be removed and disposed of at the appropriate waste disposal facility;
- Remove alien invasive plants; and
- Ensure that robust care and maintenance plans are in place.

10.1.3 Groundwater

To restrict the impacts post-closure on the groundwater environment (level, yield and quality) and mitigate the loss of groundwater from the catchment, the following is recommended:

- Use the results of the monitoring programme to validate the predicted impacts on groundwater availability after closure every five years;
- Update existing predictive tools to verify long-term impacts on groundwater;
- Present the results on an annual basis to determine compliance with the closure objectives set during the Decommissioning Phase;
- Continue the groundwater quality and groundwater level monitoring for a period of at least five years after mining ceases to establish post-closure groundwater level and quality trends. If required, the monitoring information will be used to update, verify and recalibrate the predictive tools used during the study.

10.1.4 Stormwater (Surface Water)

Prior to closure a final stormwater management plan will be prepared to identify at closure where water can be designed to flow freely from the site and away from potential areas of contamination. All berms and trenches will be flattened to a functioning topography to assist with the functionality of the stream,

except where they have been positioned to prevent additional water flowing onto rehabilitated areas. Structures which may potentially remain onsite will have a stormwater management plan which will ensure that any potential impact to surface water is managed.

To restrict the impact post closure on the surface water environment (quality, flow and functionality) and to mitigate the stagnation and degradation of the stream, the following is recommended:

- The implemented spill management plan must be continually implemented throughout closure and rehabilitation;
- Use the results of the monitoring programme to validate the predicted impacts on the surface water post closure;
- Present the results on an annual basis to determine compliance with the closure objectives set during the decommissioning phase;
- Monitoring of surface water quality must continue both upstream and downstream until the site has been fully rehabilitated, and closure has been awarded. This will help establish post-closure surface water quality trends. This data should be used to update, verify and recalibrate the predictive tools used during this study.

10.1.5 Biodiversity and Ecosystem

Prior to closure a biodiversity management plan will be prepared to identify at closure the functionality of the stream as well as the fauna and flora present on site. The required monitoring programme will need to be created and put in place to monitor and evaluate the development of the ecological function of the stream. It is advised that the site be monitored for five years to ensure that the mitigation measures proposed at closure and for rehabilitation are effective. It is also crucial to ensure that the areas is revegetated accordingly to the specialists assessment to ensure that the required habitats are restored and that indigenous fauna and flora can flourish. It is also advised that an invasive plant species removal and management plan is implemented during decommissioning and closure to ensure that only indigenous flora establishes on the proposed site at closure.

10.1.6 NNR Certificate

Once removal of the silts has been undertaken and depending on the desired end land use, it is highly recommended to assess the potential of residual radiation remaining and to identify possible latent environmental impacts remaining. This is important to ensure that once the land is handed over that there is no potential further risk to the land owners.

The National Nuclear Regulator (NNR) has set the level for gamma radiation, for which regulation is not required, below 500 Bq (Becquerel) per kg. Direct radiation originates from uranium, which is a common mineral associated in the reefs that contain gold and is contained within the slimes material. The Radiation Assessment should measure the gamma radiation emanating from the decaying of the uranium atoms.

In terms of release of radioactively contaminated land, the Safety Standards and Regulatory Practices, under section 5.4, specifies that a site used in the conduct of an authorised action may be released for

unrestricted use provided that it is demonstrated that the radioactive contamination and radioactive materials which can reasonably be attributed to the authorised action have been removed from the site, or in the case of naturally occurring radioactive nuclides, have activity concentrations below the levels of exclusion. The end land use will be dependent on the findings of such an assessment and will determine if these sites could be utilised or released for unrestricted use.

10.2 General Rehabilitation Principles

10.2.1 Vegetation Establishment

The objectives for the re-vegetation of reshaped and top-soiled land are to:

- Prevent erosion;
- Restore the land to the agreed land capability;
- Re-establish ecosystem processes to ensure that a sustainable land use can be established without requiring fertilizer additions; and
- Restore the biodiversity of the area as far as possible.

10.2.1.1 Re-vegetation Steps

The following steps should be taken during the re-vegetation of disturbed areas:

- All soils are to be ripped to full potential rooting depth to correct compaction;
- Analyse the topsoil to determine the lime and fertilizer requirements;
- Prepare the soil by adding lime and fertilizer and ploughing the area;
- Plant a grass seed mixture consisting of a range of indigenous species;
- Inspect the area after a good rainfall event;
- Eradicate weeds where necessary;
- Repeat the procedure for the next growing season;
- Define and establish the long-term land management system;
- Allow natural grasses to become re-established; and
- Conduct annual monitoring (repeatable demarcated transect surveys).

10.2.1.2 Species Selection

Some of the criteria that should be considered during the selection of the appropriate species for rehabilitation include:

- Use species which are perennial and well adapted to the area;
- The species should be tolerant of adverse soil conditions;
- Species should have a large biomass and prolific root system; and
- As areas of rehabilitation expand, maintenance costs increase, so species selected should be those with minimal maintenance cost, or with production and financial returns that exceed the cost.

10.2.1.3 Climatic Conditions

Planting will be most successful when it is done after the first rains and into freshly prepared seedbeds (provided the soil material is not prone to crusting). Water retention in the seed zone will stimulate germination and can be supported by the application of light vegetation mulches.

10.2.1.4 Vegetation Conservation

If rare and protected flora species are found on the project area during construction or operational activities, they should be conserved by removing and relocating them to another section of the project area which is suitable. The rare/protected plants can be kept in a nursery; the plants can then be replanted during rehabilitation of the disturbed areas.

Control and management of alien vegetation will contribute to the conservation of the natural vegetation. The alien species should, therefore, be removed from site and control measures must be implemented to ensure spreading of these species does not occur to other parts of the project area or the surrounding lands.

10.3 General Monitoring and Maintenance Guidelines

The purpose of monitoring is to ensure that the objectives of rehabilitation are met and that the rehabilitation process is followed. The physical aspects of rehabilitation should be carefully monitored during the operational phase as well as during the progress of establishment of desired final ecosystems.

The following items should be monitored continuously:

- Alignment of actual final topography to agreed planned landform;
- Erosion status;
- Surface drainage systems and surface water quality;
- Groundwater quality at agreed locations;
- Vegetation basal cover;
- Vegetation species diversity; and
- Proportion of land that has been fully rehabilitated.

10.3.1 Final Topography

The topography that is achieved during rehabilitation should be monitored and compared to the planned topography. The final profile achieved should be acceptable in terms of the surface water drainage requirements and the end land use objectives. The survey department should do an assessment of the reshaping carried out on the site and signoff should be obtained from the rehabilitation specialist before the topsoil is replaced.

10.3.2 Erosion Monitoring

Continuous erosion monitoring of rehabilitated areas should be undertaken and zones with excessive erosion should be identified. Erosion can either be quantified or the occurrence there-of simply recorded for the particular location.

10.3.3 Surface Water

10.3.3.1 Drainage Systems

The functionality of the surface water drainage systems should be assessed on an annual basis. This should preferably be done after the first major rains of the season and then after any major storm. An assessment of these structures will ensure that the drainage on the recreated profile matches the rehabilitation plan as well as to detect early on when any drainage structures are not functioning efficiently. These structures can then be repaired or replaced before significant erosion damage is caused.

10.3.3.2 Water Quality

The quality of all water leaving the property should be monitored on a regular basis to ensure compliance of the various constituents with the standards approved by the government. Samples should be analysed for particulate and soluble contaminants as well as biological.

10.3.4 Groundwater

The groundwater levels and quality should be measured and monitored in a similar way to the surface water to determine the impact of the reclamation and other project activities on the groundwater resources. A hydrogeologist, together with the relevant authorities, should determine the locations of the monitoring boreholes. The monitoring frequency will be determined by the regulator.

10.3.5 Vegetation Species

Biodiversity assessments and surveys should be undertaken by external experts to establish the full range of plants that have become established. The assessments should be undertaken during summer and winter months.

10.3.6 Alien Invasive Control

Invasive alien plant species are difficult to control. Methods should be used that are appropriate for the species concerned, as well as to the ecosystem in which they occur.

The satisfactory control of weeds and other invasive species is usually only achieved when several complementary methods, including biological control, improved land management practices, herbicides and mechanical methods, are carefully integrated. Such a strategy is termed an Integrated Control Strategy (ICS).

Follow-up control of alien plant seedlings, saplings and coppice regrowth is essential to maintain the progress made with initial control work, and to prevent suppression of planted or colonizing grasses. Before starting new control operations on new infestations, all required follow-up control and rehabilitation work must be completed in areas that are originally prioritized for clearing and rehabilitation.

The following additional measures are recommended in order to prevent the future introduction or spread of alien species, and to ensure the rehabilitation of transformed areas:

- There must be no planting of alien plants anywhere within the project area;
- Annual surveys, aimed at updating the alien plant list and establishing and updating the invasive status of each of the alien species, should be carried; and
- The transportation of soils or other substrates infested with alien species should be strictly controlled.

Benefits to local communities as a result of the alien plant control programme should be maximised by not only ensuring that local labour is employed, but by also ensuring that cleared alien trees are treated as a valuable wood resource that can be utilised.

11 ACTION SCHEDULE

The closure schedule needs to be linked to the financial provision estimate and forecast that is undertaken for each year of reclamation. The schedule should take into account areas that become available for rehabilitation and costs should be provided to undertake such rehabilitation.

The closure schedule addresses the timing of rehabilitation and closure activities performed during the decommissioning and post-closure phases for a particular operation. As a result of the type of mining that is undertaken (reclamation), concurrent rehabilitation will be undertaken s soon as red soil is reached and it is feasible to rehabilitate.

Areas may be available during the construction phase that may require rehabilitation, such as construction laydown areas and these could be rehabilitated after the construction phase.

Presented below is a high-level schedule of closure related aspects that should be undertaken either during the LoM and/ or during the decommissioning phase:

- Annual review and update of the Rehabilitation, Decommissioning and Closure Plan;
- One year prior to closure start with the closure engagement process with stakeholders and employees;
- The Rehabilitation phase is expected to take two years; and
- Post-closure vegetation monitoring and maintenance for three years and groundwater and surface water monitoring for five years.

12 ORGANISATIONAL CAPACITY

During final rehabilitation and closure phase of the project, suitably skilled technical persons would need to be employed to ensure that rehabilitation works are completed correctly and successfully. These positions would include an Environmental Manager, a Rehabilitation Officer and a Rehabilitation Superintendent, who will ensure that all work involving reshaping are done according to specification.

13 GAPS

This is the first draft of the rehabilitation, decommissioning and closure plan, it is envisaged that through the operational phase of this project many further specialist studies and improvements in technology will take place and as such it is recommended the this plan be revisited and updated with these findings as an annual requirement of the Financial Provision Regulations (replaced by GN R1147 if applicable in the future).

The rehabilitation, decommissioning and closure plan must be updated and reviewed based on new information that may highlight further gaps in this plan, however, this plan includes information available at present.

The following has been identified, with respect to threats, opportunities and uncertainties with respect to the compilation of this plan to define any additional work that is needed in order to reduce the level of uncertainty:

- Ongoing surface water and groundwater quality monitoring during the operational phase to determine trends overtime and to monitor changes in water quality overtime to determine if the project is impacting on water quality resources;
- Ongoing dust monitoring during the operational phase to determine trend overtime and to monitor changes in air quality overtime and to determine if the project is impacting the air quality
- The sampling results should be utilised to update the Numerical Model, initially undertaken, in order to refine the model and more accurately predict post closure impacts based on actual data obtained during the operational phase;
- Ongoing engagement with communities surrounding the area, with respect to the closure vision and tacking these issues into account when closure is being considered;
- Skill development training for employees and engagement with employees to ensure that when closure is reached and downscaling and retrenchment of staff occurs that all are aware of the process and that people have the required skills in order to find alternative employment; and
- Adopting closure recommendations as identified in the respective specialist reports, with particular emphasis on social, water and biodiversity related aspects.

14 RELINQUISHMENT CRITERIA

Relinquishment requires formal acceptance from the regulatory authority to ensure that all obligations associated with closure are achieved, prior to a closure certificate being issued. To achieve relinquishment, criteria need to be set, measured and met for all parties to understand what needs to be done to obtain a closure certificate. This provides all parties involved in the process a target that needs to be achieved and sets the standards that closure and rehabilitation are measured against. Table 14-1provides the respective environmental relinquishment criteria.

Table 14-1: Relinquishment Criteria

Aspect	Closure Requirement	Indicator	Evidence
Soil, Land Use and Land Capability	Erosion	No visible signs of erosion (sheet erosion, rill or gully formation, or bank collapse).	Post-rehabilitation slope analysis mapping must be conducted after re-grading (re-sloping) utilising an aerial photograph and generated contours. Over steep slopes must be corrected Photographic record.
Soil, Land Use and Land Capability	Post land use assessment to determine status of rehabilitated areas with respect to soil quality and that rehabilitated areas have been rehabilitated to an agreed upon land use. In addition to the above, inspections should be undertaken to identify areas of erosion and that erosion measures have been constructed.	Soil chemistry, depth (300 mm) and physical properties analysis to determine soil quality.	Post-rehabilitation slope analysis mapping must be conducted after re-grading (re-sloping) utilising an aerial photograph and generated contours. Over steep slopes must be corrected Photographic record.
Land Use	Remove all contaminated silt from the area and shape the area to promote free draining. The surrounding land to be cleared and rehabilitated and returned to the landowners.	Functioning stream with the correct free drainage. Stable, flat and cleared site, with locale and original topography.	Regular post-closure monitoring using visual observations. Photographic record.
Surface Water	Surface water qualities need to comply with the qualities as stipulated in the WUL,	Up and down stream water quality monitoring.	Monitoring reports indicating a decrease in impact from the site.

Aspect	Closure Requirement	Indicator	Evidence
	GNR.704 and the appropriate DWS and SANS Standards		
Groundwater	Surface water qualities need to comply with the qualities as stipulated in the WUL, GNR.704 and the appropriate DWS and SANS Standards	Borehole water quality monitoring.	Monitoring reports indicating a decrease in impact from the site.
Ecological Functionality	The Russell Stream needs to flow and the lost ecological functionality of the stream needs to be restored.	Seasonal river health assessments and continual biomonitoring.	Monitoring reports indicating a decrease in impact from the site. And an increased and restored functionality of the Russell stream.
Social Environment	Compliance to the companies SLP.	Successful implementation of LED projects, development of SMMEs etc. as per SLP commitments.	Sustaining local economy excluding the operation's contribution.
Community Health and Safety	The site is safe for use by humans and animals. No latent environmental impacts remain which can endanger surrounding communities.	Successful rehabilitation. and water quality monitoring results.	Evidence in final closure and rehabilitation report that appropriate risk assessment has been undertaken and control measures are in place.
Stakeholder Engagement	Aspects raised during public participation are addressed.	Grievance mechanism are in place. Minutes of forums established.	A full public participation process will be undertaken during closure.

15 CLOSURE COST METHODOLOGY

The Closure Cost Assessment for the Crown Mining Right (GP184MR) was provided. This costing includes the closure provision for the rehabilitation of Valley Silts. The costing rates were used for the costing for this Valley Silts extension.

The closure cost assessment was developed in line with the requirements of the NEMA as amended. These Regulations provide that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts.

The financial provision must guarantee the availability of sufficient funds to undertake the following:

- Rehabilitation of the adverse environmental impacts of the listed or specified activities;
- Rehabilitation of the impacts of the prospecting or mining activities, including the pumping and treatment of polluted or extraneous water;
- Decommissioning and closure of the operations;
- Remediation of latent or residual environmental impacts which become known in the future;
- Removal of building structures and other objects; and/or
- Remediation of any other negative environmental impacts.

The Financial Provisioning Regulations, 2015 (GN R1147) for the determination of financial provision for mine rehabilitation and closure were promulgated on 20 November 2015 under the NEMA, as amended.

On 1 February 2024, the Minister of Forestry, Fisheries and the Environment (Minister of DFFE) again amended the transitional period contained in regulation 17B of the Financial Provision Regulations, 2015. The transitional arrangements in regulation 17B of the Financial Provision Regulations allows the holder of a right or permit granted or issued, as the case may be, in accordance with the Mineral and Petroleum Resources Development Act, 2002 (MPRDA), who applied for such right or permit before 20 November 2015, to continue making financial provision in accordance with regulations 53 and 54 of the regulations published under the MPRDA. Stated differently, a person who applied for a right or permit prior to 20 November 2015, is not yet required to comply with the Financial Provision Regulations.

In the previous amendments to the regulation 17B of the Financial Provision Regulations, the Minister always specified a date by when the transitional period would expire and when all holders would be required to comply with the Financial Provision Regulations. However, this time the Minister has amended regulation 17B to provide that the transitional period will continue to apply until the Minister published a date by when all holders are required to comply with the Financial Provision Regulations.

It should also be noted that on 11 July 2022, the Minister of DFFE published the latest draft version of the Proposed Regulations Pertaining to Financial Provisioning for the Mitigation and Rehabilitation of Environmental Damage Caused by Reconnaissance, Prospecting, Exploration, Mining or Production Operations NEMA FP Regulation. The draft regulations are intended to repeal and replace the current Financial Provisioning Regulations, 2015.

The closure model calculates the cost of demolishing, removing and rehabilitating each infrastructure component which may include (but is not limited to):

- Generalised rehabilitation and vegetation management strategies;
- Ensuring the rehabilitated footprints are free draining;
- Vegetation that will remain post-closure;
- Radiation clearance for each rehabilitated footprint; and
- Post-closure maintenance and monitoring costs.

The following assumptions were made.

Table 15-1: Closure Cost Assumptions

Assumptions	Consequences
The calculations do not account for any value recovered from sale of plant, steel or other material.	Value recovered from sale of the Project`s operational infrastructure can be used for any other purpose.
Where contractor rates were not received, the current rates database was used and escalated with an average annual inflation of 5.9%.	Impact on overall closure cost estimate.
Water tariffs updated as per the quotations received in 2024.	Impact on overall closure cost estimate should the actual rate be different.
ERGO will: • Demolish concrete up to one (1) m below natural ground level; • Dispose all inert waste (i.e. building rubble) on site burying it 1 m underground during decommissioning; • Demolish all prefabricated buildings at the end of LoM; and • Remove all temporary structures from site prior to closure.	Listed components removed prior to closure have not been considered in the Financial Provision calculations.
General surface rehabilitation must involve the shaping of the surface topography to match the surrounding landscape. During the process of shaping the landscape and drainage lines must be properly reinstated into the topography; • The footprint areas occupied by permanent surface infrastructure will require ripping, followed by vegetation; and • Any heaps of excess material also need to be removed to ensure effective revegetation..	Ability to effectively implement the final land use.
The financial provision estimate does not include VAT	VAT must be included separately

Assumptions	Consequences
It is assumed that the machine hire rates and rehabilitation quotations received are independent and accurate.	Any changes to the prices quoted will impact the closure cost.

To ensure that the site is up to standards for the proposed land use, the following activities need to take place:

- All equipment and infrastructure need to be removed from site, and any foundations and other cemented platforms or contaminated areas will also need to be removed to a metre below the surface. After all the infrastructure has been removed the surfaces outside of the stream will need to be levelled and shaped and revegetated, all haul and other activity roads will need to be ripped and vegetated.

15.1 Annual Rehabilitation Costs

Annual rehabilitation costs will be included into Ergo's operating budget. The operation has not been initiated and a Zero (R 0.00) rand annual rehabilitation cost is reported for the site. It is anticipated that the Project will be active for a total life of mine (LoM) of 5 years. A 3 year Life of Operation where active excavation would take place, and 2 years to rehabilitate the site. Rehabilitation of the wetlands is anticipated to be undertaken during year 4 and 5 and therefore the cost for this rehabilitation is excluded from the closure cost at year 5.

15.2 Summary of Closure Costs

A summary of the closure cost estimate (excl. VAT) is presented in Table 15-2.

Table 15-2: Closure costs

	Unplanned closure (year 1)	Planned Closure (year 5)
Valley Silts Expansion	R1 700 709.77	R1 623 003.74

According to Section 7 of the NEMA Financial Provisioning Regulations, 2015, the applicant or holder of a right or permit must ensure that the financial provision is, at any given time, equal to the sum of the actual costs of implementing the rehabilitation for a period of at least 10 years forthwith. Although the date of compliance with the regulations has been extended (GN R 4296, 1 February 2024), it is considered best practice to provide provision for the 10 year period. Therefore Ergo will need to provide a guarantee of R1 623 003.74.

16 MONITORING, AUDITING AND REPORTING REQUIREMENTS

Monitoring, Auditing and Reporting will be undertaken for future revisions to this plan, which are required annually. Final monitoring and reporting on the monitoring required in achieving the relinquishment criteria will be undertaken.

The following will be undertaken during the operational phases of the project, to ensure compliance with necessary legislations:

- Annual internal monitoring, auditing and reporting to account for changes in the environment, risk profile and progression of concurrent rehabilitation to ensure that the annual liability assessment reflects the true liability at that point in time.
- An external review will be undertaken by a specialist and then by the financial auditors as part of the annual financial/ accounting audit to determine that the liability assessment is appropriate and that the quantum of the liability is included in the operations provisions.
- Appointment of an external consultant to review and update the rehabilitation, decommissioning and closure plan annually.
- Other statutory audits required, such as EMP Environmental Audits, Water Use Licence Audits, GN704 audits and Social and Labour Plan Audits, which will be undertaken as stipulated in accordance with their conditions.

Final monitoring and reporting should encompass the following items:

- Alignment of actual final topography to agreed planned landform.
- Depth of topsoil stripped and replaced.
- Chemical, physical and biological status of soils replaced due to erosion.
- Surface water drainage systems and surface water quality.
- Groundwater quality at agreed locations.
- Vegetation basal cover.
- Vegetation species diversity.
- Faunal re-colonisation.
- Proportion of land that has been fully rehabilitated.

To achieve the above an operational monitoring programme as well as a post closure monitoring programme will be developed to track the recovery of the site towards the long-term post-closure land capability goals, in accordance with the overall closure objectives.

The monitoring programme is designed to collect information to prove that the relinquishment criteria have been accomplished. The monitoring programme will include:

- Groundwater: Quality monitoring of both the shallow and deep aquifers against the parameters required by the WUL. Sampled quarterly for a five-year post-closure period;

- Surface water monitoring: Quality monitoring of the surrounding surface water against the requirements of the WUL. Sampled quarterly for a five-year post-closure period;
- Dust fall monitoring: Quality monitoring of the air quality surrounding the project area against the legislative requirements. Sampled monthly for a year post-closure period;
- Photographic records should be maintained together with findings, follow up actions and close out records as part of the Environmental Management System.

17 ENVIRONMENTAL RISK ASSESSMENT: LATENT AND RESIDUAL ENVIRONMENTAL IMPACTS

According to the Financial Provisioning Regulations, the objective of the environmental risk assessment report that relates to latent and residual impacts is to:

- Ensure timeous risk reduction through appropriate interventions;
- Identify and quantify the potential latent environmental risks related to post closure;
- Detail the approach to managing the risks;
- Quantify the potential liabilities associated with the management of the risks; and
- Outline monitoring, auditing and reporting requirements.

This Report aims to address these objectives separately in cases where they have not been considered in previous sections.

17.1 Assessment Process to Describe Latent Environmental Risks

The Environmental Impact Assessment (EIA) Report provides a detailed description of the environmental impact/ risk identification and assessment (including the methodology and findings) undertaken for the Project. Further details of the risk assessment methodology are detailed in Section 8 of this report. The EIA Report and EMPr have identified mitigation measures which, once implemented successfully, will result in the avoidance or acceptable reduction of associated biophysical, socio-economic and cultural heritage impacts.

The drivers that could result in latent environmental risks are largely defined by the historical nature of the activity and the site, as well as the proximity to water sources and wetlands. Further investigations must be conducted during annual revisions of the rehabilitation plan to provide more clarity. These investigations must include regular revision of the environmental risk assessment and consequently inform the responsible management of latent and residual impacts.

17.2 Management Activities, Costing and Monitoring Requirements

New international best practice guidelines that may be developed in the future will be considered in all annual updates of the financial provisions and changes to the risk assessment will be reported on. In addition, monitoring results and auditing reports as described above for one year after closure will inform the revised risk assessment.

18 AMENDMENT MOTIVATIONS

The plan will be updated annually where any amendments required will be incorporated into the plan to ensure it is relevant and up to date with all available specialist information, concurrent rehabilitation undertaken, changes or progress in terms of mining activities and finally the audited financial provision assessment.

19 CONCLUSION

The report serves to meet the NEMA Regulations pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GNR. 1147 of 2015, as amended) which require that a final rehabilitation, decommission and closure plan is developed which includes the determination of financial provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts of mining. This document presented the conceptual rehabilitation, decommissioning and closure plan for the Project. The rehabilitation, decommissioning and closure plan will be updated and amended annually to comply with current legislation. During this process, changes in baseline information, legislation amendments, spatial developments and any other changes which may impact the closure of the operation will be incorporated to ensure that the plan remains current and implementable.

Ergo will provide for the closure liability for premature closure associated with the project through the procurement of suitable guarantees as allowed by the Financial Provision Regulations, with such guarantees provided to the DMR following authorisation of the Project.

20 DECLARATION OF INDEPENDENCE

I, Bradly Thornton declare that:

- An independent specialist undertook the study as required by this application;
- That the work relating to the application was performed 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 the objectivity in performing such work;
- The specialist has the required expertise in conducting the specialist study relevant to this application, including knowledge of the various Acts, regulations and any guidelines that have relevance to the proposed project;
- That the specialist complies with the Acts, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Signature of Specialist

Kongiwe Environmental (Pty) Ltd

Name of company

23 April 2025

21 REFERENCES

Digby Wells Environmental. 2024. *Closure Cost assessment for Crown GP184MR.*

Enviro Acoustic Research. 2025. *Environmental Noise Impact Assessment for the Proposed alley Silts Expansion Project within Johannesburg, Gauteng Province.*

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The Biodiversity Company. 2024. *Wetland Functional and Impact Assessment for the Proposed Valley Silts Expansion Project.*

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APPENDIX A:
Curriculum Vitae

Curriculum Vitae – Gerlinde Wilreker

Chief Environmental Process Officer

Professional Registration

- South African Council for Natural Science Professionals (SACNASP) – 2009
- Environmental Assessment Practitioners Association of South Africa (EAPASA) – 2019
- International Association of Impact Assessment South Africa

Qualifications

- Management Development Programme, University of Stellenbosch Business School, 2021
- Diploma Environmental Law, University of Johannesburg, 2005
- M.Sc. Environmental Management, RAU, 2004
- B.SC. Hons Environmental Management, RAU, 2002
- B.Sc. Earth Sciences, RAU, 2001

Languages

- English – Fluent
- French – Fluent
- German – Fluent
- Afrikaans – Average

Countries Worked in

- South Africa
- Democratic Republic of Congo
- Mauritania
- Mali
- Morocco
- Senegal
- Zambia

Gerlinde has over eighteen years' work experience, predominantly in the mining industry. Her practical experience in the mining and construction industry has given her a depth of knowledge regarding project processes from pre-feasibility phases through to implementation. She is adept at working in different contexts, and problem-solving with her team to meet the required outcomes. She has expertise in relation to Environmental Authorisation Processes in terms of the South African legal regime and has extensive environmental auditing experience, particularly in the mining sector. She has a M.Sc. Environmental Management from the former RAU (now UJ) and is also a registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Partitioners Association of South Africa (EAPASA) and a Natural Scientist with the South African Council for Natural Science Professionals (SACNASP).

Her skills include:

- Project Management;
- Environmental Authorisations;
- Environmental Auditing;
- Environmental Control Officer; and
- Legal Reviews, Gap Analyses and Due Diligences.

PROJECT EXPERIENCE

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
Environmental Authorisations / Water Use Licences						
Henrietta Wind Project	2023-2024	Mauritius	Akuo Energy	Provision of strategic E&S advisory services as well as conduct IFC compliant specialist studies.	Technical Director	Project Management
Genesis Steyn Solar PV Facility	2023-2024	Free State Province, South Africa	Genesis Eco-Energy Developments (Pty) Ltd.	Environmental Authorisations and IWULA	Technical Director	Project Management, Technical review
Ergo Mining: Withok TSF Recommissioning Project	2024 - current	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Technical Director	Project Management, Technical review
Ergo Mining: Valley Silts Expansion	2024 - current	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Technical Director	Project Management, Technical review
Ergo Mining: Daggafontein Reinstatement	2024	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Technical Director	Project Management, Technical review
Ergo Mining: Withok TSF Recomissioning	2024	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Technical Director	Project Management, Technical review
Umsimbithi eMakhazeni Mining Project	2023- 2024	Mpumalanga Province, South Africa	Umsimbithi Mining (Pty) Ltd	IWULA	Technical Director	Project Management Technical review
Harmony Free State Operations IWULA	2022-2023	Free State Province, South Africa	Harmony Gold	IWULA	Technical Director	Technical review IWWP

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
Ergo Mining: Reclamation and Reprocessing of the 4L39 Dump	2022	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Technical Director	Project Management, Technical review Scoping Report
Ergo Mining: Reclamation and Reprocessing of the 5L23 Dump	2022	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Technical Director	Project Management, Technical review IWWMP
Ubuntu Colliery 2022 RSIP Update	2022	Mpumalanga Province, South Africa	Universal Coal	Updating of the Ubuntu Colliery RSIP	Technical Director	Project Management, Technical review
Wonderfontein Colliery	2020 - 2022	Mpumalanga Province, South Africa	Wonderfontein Cilliery	Assisting with improvements of the Wonderfontein water management systems and IWULA	Technical Director	Project Management, Technical review
Umsimbithi eMakhazeni Mining Project	2019-2023	Mpumalanga Province, South Africa	Umsimbithi Mining (Pty) Ltd	Amendment of Environmental authorisation process for a coal mining project near Belfast	Technical Director	Project Management, Technical review
Sibanye Kloof EMP and IWUL Amendments	2019-2024	Gauteng Province South Africa	Sibanye-Stillwater (Pty) Ltd	Amendment of the existing EMP and IWUL	Technical Director	Project Management, Technical review
Sibanye Driefontein EMP and IWUL Amendments	2019-2024	Gauteng Province South Africa	Sibanye-Stillwater (Pty) Ltd	Amendment of the existing EMP and IWUL	Technical Director	Project Management, Technical review
Ergo Mining: Reclamation and Reprocessing of the Marievale Dumps	2019-2024	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Technical Director	Project Management, Technical review

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
Ergo Mining: Reclamation and Reprocessing of the City Deep Dumps	2018-2020	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Principal Environmental Consultant	Project Management Technical review EAP, IWULA
Ergo Mining: Reclamation and Reprocessing of the Rooikraal Tailings Storage Facility	2018-2020	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Principal Environmental Consultant	Project Management Technical review EAP, IWULA
Leslie 1 Project	2017-2022	Mpumalanga Province, South Africa	Glencore Operation (Pty) Ltd	Environmental authorisation process for a coal mining project near Leandra	Principal Environmental Consultant	EAP, Project Manager. Managing specialists undertaking the specialist studies for the Environmental Impact Assessment
Umsimbithi eMakhazeni Mining Project	2017-2023	Mpumalanga Province, South Africa	Umsimbithi Mining (Pty) Ltd	Environmental authorisation process for a coal mining project near Belfast	Principal Environmental Consultant	EAP, Project Manager. Managing specialists undertaking the specialist studies for the Environmental Impact Assessment
Lephalale Coal and Power Project	2017-2020	Limpopo Province, South Africa	Dedicoal (Pty) Ltd	Environmental authorisation process for the Lephalale Coal and Power Project	Principal Environmental Consultant	EAP, Project Manager. Managing specialists undertaking the specialist studies for the Environmental Impact Assessment
Exxaro Coal Underground Coal Gasification Project	October 2015 – May 2016	Limpopo Province, South Africa	Exxaro Coal	Environmental Impact Assessment process for an underground	Environmental Consultant	Project Manager. Managing specialists undertaking the

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
				coal gasification project		specialist studies for the Environmental Impact Assessment
Fumani Gold Mine	2013 -2015	Limpopo Province, South Africa	Corridor Mining Resources	Environmental Impact Assessment process for the proposed Fumani gold mine	Environmental Consultant	Managing consultants undertaking the EIA for the proposed Fumani gold mine
Kambove Copper Processing Plant	2013	Democratic Republic of Congo	Gécamines	Environmental, Social and Health Impact study (ESHIA) for the processing plant and tailings facilities	Environmental Consultant	Managing consultants undertaking the Environmental, Social and Health Impact study (ESHIA)
PV Pant Authorisation	2012	KwaZulu Natal Province, South Africa	GX Energie	Basic assessment process for a PV plant.	Environmental Consulting	Assisting with BA compilation and public participation
Pering Mine	2009 - 2011	Northern Cape Province, South Africa	Minéro	Environmental Impact Assessment process for the proposed Reivilo lead and Zinc mine	Environmental Consultant	Compiling Scoping and EIA reports, public participation
Exxaro Coal Belfast Project	2008 -2011	Mpumalanga Province, South Africa	Exxaro Coal	Environmental authorisation process for the proposed Belfast Coal Mine	Environmental Consultant	Compiling Scoping and EIA reports, public participation
Closure Costing						
Beeshoek Closure Assessment	2020	Northern Cape, South Africa	Assmang (Pty) Ltd	Mine closure Assessment	Technical Director	Mine Closure requirement assessment

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
Ergo Mining: Reclamation and Reprocessing of the City Deep Dumps	2018-current	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Principal Environmental Consultant	Closure and Rehabilitation costing
Ergo Mining: Reclamation and Reprocessing of the Rooikraal Tailings Storage Facility	2018-current	Gauteng, South Africa	DRDGOLD (Pty) Ltd	Environmental Authorisations and IWULA	Principal Environmental Consultant	Closure and Rehabilitation costing
Total Coal Mine Closure Application	July 2015 – June 2016	KwaZulu-Natal, South Africa	Total Coal	Mine closure application and Basic Assessment for the closure of the Steincoalspruit Coal Mine	Environmental Consultant	Project Manager, review of mine closure application document and Basic Assessment, client and authority liaison
Diesel Storage Facilities	2011	South Africa	Basil Read	EMP and closure costings for the installations of various diesel storage facilities throughout South Africa.	Environmental Consultant	EMP and closure costing
Environmental Control Officer						
Black Rock Expansion Project - Environmental Control Officer	2013 – 2015	Northern Cape Province, South Africa	Assmang Black Rock	Black Rock Expansion Project	Environmental Control Officer	Environmental Officer duties which include environmental compliance site visits, managing of contractors and their procedures as per client's EMS

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
Sishen Ramp-Up Projects – Bucket & Bowl, Life of Mine and various Housing Projects	2011 – 2013	Northern Cape Province, South Africa	Kumba Iron Ore	Bucket & Bowl, Life of Mine and various Housing Projects	Environmental Control Officer	Environmental Officer duties which include environmental compliance site visits, managing of contractors and their procedures as per client's EMS
Sishen Ramp-Up Projects – Diesel Tanks 5 & 6, Aldag 1 extension, Lakutshona and Sesheng Housing Projects	2011 – 2013	Northern Cape Province, South Africa	Kumba Iron Ore	Diesel Tanks 5 & 6, Aldag 1 extension, Lakutshona and Sesheng Housing Projects	Environmental Control Officer	Environmental Officer duties which include environmental compliance site visits, managing of contractors and their procedures as per client's EMS
Auditing						
GOSA 2024 Audits	2024	Mpumalanga and Kwa-Zulu Natal Provinces South Africa	Glencore Operations South Africa (Pty) Ltd	External audits of 60 Environmental Authorisations for the Coal operations in Mpumalanga	Technical Director / Environmental auditor	External Audit Technical review
GOSA 2023 Audits	2023	Mpumalanga and Kwa-Zulu Natal Provinces South Africa	Glencore Operations South Africa (Pty) Ltd	External audits of 60 Environmental Authorisations for the Coal operations in Mpumalanga	Technical Director / Environmental auditor	External Audit Technical review
GOSA 2022 Audits	2022	Mpumalanga and Kwa-Zulu Natal Provinces South Africa	Glencore Operations South Africa (Pty) Ltd	External audits of 60 Environmental	Technical Director / Environmental auditor	External Audit Technical review

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
				Authorisations for the Coal operations in Mpumalanga		
GOSA 2021 Audits	2021	Mpumalanga and Kwa-Zulu Natal Provinces South Africa	Glencore Operations South Africa (Pty) Ltd	External audits of 60 Environmental Authorisations for the Coal operations in Mpumalanga	Environmental auditor	External Audit
GOSA 2020 Audits	2020	Mpumalanga Province South Africa	Glencore Operations South Africa (Pty) Ltd	External audits of 60 Environmental Authorisations for the Coal operations in Mpumalanga	Environmental auditor	External Audit
Sibanye External Audits	2019 - 2020	Gauteng, Mpumalanga and Free State Provinces South Africa	Sibanye-Stillwater (Pty) Ltd	External audits of EMPr's for the operations in Gauteng, Mpumalanga and Free State Provinces	Technical Director	Project Management, client liaison, technical review, Auditor
GOSA 2019 Audits	2019	Mpumalanga Province South Africa	Glencore Operations South Africa (Pty) Ltd	External audits of 60 Environmental Authorisations for the Coal operations in Mpumalanga	Environmental auditor	External Audit
GOSA 2018 Audits	2018	Mpumalanga Province South Africa	Glencore Operations South Africa (Pty) Ltd	External audits of 47 Environmental Authorisations for the Coal operations in Mpumalanga	Environmental auditor	External Audit
GOSA 2017	2017	Mpumalanga Province South Africa	Glencore Operations South Africa (Pty) Ltd	External audits of 47 Environmental	Environmental auditor	External Audit

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
				Authorisations for the Coal operations in Mpumalanga		
Cronimet Legal Compliance	2012-2013	Limpopo Province, South Africa	Cronimet	Legal compliance auditing of Cronimet mine	Environmental auditor	Monthly environmental auditing of chrome mine facilities
PPC Legal Compliance	2005 - 2008	South Africa	PPC	Legal compliance auditing of various quarries across South Africa	Environmental auditor	Monthly environmental auditing of chrome mine facilities
Due Diligence						
Environmental, Social and Governance Due Diligence Services	2024	Morocco	Vantage Mezzanine Fund IV	ESD Due Diligence	Technical Director	ESD Due Diligence
Rustenburg Chrome Mine Gap Analysis	2023-2024	North West Province, South Africa	Clover Alloys (Pty) Ltd	Gap Analysis	Technical Director	Environmental Legal Gap Analysis
Glencore Greenfields Gap Analysis	2023	Mpumalanga Province South Africa	Glencore Operation (Pty) Ltd	Gap Analysis	Technical Director	Environmental Legal Gap Analysis
Glencore Brownfields Gap Analysis	2023	Mpumalanga Province South Africa	Glencore Operation (Pty) Ltd	Gap Analysis	Technical Director	Environmental Legal Gap Analysis
Glencore Brownfields Gap Analysis	2022	Mpumalanga Province South Africa	Glencore Operation (Pty) Ltd	Gap Analysis	Technical Director	Environmental Legal Gap Analysis
Zonnebloem Complex	2018	Mpumalanga Province South Africa	Glencore Operation (Pty) Ltd	Gap Analysis	Principal Environmental Consultant	Environmental Legal Gap Analysis
Eastplats Due Diligence	2014	North West Province, South Africa	Eastplats	An environmental legislative overview with an associated environmental site	Environmental Consultant	Compiling environmental due diligence

Project	Dates	Location	Client	Project Description	Position Held	Activities Performed
				assessment, which in turn assessed the availability and status of the various environmental authorizations, permits and licenses required for legislative compliance at the Eastern Plat Asset.		
PTM Waterberg Project Concept Study	2013	Limpopo Province, South Africa	Platinum Group Metals	Concept study for Platinum mine in the Waterberg.	Environmental Consultant	Environmental input into the Preliminary Economic Assessment
Facilitation						
AEH (MEH/TEH) Management Systems compilation	2019-2020	Mali Senegal Zambia	EBS Advisory (Pty) Ltd	Compilation of an Environmental Management System for AEH operations in Uganda, Zambia, Mali and Senegal	Support function to the Project Manager at EBS Advisory in the Johannesburg office, primarily with respect to understanding the French ESMS requirements.	Project Management and Client Meetings. Research and Preparation Gap Analysis and ESMS Mapping Report Writing and ESMS complication.
SNIM Iron Ore Project	2014 - 2015	Mauritania	SNIM	Feasibility Study for Iron Ore Plant upgrade	Environmental Consultant	Assisting with the liaison between the client and the engineering team, interpretation services, translation of technical documents

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APPENDIX B:
Closure Costing

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Description	Closure				
	Quantity	Unit	Rate	Amount	Comments
Unplanned - Year 1					
Rehabilitation of stockpile area and other infrastructure areas					
Shaping of area - To ensure site drainage	8	ha	R 40 454.33	R 323 634.64	
Stormwater management site establishment	1	Sum	R 7 033.88	R 7 033.88	
Radiation clearance	1	Item	R 144 000.00	R 144 000.00	
Radiation clearance Soil samples	1	Item	R 66 493.26	R 66 493.26	
Rehabilitation of Wetland Area					
Shaping - To ensure site drainage	5	ha	R 40 454.33	R 202 271.65	
Stormwater management site establishment	1	Sum	R 7 033.88	R 7 033.88	
Site Establishment for rehabilitation	1	Sum	R 108 015.00	R 108 015.00	Includes Site Establishment/De-establishment and Pre-Project meetings
Establish vegetation	5	ha	R 62 141.82	R 310 709.09	
Vegetation Monitoring	5	Ha	R 5 340.25	R 26 701.25	Monitoring for five years for 25% of the area. The percentage is already worked into the rate.
Vegetation Maintenance	5	Ha	R 58 864.77	R 294 323.86	Maintenance for five years for 25% of the area. The percentage is already worked into the rate.
Radiation clearance	1	Item	R 144 000.00	R 144 000.00	
Radiation clearance Soil samples	1	Item	R 66 493.26	R 66 493.26	
				R -	
Total Cost Unplanned - Year 1				**R 1 700 709.77**	
Planned - Year 5					
Rehabilitation of stockpile area and other infrastructure areas					
Shaping of area - To ensure site drainage	8	ha	R 40 454.33	R 323 634.64	
Stormwater management site establishment	1	Sum	R 7 033.88	R 7 033.88	
Radiation clearance	1	Item	R 144 000.00	R 144 000.00	
Radiation clearance Soil samples	1	Item	R 66 493.26	R 66 493.26	
Rehabilitation of Wetland Area					
Shaping - To ensure site drainage	0	ha	R 40 454.33	R -	Area is 20ha with an additional 1.5ha drying area. This area will however have been rehabilitated during year 4 and 5 and costing is therefore excluded.
Stormwater management site establishment	0	Sum	R 7 033.88	R -	
Site Establishment for rehabilitation	0	Sum	R 108 015.00	R -	Includes Site Establishment/De-establishment and Pre-Project meetings
Establish vegetation	0	ha	R 62 141.82	R -	
Vegetation Monitoring	22	Ha	R 5 340.25	R 117 485.50	Monitoring for five years for 25% of the area. The percentage is already worked into the rate.
Vegetation Maintenance	22	Ha	R 58 864.77	R 1 295 024.98	Maintenance for five years for 25% of the area. The percentage is already worked into the rate.
Radiation clearance	1	Item	R 144 000.00	R 144 000.00	
Radiation clearance Soil samples	1	Item	R 66 493.26	R 66 493.26	
Planned Closure - Year 5				**R 1 623 003.74**	

APPENDIX E:

Environmental Management Programme Report

FINAL ENVIRONMENTAL MANAGEMENT PROGRAMME

Project:	Ergo Mining: Valley Silts Expansion Project
Report Title:	Final Environmental Management Programme Report: Ergo Mining: Valley Silts Expansion Project
Applicant:	Ergo Mining (Pty) Ltd
Project No:	DRDG#052
Compilation Date:	3 June 2025
Status of Report:	Final for Submission

Verification	Capacity	Name	Signature	Date
By Author	EAP	Ripfumelo Macevele		3 June 2025
Reviewed by	Chief Executive	Bradly Thornton		3 June 2025

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1 INTRODUCTION

Kongiwe Environmental (Pty) Ltd (Kongiwe) has been appointed by Ergo Mining (Pty) Ltd (Ergo), as the independent Environmental Service Provider (EAP) tasked with conducting the Scoping and Environmental Impact Assessment (S&EIA) process which is aimed at critically evaluating the potential environmental and social impacts of the proposed **Valley Silts Expansion Project** (hereafter the Proposed Project).

1.1 Project Introduction

Ergo, a subsidiary of DRDGOLD Limited, intends to expand its Valley Silts reclamation operation (the Valley Silts Expansion Project). The expansion involves mechanically excavating gold-bearing silts from the Russell Stream valley, extending from the old dam wall to Nasrec Road (Blocks N1 to N20), situated immediately west of the authorised and existing Valley Silts reclamation project area and the remaining Blocks (N21 and N22) being located either side of Crownwood Road, near Booysens Reserve and Riverlea, Johannesburg.

Ergo obtained an Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) for the mechanical reclamation of gold bearing silts from a section near the Russell Stream north of NASREC near Booysens Reserve, in Johannesburg. The reclamation authorisation for the removal of silts, falls within Mining Right GP 184 MR. Further to this, Ergo holds various Mining Rights (MR) in respect of slimes dams and sand dumps extending 65 km from Western Johannesburg to Eastern Ekurhuleni with most activities occurring on the central and eastern sections of the Witwatersrand mining belt.

The reclamation of silts within the already authorised Valley Silts Project area has been ongoing since May 2023. The construction and site establishment began in October 2022 and as such, the requirement to prepare for the Valley Eastern Expansion, Southern Expansion, and Valley Expansion Northwest is now necessary for continuous reclamation operation, as well as a sustainable feed source to the process plant.

The Valley Silts resource has three primary sectors. The current approved reclamation area is Sector 1 and extends from the dam wall to the end of the stockpile area near Crownwood Road. The site is already established with fully fenced hard park facilities, solar powered security lights, well maintained haul roads, and site offices. Access is fully controlled by security for all vehicles.

The Expansion Phase of the project will consist of Sector 2 and Sector 3 (Figure 5-1).

Sector 2 will extend from the old dam wall to Nasrec Road (Blocks N1 to N20), with the remaining Blocks (Sector 3: N21 and N22) being located either side of Crownwood Road. As reclamation exceeds the delivery rate, stockpile areas are therefore required for temporary storage. Stockpiled silts are moved in a sequential manner due to the moisture content, the drying process, as well as oxidation.

The detailed plans are based on a 1:1 000 scale survey plan and all blocks are based on a delivery rate required by Ergo. Individual blocks will be removed in sequence.

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Prospecting trenching will determine the depositional flank extents and all material will be removed from the natural flow path as well as the flanks. Paddocks and storm water controls are required to protect the stream from any extraneous ingress, and these will be installed. The current infrastructure at the Valley Silts Project area will be utilised for the Expansion project. Hard Park, cut off trenches and stormwater collection points (sump) are pre-installed and appropriate for further use. The proposed reclamation will employ a methodology consistent with previous practices specifically through mechanical excavation techniques.

1.2 Description of the Project Location

The Proposed Project is located within the Russell Stream valley, near Booysens Reserve. The project area stretches from New Canada Road, following the valley southeast, past the Nasrec Road bridge and past Crownwood Road until the stream meets the M1.

The Proposed Project is situated in the City of Johannesburg Metropolitan Municipality (CoJMM). The Russell Stream (also referred to as the Klipspruit) is surrounded by industrial, commercial, residential and undeveloped land. The closest residential area to the project is Riverlea, the outskirt of the suburb is situated approximately 120m from the Valley silts project area.

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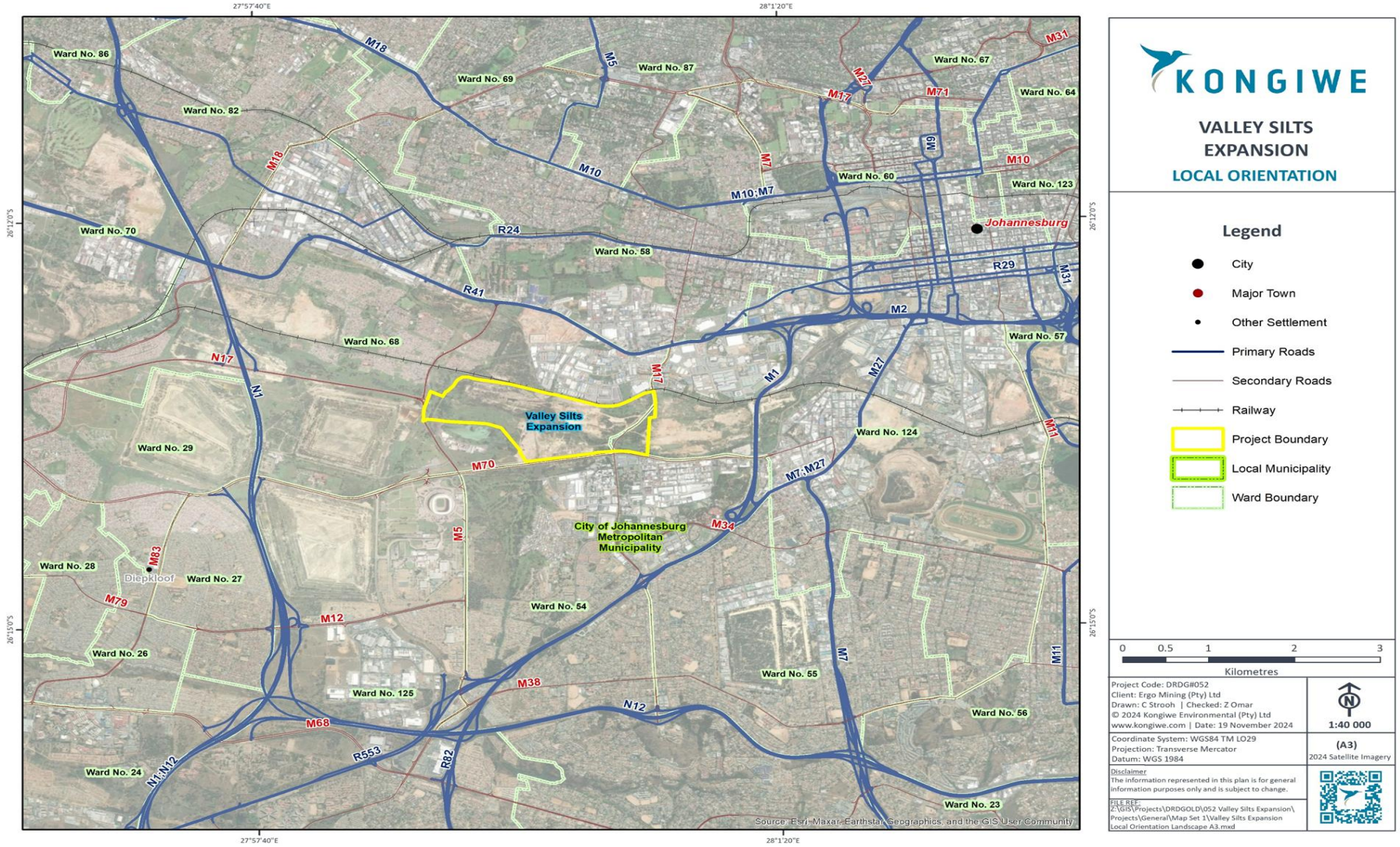


Figure 1-1: Locality map of the Proposed Project

The following infrastructure is encountered in the area (Figure 1-2 and Figure **1-3**):

- National and provincial roads (M70, M17, N17, N1);
- Residential and commercial properties:
- Industrial properties;
- FNB Soccer City Sports Centre;
- Power lines;
- Sewer lines;
- Railway line;
- Water reticulation systems; and
- Historic Mine Dumps.

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Figure 1-2: Infrastructure found in the project area including pipelines and powerlines.

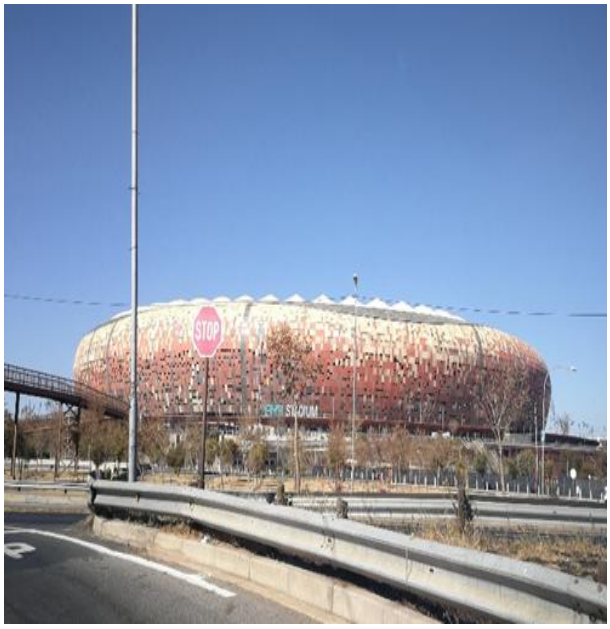


Figure 1-3: FNB Stadium (Soccer City)



Figure 1-4: Disturbed undeveloped terrain.



Figure 1-5: Vegetation along the banks of the Russell stream

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Figure 1-6: The old Crown Ave. bridge over the Russell stream.



Figure 1-7: Dense vegetation found in parts of the study area.



Figure 1-8: Train bridge over the western section of the project area.



Figure 1-9: Illegal dumping in the western section of the project area.

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The properties of interest for the Valley Silts Expansion Project are illustrated by Figure 1-10 and Table 1-1 & Table 1-2 overleaf.

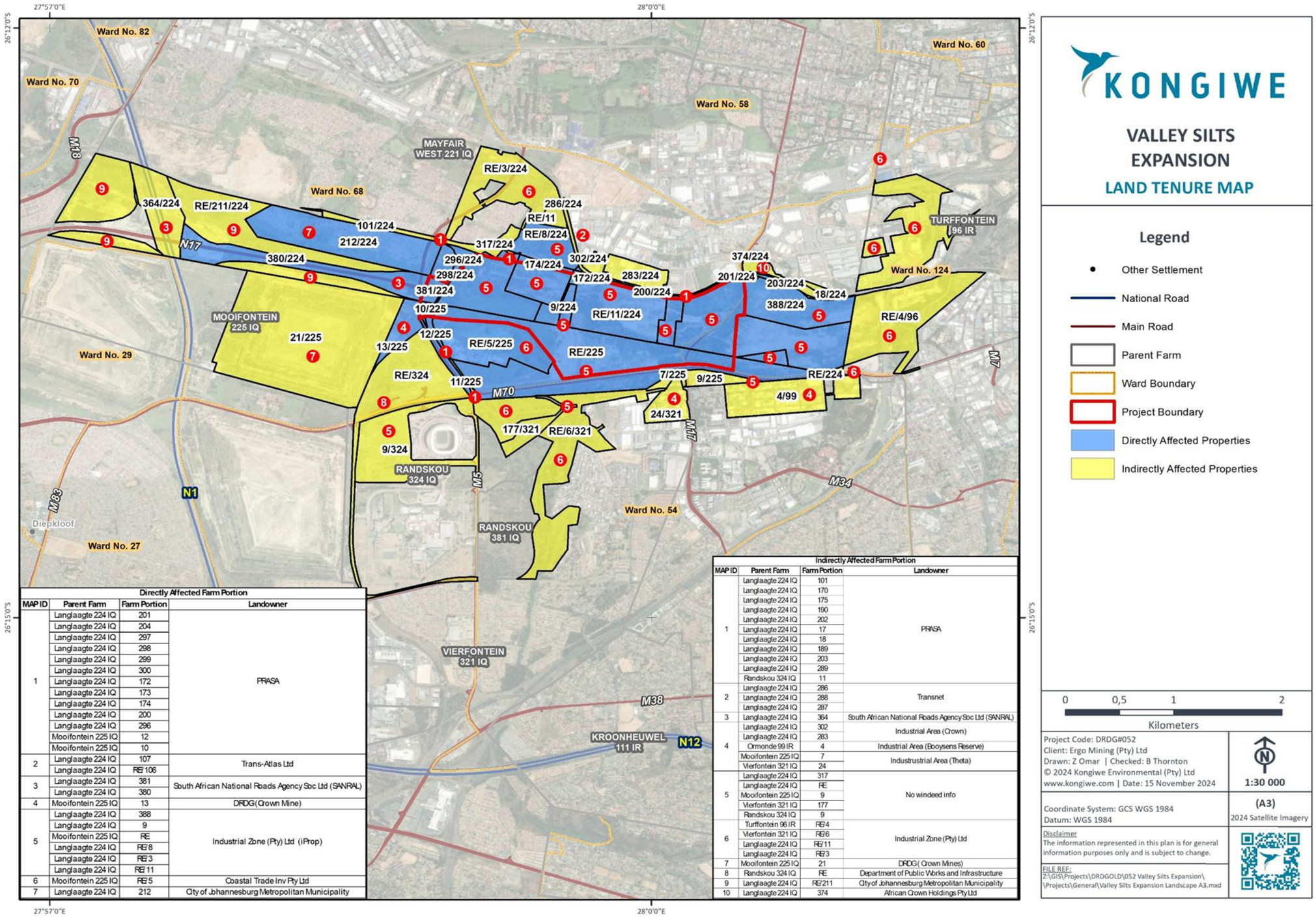
Table 1-1: Property Details

Application Area (ha)	The Proposed Project site covers an area of 54 ha
Magisterial District	City of Johannesburg Metropolitan Municipality (CoJ).
Distance and Direction from Nearest Town	The site is within the City of Johannesburg. Riverlea, Nasrec, Theta and Amalgam are located in close proximity to the Russell stream and the Valley Silts area

Table 1-2: Project area land tenure

Property	Portion	Owner
Langlaagte 224 IQ	298	PRASA
Langlaagte 224 IQ	299	PRASA
Langlaagte 224 IQ	300	PRASA
Langlaagte 224 IQ	9	Industrial Zone (Pty) Ltd (iProp)
Langlaagte 224 IQ	107	Trans-Atlas Ltd
Langlaagte 224 IQ	296	PRASA
Mooifontein 225 IQ	RE	Industrial Zone (Pty) Ltd (iProp)
Langlaagte 224 IQ	RE/106	Trans-Atlas Ltd
Langlaagte 224 IQ	RE/8	Industrial Zone (Pty) Ltd (iProp)
Mooifontein 225 IQ	10	PRASA
Langlaagte 224 IQ	381	South African National Roads Agency Soc Ltd (SANRAL)
Langlaagte 224 IQ	RE/3	Industrial Zone (Pty) Ltd (iProp)
Langlaagte 224 IQ	RE/11	Industrial Zone (Pty) Ltd (iProp)

Refer to Figure 1-10 for the Valley Silts Expansion project area land tenure map.



Directly Affected Farm Portion

MAP ID	Parent Farm	Farm Portion	Landowner
1	Langlaagte 224 IQ	201	PRASA
	Langlaagte 224 IQ	204	
	Langlaagte 224 IQ	297	
	Langlaagte 224 IQ	298	
	Langlaagte 224 IQ	299	
	Langlaagte 224 IQ	300	
	Langlaagte 224 IQ	172	
	Langlaagte 224 IQ	173	
	Langlaagte 224 IQ	174	
	Langlaagte 224 IQ	200	
	Langlaagte 224 IQ	296	
	Mooifontein 225 IQ	12	
	Mooifontein 225 IQ	10	
2	Langlaagte 224 IQ	107	Trans-Atlas Ltd
	Langlaagte 224 IQ	RE/106	
3	Langlaagte 224 IQ	381	South African National Roads Agency Soc Ltd (SANRAL)
	Langlaagte 224 IQ	380	
4	Mooifontein 225 IQ	13	DRDG(Crown Mine)
5	Langlaagte 224 IQ	388	Industrial Zone (Pty) Ltd (iProp)
	Langlaagte 224 IQ	9	
	Mooifontein 225 IQ	RE	
	Langlaagte 224 IQ	RE/8	
	Langlaagte 224 IQ	RE/3	
	Langlaagte 224 IQ	RE/11	
6	Mooifontein 225 IQ	RE/5	Coastal Trade Inv Pty Ltd
7	Langlaagte 224 IQ	212	City of Johannesburg Metropolitan Municipality

Indirectly Affected Farm Portion

MAP ID	Parent Farm	Farm Portion	Landowner
1	Langlaagte 224 IQ	101	PRASA
	Langlaagte 224 IQ	170	
	Langlaagte 224 IQ	175	
	Langlaagte 224 IQ	190	
	Langlaagte 224 IQ	202	
	Langlaagte 224 IQ	17	
	Langlaagte 224 IQ	18	
	Langlaagte 224 IQ	189	
	Langlaagte 224 IQ	203	
	Langlaagte 224 IQ	289	
	Randskou 324 IQ	11	
2	Langlaagte 224 IQ	286	Transnet
	Langlaagte 224 IQ	288	
	Langlaagte 224 IQ	287	
3	Langlaagte 224 IQ	364	South African National Roads Agency Soc Ltd (SANRAL)
4	Langlaagte 224 IQ	302	Industrial Area (Crown)
	Langlaagte 224 IQ	283	
	Ormonde 99 IR	4	Industrial Area (Booysens Reserve)
	Mooifontein 225 IQ	7	Industrustrial Area (Theta)
	Vierfontein 321 IQ	24	
5	Langlaagte 224 IQ	317	No windeed info
	Langlaagte 224 IQ	RE	
	Mooifontein 225 IQ	9	
	Vierfontein 321 IQ	177	
	Randskou 324 IQ	9	
6	Turffontein 96 IR	RE/4	Industrial Zone (Pty) Ltd
	Vierfontein 321 IQ	RE/6	
	Langlaagte 224 IQ	RE/11	
	Langlaagte 224 IQ	RE/3	
7	Mooifontein 225 IQ	21	DRDG (Crown Mines)
8	Randskou 324 IQ	RE	Department of Public Works and Infrastructure
9	Langlaagte 224 IQ	RE/211	City of Johannesburg Metropolitan Municipality
10	Langlaagte 224 IQ	374	African Crown Holdings Pty Ltd

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VALLEY SILTS EXPANSION

LAND TENURE MAP

Legend

- Other Settlement
- National Road
- Main Road
- Parent Farm
- Ward Boundary
- Project Boundary
- Directly Affected Properties
- Indirectly Affected Properties

0 0,5 1 2

Kilometers

Project Code: DRDG#052
Client: Ergo Mining (Pty) Ltd
Drawn: Z Omar | Checked: B Thornton
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www.kongiwe.com | Date: 15 November 2024

1:30 000

Coordinate System: GCS WGS 1984
Datum: WGS 1984

(A3)
2024 Satellite Imagery

Disclaimer
The information represented in this plan is for general information purposes only and is subject to change.

FILE REF:
Z:\GIS\Projects\DRDGOLD\052 Valley Silts Expansion\
\Projects\General\Valley Silts Expansion Landscape A3.mxd

Figure 1-10: Land tenure map of the Proposed Project

2 DETAILS OF THE EAP

Founded in 2016, Kongiwe is a contemporary problem-solving consultancy specialising in solving real world environmental challenges. We pride ourselves on using the latest technology available to realise pragmatic solutions for our clients. The company's purpose is: '*To solve environmental and social challenges by providing expert bespoke solutions that promote current and future sustainability globally*'.

Based in Johannesburg, South Africa, our team of professional Environmental Scientists are highly trained in various environmental disciplines and have significant, hands-on experience in an array of projects across various industries. The company has extensive environmental and project management experience in multiple sectors, with significant experience in South Africa, as well as internationally. Kongiwe focuses on the integration of environmental studies and processes into larger engineering and mining projects. Moreover, Kongiwe provides clients with strategic environmental assessments and compliance advice, the identification of environmental management solutions and mitigation / risk minimising measures throughout the project lifecycle.

2.1.1 Contact Person and Corresponding Address

Details of the Environmental Assessment Practitioner (EAP) who prepared the report are presented below:

Table 2-1: Details of the EAP

Name of Practitioner	**Ripfumelo Macevele**
EAP Registration No.	Reg.EAP 2019/1051
Tel No.	+27 (10) 140 6508
Fax No.	072 984 8574
E-mail Address	rmacevele@kongiwe.com

2.1.2 Expertise of the EAP

Ripfumelo Macevele is an Environmental Assessment Practitioner at Kongiwe Environmental. He is EAPASA Registered Environmental Assessment Practitioner (2019/1051) as well as registered with SACNASP as Environmental Science Candidate Natural Scientist (128491) and has extensive experience in executing the process to obtain Environmental Approvals through Environmental Impact Assessment and conducting Environmental Monitoring, Auditing & Reporting and Developing Environmental Management Plans as well as Water Use Licence applications and Public Participation. Qualifications in Appendix A.

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3 DESCRIPTION OF THE ASPECTS OF THE ACTIVITY

This document must be read in conjunction with the EIA. To minimise repetition throughout the documentation, the EAP refers the reader to Chapter 2 and Chapter 3 of the EIA.

4 DESCRIPTION OF THE BASELINE ENVIRONMENT

This document is kept as concise as possible. For an overview of the baseline environment of this project please refer to Chapter 8 of the EIA.

5 COMPOSITE MAP

The figures below illustrate the preferred layout for the Valley Silts Expansion project.

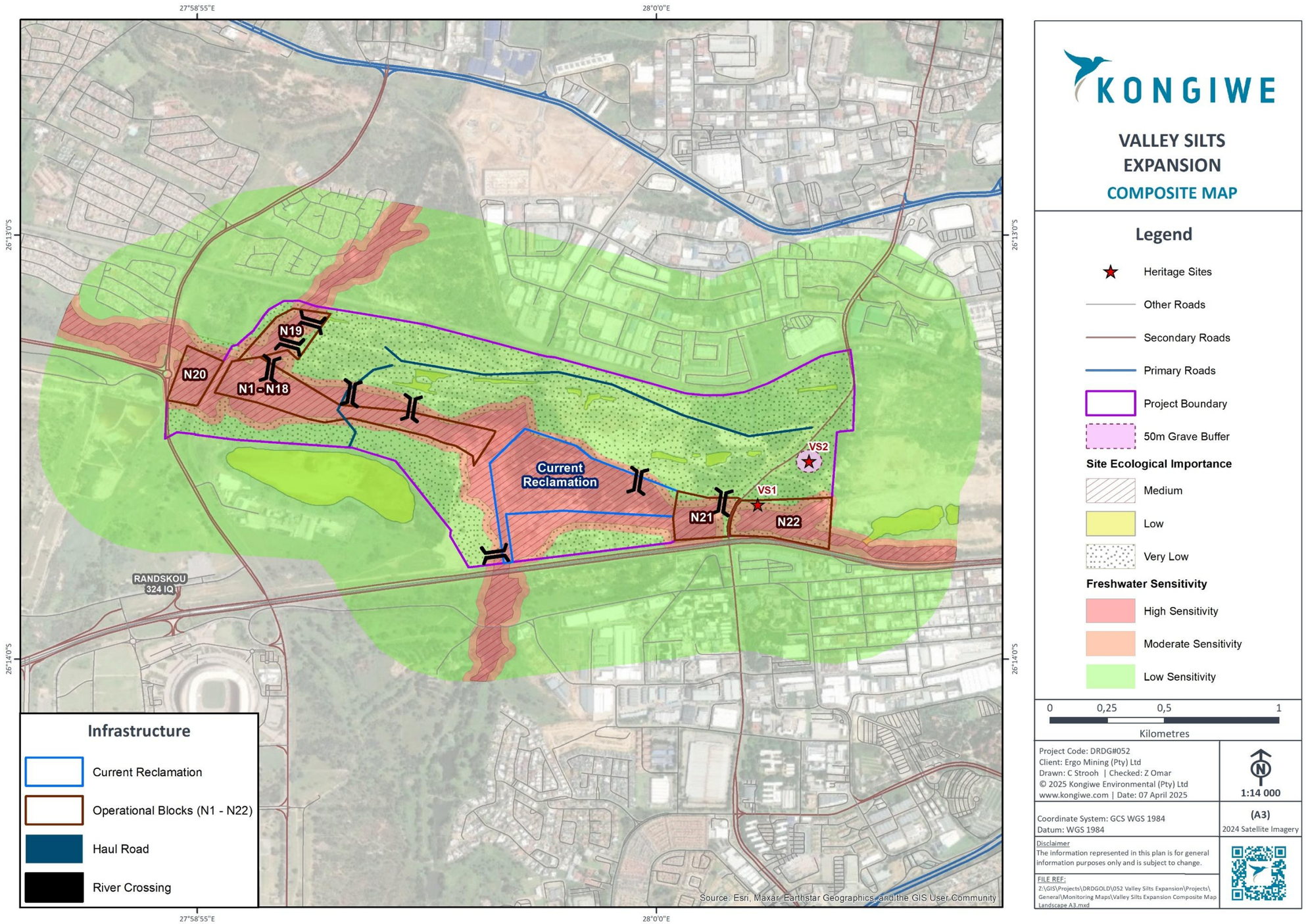


Figure 5-1: Valley Silts Expansion Infrastructure Map.

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6 IMPACT MANAGEMENT OBJECTIVES

The EMPr is compiled with the aim of achieving a required end state that, as far as possible, ensures that environmental quality is maintained. The impact management objectives and outcomes for Valley Silts Expansion project are as follows:

- To minimise the negative environmental impacts as far as feasible;
- To maximise the positive and minimise the negative socio-economic impacts;
- To capture, contain and recycle all contaminated water arising from the reclamation operations on site and to prevent the discharge of contaminated water to the environment; and
- To maintain cordial relationships with local residents, authorities and other stakeholders via sustained open communication.

The EMPr describes how activities that have, or could have, an adverse impact on the environment will be mitigated, controlled and monitored. The EMPr will address the environmental impacts during the construction, operational, decommissioning (where applicable post-closure) phases of the Project. Due regard must be given to environmental protection during the entire the Valley Silts Expansion project, and several environmental recommendations are made in this regard. These recommendations are aimed at ensuring that the contractor maintains adequate control over the Project to:

- Minimise the extent of an impact during the life of the Valley Silts Expansion project;
- Maintain a state of Environmental Quality following completion of the Valley Silts Expansion project;
- Ensure appropriate restoration of areas affected by the Valley Silts Expansion project ; and
- Prevent long term environmental degradation.

The management and mitigation measures identified within the EIA process are systematically addressed in this EMPr and ensure the minimisation of adverse environmental impacts to an acceptable level.

Ergo must ensure that the implementation of the project complies with the requirements of all environmental authorisations, permits and obligations emanating from relevant environmental legislation.

Should there be a conflict of interpretation between this EMPr and the Environmental Authorisation (EA) (once issued), the stipulations in the EA shall supersede those of this EMPr, unless otherwise agreed by the Competent Authority (CA) in writing. Similarly, any provisions in the legislation overrule any provisions or interpretations within this EMPr. This EMPr shall be binding on all parties involved in the operational phase and shall be enforceable at all levels of operational management.

This document must be adhered to and updated as relevant throughout the project life cycle.

6.1 Aspects for Inclusions as Considerations of the Environmental Authorisation

Should the Department of Mineral Resources and Energy (DMRE) grant the EA for this project, it should be subject to the following conditions:

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- The Proposed Project may not commence prior to the EA being issued;
- The Proposed Project should remain in full compliance with the requirements of the EMPr and with all regulatory requirements;
- The EMPr should be implemented by qualified environmental personnel who have the competence and credibility to interpret the requirements of the EMPr. Such persons must be issued with a written mandate by Ergo management to provide guidance and instructions to employees and contractors;
- Ergo must undertake external auditing of the environmental performance as per the conditions of the Environmental Authorisation and provide the DMRE with a copy of the auditing report;
- The Applicant must report to the Department, with reason, if requirements of the EA have not been met.
- Stakeholder engagement must be maintained during the construction, operational and decommissioning/rehabilitation phases of the Proposed Project, with the emphasis on the continuing provision of information;
- A community forum should be implemented by Ergo, with the aim of engaging Stakeholders and the public;
- All laydown, storage areas etc should be restricted to transformed areas close to the preferred option and existing roads should be used as far as possible;
- Implement the stormwater management plan;
- Keep stormwater away from the working areas;
- Prevent rainwater and the process water that has fallen on site from leaving the site in an uncontrolled and unregulated fashion;
- Stormwater drainage shall be such that no surface water ponds other than in natural watercourses save for that associated with the attenuation of stormwater for a period not exceeding 6 hours;
- Prevent rainwater and the process water that has fallen on site from leaving the site in an uncontrolled and unregulated fashion;
- Prevent dust pollution during dry, windy conditions.
- All necessary authorisation must be in place prior to commencement of the Proposed Project activities.
- Ergo must adhere to the Closure and Rehabilitation Plan contained in the EMPr and attached as an appendix to this report.
- The Applicant must maintain all financial responsibility throughout all phases of the project lifespan, including monitoring.
- Should the economic gold price diminish and not be seen as favourable to continue reclamation activities, Ergo must continue to implement monitoring and rehabilitation requirements as set out in this EMP.
- The Applicant must ensure that there are sufficient funds set aside to complete the project fully.
- Management and Monitoring plans contained in the EMPr must be strictly adhered to.
- A Chance Find procedure for heritage resources and artefacts needs to be in place.

6.2 Determination of Rehabilitation Objectives

Rehabilitation has been dealt with throughout this EIA. Mitigation / Management and Monitoring measures are proposed in the EMPr. Please refer to Section 3.7 of the EIA for more detail on the proposed rehabilitation plans. Please also refer to the Closure and Rehabilitation Report provided in Appendix D.

The objective of the site rehabilitation (in accordance with the NEMA 2014 EIA Regulations, as amended) must be measurable, practical and is feasible to implement through:

Providing the vision, objectives, targets and criteria for final rehabilitation of the project:

- Outlining the principles for rehabilitation;
- Explaining the risk assessment approach and outcomes and link decommissioning activities to risk rehabilitation;
- Detailing the decommissioning and rehabilitation actions that clearly indicate the measures that will be taken to mitigate and/ or manage identified risks and describes the nature of residual risks that will need to be monitored and managed post closure;
- Identifying knowledge gaps and how these will be addressed and filled;
- Detailing the full closure costs for the life of project at increasing levels of accuracy as the project develops and approaches closure in line with the final land use proposed; and
- Outlining monitoring, auditing and reporting requirements.

This section **must** be read in conjunction with the EIA as well as follow the recommendations proposed by independent specialists.

6.2.1 Rehabilitation Principles

Final rehabilitation will be carried out once the Valley Silts Expansion project goes into its decommissioning phase. The principles for proper rehabilitation, which should be followed, are:

- Preparing a comprehensive closure and rehabilitation plan prior to the commencement of any activities on site;
- Stormwater management must be in place at the site prior to commencing with any activities;
- Landform design (shaping);
- Grassing;
- Maintenance management and eradication of invader species;
- A plan which negates how waste will be managed on site; and
- An Emergency Preparedness/Response plan .

The objective of the site rehabilitation (in accordance with the NEMA EIA Regulations of 2014, as amended) must be measurable, practical and be feasible to implement through:

- Providing the vision, objectives, targets and criteria for final rehabilitation of the project;
- Outlining the principles for rehabilitation;

- Explaining the risk assessment approach and outcomes and link decommissioning activities to risk rehabilitation;
- Detailing the decommissioning and rehabilitation actions that clearly indicate the measures that will be taken to mitigate and/ or manage identified risks and describes the nature of residual risks that will need to be monitored and managed post decommissioning;
- Identifying knowledge gaps and how these will be addressed and filled;
- Outlining monitoring, auditing and reporting requirements.

Mitigation / Management and Monitoring measures are proposed in the EMPr in Section 8.

6.2.2 Decommissioning and Post-Decommissioning Phase Activities

6.2.2.1 Decommissioning Phase Activities

Once the silts have been removed from the targeted areas, decommissioning will commence with the removal of all associated vehicles and infrastructure from the site as well as the removal of berms, paddocks, diversion trenches, infrastructure, and anything else installed during construction and operations.

Care will be taken to ensure that the material and excavated soil required for backfilling are free of contamination from hydrocarbons.

Post-decommissioning activities will entail the assessment of rehabilitation and will address any further rehabilitation requirements. Monitoring must occur for at least five years after decommissioning and rehabilitation, or until satisfactory results are achieved.

The rehabilitation plan is comprised of the following basic stages:

1. Removal of existing infrastructure;
2. Re-shaping of the landforms;
3. Re-vegetation of the landscape; and
4. Monitoring and maintenance.

This is described in more detail in Section 3.7 of the EIA.

6.2.2.2 Maintenance and Aftercare

Maintenance will specifically need to focus on the rehabilitated areas in accordance with the approved EMPr. Continuous erosion monitoring of rehabilitated areas and slopes should be undertaken and zones with excessive erosion should be identified. The cause of the erosion should be identified, and rectified. Zones with erosion will need to be repaired with topsoil.

Furthermore, groundwater and surface water monitoring will have to take place in accordance with the requirement of the specialist studies and the EMPr. The monitoring process will be used to assess whether the rehabilitation process has been successful or not and to indicate that no further deterioration on surface and/or groundwater quality is foreseen.

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6.2.3 Health and Safety

Regarding the safety of both the public and the employees, Ergo has completed a workers' safety assessment as well as a public safety assessment.

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7 ROLES AND RESPONSIBILITIES

To ensure the success of the EMPr, it is important to assign definite roles and responsibilities. Compulsory adherence to the EMPr is required. The obligations of the EMPr create a legally binding document in terms of environmental legislation and civil law. It is important that Ergo, its contractors and sub-contractors ensure that all relevant aspects of the EMPr are communicated to all of their employees. It is the duty of Ergo, its contractors, sub-contractors and their employees to fulfil the project objectives with specific reference to the prevention and mitigation of impacts caused by the project development activities. It is the responsibility of the DMR to ensure that the development takes place in accordance with relevant legislation.

7.1 Government Departments

As the responsibility for the protection of our natural heritage lies with the government departments, they have the power to conduct site inspections to ensure that the development complies with all legislation, regulations and standards. They may enforce penalties where non-compliance occurs.

7.2 Project Developers

The Project Developer is accountable for ensuring compliance with the EMPr and any conditions of approval from the competent authority (CA). Where required, an environmental officer (EO) must be contracted by the Project Developer to objectively monitor the implementation of the EMPr according to relevant environmental legislation, and the conditions of the environmental authorisation (EA). The Project Developer is further responsible for providing and giving mandate to enable the EO to perform responsibilities, and he must ensure that the EO is integrated as part of the project team while remaining independent. The Project Developer must:

- Be fully conversant with the conditions of the EA;
- Ensure that all stipulations within the EMPr are communicated and adhered to by its Contractor(s);
- Issuing of site instructions to the Contractor; and
- Ensure that periodic environmental performance audits are undertaken on the project implementation.

7.3 Site Manager

The Site Manager will oversee all the activities. He will be responsible for the activities on site and see to the implementation of the EMPr and will establish a communication network between the different components conducting the work. All incidents and reports will be made to the Site Manager. Ultimate responsibility in terms of compliance to the EMPr lies with the Site Manager.

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7.4 Contractors

Where contractors are used during the life of the project, the on-site responsibility for environmental and social matters lies with the Contractor Engineer. He will be responsible for the day-to-day direction and management of the contractor's activities on the site throughout the life of the project.

7.5 Environmental Officer

An Environmental Officer (EO) is appointed. It will be the responsibility of the EO to:

- Oversee that the day-to-day activities that will take place on site comply with the EMPr and the relevant legislation;
- Monitor the activities through monthly site inspections to ensure compliance to the EMPr;
- Assess the EMPr as to its effectiveness in mitigating and preventing impacts;
- Assess compliance to the EA;
- Identify any non-compliances and to advise to the immediate action and remediation;
- Ensure that the best environmental options are followed throughout;
- Prepare a detailed communication strategy for liaison with I&APs, stakeholders and contractors;
- Manage and document forward and backward information flows between the Site Manager, the Contractors, the I&APs and Ergo. This includes information pertaining to monitoring and evaluation;
- Assist Ergo upon request, with project communication with I&APs;
- Ensure meaningful participation with the I&APs, including capacity building exercises where the need is identified;
- Give induction and environmental awareness training;
- Ensure that a record keeping system is maintained; and
- Promote co-regulation, shared responsibility and a sense of ownership amongst all parties involved.

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8 IMPACT MITIGATION PER PHASE

The management measures have been organised in the following project phases:

- Pre-Construction Phase;
- Construction Phase;
- Operational Phase;
- Decommissioning Phase; and
- Post-Decommissioning Rehabilitation Phase.

The tables in this section provide the management measures (actions) recommended to manage the potential impacts rated during the different phases. In addition to the management measures provided the tables indicate the person responsible to ensure that these commitments are adhered to and implemented as well as specifying the priority of these commitments (either prior to a phase, during a phase and/ or ongoing), and the outcomes.

The construction, operation, decommissioning and where applicable post-decommissioning impacts associated with the Valley Silts Expansion project are discussed for the following environmental aspects:

- Biodiversity;
- Wetlands;
- Surface water;
- Groundwater;
- Air quality;
- Heritage
- Traffic
- Socio-Economic

The objectives and EMPr tables are required to be reviewed and possibly modified whenever changes, such as the following, occur:

- Planned activities change (i.e., in terms of the components and/or layout of the facility);
- Modification to or addition to environmental objectives and targets;
- Additional or unforeseen environmental impacts are identified, and additional measures are required to be included in the EMPr to prevent deterioration or further deterioration of the environment;
- Relevant legal or other requirements are changed or introduced; and
- Significant progress has been made on achieving an objective or target such that it should be modified.

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8.1 Pre-Construction Phase Mitigation Measures

It is important to take note of that Proposed Project is the expansion of the Valley Sils project. The removal of silts within the already authorised Valley Silts Project area has been ongoing since May 2023. The construction and site establishment began in October 2022 and as such, the requirement to prepare for the Valley Eastern Expansion, Southern Expansion, and Valley Expansion Northwest is now necessary. As much as possible, the existing infrastructure will be utilised for the Proposed Project and the following infrastructures are not existing and will be required on site: drying stockpiles area; stormwater control berms/paddocks; river crossings; and additional site access roads. Ergo will commence with the pre-construction and construction phase for its project related infrastructure in line with its approved environmental authorisations. During the construction phase the following activities will take place on site:

Table 8-1: Summary table of the Activities associated with the pre-construction phase of the project

Activity	Description
Pre-Construction:	
1	Permitting and approvals
2	Initiation of a community forum for engagement throughout the project life cycle
3	Start implementing monitoring plans, Authorisation, Licensing and EMPr condition.
4	Employment of workers should this be required

The pre-construction activities for the Valley Silts Expansion Project are crucial for ensuring that all elements are in place for a successful and responsible execution of the project. The pre-construction involves obtaining the necessary Environmental Authorisation and other relevant permits and licenses as well as implementation of the monitoring plans, initiation of a community forum for engagement throughout the Valley Silts Expansion project life cycle and design mitigation. Additionally, the Proposed Project will involve the employment of workers, although this will be kept to a minimal level to align with operational needs.

Table 8-2: Pre-Construction Phase Mitigation Measures

Reference No.	Aspect	Activities	Impact	Size and Scale of Disturbance Post-Mitigation	Mitigation Measures	Compliance with standards	Time period for Implementation & Responsible Person	Outcomes
	Pre-Construction: Site Preparation and Design							
1	All	Permitting	Commencement of activities without relevant authorisations.	Site	❖ Ensure all necessary permits have been obtained prior to commencement of activities.	❖ National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) ❖ National Water Act, 1998 (Act No. 36 of 1998) (NWA) ❖ Heritage Resources Act, 1999 (Act No.25 of 1999) (HRA) ❖ City of Johannesburg Municipality By-Laws	When: ❖ Prior to commencement of Activities Responsibility: ❖ Licence holder	Prevention of undertaking of unauthorised activities.
2	Flora	Project Design	Project Design and infrastructure placement could result in destruction of sensitive habitats and vegetation	Site	❖ A site walkthrough must be conducted prior to the construction phase. Priority must be the identification of any listed flora and fauna species. ❖ Any individual protected plant that may be observed needs a relocation or destruction permit for any	❖ NEMA; ❖ NWA; ❖ Regulations on Use of Water for Mining and Related Activities aimed at the Protection of Water Resources (GN R704 of 12 February 2010);	When: ❖ Prior to commencement of Activities Responsibility:	Impact concentrated to proposed project area

Reference No.	Aspect	Activities	Impact	Size and Scale of Disturbance Post-Mitigation	Mitigation Measures	Compliance with standards	Time period for Implementation & Responsible Person	Outcomes
					individual that may be removed or destroyed as a result of the activities. Preferably, the plants should be relocated to an area that will not be impacted on by future activities. ❖ Development activities must as far as possible take place only within the 'Very Low' sensitivity areas. This includes laydown, material storage, earth deposition and storage etc. that will result from the construction activities. ❖ Areas of dense and healthy indigenous vegetation, even secondary communities outside of the direct project footprint, should not be fragmented or disturbed further. This is particularly relevant to the wetland habitats. ❖ Areas to be developed/disturbed must be specifically demarcated so that during the construction/activity phase, only the demarcated areas are to be impacted upon. ❖ No plant species, whether indigenous or exotic, may be brought into/taken from the Project Area (apart from plants used for rehabilitation purposes as part of the rehabilitation plan), to prevent the spread of exotic or invasive species or the illegal collection of plants. ❖ Leaking equipment and vehicles must be repaired immediately or be removed from Project Area to facilitate repair. ❖ A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas.	❖ Gauteng C-Plan.	❖ Licence holder	
3	Fauna	Pre-construction and site clearance	Impact to local fauna due to pre-construction activities	Site	❖ No trapping, killing, or poisoning of any wildlife is to be allowed. Signs must be put up to enforce this. These	❖ The National Environmental Management: Protected	When:	Impact concentrated to proposed project area

Reference No.	Aspect	Activities	Impact	Size and Scale of Disturbance Post-Mitigation	Mitigation Measures	Compliance with standards	Time period for Implementation & Responsible Person	Outcomes
					actions are illegal in terms of provincial environmental legislation. ❖ A qualified environmental officer must be on site when clearing begins. The area must be walked though prior to construction to ensure that no faunal species remain in the habitat and get killed. Should animals not move out of the area on their own, relevant specialists must be contacted to advise on how the species can be relocated. ❖ Should any Species of conservation concern (SCC) fauna be observed nesting within the proposed footprint area before or during construction, all activities must cease immediately. A relevant faunal specialist must be consulted to facilitate the capture or removal of any SCC animals. ❖ Ergo must include the importance and sensitivity of surrounding areas and their functions, especially those that pertains to the partially functional wetland areas, into their induction and safety toolbox talks.	Areas Act (Act No. 57 of 2003 (NEM:PAA)); ❖ NEMA; ❖ NEM:WA ❖ National Biodiversity Assessment (NBA) ❖ Gauteng C-Plan National Spatial Biodiversity Assessment (NSBA) National Freshwater Ecosystem Priority Areas (NFEPA's); ❖ The Environment Conservation Act (Act No. 73 of 1989) (ECA); ❖ Alien and Invasive Species Regulations, 2014 ; ❖ Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA); ❖ Mining and Biodiversity Guidelines. ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014;	❖ Prior to commencement of Activities Responsibility: ❖ Licence holder	
4	Alien Species	Pre-construction and site clearance	Pre-construction activities leading to the spread of Alien Species	Site	❖ The implementation of an AIP management plan is crucial, especially considering the widespread invasive species identified on site which, if left unchecked, will continue to grow and spread prolifically leading to further and more significant deterioration of the health of the natural environment nearby to the Project Area. The plan must especially pertain to any recently cleared and changed areas. ❖ It is recommended that all waste be removed from site on a weekly basis to prevent rodents and pests from entering the site and proliferating.	❖ NEM:PAA; ❖ NEMA; ❖ NEM:WA ❖ National Biodiversity Assessment (NBA) ❖ Gauteng C-Plan National Spatial Biodiversity Assessment (NSBA) National Freshwater Ecosystem Priority Areas (NFEPA's); ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014 ; ❖ CARA; ❖ Mining and Biodiversity Guidelines. ❖ ECA;	When: ❖ Prior to commencement of Activities Responsibility: ❖ Licence holder	Impact concentrated to proposed project area

Reference No.	Aspect	Activities	Impact	Size and Scale of Disturbance Post-Mitigation	Mitigation Measures	Compliance with standards	Time period for Implementation & Responsible Person	Outcomes
						❖ Alien and Invasive Species Regulations, 2014;		
5	Waste management	Pre-construction and site clearance	Mismanagement of waste generation on site leading to an impact to the environment.	Site	❖ Waste management must be a priority and all waste must be collected and stored adequately. ❖ Do not litter or dump any material outside of specially demarcated and managed zones. Protocols to be established to explain and enforce this. ❖ The Contractor must supply sealable and properly marked domestic waste collection bins and all solid waste collected must be disposed of at a licensed disposal facility. ❖ Under no circumstances may domestic waste be burned on site. Waste must never be stored in an open pit where it is susceptible to the elements such as wind and rain.	❖ NEMA, ❖ NEM:WA	When: ❖ At the start of the project. ❖ Daily Responsibility: ❖ Contractor. ❖ EO. ❖ Health and Safety Officer	Prevention of uncontrolled and unmanaged waste generation and disposal
6	Contractors	Contractor management	Lack of knowledge of EMPr and procedure could result in environmental degradation.	Site	❖ Contractors must be trained and given a copy of the EMPr and of the detailed site layout plans to ensure compliance with the requirements. ❖ Contractors must have a plan in place to implement the management measures set out in the EMPr. ❖ The EO is to supervise the contractors to ensure that management measures are being adhered to. ❖ All personnel are to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on all sensitive environmental receptors near to the Project Area to inform contractors and site staff of the presence of sensitive habitat features, such as wetland areas, and management requirements in line with the Environmental Authorisation and within the EMPr.	None	When: ❖ At the start of the project. ❖ Annually for the LoO. ❖ During induction (at the start of the project and annually). Responsibility: ❖ Contractor. ❖ EO	Raising staff and contractor environmental awareness.

Reference No.	Aspect	Activities	Impact	Size and Scale of Disturbance Post-Mitigation	Mitigation Measures	Compliance with standards	Time period for Implementation & Responsible Person	Outcomes
					❖ Contractors and employees must all undergo an environmental induction and be made aware of the sensitive habitats nearby to the Project Area			
7	Surface Water	Removal of vegetation and alteration to the topography.	Erosion and wash off of exposed soils leading to siltation in down gradient watercourses.	Site	❖ Clearance of vegetation must be limited as far as possible; ❖ The SWMP must be implemented as a first step during the construction phase; and ❖ Water quality monitoring must be implemented upstream and downstream of construction sites.	❖ Guideline Document for the Implementation of Regulations; ❖ GN R704.	When: ❖ Prior to commencement of Activities. Responsibility: ❖ Licence holder.	Reducing negative impacts on surface water resources i
8	Surface Water Groundwater	Site planning	Improper planning may lead to surface water and groundwater pollution during construction and operational phases.	Site	❖ Compilation of a Stormwater Management Plan aimed at reducing and/or eliminating adverse impacts on the receptors identified. These include existing private groundwater users, wetlands, rivers and streams. The Water Management Plan is to include the compilation of a Water Quality Monitoring Programme. ❖ An Emergency Response Plan to contain spills is required to be in place prior to construction and operation. ❖ Implement a groundwater and surface water monitoring programme before reclamation and construction starts.	❖ Guideline Document for the Implementation of Regulations; ❖ GN R704.	When: ❖ Prior to commencement of Activities. Responsibility: ❖ Licence holder.	Reducing negative impacts on surface water resources in the event of spills.
9	Air Quality	Baseline dust fallout monitoring	Air pollution and dustfall	Site	❖ Initiate dust fallout monitoring prior to commencement of activities to establish baseline against which to monitor.	❖ National Standards for Ambient Air Quality for PM_{10} and for $PM_{2.5}$; ❖ National Dust Control Regulations.	When ❖ Prior to commencement of Activities. Responsibility: ❖ Licence holder.	Establishing baseline air quality to measure baseline project life-span air quality.
10	Heritage	Site clearance	Destruction of heritage sites	Site	❖ Implement a chance to find procedures in case where possible heritage finds are uncovered.	❖ Recommendations from South African Heritage Resources Agency (SAHRA)	When:	Minimise risk of damaging heritage resources.

Reference No.	Aspect	Activities	Impact	Size and Scale of Disturbance Post-Mitigation	Mitigation Measures	Compliance with standards	Time period for Implementation & Responsible Person	Outcomes
			Impact on potential palaeontological resources Potential discovery of heritage resources		❖ A detailed "walk down" of the final approved alignment will be required before construction commences. ❖ Any significant features of significance identified during this walkdown will require formal mitigation (i.e., permitting where required) or where possible a slight change in design could accommodate such resources. ❖ If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Procedure must be implemented immediately and the Environmental Officer (EO) in charge of these developments must report to SAHRA. ❖ Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA.	under Section 36 and 38 of NHRA.	❖ Prior to commencement of Activities. Responsibility: ❖ Applicant. ❖ Heritage specialist. ❖ EO	
11	Social Noise	Recruitment Prior to activities	Community complaints Community engagement Noise impacts	Local Site	❖ Compilation of a Stakeholder Engagement Plan to be implemented for the life of the project. ❖ Instatement of a community liaison forum for community members to allow community member to participate in the project through engagement. ❖ All employees and contractors should receive induction that includes an environmental awareness component (noise). This is to allow employees and contractors to realize the potential noise risks that activities (especially night-time activities) pose to the surrounding environment. ❖ Ensure a good working relationship between Ergo and all potentially noise-sensitive receptors. Communication channels should be established to ensure prior notice to	❖ Stakeholder engagement plan; ❖ Emergency Preparedness and Response Plan.	When: ❖ Prior to commencement of activities. Responsibility: ❖ Applicant. ❖ EO. ❖ HR.	Minimise negative impacts on local communities.

Reference No.	Aspect	Activities	Impact	Size and Scale of Disturbance Post-Mitigation	Mitigation Measures	Compliance with standards	Time period for Implementation & Responsible Person	Outcomes
					the sensitive receptor if work is to take place close to them (especially if work is to take place within 200 m from them at night). ❖ Compilation of an Emergency Preparedness and Response Plan to be implemented for the life of the project. ❖ Compilation of Employee Awareness Plans.			

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8.2 Construction Phase Mitigation Measures

Ergo will commence with the construction phase for its project related infrastructure in line with its approved environmental authorisations. During the construction phase the following activities will take place on site:

Table 8-3: Summary table of the Activities associated with the construction phase of the project

Activity	Description
Construction Phase	
5	Removal of vegetation and site clearance
6	Preparation of access roads should this be required
7	Expansion of the stormwater management infrastructure
8	Instatement of waste management and dust control measures on site
9	Instatement of traffic signage, access
10	Operation of construction machinery and vehicles

Table 8-4: Construction Phase Mitigation Measures

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
Biodiversity and Wetlands								
1	Vegetation and Habitats	Construction activities	Impact to the local flora and habitats due to the construction of the proposed activity.	❖ Laydown and construction preparation activities (such as cement mixing, temporary toilets, etc.) must be limited to already modified areas and should take up the smallest footprint possible. ❖ Areas classified as medium sensitivity (water resource habitat) must have mitigations applied as stipulated in the accompanying freshwater/wetland assessment. ❖ Develop post-reclamation environments, in conjunction with regional development plans; and the recreation of habitats, where possible; or structure altered landscapes to be compatible with regional habitats. ❖ It is recommended that areas to be developed/disturbed be specifically demarcated so that during the construction/activity phase, only the demarcated areas be impacted upon. ❖ Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should not be	Local.	❖ NEM:PAA; ❖ NEMA; ❖ NEM:WA ❖ NBA ❖ Gauteng C-Plan National Spatial Biodiversity Assessment (NSBA) National Freshwater Ecosystem Priority Areas (NFEPA's); ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014 ; ❖ CARA; ❖ Mining and Biodiversity Guidelines. ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014;	When: ❖ Duration of the project. Responsibility: ❖ Contractor, EO. ❖ Health and Safety Officer	Minimise negative impacts on Flora.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				fragmented or disturbed further if possible. ❖ All vehicles and personnel must make use of existing roads and walking paths as far as possible, especially construction/operational vehicles. ❖ The clearing of vegetation must be minimised where possible. All activities must be restricted to within the authorised areas. ❖ Materials may not be stored for extended periods of time and must be removed from the Project Area of Interest (PAOI) once the construction phase has been concluded. No permanent construction phase structures should be permitted. Construction buildings should preferably be prefabricated or constructed of re-usable/recyclable materials. No storage of vehicles or equipment will be allowed outside of the designated laydown areas. ❖ Areas that are denuded during construction need to be re-vegetated with indigenous vegetation according to a habitat rehabilitation plan, to prevent erosion during flood and wind events and to promote the regeneration of functional habitat. This will also reduce the likelihood of encroachment by alien invasive plant species. ❖ A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. ○ Drip trays or any form of oil absorbent material must be placed				

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				underneath vehicles/machinery and equipment when not in use. ○ No servicing of equipment on site unless necessary. ○ All contaminated soil stone shall be treated in situ or removed and be placed in containers. ○ Appropriately contain any generator diesel storage tanks, machinery spills (e.g., accidental spills of hydrocarbons, oils, diesel etc.) in such a way as to prevent them from leaking and entering the environment. ○ Construction activities and vehicles could cause spillages of lubricants, fuels and waste material negatively affecting the functioning of the ecosystem. ○ All vehicles and equipment must be maintained, and all re-fueling and servicing of equipment is to take place in demarcated areas outside of the PAOI. ❖ It must be made an offence for any staff member to remove any indigenous plant species from the PAOI or bring any alien species in. This is to prevent the spread of exotic or alien species or the illegal collection of plants. ❖ All construction waste must be removed from site at the closure of the construction phase. ❖ Storm Water run-off & Discharge Water Quality monitoring ○ Avoid unnecessary vegetation clearing and avoid preferential surface flow paths; ○ Cut-off trenches must be incorporated into the design to decrease contamination of watercourses via heavy metals.				

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				○ Contain wastewater in a sump . Contaminated water must not be discharged into the watercourses; ○ Clean and dirty water must be separated. ○ Keep the surface & sub-surface water and stormwater that may run off from the reclamation areas away from the low lying areas. Prevention from leaving the PAOI in an uncontrolled manner; ○ Implement Storm Water Run-Off & Discharge Water Quality monitoring; ○ Storage of potential contaminants in bunded area.				
2	Fauna	Construction activities	Impact to local fauna due to the proposed construction activities.	❖ A qualified environmental officer must be on site when activities begin. Should animals not move out of the area on their own, relevant specialists must be contacted to advise on how the species can be relocated. ❖ Clearing and disturbance activities must be conducted in a progressive linear manner always outwards and away from the centre of the PAOI and over several days, so as to provide an easy escape route for all small mammals and herpetofauna. ❖ The areas to be disturbed must be specifically and responsibly demarcated to prevent the movement of staff or any individual into the surrounding environments, signs must be put up to enforce this. ❖ The duration of the activities should be minimised to as short a term as possible, to reduce the period of disturbance on fauna. ❖ Noise must be kept to an absolute minimum during the evenings and at night to minimise all possible	Local.		When: ❖ Duration of the project. Responsibility: ❖ Contractor. ❖ EO. ❖ Health and Safety officer	Minimise negative impacts on fauna.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				disturbances to reptile species and nocturnal mammals. ❖ No trapping, killing, or poisoning of any wildlife is to be allowed and signs must be put up to enforce this. Monitoring must take place in this regard. ❖ Outside lighting should be designed and limited to minimise impacts on fauna. All outside lighting should be directed away from any sensitive areas. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (green/red) lights should be used wherever possible. ❖ All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife. Speed limits must be enforced to ensure that road killings and erosion is limited. ❖ Any holes/deep excavations must be dug in a progressive manner and shouldn't be left open overnight. Should any holes remain open overnight they must be properly covered temporarily to ensure that no small fauna species fall in. Holes must be subsequently inspected for fauna prior to backfilling. ❖ If fencing is required: wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed, the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area.				
3	Alien Species	Construction activities	Spread of Alien Species due to the construction activities	❖ An Alien Invasive Plant (AIP) Management Plan must be compiled and implemented. This should	Local.		When:	Minimise negative impacts on Biodiversity

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				regularly be updated to reflect the annual changed in AIP composition. ❖ The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas. Footprints of the roads must be kept to prescribed widths.			❖ Duration of the project. Responsibility: ❖ Contractor. ❖ EO. ❖ Health and Safety Officer	
4	Dust	Construction Activities	Generation of dust due to the construction activities	❖ Dust-reducing mitigation measures must be put in place and must be strictly adhered to. This includes the wetting of exposed soft soil surfaces. No non-environmentally friendly suppressants may be used as this could result in the pollution of water sources.	Local.		When: ❖ Duration of the project. Responsibility: ❖ Contractor. ❖ EO.	Minimise negative impacts on Biodiversity
5	Waste	Construction Activities	Negative impact of generated waste on the local environment	❖ Waste management must be a priority and all waste must be collected and stored effectively and responsibly according to a site-specific waste management plan. Dangerous waste such as metal wires and glass must only be stored in fully sealed and secure containers, before being moved off site as soon as possible. ❖ Litter, spills, fuels, chemical and human waste in and around the PAOI must be minimised and controlled according to the waste management plan. ❖ Cement mixing may not be performed on the ground. It is recommended that only closed side drum or pan type concrete mixers be utilised. Any spills must be immediately contained and isolated from the natural environment, before being removed from site. ❖ Toilets at the recommended Health and Safety standards must be provided. These should be emptied regularly and once no longer required,	Local.		When: ❖ Duration of the project. Responsibility: ❖ Contractor, ❖ EO, ❖ HR.	Minimise negative impacts on Fauna.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				they must be pumped dry to prevent leakage into the surrounding environment and removed from site. ❖ The Contractor should supply suitable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility within every 10 days at least. ❖ Where a registered disposal facility is not available close to the PAOI, the Contractor shall provide a method statement with regards to waste management. Under no circumstances may domestic waste be burned on site or buried on open pits. ❖ Refuse bins will be responsibly emptied and secured. Temporary storage of domestic waste shall be in covered and secured waste skips. Maximum domestic waste storage period will be 10 days.				
6	Environmental Awareness Training	Construction Activities	Negative impacts to the local environment due to improper environmental awareness training	❖ All personnel and contractors are to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the PAOI to inform contractors and site staff of the presence of protected species, their identification, conservation status and importance, biology, habitat requirements and management requirements in line with the Environmental Authorisation and within the EMPr. Contractors and employees must all undergo the induction and must be made aware of any sensitive areas to be avoided (water resources).	Local		When: ❖ Duration of the project. ❖ construction Responsibility: ❖ Contractor. ❖ EO. ❖ Health and Safety Officer	Minimise negative impacts on the biodiversity

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
7	Erosion	Construction Activities	Negative impacts to the local environment due possible erosion	❖ Speed limits must be put in place to reduce erosion. Soil surfaces must be wetted as necessary to reduce the dust generated by the project activities. Speed bumps and signs must be erected to enforce slow speeds. ❖ Only existing access routes and walking paths may be made use of. ❖ Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events etc. ❖ A stormwater management plan must be compiled and implemented if necessary.	Local		❖ Duration of the project. ❖ construction Responsibility: ❖ Contractor. ❖ EO. Health and Safety Officer	Minimise the possibility of erosion occurring.
8	Wetlands	Construction Activities	Loss of wetlands and associated organic material and vegetation through site excavation Increased contamination of downstream watercourse through the upheaval and liberation of toxins accumulated / trapped in the sediments Flow impediment leading to flooding, backlogging or wetland drowning upstream of the expansion activities Flow concentration leading to increased erosion and scouring downstream of the expansion activities Sedimentation and increased turbidity in downstream watercourses	❖ Construction activities must take place during the low flow period (as much as possible). In addition to this, basic stormwater structures such as berms must be designed and implemented prior to and throughout the duration of the construction activities; ❖ A qualified Hydrologist must develop a suitable and adaptive Stormwater management plan to ensure no erosion takes place and that clean water reports back to the local watercourses; ❖ The water resources outside of the specific project site area must be avoided; ❖ Prevent uncontrolled access of vehicles through the watercourse that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas; ❖ Laydown yards, camps and storage areas must be beyond the watercourse and associated buffer areas. ❖ Have action plans on site, and training for contactors and employees in the	Local	❖ South Africa's National Biodiversity Strategy and Action Plan (NBSAP) ❖ NEM:PAA; ❖ NEMA; ❖ NEM:WA ❖ NBA ❖ Gauteng C-Plan National Spatial Biodiversity Assessment (NSBA) National Freshwater Ecosystem Priority Areas (NFEPA's); ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014 ; ❖ CARA; ❖ Mining and Biodiversity Guidelines. ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014; ❖ DWS Risk Assessment Protocol; ❖ National Wetland Classification Systems (NWCS).	When: ❖ Duration of the project. ❖ Construction. Responsibility: ❖ Applicant ❖ Contractor. ❖ EO.	Minimise the impact on the wetland system.
		Construction Activities	Altered hydrological regimes from increased bare surfaces and altered topography with		Local		When:	Minimise the impact on the wetland system.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
			subsequent increase in overland flow and flood peaks Potential loss / disturbance of wetland soil and vegetation Impaired water quality of the Russel Stream with leachate from the drying area	event of spills, leaks and other impacts to the drainage systems; ❖ The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly; ❖ All chemicals and toxicants to be used for the construction must be stored outside the watercourses and in a bunded area; ❖ Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) or construction materials on site (e.g. concrete) in such a way as to prevent them leaking and entering the environment; ❖ All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site; ❖ Mixing of concrete must under no circumstances take place within the drainage systems. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished; ❖ All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping"; ❖ Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. These should not be placed near any watercourse or in buffer zones. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired			❖ Duration of the project. ❖ Construction. Responsibility: ❖ Applicant. ❖ Contractor. ❖ EO.	
		Construction Activities	Altered hydrological regimes from hardened surfaces arising from compacted surfaces attributed to the use of machinery and equipment Increase in erosion and sedimentation of receiving systems attributed to altered hydrological regimes Impaired water quality from contamination of water resources by stochastics spills and leaks from machinery and equipment (e.g., fuel and machine oils) Loss or degradation of ecosystem services attributed to the above-mentioned impacts		Local		When: ❖ Duration of the project. ❖ Construction. Responsibility: ❖ Applicant. ❖ Contractor. ❖ EO.	Minimise the impact on the wetland system.
		Construction Activities	Altered hydrological regimes from channelling or diversion of flow during crossing preparation and installation and, from compacted surfaces attributed to the use of heavy machinery		Local		When: ❖ Duration of the project. ❖ Construction. Responsibility: ❖ Applicant.	Minimise the impact on the wetland system.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
			Increase in erosion and sedimentation of receiving systems attributed to altered hydrological regimes Establishment and proliferation of alien vegetation from disturbances related to installation of infrastructure Impaired water quality attributed to the above-mentioned impacts and from contamination by polluted runoff Loss or degradation of ecosystem services	alternative to the surrounding vegetation); ❖ The haul road and associated road margins, and silt traps must be inspected on a monthly basis for signs of erosion. When erosion is observed, the area should be rehabilitated within 7 days. In addition, inspections following a >50 mm/ 24 hr rainfall event must occur within 7 days of the event; ❖ No dumping of construction material on-site may take place; ❖ All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported; and ❖ Make sure all excess consumables and building materials / rubble are removed from site and deposited at an appropriate waste facility.			❖ Contractor. EO.	
		Construction Activities	Final landscaping and reshaping		Local		When: ❖ Duration of the project. ❖ Construction. Responsibility: ❖ Applicant. ❖ Contractor. ❖ EO.	Minimise the impact on the wetland system.
		Construction Activities	Potential contamination of wetlands from polluted runoff Wetland pollution from indiscriminate dumping of litter		Local		When: ❖ Duration of the project. ❖ Construction. Responsibility: ❖ Applicant. ❖ Contractor. EO.	Minimise the impact on the wetland system.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
		Construction Activities	Operation of stormwater management (runoff generated from hardened surfaces)		Local		When: ❖ Duration of the project. ❖ Construction. Responsibility: ❖ Applicant. ❖ Contractor. ❖ EO.	Minimise the impact on the wetland system.
Surface Water and Groundwater								
9	Surface Water	Removal of vegetation and alteration to the topography.	Erosion of silt and consequent deterioration of water quality in the Russell Stream.	❖ Clearance of vegetation must be limited as far as possible; ❖ The SWMP must be implemented as a first step during the construction phase; and ❖ Water quality sampling must continue upstream and downstream of construction areas. Should there be a deterioration in water quality from upstream to downstream, then immediate action should be undertaken to identify and address the issue.	Local	❖ DWAF Best Practice Guidelines ❖ Guideline Document for the Implementation of Regulations ❖ GN R704	When: ❖ Duration of the project – specifically construction. Responsibility: ❖ Contractor. ❖ EO.	Minimise soil erosion and reduce deterioration of water quality.

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Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
10	Groundwater	Construction Activities	Impact on the local groundwater quality	❖ Implement a groundwater monitoring program before excavation starts. Use the dedicated groundwater monitoring boreholes along the Russell Stream to measure the groundwater status, impact of the activities on the groundwater environment and changes in groundwater qualities and levels post closure. ❖ Develop sound surface runoff management plans to ensure that all dirty runoff from the stockpile areas, but also from the adjacent slimes dams and sand dumps are contained and diverted to the cut-off trenches and sumps. No pooling of water on surface allowed. ❖ Ensure that cut-off trenches and sumps are designed to contain all dirty water generated during the process, to prevent overflows and spillages	Local.	❖ DWAF Best Practice Guidelines ❖ Guideline Document for the Implementation of Regulations ❖ GN R704	When: ❖ Duration of the project – specifically construction phase. Responsibility: ❖ Contractor. ❖ EO.	Minimise soil erosion and reduce deterioration of water quality.
Air Quality								
11	Air Quality	PM2.5 and PM10 Vegetation clearance. Hauling of silts, turning of silts in the drying process and loading of dried silts onto haul trucks	Vegetation clearance. Hauling of silts, turning of silts in the drying process and loading of dried silts onto haul trucks causes the emission of particulate matter into the air, thus increasing existing ambient air concentrations of criteria pollutants (both PM_{10} and $PM_{2.5}$) at receptors.	❖ Limit vegetation clearance within the development footprint ❖ Haul roads in drying area 1 should be kept as far from the northern boundary as possible to reduce the impact on the Riverlea residential area. Ideally this drying area should be relocated further eastwards. Also, in drying area 3 haul roads should be kept as far from the southern boundary as possible to reduce the impact on the Theta industrial area to the south. Wet suppression / chemical stabilization of unpaved haul roads are possible additional mitigation measures. The drop height for loading of dried silt onto haul trucks should be kept to a minimum.	Local	❖ National Standards for Ambient Air Quality for PM10 and for PM2.5; ❖ National Dust Control Regulations.	When ❖ Duration of the construction phase of the project. Responsibility: ❖ Contractor. ❖ EO.	Minimise generation of PM.
Heritage								

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
12	Heritage	Main Activities	Destruction of stone structure Destruction of graves Destruction of graves	❖ Implement a chance to find procedures in case where possible heritage finds are uncovered. ❖ Demarcate heritage resource on site as no-go ❖ A detailed "walk down" of the final approved alignment will be required before construction commences. ❖ Any significant features of significance identified during this walkdown will require formal mitigation (i.e., permitting where required) or where possible a slight change in design could accommodate such resources. ❖ If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Procedure must be implemented immediately and the Environmental Officer (EO) in charge of these developments must report to SAHRA. ❖ Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA.	Local.	❖ Recommendations from SAHRA under Section 36 and 38 of NHRA.	When: ❖ Prior to commencement of Activities. ❖ Duration of the construction phase of the project. ❖ Duration of the operation phase of the project. Responsibility: ❖ Licence holder. ❖ Heritage specialist.	Minimise risk of damaging heritage resources.
Social								
13	Social	Main Activities	Employment and Income	❖ Ergo should consider a local internship/job shadowing strategy for the local communities in Ward 68. ❖ Develop a database of potential suppliers within the local area (including the wards around the project). ❖ Ergo to earmark a percentage of potential intermediary inputs that it could source from local suppliers, HDSAs and Small, Medium and Micro-sized Enterprises (SMMEs). ❖ Preference should be given to capable subcontractors who based within the local municipal area.	Local.	❖ NEMA; ❖ Occupational Health and Safety (Act No. 85 of 1993); ❖ National Spatial Development Framework; ❖ NEM:AQA; ❖ National Dust Control Regulations (Government Notice No. R827, 2013).	When: ❖ Duration of the construction phase of the project. Responsibility: ❖ Contractor. ❖ EO. ❖ Ergo	Maximise, as far as possible, positive social impacts.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				❖ Encourage the company's existing suppliers to enter into a Joint Venture (JV) with local SMMEs to aid with the transfer of skills. ❖ Develop skills development and training targets for local procurement and include these in contractor management plans. ❖ Communicate the local employment strategy clearly to the local communities adjacent to the mine				
		Main Activities	Potential contribution to social funds	❖ Ergo should consider a local internship/job shadowing strategy for the local communities in Ward 68. ❖ Develop a database of potential suppliers within the local area (including the wards around the project). ❖ Ergo to earmark a percentage of potential intermediary inputs that it could source from local suppliers, HDSAs and Small, Medium and Micro-sized Enterprises (SMMEs). ❖ Preference should be given to capable subcontractors who based within the local municipal area. ❖ Encourage the company's existing suppliers to enter into a Joint Venture (JV) with local SMMEs to aid with the transfer of skills. ❖ Develop skills development and training targets for local procurement and include these in contractor management plans. ❖ Communicate the local employment strategy clearly to the local communities adjacent to the mine.	Local.	❖ NEMA; ❖ OSHA;. ❖ National Spatial Development Framework; ❖ NEM:AQA National Dust Control Regulations (Government Notice No. R827, 2013)	When: ❖ Duration of the construction phase of the project Responsibility: ❖ Contractor ❖ EO ❖ Ergo	Maximise, as far as possible, positive social impacts
		Main Activities	Community safety	❖ Strict adherence to the mitigation measures of the air quality impact report. ❖ Strict security measures to apply at the Project.	Local.	❖ NEMA; ❖ OSHA;. ❖ National Spatial Development Framework;	When:	Minimise, as far as possible, Negative social impacts

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				❖ The company to cooperate with the local SAPS and community safety forums. ❖ Establish a communication strategy and network with the local community in Wards 68, 54 and 124 and 125. The communication strategy should include protocols to lodge complaints, complaints register, speedy resolution of complaints and meetings with community leaders on a regular (quarterly) basis. ❖ Strict adherence to the mitigation measures of the air quality impact report.		❖ NEM:AQA National Dust Control Regulations (Government Notice No. R827, 2013)	❖ Duration of the construction phase of the project Responsibility: ❖ Contractor ❖ EO ❖ Ergo	Maximise, as far as possible, positive social impacts
		Main Activities	Informal Influx	❖ Engage with local representatives to communicate the recruitment strategy of the Project and to register complaints related to increase level of influx into informal settlements. ❖ Solutions to address service delivery require interventions from the local authorities. However, the applicant can address potential issues that could lead to unrest by ensuring that an effective grievance mechanism is put in place to ensure that stakeholders are provided with a platform to raise their concerns/complaints.	Local.	❖ NEMA; ❖ OSHA;. ❖ National Spatial Development Framework; ❖ NEM:AQA National Dust Control Regulations (Government Notice No. R827, 2013)	When: ❖ Duration of the construction phase of the project Responsibility: ❖ Contractor ❖ EO ❖ Ergo	Minimise, as far as possible, Negative social impacts
		Main Activities	Increase in nuisance factors	❖ Strict adherence to the mitigation measures of the traffic and air quality impact reports. ❖ A grievance management mechanism should be in place to receive incident related queries.	Local.	❖ NEMA; ❖ OSHA;. ❖ National Spatial Development Framework; ❖ NEM:AQA National Dust Control Regulations (Government Notice No. R827, 2013)	When: ❖ Duration of the construction phase of the project Responsibility: ❖ Contractor ❖ EO ❖ Ergo	Minimise, as far as possible, Negative social impacts Maximise, as far as possible, positive social impacts
Traffic								

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Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
14	Traffic	Construction activities	Increased traffic	❖ Flagmen and/ or traffic directing personnel at Crownwood Road and Telkom Road intersection and at Crownwood Road and Valley Silts Access in the Weekday AM and Weekday PM Peak hours during operational days.	Local.	❖ National Road Traffic Act, 1996 (Act No. 93 Of 1996) (NTA), and Regulations.	When: ❖ Duration of the project. Responsibility: ❖ Site/Site manager. ❖ Contractor.	Reduce risk of additional impacts due to increased traffic
Health								
15	Health	Construction activities	Increase in dust generation could lead to community health issues	❖ Implement dust suppression on access and haul roads ❖ Dust monitoring at the nearest community to assess exceedances. Should exceedances occur determine cause and implement mitigation measures.	Local.	❖ NEMA; ❖ OSHA;. ❖ NEM:AQA National Dust Control Regulations (Government Notice No. R827, 2013)	When: ❖ Duration of the construction phase of the project Responsibility: ❖ Contractor ❖ EO ❖ Ergo	Minimise, as far as possible, Negative Health impacts Maximise, as far as possible, positive health impacts

8.3 Operational Phase Mitigation Measures

The following activities are planned by the Applicant for the operation phase of the project.

Table 8-5: Summary table of the Activities associated with the operational phase of the project

Activity	Description
Operational Phase	
9	Reclamation of Silts
10	Stockpiling silts
11	Transporting silts
12	Continued community engagement

Table 8-6: Operational Phase Mitigation Measures

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
Biodiversity and Wetlands								
1	Vegetation and Habitats	Operational activities	Operational activities leading to an impact to local Flora and habitats	❖ Areas classified as medium sensitivity (water resource habitat) must have mitigations applied as stipulated in the accompanying freshwater/wetland assessment. ❖ Develop post-reclamation environments, in conjunction with regional development plans; and the recreation of habitats, where possible; or structure altered landscapes to be compatible with regional habitats. ❖ Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should not be fragmented or disturbed further if possible. ❖ All vehicles and personnel must make use of existing roads and walking paths as far as possible, especially construction/operational vehicles. ❖ The clearing of vegetation must be minimised where possible. All activities must be restricted to within the authorised areas. ❖ Areas that are denuded during construction need to be re-vegetated with indigenous vegetation according to a habitat rehabilitation plan, to prevent erosion during flood and wind events and to promote the regeneration of functional habitat. This will also reduce the likelihood of encroachment by alien invasive plant species.	Local.	❖ NEM:PAA; ❖ NEMA; ❖ National Biodiversity Assessment (NBA) ❖ Gauteng C-Plan National Spatial Biodiversity Assessment (NSBA) National Freshwater Ecosystem Priority Areas (NFEPA's) ❖ ECA; ❖ National Standards for Ambient Air Quality for PM10 and for PM2.5; ❖ National Dust Control Regulations ❖ Alien and Invasive Species Regulations, 2014 ❖ CARA; ❖ Mining and Biodiversity Guidelines	When: ❖ Duration of the project. ❖ Operation. Responsibility: ❖ Contractor. ❖ EO.	Minimise negative impacts on Biodiversity.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				❖ A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. ○ Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use. ○ No servicing of equipment on site unless necessary. ○ All contaminated soil / yard stone shall be treated in situ or removed and be placed in containers. ○ Appropriately contain any generator diesel storage tanks, machinery spills (e.g., accidental spills of hydrocarbons, oils, diesel etc.) in such a way as to prevent them from leaking and entering the environment. ○ Construction activities and vehicles could cause spillages of lubricants, fuels and waste material negatively affecting the functioning of the ecosystem. ○ All vehicles and equipment must be maintained, and all re-fueling and servicing of equipment is to take place in demarcated areas outside of the PAOI. ❖ It must be made an offence for any staff member to remove any indigenous plant species from the PAOI or bring any alien species in. This is to prevent the spread of exotic or alien species or the illegal collection of plants. ❖ Storm Water run-off & Discharge Water Quality monitoring ○ Avoid unnecessary vegetation clearing and avoid preferential surface flow paths; ○ Cut-off trenches must be incorporated into the design to decrease contamination of watercourses via heavy metals ○ Contain wastewater in a sump . Contaminated water must not be discharged into the watercourses;				

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				○ Clean and dirty water must be separated. ○ Keep the surface & sub-surface water and stormwater that may run off from the reclamation areas away from the low lying areas, such as wetlands, as well as the surrounding areas. Prevention from leaving the PAOI in an uncontrolled manner; ○ Implement Storm Water Run-Off & Discharge Water Quality monitoring; ○ Storage of potential contaminants in bunded areas.				
2	Fauna	Operational activities	Operational activities on site leading to an impact to local fauna.	❖ A qualified environmental officer must be on site when activities begin. Should animals not move out of the area on their own, relevant specialists must be contacted to advise on how the species can be relocated. ❖ Clearing and disturbance activities must be conducted in a progressive linear manner always outwards and away from the centre of the PAOI and over several days, so as to provide an easy escape route for all small mammals and herpetofauna. ❖ The areas to be disturbed must be specifically and responsibly demarcated to prevent the movement of staff or any individual into the surrounding environments, signs must be put up to enforce this. ❖ Noise must be kept to an absolute minimum during the evenings and at night to minimise all possible disturbances to reptile species and nocturnal mammals. ❖ No trapping, killing, or poisoning of any wildlife is to be allowed and signs must be put up to enforce this. Monitoring must take place in this regard. ❖ Outside lighting should be designed and limited to minimise impacts on fauna. All outside lighting should be directed away from any sensitive areas. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (green/red) lights should be used wherever possible. ❖ All operational and maintenance motor vehicle operators should undergo an environmental	Local.		When: ❖ Duration of the project. ❖ Operation. Responsibility: ❖ Contractor. ❖ EO.	Minimise negative impacts on fauna

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife. Speed limits must be enforced to ensure that road killings and erosion is limited. ❖ Any holes/deep excavations must be dug in a progressive manner and shouldn't be left open overnight. Should any holes remain open overnight they must be properly covered temporarily to ensure that no small fauna species fall in. Holes must be subsequently inspected for fauna prior to backfilling. ❖ If fencing is required; wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed, the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area.				
3	Alien Species	Operational Activities	Operational activities leading to the spread of alien species	❖ An Alien Invasive Plant (AIP) Management Plan must be compiled and implemented. This should regularly be updated to reflect the annual changed in AIP composition. ❖ The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas. Footprints of the roads must be kept to prescribed widths.	Local.		When: ❖ Duration of the project. ❖ Operation. Responsibility: ❖ Contractor. ❖ EO.	Minimise negative impacts on Biodiversity.
4	Dust	Operational activities	Operational Activities leading to dust generation	❖ Dust-reducing mitigation measures must be put in place and be strictly adhered to. This includes the wetting of exposed soft soil surfaces as and when required. Only environmentally friendly suppressants may be used to avoid the pollution of water sources.	Local		When ❖ Duration of the project ❖ rehabilitation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Biodiversity.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
5	Waste management	Operational Activities	Operational activities leading to the generation of waste on site.	❖ Waste management must be a priority and all waste must be collected and stored effectively and responsibly according to a site-specific waste management plan. Dangerous waste such as metal wires and glass must only be stored in fully sealed and secure containers, before being moved off site as soon as possible. ❖ Litter, spills, fuels, chemical and human waste in and around the PAOI must be minimised and controlled according to the waste management plan. ❖ Cement mixing may not be performed on the ground. It is recommended that only closed side drum or pan type concrete mixers be utilised. Any spills must be immediately contained and isolated from the natural environment, before being removed from site. ❖ Toilets at the recommended Health and Safety standards must be provided. These should be emptied regularly and once no longer required, they must be pumped dry to prevent leakage into the surrounding environment and removed from site. ❖ The Contractor should supply suitable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility within every 10 days at least. ❖ Where a registered disposal facility is not available close to the PAOI, the Contractor shall provide a method statement with regards to waste management. Under no circumstances may domestic waste be burned on site or buried on open pits. ❖ Refuse bins will be responsibly emptied and secured. Temporary storage of domestic waste shall be in covered and secured waste skips. Maximum domestic waste storage period will be 10 days.	Local.		When: ❖ Duration of the project ❖ Operation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Biodiversity.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
6	Erosion	Operational Activities	Operational activities leading to erosion.	❖ Speed limits must be put in place to reduce erosion. Soil surfaces must be wetted as necessary to reduce the dust generated by the project activities. Speed bumps and signs must be erected to enforce slow speeds. ❖ Only existing access routes and walking paths may be made use of. ❖ Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events etc. ❖ A stormwater management plan must be compiled and implemented if necessary. ❖ Precautions must be taken against the erosion damage that would be caused by unplanned pipe leaks or leaching in general. This involves the installation of leak warning and detection systems, as well as the planting of dense indigenous pioneer grass seeds across all bare earth areas.	Local.		When: ❖ Duration of the project ❖ Operation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Biodiversity.
7	Wetlands	Excavation	Loss of wetlands and associated organic material and vegetation through site excavation Increased contamination of downstream watercourse through the upheaval and liberation of toxins accumulated / trapped in the sediments Flow impediment leading to flooding, backlogging or wetland drowning upstream of the expansion activities Flow concentration leading to increased erosion and scouring	❖ Prevent the unnecessary destruction and fragmentation of the vegetation community of the wetland areas; and ❖ Limit the construction area to the defined project areas and only impact those areas where it is unavoidable to do so otherwise. ❖ The water resources outside of the specific project site area must be avoided; ❖ Prevent uncontrolled access of vehicles through the watercourse that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas; ❖ Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the drainage systems; ❖ The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly; ❖ All chemicals and toxicants to be used during the operation must be stored outside the watercourses and in a bunded area;	Local.	❖ South Africa's National Biodiversity Strategy and Action Plan (NBSAP) ❖ NEM:PAA; ❖ NEMA; ❖ NEM:WA ❖ National Biodiversity Assessment (NBA) ❖ Gauteng C-Plan National Spatial Biodiversity Assessment (NSBA) National Freshwater Ecosystem Priority Areas (NFEPA's); ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014 ; ❖ CARA; ❖ Mining and Biodiversity Guidelines. ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014; ❖ DWS Risk Assessment Protocol; ❖ National Wetland Classification Systems (NWCS).	When: ❖ Duration of the project ❖ Operation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Wetland.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
			downstream of the expansion activities Sedimentation and increased turbidity in downstream watercourses	❖ Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) in such a way as to prevent them leaking and entering the environment; ❖ All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site; ❖ Mixing of concrete must under no circumstances take place within the drainage systems. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished; ❖ All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping"; ❖ Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. These should not be placed near any watercourse or in buffer zones. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation); ❖ The haul road and associated road margins, and silt traps must be inspected on a monthly basis for signs of erosion. When erosion is observed, the area should be rehabilitated within 7 days. In addition, inspections following a >50 mm/ 24 hr rainfall event must occur within 7 days of the event; ❖ No dumping of waste material on-site may take place; ❖ All waste generated on-site during operation must be adequately managed. Separation and recycling of different waste materials should be supported; and ❖ Make sure all excess rubble are removed from site and deposited at an appropriate waste facility.				
		Drying and hauling	Altered hydrological regimes from increased bare surfaces and altered topography with subsequent increase in overland flow and flood peaks Potential loss / disturbance of wetland soil and vegetation Impaired water quality of the Russel Stream with leachate from the drying area		Local		When: ❖ Duration of the project ❖ Operation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Wetland.
		Operation of machinery and equipment and vehicle movement.	Altered hydrological regimes from hardened surfaces arising from compacted surfaces attributed to the use of machinery and equipment Increase in erosion and sedimentation of		Local.		When ❖ Duration of the project ❖ rehabilitation Responsibility: ❖ Contractor	Minimise negative impacts on Biodiversity.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
			receiving systems attributed to altered hydrological regimes Impaired water quality from contamination of water resources by stochastics spills and leaks from machinery and equipment (e.g., fuel and machine oils) Loss or degradation of ecosystem services attributed to the above-mentioned impacts				❖ EO	
		River Crossings	Altered hydrological regimes from channelling or diversion of flow during crossing preparation and installation and, from compacted surfaces attributed to the use of heavy machinery Increase in erosion and sedimentation of receiving systems attributed to altered hydrological regimes Establishment and proliferation of alien vegetation from disturbances related to installation of infrastructure Impaired water quality attributed to the above-mentioned impacts and		Local		When: ❖ Duration of the project ❖ Operation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Biodiversity.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
			from contamination by polluted runoff Loss or degradation of ecosystem services					
		Landscaping	Final landscaping and reshaping		Local.		When ❖ Duration of the project ❖ rehabilitation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Biodiversity.
		Vehicle traffic.	Potential contamination of wetlands from polluted runoff Wetland pollution from indiscriminate dumping of litter		Local		When: ❖ Duration of the project ❖ Operation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Biodiversity.
		Stormwater	Operation of stormwater management (runoff generated from hardened surfaces)		Local.		When ❖ Duration of the project ❖ rehabilitation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Biodiversity.
Surface Water and Groundwater								
8	Surface Water	Excavation of the silt with impacts on water quality.	The excavation of the silt has the potential to increase oxygen levels within the silt, with	❖ Berms, paddocks and silt traps as per the proposed SWMP should be constructed around the reclamation and stockpiling areas to contain and evaporate dirty water.	Local.	❖ DWAF Best Practice Guidelines; ❖ Guideline Document for the Implementation of Regulations; ❖ GN R704.	When:	Reduction of the deterioration of water quality and quantity.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
			subsequent oxidization reactions that could result in potential acidic conditions and leaching of salts and metals, which may impact on downstream water quality. The current water quality does not show any significant impacts as a result of this from the current reclamation operation at Sector 1, however, there is a potential for this to occur should mitigation measures not be implemented.	❖ There is no feasible mitigation to prevent water seeping from the river into the voids, however, berms placed between the reclamation areas and the Russell Stream would assist to reduce inflow into the reclamation areas. ❖ Paddocks must be implemented downslope of the stockpiling area to capture, contain and evaporate runoff and seepage from the stockpiles; and ❖ Once the operational phase is complete, any remnants of the stockpiles must be removed. ❖ Implementation of the proposed SWMP. It must be ensured that stormwater measures are designed, constructed and operated to ensure that stormwater does not spill more than once in 50 years, to be compliant with GN R704 regulations; ❖ Water quality sampling must continue upstream and downstream of the reclamation and stockpiling areas. Should there be a deterioration in water quality from upstream to downstream, then immediate action should be undertaken to identify and address the issue. And; ❖ Implementation of the stormwater monitoring plan.		❖ DWAF Best Practice Guidelines; ❖ Guideline Document for the Implementation of Regulations; ❖ GN R704	❖ During operations. Responsibility: ❖ Site/Site manager.	
		Excavation of the silt with impacts on water quantity.	Excavation of silt to levels below the riverbed of the Russell Stream, could result in water seeping from the Russell Stream into the reclamation voids, resulting in a loss of water quantity in the river.		Local.		When: ❖ During operations. Responsibility: ❖ Site/Site manager.	Reduction of the deterioration of water quality and quantity.
		Stockpiling of the silts.	Runoff and moisture from the stockpiled drying silt may potentially have poor water quality		Local.		When: ❖ During operations. Responsibility: ❖ Site/Site manager.	Reduction of the deterioration of water quality and quantity.
		Uncontrolled dirty water runoff from the reclamation and stockpiling areas.	Runoff into the downslope Russell Stream impacting on water quality and sedimentation.		Local.		When: ❖ During operations.	Reduction of the deterioration of water quality and quantity.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
							Responsibility: ❖ Site/Site manager.	
		Poor maintenance of stormwater infrastructure.	Silted paddocks and eroded berms, can lead to spills into the downslope Russell Streams impacting on water quality and sedimentation.		Local.		When: ❖ During operations. Responsibility: ❖ Site/Site manager.	Reduction of the deterioration of water quality and quantity.
		Flooding of the reclamation and stockpiling areas.	Mechanical reclamation will take place within the Russell Stream floodplain. The stockpiling of silt is in close proximity to the floodplain. High rainfall such as a 1:50 year storm event can potentially result in flooding and consequent downstream water quality issues.		Local.		When: ❖ During operations. Responsibility: ❖ Site/Site manager.	Reduction of the deterioration of water quality and quantity.
9	Groundwater Quality	Main Activities	Impact on the local groundwater quality	❖ Maintain sound surface runoff management to ensure that all dirty runoff is contained and diverted to the cut-off trenches and sumps. No pooling of water on surface allowed. ❖ Monitor groundwater quality in all boreholes. The groundwater monitoring network efficiency must be assessed and new monitoring boreholes drilled, if required. ❖ Ensure that cut-off trenches with sumps can contain all dirty water generated during the desilting process to prevent overflows and spillages. ❖ Ensure that sufficient cutoff trenches and berms are implemented to avoid future wash of silt and	Local.	❖ DWAF Best Practice Guidelines ❖ Guideline Document for the Implementation of Regulations ❖ GN R704	When ❖ During operations Responsibility: ❖ Site manager	Prevention of additional groundwater contamination.

Reference no.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				slimes from the historical TSF situated adjacent to the Valley Silts project.				
	Groundwater Quantity	Main Activities	Reduction in aquifer yield	❖ Monitor groundwater levels in all monitoring boreholes				
Air Quality								
10	Air Quality	Refer to construction mitigation measures as these are applicable to operation as well.						
Heritage								
11	Heritage	Refer to construction mitigation measures as these are applicable to operation as well.						
Social								
12	Social-Economic	Due to the short construction period, the operational and construction period are jointly assessed. Refer to construction mitigation measures as these are applicable to operation as well.						
Traffic								
13	Traffic	Refer to construction mitigation measures as these are applicable to operation as well.						
Noise								
14	Noise	Main activities	Numerous simultaneous operation activities	❖ The potential significance from reclamation noises would be low for daytime activities and additional mitigation measures are not required or recommended.	Local.	❖ SANS 10328:2008 ❖ Regulation 2(d) of GN R154 of 1992 (and GN 5479 of August 1999). ❖ Safety Standards (Regulation No. 388 dated 28 April 2006).	When: ❖ Duration of the operation phase of the project. Responsibility: ❖ Contractor. ❖ Ergo	Prevent noise impacts emanating from operation activities
Health								
15	Health	Main activities	Increase in dust generation could lead to community health issues	❖ Implement dust suppression on access and haul roads ❖ Only clear one reclamation block at a time. ❖ Keep drop height into vehicles to a minimum ❖ Minimal handling of material ❖ Dust monitoring at the nearest community to assess exceedances. Should exceedances occur determine cause and implement mitigation measures.	Local.	❖ NEMA; ❖ OSHA;. ❖ NEM:AQA National Dust Control Regulations (Government Notice No. R827, 2013)	When: ❖ Duration of the construction phase of the project Responsibility: ❖ Contractor ❖ EO ❖ Ergo	Minimise, as far as possible, Negative Health impacts Maximise, as far as possible, positive health impacts

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8.4 Decommissioning Mitigation Measures

The following activities are planned by the Applicant for the decommissioning phase of the project.

Table 8-7: Summary table of the Activities associated with this decommissioning phase of the project

Activity	Description
Decommissioning Phase	
13	Demolition of infrastructure and rehabilitation of the Valley Silts area
14	Closure forum to be established with key stakeholders.

Table 8-8: Closure and Decommissioning Phase Mitigation Measures

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
Vegetation and Habitats								
1	Flora and Habitat	Decommissioning activities	Decommissioning activities leading to a possible negative impact to the environment.	❖ Implement the rehabilitation plan. ❖ Revegetation of exposed areas should take place as soon as possible after shaping the area to a free draining surface.	Local.	❖ NEMA; ❖ National Biodiversity Assessment (NBA); ❖ Gauteng C-Plan; NEM:BA ❖ Alien and Invasive Species Regulations, 2013; ❖ NEM:BA Alien and Invasive Species Lists, 2016.	When: ❖ Duration of the project. ❖ Rehabilitation. Responsibility: ❖ Contractor. ❖ EO.	Minimise negative impacts on Biodiversity.
2	Fauna	Decommissioning activities	Decommissioning activities leading to a negative impact to the local fauna.	❖ See mitigation for the impacts during the construction and operational phase.	Local.		When ❖ Duration of the project. ❖ Rehabilitation. Responsibility: ❖ Contractor. ❖ EO.	Minimise negative impacts on Biodiversity.
3	Alien Species	Decommissioning activities	Decommissioning activities leading to a negative impact to the local biodiversity	❖ An Alien Invasive Plant (AIP) Management Plan must be compiled and implemented. This should regularly be updated to reflect the annual changed in AIP composition.	Local.	❖ NEMA ❖ National Biodiversity Assessment (NBA) ❖ Gauteng C-Plan	When ❖ Duration of the project ❖ rehabilitation	Minimise negative impacts on Biodiversity.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
						❖ NEM:BA Alien and Invasive Species Regulations, 2013 ❖ NEM:BA Alien and Invasive Species Lists, 2016	Responsibility: ❖ Contractor ❖ EO	
4	Waste Management	Decommissioning activities	Decommissioning activities leading to the generation of waste.	❖ See mitigation for the impacts during the construction and operational phase.	Local		When ❖ Duration of the project ❖ rehabilitation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Biodiversity.
5	Erosion	Decommissioning activities	Decommissioning activities leading to Erosion	❖ Speed limits must be put in place to reduce erosion. Soil surfaces must be wetted as necessary to reduce the dust generated by the project activities. Speed bumps and signs must be erected to enforce slow speeds. ❖ Only existing access routes and walking paths may be made use of. ❖ Areas that are denuded during operations need to be re-vegetated with indigenous vegetation to prevent erosion during flood events etc. ❖ A stormwater management plan must be compiled and implemented if necessary.	Local		When ❖ Duration of the project ❖ rehabilitation Responsibility: ❖ Contractor ❖ EO EO	Minimise negative impacts on Biodiversity.
6	Wetland	Rehabilitation	Potential loss or degradation of wetlands through inappropriate closure	❖ See mitigation for the impacts during the construction and operational phase.	Local	❖ South Africa's National Biodiversity Strategy and Action Plan (NBSAP) ❖ NEM:PAA; ❖ NEMA; ❖ NEM:WA ❖ National Biodiversity Assessment (NBA) ❖ Gauteng C-Plan National Spatial Biodiversity Assessment (NSBA) National Freshwater Ecosystem Priority Areas (NFEPA's); ❖ ECA;	When ❖ Duration of the project ❖ rehabilitation Responsibility: ❖ Contractor ❖ EO	Minimise negative impacts on Wetlands
		Landscaping	Final landscaping and concurrent rehabilitation		Local		When ❖ Duration of the project	Minimise negative impacts on Wetlands

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
						❖ Alien and Invasive Species Regulations, 2014 ; ❖ CARA; ❖ Mining and Biodiversity Guidelines. ❖ ECA; ❖ Alien and Invasive Species Regulations, 2014; ❖ DWS Risk Assessment Protocol; ❖ National Wetland Classification Systems (NWCS).	❖ rehabilitation Responsibility: ❖ Contractor EO	
Surface Water and Groundwater								
7	Surface Water	Exposure of soil during the closure and rehabilitation phase activities, once all silt has been removed.	Erosion and consequent deterioration of water quality in the Russell Stream.	❖ Stormwater management measures (e.g. berms) should remain in place while rehabilitation is taking place, to prevent runoff from bare areas from flowing into the Russell Stream; ❖ Revegetation of exposed areas should take place as soon as possible after shaping the area to a free draining surface; and ❖ Water quality monitoring must continue upstream and downstream until the site has been fully rehabilitated.	Local.	❖ DWAF Best Practice Guidelines; ❖ Guideline Document for the Implementation of Regulations; ❖ (GN R704.	When: ❖ During rehabilitation operations. Responsibility: ❖ Site manager. ❖ Contractor. ❖ EO.	Reduction of the deterioration of water quality.
8	Groundwater Quality	Decommissioning activities	Water quality impacts when silt has been removed	❖ Monitor groundwater quality in all boreholes. ❖ Maintain sound surface runoff management to ensure that all dirty runoff is contained and diverted away from the Russell Stream.	Local.	❖ DWAF Best Practice Guidelines ❖ Guideline Document for the Implementation of Regulations ❖ GN R704	When: ❖ During rehabilitation operations Responsibility: ❖ Site manager. ❖ Contractor. ❖ EO	Reduction of the deterioration of ground water quality.
	Groundwater Quantity	Decommissioning activities	Reduction in aquifer yield	❖ Monitor groundwater quality in all boreholes.				
Air Quality								
9	Air Quality	Refer to construction mitigation measures as these are applicable to decommissioning as well.						
Social								
10	Social	Decommissioning activities	Land Restoration	❖ Facilitate the develop a future land use plan in consultation with the CoJ and local communities.	Local.	❖ NEMA; ❖ Occupational Health and Safety (Act No. 85 of 1993);	When:	Maximise, as far as possible, Positive social impacts.

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				❖ Consider implementing a portable skills programme for the existing workforce. ❖ Consider placement of workers in other Ergo operations. ❖ The applicant to apply for a land clearance certificate from the NNR-upon approval of the clearance certificate after complying with the conditions stipulated in the clearance certificate ❖ Communicate upfront the proposed end land uses envisaged for the area once the reclamation process has been completed. ❖ Mine security patrols should monitor the perimeters of the project site thereby providing an increased security presence. ❖ Ergo to collaborate with the CoJ and implement CoJ's land use management system to prevent illegal settlements. **Additional Recommendations** On-going stakeholder engagement is recommended to understand issues on the ground. To ensure effective consultation with community members during the authorisation, construction, operation and decommissioning phases of Ergo reclamation projects with CoJ, it is recommended that a Community Consultation Forum (Forum) be established. In establishing the Forum, that Ergo needs to take the following into consideration: ❖ Communities should democratically elect representatives to voluntarily sit on the Forum, which meets quarterly. ❖ Representatives would be responsible for disseminating project information to community members, and Ergo would be responsible for taking minutes and attendance registers at Forum meetings. ❖ The composition of the Forum might include the following Committee members: ○ Community members from the communities within the Projects area of interest; ○ Focus should especially be on areas that represents a larger risk in terms of social		❖ National Spatial Development Framework; ❖ NEM:AQA; ❖ National Dust Control Regulations (Government Notice No. R827, 2013).	❖ Duration of the construction phase of the project. Responsibility: ❖ Contractor. ❖ EO. ❖ Ergo	
		Decommissioning activities	Cessation of employment and income		Local.	❖ NEMA; ❖ Occupational Health and Safety (Act No. 85 of 1993); ❖ National Spatial Development Framework; ❖ NEM:AQA; ❖ National Dust Control Regulations (Government Notice No. R827, 2013).	When: ❖ Duration of the construction phase of the project. Responsibility: ❖ Contractor. ❖ EO. Ergo	Minimise, as far as possible, Negative social impacts.
		Decommissioning activities	Community safety		Local.	❖ NEMA; ❖ Occupational Health and Safety (Act No. 85 of 1993); ❖ National Spatial Development Framework; ❖ NEM:AQA; ❖ National Dust Control Regulations (Government Notice No. R827, 2013).	When: ❖ Duration of the construction phase of the project. Responsibility: ❖ Contractor. ❖ EO. Ergo	Minimise, as far as possible, Negative social impacts.
		Decommissioning activities	Potential Land Invasion		Local.	❖ NEMA; ❖ Occupational Health and Safety (Act No. 85 of 1993); ❖ National Spatial Development Framework; ❖ NEM:AQA;	When: ❖ Duration of the construction phase of the project.	Minimise, as far as possible, Negative social impacts.

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Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
				mobilisation including informal settlements – specifically in Wards 68; ○ Representatives from the Municipal Authorities; and ○ Ergo's representatives from the following divisions: Community Relations and Environmental Management. ❖ Forum members would be required to hold meetings with their communities and provide Ergo with copies of the attendance registers and minutes of these meetings. ❖ Solutions to address service delivery require interventions from the local authorities. However, the applicant can address potential issues that could lead to unrest by ensuring that an effective grievance mechanism is put in place to ensure that stakeholders are provided with a platform to raise their concerns/complaints. ❖ Collaborate with the unit of the DMRE that deals with illegal mining-related issues and the SAPS to establish standard operating procedures for the control and/or removal of unauthorised individuals		❖ National Dust Control Regulations (Government Notice No. R827, 2013).	Responsibility: ❖ Contractor. ❖ EO. Ergo	
Traffic								
11	Traffic	Refer to construction mitigation measures as these are applicable to operation as well.						
Health								
12	Health	Decommissioning activities	Removal of dust source	❖ Implement dust suppression on access and haul roads ❖ Rehabilitate areas and revegetate ❖ Dust monitoring at the nearest community to assess exceedances. Should exceedances occur determine cause and implement mitigation measures.	Local.	❖ NEMA; ❖ OSHA;. ❖ NEM:AQA National Dust Control Regulations (Government Notice No. R827, 2013)	When: ❖ Duration of the construction phase of the project Responsibility: ❖ Contractor ❖ EO ❖ Ergo	Minimise, as far as possible, Negative Health impacts Maximise, as far as possible, positive health impacts

8.5 Post-Closure Mitigation Measures

The following activities are expected to occur during the post-closure phase of the project.

Table 8-9: Summary table of the Activities associated with this post-closure phase of the project

Activity	Description
Post-Closure	
19	Post-Closure Monitoring
20	Rehabilitation activities

Table 8-10: Post-Closure Phase Mitigation Measures

Reference No.	Aspect	Activities	Impact	Mitigation Measures	Size and Scale of Disturbance Post-Mitigation	Compliance with Standards	Time Period for Implementation & Responsible Person	Outcomes
Monitoring								
1	Surface water	Water quality monitoring Water quality monitoring	Water pollution	❖ Monitor and maintain surface water and groundwater management structures until the completion of the rehabilitation phase and the property has been handed back to the rightful land owner. ❖ Monitor surface water and groundwater quality. ❖ No pooling of water on surface allowed. ❖ Effective stormwater management that captures and contains all site runoff; ❖ Removal of all reclamation infrastructures and successful rehabilitation of the area to a free draining area that is vegetated; and ❖ Water quality monitoring upstream and downstream of the proposed project until rehabilitation is successfully completed.	Local	❖ DWAF Best Practice Guidelines ❖ Guideline Document for the Implementation of Regulations ❖ GN R704	When ❖ Post closure timeframe Responsibility: ❖ Site manager ❖ EO	Water quality improvement
2	Groundwater							
3	Vegetation	Vegetation monitoring	Vegetation re-establishment Alien Invasive species encroachment	❖ Monitor revegetation of rehabilitated areas. ❖ Removal of alien invasive species.	Local	❖ NEMA ❖ CARA ❖ NEM:BA	When ❖ Post closure timeframe Responsibility: ❖ Site manager EO	Vegeattion re-establishment

9 SPECIFIC IMPACT MANAGEMENT PLANS

The impact management actions per Phase are detailed in Section 8 of this report. The impact management outcomes for the project are as follows:

- Maintain the footprint of the activity and restrict activities to the designated Valley Silts Expansion area. Avoid and protect all sensitive areas/no-go areas
- Protect sensitive areas as far as practicable;
- Minimise dust fallout during stockpiling and hauling;
- Reduce groundwater pollution and seepage,
- Reduce surface water pollution;
- Prevent further land, stream and wetland contamination;
- Maintain transparent engagement and communication; and
- Ensure the full rehabilitation of a site by removing all infrastructures and aligning rehabilitation of the land for its intended future use.

The following compliance mechanisms are required by Ergo on an annual basis or as determined by the Environmental Authorisation:

- An environmental audit of the EMPr should be undertaken on an annual basis by an independent auditor.
- An internal audit should be undertaken annually.

9.1 Environmental Awareness Plan

9.1.1 Communication Chain

The communication of the environmental risks for each phase of the project will take place for the management, administrative and site worker sectors of the site, as well as contractors and sub-contractors.

9.1.2 Management Sector

A workshop will be conducted to inform all management of the risks associated with the project. The risks for all aspects will be explained and the appropriate management options discussed. The workshop will also elaborate on the monitoring programmes that will be implemented to identify and monitor the level of impact on the environment and discuss various remediation actions, should there be deterioration.

The evaluation process is integral in the assurance that the site reduces any possible environmental risks associated with the project. The workshop will be conducted prior to the construction phase to ensure that all risks are discussed before there is any chance of the impacts occurring.

The workshop may be repeated at certain stages during the construction phase, in the case of new employees.

This workshop will seek to explain the following necessary actions:

- Risks associated with each aspect will be discussed to ensure that there is an understanding of how each action of the project may impact on the environment.
- The mitigation of the environmental risk will be elaborated on.
- It is important that each person understands these management strategies as it ensures that the impact on the environment is kept to a minimum.
- Data collection regarding each aspect will also be explained to ensure that each aspect is monitored according to those protocols specified by the authorisations and licence. Along with data collection, the reporting of findings will be discussed.
- This workshop will take place before the construction phase begins, thus ensuring a full understanding of the project and its associated environmental risks before any construction activity is undertaken.
- The workshop will be repeated at the beginning of the operational phase as part of a handover to the next responsible party.
- The following communication channels and media will/ can be used to communicate environmental and social issues with Ergo employees during construction:

    - Head of Department (HOD) Meetings: The Site Manager communicates information to senior management on environmental issues and the information is minuted.
    - HSEC Meetings: 'Environmental issues' should be an agenda item on monthly safety, health & environmental meeting agendas.
    - Publications: Leaflets, posters etc. are produced by the relevant department or other designated persons, for use on notice boards, and distribution.
    - EMS Database: Feedback from line management on objectives, targets and actions.
    - Daily/ Weekly Safety Meeting: All meetings are scheduled to commence with a discussion on safety, health & environmental topics.

9.1.3 Construction Workers Sector

The workers associated with the activities on site will attend an induction course to ensure that each person is aware of the environmental risks associated with the project. This induction will form part of the health and safety induction. The environmental risks of each aspect as well as the mitigation will be elaborated on.

A debriefing should take place when the project moves from one phase to the next. A Job Hazard Analysis (JHA) or Issue Base Risk Assessment could also be conducted to identify potential risks associated with the project.

Furthermore, weekly toolbox talks / green meetings must cover topics raising awareness on environmental and social issues relating to the project.

9.1.4 Contractors

A Risk Conversancy Training (RCT) is conducted and is applicable to all contactors. Here focus will be on activities that carry an environmental risk, actions to be taken to reduce these risks, and procedures to be followed in the event of an incident.

Furthermore, weekly toolbox talks / meetings must cover topics raising awareness on environmental and social issues relating to the project.

9.1.5 Environmental Officer

The EO will oversee environmental awareness induction training to all contractor staff. The EO will ensure that the necessary environmental induction training takes place and that records of attendance are maintained and up to date.

An EO must also be present on site during the pre-construction and construction phases of the project to ensure compliance and the implementation of the EA, WUL and EMPr condition.

9.2 Strategic Communication Plan

9.2.1 Environmental Communication Strategies

Ergo Management is required to establish procedures for the internal communication between the various levels and functions of the organisation, and receiving, documenting and responding to environmental risks for each phase of the project will take place for the management, administrative and worker sectors of the site, as well as contractors. The organisation shall conduct processes for external communication on its significant environmental aspects and record its decision in line with Ergo communication policy as well as conditions stated in any EA or License.

9.2.1.1 Stakeholder Engagement Plan

A Stakeholder Engagement Plan (SEP) and Grievance Mechanism (GM) must be compiled for a project. The SEP needs to provide guidance for engagement with Stakeholders.

9.2.1.2 Internal Communication

Internal communication is done within the Administrative Sector.

9.2.1.3 External Communication Strategies

The following communication channels and media can be used to communicate environmental issues to individuals who are not employed by Ergo or its subcontractors:

- **Environmental Stakeholder Engagement Forum:** An Environmental Stakeholder engagement forum must be established and used to keep interested and affected parties informed of the significant environmental aspects identified through the Environmental Impact Assessments and Management Plans. This forum should preferable be initiated prior to commencing with any activities on site. This is also the forum where interested and affected parties get the opportunity to raise environmental concerns. Records must be kept of all decisions and concerns. The Environmental Stakeholder engagement meetings must be chaired by the personal of Ergo, or another appropriately appointed competent individual.

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- **Publications:** Selected publications should be produced and used to communicate environmental issues to outside parties. Examples include newsletters and Annual Reports.
- **Communication from External Parties and Employees:** A clear communication point is established within the company through the Ergo communication procedure that determines who is responsible for liaison with the media in respect of any crisis that may arise. A complete procedure for media liaison is available to all employees. Communication from external interested and affected parties may be received by email, fax, telephonically or by mail. Where required, a written response will be sent, on receiving such communication, by the appropriately appointed individual under signature of the Site Manager, to the respective interested and / or affected party. All telephonic or facsimile correspondence received on the site must be forwarded to the relevant department for action. All events or concerns will be captured and actioned on an existing and / or future database.
- **E-mail:** E-mail communication received must be stored, with replies, in an appropriate folder on a server. E-mail messages, relevant to environmental management, should be kept for a minimum of two years before deletion.
- **Mail:** Correspondence received by mail must be filed, along with the response (where relevant), within the relevant department's filing system for a minimum period of two years. Paper correspondence will be archived in this department.
- **Storage of Correspondence:** All original correspondence must be retained by the Site Manager for a minimum period of two years.
- **Environmental Reports:** Copies of relevant specialist study reports and Environmental Impact Assessments will be available on request from an external party by the Site Manager.
- **Queries from Interested and Affected Parties:** Response to queries about environmental impacts and aspects will be addressed by the relevant department and approved by the Site Manager.

9.2.1.4 Evaluation of the Environmental Awareness Plan

The evaluation of the environmental awareness and training plan will be conducted by Ergo management. This evaluation will entail the auditing of the operation in both the construction and operation phase once activity has commenced. The environmental awareness and training plan described above is sufficient to make all those involved in the project aware of those risks that may occur as well as the necessary mitigation required to minimize these risks.

The environmental awareness and training plan indicate that Ergo is serious about the environments well-being and empowerment of the local people. Environmental issue will be highlighted at monthly meetings scheduled at the site.

9.2.1.5 Emergency Incident Reporting

Environmental incident reporting is a vital part of communication at the Valley Silts Expansion project. Employees are required to report all environmentally related problems, incidents and pollution, so that the appropriate litigator action can be implemented timeously. In the event of an Environmental Incident, the incident must be reported according to the Incident Reporting Procedure.

An Emergency Incident Preparedness and Response Plan needs to be developed.

9.2.1.6 Induction

All full-time staff and contractors are required to attend an induction session. Employees are inducted when they start on the project. Any contractor, who works on the project is required to undergo prescribed induction training. This induction will form part of the health and safety induction.

Environmental issues and aspects related to the project will be addressed in the induction sessions. All environmental impacts and aspects and their mitigatory measures will be discussed, explained and communicated to employees. The induction sessions will be modified according to the level of employee attending the induction session so that all employees gain a suitable understanding of environmental issues and pollution.

The records of all individuals attending induction sessions to be kept; the records to be kept include names, ID, contact details, designation and signature.

9.2.1.7 On the Job Training

On the job training is an essential tool in environmental awareness. Employees will be given details of the expected environmental issues and concerns specifically related to their occupation. Employees will be trained on how to respond if an environmental problem or source of environmental pollution arises. The training will be on-going, and all new employees will be provided with the same standard of training as existing employees. In addition, contractors working on the project will be subjected to a Risk Conversancy Training (RCT).

The records of all individuals receiving on the job training to be kept; the records to be kept include names, employee number, contact details, designation and signature.

9.2.1.8 Hazardous Substances

Individuals dealing with potential hazardous situations and risks that could lead to hazardous spills, pollution incidents, excessive dust or other forms of environmental damage should receive appropriate job specific training on the risks and potential consequences of their appointment and work situation, how to avoid environmental impacts and how to respond during an environmental incident or emergency situation. All these actions will be done in accordance with Ergo procedures on management of hazardous substances.

9.2.1.9 Dust mitigation

Individuals dealing with potential situations and risks that could lead to excessive dust should receive appropriate job-specific training on the risks and potential consequences of their appointment and work situation, how to avoid environmental impacts and how to respond during an environmental incident or emergency situation.

9.2.1.10 Fire Incidents

Individuals dealing with potential hazardous situations and risks that could lead to fire incidents or emergencies should receive appropriate job-specific training on the risks and potential consequences of their

appointment and work situation, how to avoid environmental impacts and how to respond during an environmental incident or emergency situation.

9.2.1.11 Pollution Incidents or Forms of Environmental Damage

Any incident or form of environmental damage must be dealt with in accordance with the Incident management procedure. This document is held with Ergo.

Individuals dealing with potential situations and risks that could lead pollution incidents or other forms of environmental damage to receive appropriate job-specific training on the risks and potential consequences of their appointment and work situation, how to avoid environmental impacts and how to respond during an environmental incident or emergency situation.

9.2.1.12 Waste Management

Site personnel and contractors responsible for the operation and safe handling of the various waste streams will receive appropriate job-specific training on the risks and potential consequences of their appointment and work situation, how to avoid environmental impacts and how to respond during an environmental incident or emergency situation. Ergo must ensure that training and awareness programmes cover the safe transportation, handling, storage, transfer, handling, use and disposal of all waste streams, and the location of waste receptacles for each waste stream. All waste management activities must be done in accordance with Ergo procedures, the EMPr and in terms of registers dealing with storage of waste in specific areas.

Staff awareness training programme will accommodate training, on which bin to use for organic waste and on sealing the lid on the bin once organic waste has been discarded.

9.2.1.13 Water Management

All persons responsible for active water management will receive appropriate job-specific training on the risks and potential consequences of their appointment and work situation, how to avoid environmental impacts and how to respond during an environmental incident or emergency.

9.2.1.14 Water Consumption and Use

All staff will receive training on minimising water consumption and how to use water sparingly.

9.3 Emergency Response Plan

An Environmental Emergency Response Plan defines the process to follow to respond rapidly and effectively to and manage emergency situations that may arise as a result of the Valley Silts Expansion project. This plan must be initiated when an emergency:

- Cannot be immediately brought under control;
- Has the potential to extend beyond site boundaries;
- Has the potential to significantly impact on the environment and/or community; and

- Requires assistance from External Emergency Services.

Ergo will develop an Emergency Response Plan for the Valley Silts Expansion project.

This plan outlines response actions for potential incidents of any size. It details response procedures that will minimise potential health and safety hazards, environmental damage, and clean-up efforts. The plan has been prepared to ensure quick access to all the information required in responding to an emergency event. The plan will ensure that Contractors comply with all procedures described in this document.

9.3.1 Intent

A Work Method Statement should be prepared prior to the commencement of any activities, detailing how this plan is to be implemented as well as details of relevant responsible parties for the implementation. The method statement must also reflect conditions of the IFC Performance Standard 1 and include the following:

- Areas where accidents and emergency situations may occur;
- Communities and individuals that may be impacted, as read in the specialist studies;
- Response procedure;
- Provisions of equipment and resources;
- Designation of responsibilities; and
- Communication, both internally and externally.

The purpose of this plan is to define the emergency response structure and process of the Valley Silts Expansion project. The objectives of the plan are:

- To ensure communication of all vital information as soon as possible;
- To provide clear guidance in the management of emergencies that have the potential to impact on life, property, environment and community;
- Clearly define roles and responsibilities;
- To facilitate the reorganisation and reconstruction activities so that normal operations can be resumed;
- For employees to be able to take prompt effective action to reduce the risk of injury, minimise environmental impact and property damage likely to result from possible emergencies;
- To specify the emergency communication process necessary to establish links with key site personnel.

The Emergency Preparedness and Response Code of Practice will be compiled in accordance with the Occupational Health and Safety OHSAS 18001, and the Site Health and Safety Act, 1996 (Act No. 29 of 1996).

9.3.2 Planning

There are three levels of emergency, these are delineated as follows:

- Local Emergency: An alert confined to a specific locality.

- Site Emergency: An alert that cannot be localised and which presents danger to other areas within the site boundary or outside the site boundary.
- Evacuation: An alert when all personnel are required to leave the affected area and assemble in a safe location.

If there is any doubt as to whether any hazardous situation constitutes an emergency, then it must be treated as an Evacuation, and every effort must be made to reduce or stop the cause of any emergency provided it is safe to do so. Factors effecting the success of the emergency response strategy include:

- The type and scale of incident/accident will govern the type of response.
- The scale of the incident, accident or emergency will govern the resources required to bring under control.
- Communications after which an incident or emergency is first reported governs scale, type and resources required to maintain effective control and bring to resolution.

To facilitate the effective implementation of the procedures, copies of the Environmental Emergency Response Plan must be placed in accessible and visible locations around the site.

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Table 9-1: Emergency Scenario Contingency Planning

Incident	Prevention Measures	Procedures	Designation
Spill which would result in the contamination of land, surface or groundwater.	❖ All equipment refuelling, servicing and maintenance activities should only be undertaken within appropriately sealed/contained designated areas. ❖ No refuelling, storage, servicing, or maintenance of equipment should take place within sensitive environmental resources to reduce the risk of contamination by spills. ❖ Any fluids drained from the machinery during servicing should be collected in leak-proof containers and taken to an appropriate disposal or recycling facility. ❖ A spill must be given the highest priority, and clean-up turn-around time must be as fast as possible, ❖ Ensure all paddocks and stormwater systems have sufficient capacity to hold dirty water – especially during rainfall events. ❖ Adhere to the stormwater management plan for this EMPr. ❖ Contact details of emergency services and the Response Contractors are to be clearly displayed on the site. All staff are to be made aware of these details and must be familiar with the procedures for notification in the event of an emergency.	1. Spill or release identified. 2. Assess person safety, safety of others and environment. 3. Stop the spill if safely possible. 4. Contain the spill to limit entering surrounding areas. 5. Identify the substance spilled. 6. Quantify the spill {under or over guideline/threshold levels). 7. Notify the Site Manager and emergency response crew and authorities {in the event of major spill). 8. Inform users {and downstream users) of the potential risk. 9. Clean up of the spill as fast as possible. 10. Record of the spill incident on company database.	Contractor, Site Manager, EO

Ergo's EO Representative, who is responsible for managing the day-to-day on-site implementation of this Plan, must act as liaison and advisor on all environmental and related issues.

It is necessary to prevent land from becoming sterilised due to a spill. Criteria that may be considered for restoring the affected area include natural biodegradation of oil, replacement of soil and revegetation. Further, a radiation walk-over should be undertaken for spills of a reportable size and affecting large expanses of land which is intended for future use as residential housing or commercial property. Results from the survey must be reported back to the Competent Authority and National Nuclear Regulator.

Once a spill of reportable size has been contained, the EO and the relevant Authority must be consulted to confirm that the appropriate clean up levels are met.

9.4 Conceptual Stormwater Management Plan

Please refer to Section 3.6 of the EIA and the surface water Impact assessment in Appendix D5 for a detailed description of the Conceptual Stormwater Management Plan. The water quality monitoring requirements can be found in the Surface water Impact Assessment.

The current stormwater management for the Valley Silts project will be extended to cover the Proposed Project area. This expansion will include additional silt traps and stormwater control berms/paddocks to capture any stormwater in the dirty water areas. The conceptual Stormwater Management Plan (SWMP) of the Valley Silts Expansion project has been developed. The purpose of the conceptual SWMP is to ensure that clean (areas unimpacted by the proposed reclamation activities) and dirty areas (impacted areas) are adequately separated, by diverting runoff from clean areas away from dirty areas towards the Russell Stream and ensuring that dirty runoff from the operational areas is captured, contained and managed appropriately.

9.4.1 Clean and Dirty Areas

9.4.1.1 Dirty Areas

Ergo dirty areas include the following:

- Reclamation blocks – reclamation of the silts has the potential to contaminate the Russell Stream with heavy metals, salts, acidic water and elevated SS. Water within the reclamation blocks will need to be contained and managed;
- Drying stockpiles – moisture seeping from the stockpiled silts is expected to have similar water quality to that described above and will need to be contained and managed; and
- Hard park areas – the two hard park areas will be used to park heavy machinery that have the potential to leak hydrocarbons. Drip mats or trays should be placed beneath parked machinery.

9.4.1.2 Clean Areas

All areas surrounding the above-mentioned dirty areas should be treated as clean areas and should be diverted away from flowing into dirty areas.

9.4.2 Proposed Stormwater Measures

The proposed conceptual SWMP is indicated on Figure 9-1 and is discussed below.

9.4.2.1 Reclamation Blocks

9.4.2.1.1 Dirty Water Management

All It is proposed that berms are constructed around the reclamation blocks to contain dirty water runoff. Dirty water within the reclamation blocks can be allowed to evaporate and can be used for dust suppression on the haul roads. Should there be a large accumulation of stormwater within the bermed off reclamation areas, then the excess stormwater will need to be released gradually to silt traps, that will settle out silts before entering the Russell Stream. This is currently done at the existing reclamation operation. The proposed heights of the berms are provided in Table 9-2.

9.4.2.1.2 Clean Water Management

Upslope runoff will be diverted around the reclamation blocks by berms towards the Russell Stream.

9.4.2.2 Drying Stockpiles

9.4.2.2.1 Dirty Water Management

Runoff and seepage from the stockpiles will be captured and contained in paddocks and bermed off areas. Dirty water within the paddocks will be allowed to evaporate. The proposed heights of the berms and paddocks are provided in Table 9-2.

9.4.2.2.2 Clean Water Management

Upslope runoff will be diverted around the stockpile areas by berms towards the Russell Stream.

9.4.3 Flood Projection

The berms at the bottom of the reclamation blocks as well as the paddocks running along the Russell Stream, will prevent flooding of the reclamation and stockpile areas. The berms and paddocks were sized to contain or divert the 1:50 year flood event as required by GN R704 and are provided in in Table 9-2.

Table 9-2: Proposed berm and paddock heights

Berm/Paddock Section*	Berm Height (m)	Berm/Paddock Section*	Berm Height (m)
1 - 2	4	23 - 24	1.5
1 - 3	3	24 - 25	1.5
2 - 4	1.5	23 - 25	1.5
3 - 4	1.5	26 - 27	3
5 - 6	1.5	28 - 29	2
6 - 7	1.5	30 - 31	4
7 - 8	2.5	31 - 32	1.5

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5 - 8	2.5	32 - 33	1.5
9 - 10	1.5	30 - 33	2
7 - 10	1.5	34 - 35	1.5
7 - 11	3.5	35 - 36	1.5
11 - 12	2	36 - 37	1.5
10 - 12	1.5	34 - 37	1.5
12 - 13	4	38 - 39	1.5
14 - 15	2	40 - 41	5
51 - 52	2	41 - 42	2
16 - 17	4	43 - 44	2
17 - 18	3	44 - 45	1.5
18 - 19	1.5	43 - 45	5.5
16 - 19	1.5	46 - 47	5
19 - 20	2	47 - 48	2
20 - 21	2	48 - 49	2
21 - 22	2	46 - 50	5.5

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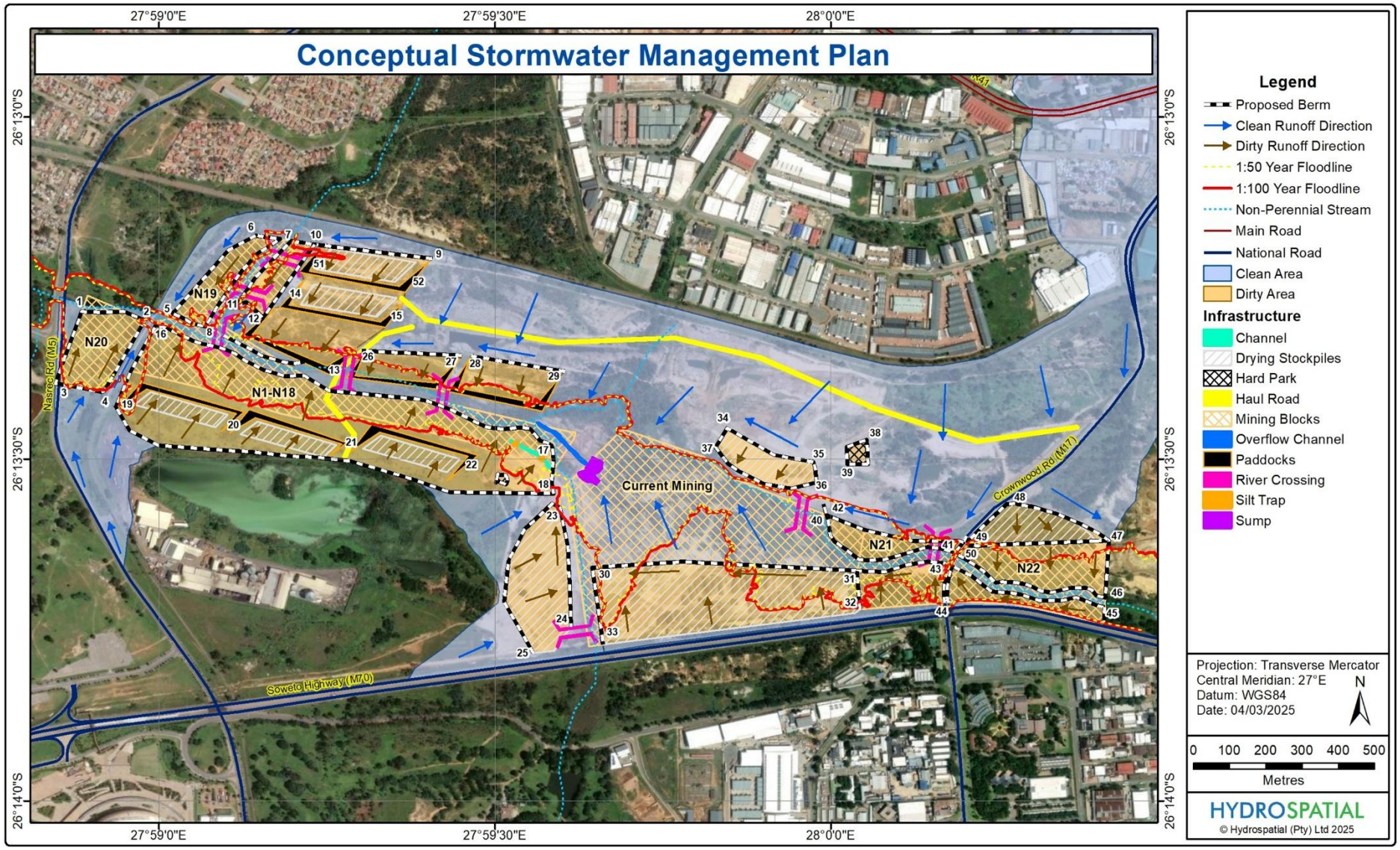


Figure 9-1: Proposed conceptual stormwater management plan

9.4.4 Surface Water Monitoring plans

9.4.4.1 Surface water quality

A surface water quality monitoring programme is essential as a management tool to detect negative water quality impacts as they arise and to ensure that the necessary mitigation measures are implemented. Should the project be approved, it is recommended that Ergo continues to monitor the upstream, middle and downstream sections of the Russell Stream (Table **9-3**).

Table 9-3: Description of the surface water quality sampling locations

Sampling Point	Monitored by	Monitoring Period Assessed	Location from Project	Location Description	Latitude	Longitude
CR1	Ergo	Jun 2021 – Jan 2025	Upstream of Project	Russell Stream - Lake Road	-26.226111°	28.024167°
CR4	Ergo	Jun 2021 – Jan 2025	Upstream of Project	Small bridge at CGR (Crownwood Road)	-26.226667°	28.002778°
CR7	Ergo	Jun 2021 – Jan 2025	Downstream of Project	Russell Stream - bridge at Randshow Road (Riverlea)	-26.220556°	27.981667°
CR11	Ergo	Jun 2021 – Jan 2025	Downstream of Project	New Canada Road bridge	-26.210556°	27.952778°

Water quality sampling should be done in accordance with the DWS Best Practice Guideline G3: Water Monitoring Systems. Samples must be kept cool (+-4°C), out of direct sunlight, and transported immediately to an accredited laboratory for water quality analysis within 24 hours of sampling. The impacts on water quality should be determined by comparing the monitoring results against the Klip River Catchment guideline limits and SANS 241:2015, and importantly against previous results, to determine any deviations in trends over time. If the trend analysis indicates any deviations to the baseline monitoring, in terms of deteriorating water quality, then an immediate investigation must be undertaken to determine whether the operation may be responsible. If responsible, urgent action must be undertaken to implement mitigation measures to prevent further contamination.

Table 9-4: Water Quality limits

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits	
		Tolerable	Unacceptable	Risk	Limit
pH - Value @ 25 ºC	pH units		< 6.0; > 9.0	Operational	≥ 5 to ≤ 9.7
Electrical Conductivity @ 25°C	mS/m	100 - 150	> 150	Aesthetic	≤ 170
Total Dissolved Solids @ 180°C	mg/ℓ	---	---	Aesthetic	≤ 1 200
Total Acidity as CaCO3	mg/ℓ	---	---	---	---
Chloride as Cl	mg/ℓ	75 - 100	> 100	Aesthetic	≤ 300
Sulphate as SO4	mg/ℓ	350 - 500	> 500	Acute health	≤ 500
Fluoride as F	mg/ℓ	0.7 - 1.00	> 1.00	Chronic health	≤ 1.5

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Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits	
		Tolerable	Unacceptable	Risk	Limit
Nitrate as N	mg/ℓ	4.0 - 7.0	> 7.0	Acute health	≤ 11
Nitrite as N	mg/ℓ	---	---	Acute health	≤ 0.9
Bromide as Br	mg/ℓ	---	---	---	---
Ortho Phosphate as P	mg/ℓ	---	---	---	---
Total Cyanide as CN	mg/ℓ	---	---	---	---
Free and Saline Ammonia as N	mg/ℓ	---	---	---	---
Sodium as Na	mg/ℓ	80 - 100	> 100	Aesthetic	≤ 200
Potassium as K	mg/ℓ	---	---	---	---
Calcium as Ca	mg/ℓ	---	---	---	---
Magnesium as Mg	mg/ℓ	30-70	> 70	---	---
Aluminium as Al (Dissolved)	mg/ℓ	0.3 - 0.5	> 0.5	Operational	≤ 0.3
Antimony as Sb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.02
Arsenic as As (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01
Barium as Ba (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.7
Beryllium as Be (Dissolved)	mg/ℓ	---	---	---	---
Bismuth as Bi (Dissolved)	mg/ℓ	---	---	---	---
Boron as B (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2.4
Cadmium as Cd (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.003
Hexavalent Chromium as Cr	mg/ℓ	---	---	---	---
Total Chromium as Cr (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.05
Cobalt as Co (Dissolved)	mg/ℓ	---	---	---	---
Copper as Cu (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 2
Iron as Fe (Dissolved)	mg/ℓ	1.0 - 1.5	> 1.5	Chronic health	≤ 2
Ferrous Iron as Fe2+ (Dissolved)	mg/ℓ	---	---	---	---
Ferric Iron as Fe3+ (Dissolved)	mg/ℓ	---	---	---	---
Lead as Pb (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.01
Lithium as Li (Dissolved)	mg/ℓ	---	---	---	---
Manganese as Mn (Dissolved)	mg/ℓ	2.0 - 4.0	> 4.0	Chronic health	≤ 0.4
Mercury as Hg (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.006
Molybdenum as Mo (Dissolved)	mg/ℓ	---	---	---	---
Nickel as Ni (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.07

Parameter	Units	Klip River Catchment Limits		SANS 241:2015 Limits	
		Tolerable	Unacceptable	Risk	Limit
Phosphorus as P (Dissolved)	mg/ℓ	---	---	---	---
Selenium as Se (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.04
Silicon as Si (Dissolved)	mg/ℓ	---	---	---	---
Silver as Ag (Dissolved)	mg/ℓ	---	---	---	---
Strontium as Sr (Dissolved)	mg/ℓ	---	---	---	---
Thallium as Tl (Dissolved)	mg/ℓ	---	---	---	---
Thorium as Th (Dissolved)	mg/ℓ	---	---	---	---
Tin as Sn (Dissolved)	mg/ℓ	---	---	---	---
Titanium as Ti (Dissolved)	mg/ℓ	---	---	---	---
Tungsten as W (Dissolved)	mg/ℓ	---	---	---	---
Uranium as U (Dissolved)	mg/ℓ	---	---	Chronic health	≤ 0.03
Vanadium as V (Dissolved)	mg/ℓ	---	---	---	---
Zinc as Zn (Dissolved)	mg/ℓ	---	---	Aesthetic	≤ 5
Zirconium as Zr (Dissolved)	mg/ℓ	---	---	---	---
Suspended Solids	mg/ℓ	30 - 55	> 55	---	---
Turbidity	NTU	---	---	Aesthetic	≤ 5

Reporting should continue to be done on a monthly / quarterly basis (or as recommended by the DWS). It is recommended that monitoring reports include trend analyses. It is further recommended that the water quality from upstream monitoring points is compared to downstream monitoring points.

9.4.4.2 Stormwater infrastructure

Water infrastructure (channels, berms and paddocks) should be monitored on a monthly basis during the dry season, and on a weekly basis during the wet season. They should further be monitored immediately after any large storm events. Should blockages, silted up structures or breaches occur, immediate action should be undertaken to remove debris and repair breaches. Monitoring should be undertaken by the onsite Environmental Officer (EO) or maintenance manager. Inspections must be recorded and should include the following:

- Date of inspection;
- Rainfall amount received;
- Photographs of blockages, silted up structures or breaches witnessed;
- What action was undertaken to fix issues, and the amount of time taken to address them; and
- Photographs post action taken.

Inspection reports should be kept ready and supplied to the DWS when requested, or as part of the WUL conditions.

9.5 Groundwater Management

Please refer to Chapter 11 and 12 of the Groundwater report in Appendix D6 for a detailed view of the required groundwater management and monitoring requirements.

9.5.1 Groundwater Objectives and Targets

The following objectives and targets are proposed for groundwater management at the operations:

- Implement a management plan aimed at reducing and/or eliminating adverse impacts on the receptors identified, including watercourses. The management plan must be earmarked at achieving conditions comparable to the best-case scenario presented in this report.
- Track and record the progress of implementation of all groundwater management measures.
- Implement sufficient monitoring procedures to measure the effectiveness of groundwater management measures.
- Analyse the information obtained from all monitoring programs against compliance targets to establish trends and to determine the need to trigger additional actions to reduce adverse impacts.
- Should the trends indicate adverse impacts on groundwater levels and/or quality, implement suitable measures within the shortest possible time to remediate and/or eliminate such adverse impacts identified.

9.5.2 Over-arching Groundwater Management Measures

Several broad over-arching groundwater management measures should be implemented by Ergo for the project to minimise impacts on groundwater, as detailed in Table 9-5.

Table 9-5: Over-arching groundwater management measures

Construction Phase
A dedicated groundwater monitoring network must be established including the four monitoring boreholes drilled as part of the project.
Make financial provision for sufficient groundwater level and quality monitoring to implement the groundwater monitoring program, before the reclamation starts in the Extension area.
Implement stormwater runoff management measures to ensure that all dirty runoff is contained and reused in the project water balance. Avoid ponding of water over exposed areas.
Ensure that dirty water containment measures are designed to contain all dirty water generated during the project to prevent overflows and spillages.
Implement sound house-keeping measures to prevent and clean spills, address leaks and undertake regular inspections. Ensure that the record-keeping procedure is in place and that instructions given are carried out.
Measure rainfall on site.
Operational Phase

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Complete regular inspections of dirty water containment structures, specifically noting incidences of overflow and leakage. If the latter is identified, measures must be taken to rectify immediately.
Maintain sound house-keeping measures to prevent spills and leaks.
Continue the groundwater monitoring programme.
Measure rainfall on site.
Record all groundwater-related complaints and deal with each complaint within the agreed timeframe.
Decommissioning and Closure Phase
Complete all rehabilitation to a satisfactory level, focussing specifically on the water drainage and collection system.
Ensure that all tailings and silt material is removed from the footprint.
Continue with the groundwater monitoring period for a minimum of two years after completion of the rehabilitation. The continued need for groundwater monitoring will depend on the outcome of the final closure assessment.

9.5.3 Specific Groundwater Management Measures

9.5.3.1 Measures to Reduce Impacts on Groundwater Availability

The project is not expected to have any impacts on groundwater availability in the region. The following specific measures are however recommended to minimise and/or eliminate the impacts on groundwater levels and availability:

- None of the private boreholes are located within the zones of unacceptable impacts delineated as part of this assessment. It is however recommended that borehole VAL1 is included in the monitoring programme on an annual basis. Even though borehole CRGB15 is located closer to the project, it is downstream of a historical TSF and will not reflect impacts associated with the Valley Silts Project.
- Ensure that an effective surface water collection and retention system is in place to ensure that all flow and collected water is directed towards the cut-off trenches with sumps and not allowed to freely drain away from the various silt holding areas.

9.5.3.2 Measures to Reduce Impacts on Groundwater Quality

The following specific measures are recommended to reduce the risk of deterioration of groundwater quality and the volume of leachate available for infiltration to the aquifers:

- To minimise negative long-term impacts associated with the project, it is important that silt reclamation must be completed to soil level at the site. All silt must be removed.
- No ponding must be allowed on exposed areas. Process water that is allowed to pond uncontrolled will increase the risk of infiltration to the underlying aquifers.
- After rehabilitation, the footprint area must be made free draining to minimise infiltration of water to the aquifers.
- Ensure that clean and dirty water is separated at the reclamation and drying areas, and that dirty water is contained. Contain dirty water in adequately sized and lined sumps. Prevent dirty water runoff from leaving the area.
- All dirty water being pumped from the reclamation areas should reused in the water balance of pumped off site to prevent unnecessary discharge into the natural environment.

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- Ergo must implement a water quality monitoring program during reclamation, focussed specifically on monitoring groundwater and process water quality. If the results of the monitoring indicate deterioration of quality to within the criteria specified for the likely case scenario in this assessment, Ergo must take measures to address and rectify non-compliances.
- A dedicated groundwater monitoring network must be established that includes borehole VAL1 as identified during the hydrocensus, on an annual basis.
- The impact and risk assessment presented in this report must be updated if any component of the project changes to what was used in this study or if additional information becomes available that deviates from that used.

9.5.4 Groundwater Monitoring

To monitor and prevent the spread of groundwater contamination, groundwater management procedures and practices must be implemented that are in line with accepted practices and in accordance with the requirements of the Environmental Management Plan (EMP). It is recommended to implement the groundwater monitoring program presented in this report. The key objectives of the groundwater monitoring program are to:

- Detect short and long-term trends;
- Recognise changes in groundwater quality and levels;
- Measure impacts and implement mitigation measures; and
- Develop improved monitoring systems.

Groundwater monitoring must be undertaken to establish the extent of contamination in the shallow weathered and deeper fractured aquifers, during and after the reclamation activities.

9.5.4.1 Monitoring Locations

Monitoring must be undertaken in the four newly drilled boreholes as well as borehole VAL1. These boreholes are optimally located from a groundwater perspective. No additional monitoring boreholes are required, based on the outcome of this assessment.

If these boreholes are destroyed during reclamation, they must be replaced as soon as possible.

Table 9-6: Monitoring Borehole Location

Borehole ID	VS-BH 1s	VS-BH 1d	VS-BH 2s	VS-BH 2d
Latitude	26°13'39.64"S	26°13'39.59"S	26°13'17.35"S	26°13'17.31"S
Longitude	28°00'23.73"E	28°00'23.73"E	27°59'01.50"E	27°59'01.48"E

9.5.4.2 Monitoring Requirements

The monitoring requirements are presented in Table 9-7.

Table 9-7: Groundwater monitoring requirements

Monitoring parameter	Element for analysis	Monitoring frequency	Monitoring trigger-response criteria
Depth to groundwater level in existing boreholes	Groundwater level	Quarterly	Variations by more than 3 m for 2 consecutive months should be investigated
Water quality analysis in all existing boreholes and process water	All elements included in the analyses completed as part of this assessment	Quarterly	Variations in concentrations of more than 15% for major cations and anions and more than 7% for metal concentrations for more than 2 consecutive months should be investigated. Any result that exceeds specified water quality objectives must be investigated when it occurs
Groundwater level and quality in borehole Val1 (hydrocensus BH)	Groundwater level as well as all elements included in analyses presented in this report	Quarterly	As above
Rainfall	Rain depth (mm)	Daily on site	None

The monitoring trigger-response criteria listed in Table 9-7 must be reviewed on an annual basis and updated, based on the outcome of the monitoring program results. All monitoring information must be entered into a spreadsheet for record keeping and analysis. Copies of the certificates of analyses must be kept on file for inspection. If significant exceedances are recorded during the monitoring program, the following actions should be taken:

- Log the exceedances in the incident reporting system within 24-hours of it occurring.
- Undertake an investigation to identify causes of the exceedances.
- Implement the necessary remedial actions according to the outcome of the investigation and consultation with the affected parties.
- Report significant exceedances to the Environmental and General Managers as well as to the regulatory authority and track the incident until completion.

The results of the monitoring program must be reported quarterly and on an annual basis for the purpose of internal Ergo water management. These reports must also be submitted to the authorities for review.

9.5.4.3 Groundwater Monitoring Reports

Monitoring reports must contain the following information:

- Monitoring borehole location map;
- Geology map;
- All coordinates of the groundwater sampling sites;
- Certificates of analysis must be included for quality assurance. Monitoring results will be compared to South African National Standards (SANS241) and the Klip River catchment guideline limits (Table 9-4);

- Time-series graphs for key indicator elements (e.g. pH, EC, TDS, Fe, Mn, Cd, Ni, Al, Pb and SO_4);
- Trilinear or other analytical groundwater plots;
- A discussion regarding observed trends and potential groundwater contamination; and
- Recommendations regarding possible amendments or additions to the groundwater monitoring program, based on trends and other information observed.

9.5.4.4 Quality Assessment and Quality Control

Quality assurance means:

- Developing a system of activities to ensure that measurements meet defined standards of quality with a stated level of confidence;
- Defining monitoring objectives, quality control procedures to be followed and quality assessment;
- To define data quality objectives, including accuracy, precision, completeness, representativeness and comparability; and
- Designing a network, selecting sampling sites, selecting instruments and designing the sampling system, as discussed above.

All monitoring equipment must be maintained as required, and calibration must be undertaken on a regular basis.

To ensure that the Groundwater Monitoring Strategy complies with the above, it is important that analytical laboratories used should be accredited for each type of analysis required, to ensure that accurate analytical methods are used.

While only one or two of the common major ions found in waters may be specified as key indicators, it is necessary to analyse for the full suite of common ions for quality control purposes and to detect discrete events and long-term trends in anion composition.

Special attention must be paid to sampling methods and to preservation and handling of samples prior to analysis. pH and conductivity must be measured in the field.

Close attention must be given to siting, logging and construction of monitoring boreholes and assessment of their condition must be made quarterly.

The following sampling protocol is proposed:

- Sterilised plastic bottles, with a plastic cap and no liner within the cap are required for the sampling. Sample bottles should be marked clearly with the borehole name, date of sampling, water level depth and the sampler's name;
- Water levels should be measured prior to taking the sample, using a dip meter (m bgl);
- Each borehole to be sampled should be purged (to ensure sampling of the aquifer and not stagnant water in the casing) using a submersible pump or a clean disposable polyethylene bailer. At least three

borehole volumes of water should be removed through purging; or through continuous water quality monitoring, until the electrical conductivity value stabilises;

- The following field measurements should be recorded on a field form for each sampling point: pH, EC and temperature;
- Samples should be kept cool in a cooler box in the field and kept cool prior to being submitted to the laboratory; and
- The pH and EC meter used for field measurements should be calibrated daily using standard solutions obtained from the instrument supplier.

9.6 Terrestrial monitoring

Table 9-8:Terrestrial monitoring requirements

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Management outcome: Vegetation and Habitats				
Laydown and construction preparation activities such as cement mixing, temporary toilets, etc.) must be limited to already modified areas and should take up the smallest footprint possible	Construction Phase	Project manager, Environmental Officer	Development footprint	Ongoing
Areas classified as medium sensitivity (water resource habitat) must have mitigations applied as stipulated in the accompanying freshwater/wetland assessment	Life of operation	Project manager	Medium sensitivity areas	Ongoing
Develop post- reclamation environments, in conjunction with regional development plans; and the recreation of habitats, where possible; or structure altered landscapes to be compatible with regional habitats.	Life of operation	Project manager, Environmental Officer	Development footprint	Ongoing
It is recommended that areas to be developed/disturbed be specifically demarcated so that during the construction/activity phase, only the demarcated areas be impacted upon.	Construction Phase	Project manager, Environmental Officer	Development footprint	Ongoing
Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should not be fragmented or disturbed further if possible.	Construction Phase	Project manager, Environmental Officer	Development footprint	Ongoing
All vehicles and personnel must make use of existing roads and walking paths as far as possible, especially construction/operational vehicles.	Construction Phase	Project manager, Environmental Officer	Development footprint	Ongoing
The clearing of vegetation must be minimised where possible. All activities must be restricted to within the authorised areas.	Life of operation	Project manager, Environmental Officer	Areas of indigenous vegetation	Ongoing
Materials may not be stored for extended periods of time and must be removed from the PAOI once the construction phase has been concluded. No permanent construction phase structures should be	Construction and Operational Phase	Project manager, Environmental Officer	Laydown areas	Ongoing

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
permitted. Construction buildings should preferably be prefabricated or constructed of re-usable/recyclable materials. No storage of vehicles or equipment will be allowed outside of the designated laydown areas.				
Areas that are denuded during construction need to be re-vegetated with indigenous vegetation according to a habitat rehabilitation plan, to prevent erosion during flood and wind events and to promote the regeneration of functional habitat. This will also reduce the likelihood of encroachment by alien invasive plant species.	Operational Phase	Project manager, Environmental Officer	Assess the state of rehabilitation and encroachment of alien vegetation	Quarterly for up to two years after the closure
A habitat rehabilitation plan must be implemented, and areas of bare ground must be revegetated with species indigenous to the region	Life of operation	Project manager, Environmental Officer	Rehabilitation	Ongoing
A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. • Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use. • No servicing of equipment on site unless necessary. • All contaminated soil / yard stone shall be treated in situ or removed and be placed in containers. • Appropriately contain any generator diesel storage tanks, machinery spills (e.g., accidental spills of hydrocarbons, oils, diesel etc.) in such a way as to prevent them from leaking and entering the environment.	Life of operation	Environmental Officer & Contractor	Spill events, Vehicles dripping.	Ongoing

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Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
• Construction activities and vehicles could cause spillages of lubricants, fuels and waste material negatively affecting the functioning of the ecosystem. • All vehicles and equipment must be maintained, and all re-fueling and servicing of equipment is to take place in demarcated areas outside of the PAOI.				
It must be made an offence for any staff member to remove any indigenous plant species from the PAOI or bring any alien species in. This is to prevent the spread of exotic or alien species or the illegal collection of plants.	Life of operation	Project manager, Environmental Officer	Any instances	Ongoing
All construction waste must be removed from site at the closure of the construction phase.	Construction phase	Environmental Officer & Contractor	Construction waste	During Phase
Storm Water run-off & Discharge Water Quality monitoring • Avoid unnecessary vegetation clearing and avoid preferential surface flow paths; • Cut-off trenches must be incorporated into the design to decrease contamination of watercourses via heavy metals. • Contain wastewater in a sump . Contaminated water must not be discharged into the watercourses; • Clean and dirty water must be separated. • Keep the surface & sub-surface water and storm water that may run off from the dumps reclamation areas away from the low lying areas, such as wetlands, as well as the surrounding areas. Prevention from leaving the PAOI in an uncontrolled manner; • Implement Storm Water Run-Off & Discharge Water Quality monitoring;	Life of operation	Project manager, Environmental Officer	Water Quality	Monthly

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Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
• Storage of potential contaminants in bunded areas.				
Management outcome: Fauna				
A qualified environmental officer must be on site when activities begin. Should animals not move out of the area on their own, relevant specialists must be contacted to advise on how the species can be relocated.	Construction Phase	Environmental Officer & Contractor	Presence of any floral or faunal SCC	Ongoing
Clearing and disturbance activities must be conducted in a progressive linear manner always outwards and away from the centre of the PAOI and over several days, so as to provide an easy escape route for all small mammals and herpetofauna.	Construction Phase	Environmental Officer & Contractor	Progressive land clearing operations and the movement of fauna	Ongoing
The areas to be disturbed must be specifically and responsibly demarcated to prevent the movement of staff or any individual into the surrounding environments, signs must be put up to enforce this.	Construction/Operational Phase	Project manager, Environmental Officer	Infringement into these areas	Ongoing
The duration of the activities should be minimised to as short a term as possible, to reduce the period of disturbance on fauna.	Construction	Project manager, Environmental Officer & Design Engineer	Construction/Closure Phase	Ongoing
Noise must be kept to an absolute minimum during the evenings and at night to minimise all possible disturbances to reptile species and nocturnal mammals.	Construction/Operational Phase	Environmental Officer	Noise levels	Ongoing
No trapping, killing, or poisoning of any wildlife is to be allowed and signs must be put up to enforce this. Monitoring must take place in this regard.	Life of operation	Environmental Officer	Evidence of trapping etc	Ongoing
Outside lighting should be designed and limited to minimise impacts on fauna. All outside lighting should be directed away from any sensitive areas. Fluorescent and mercury vapor lighting should be avoided, and sodium vapor (green/red) lights should be used wherever possible.	Construction/Operational Phase	Project manager, Environmental Officer & Design Engineer	Light pollution and period of light	Ongoing

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife. Speed limits must be enforced to ensure that road killings and erosion is limited.	Life of operation	Health and Safety Officer	Compliance to the training	Ongoing
Schedule activities and operations during least sensitive periods, to avoid migration, nesting, and breeding seasons. In this case, activities should take place during the day.	Life of operation	Project manager, Environmental Officer & Design Engineer	Activities should take place during the day	Ongoing
Any holes/deep excavations must be dug in a progressive manner and shouldn't be left open overnight. Should any holes remain open overnight they must be properly covered temporarily to ensure that no small fauna species fall in. Holes must be subsequently inspected for fauna prior to backfilling.	Planning and Construction	Environmental Officer & Contractor, Engineer	Presence of trapped animals and open holes	
If fencing is required: wildlife-permeable fencing with holes large enough for mongoose and other smaller mammals should be installed, the holes must not be placed in the fence where it is next to a major road as this will increase road killings in the area.	Planning and Construction	Environmental Officer & Contractor, Engineer	Fauna movement corridor	
Management outcome: Alien Species				
An Alien Invasive Plant (AIP) Management Plan must be compiled and implemented. This should regularly be updated to reflect the annual changed in AIP composition.	Life of operation	Project manager, Environmental Officer & Contractor	Manage and assess presence and encroachment of alien vegetation	Twice a year
The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas. Footprints of the roads must be kept to prescribed widths.	Construction/Operational Phase	Project manager, Environmental Officer & Contractor	Footprint Area	Life of operation
A pest control plan must be put in place and implemented; it is imperative that poisons not be used to control pests.	Life of operation	Environmental Officer & Health and Safety Officer	Evidence or presence of pests	Life of operation

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Management outcome: Dust				
Dust-reducing mitigation measures must be put in place and must be strictly adhered to. This includes the wetting of exposed soft soil surfaces. No non-environmentally friendly suppressants may be used as this could result in the pollution of water sources.	Construction phase	Contractor	Dustfall	Dust monitoring program.
Management outcome: Waste Management				
Waste management must be a priority, and all waste must be collected and stored effectively and responsibly according to a site-specific waste management plan. Dangerous waste such as metal wires and glass must only be stored in fully sealed and secure containers, before being moved off site as soon as possible.	Life of operation	Environmental Officer & Contractor	Waste Removal	Weekly
Litter, spills, fuels, chemical and human waste in and around the PAOI must be minimised and controlled according to the waste management plan.	Construction/Closure Phase	Environmental Officer & Health and Safety Officer	Presence of Waste	Daily
Cement mixing may not be performed on the ground. It is recommended that only closed side drum or pan type concrete mixers be utilised. Any spills must be immediately contained and isolated from the natural environment, before being removed from site.	Construction Phase	Environmental Officer & Contractor	Cement mixing and spills	Every occurrence
Toilets at the recommended Health and Safety standards must be provided. These should be emptied regularly and once no longer required, they must be pumped dry to prevent leakage into the surrounding environment and removed from site.	Life of operation	Environmental Officer & Health and Safety Officer	Number of toilets per staff member. Waste levels	Daily
The Contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility.	Life of operation	Environmental Officer & Health and Safety Officer	Availability of bins and the collection of the waste	Ongoing
Where a registered disposal facility is not available close to the PAOI, the Contractor shall provide a method statement with regards to waste management. Under no circumstances may domestic waste be burned on site or buried on open pits.	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Collection/handling of the waste	Ongoing

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Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Refuse bins will be responsibly emptied and secured. Temporary storage of domestic waste shall be in covered and secured waste skips.	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Management of bins and collection of waste	Ongoing, every 10 days
Management outcome: Environmental Awareness Training				
All personnel and contractors are to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the PAOI to inform contractors and site staff of the presence of protected species, their identification, conservation status and importance, biology, habitat requirements and management requirements in line with the Environmental Authorisation and within the EMPr. Contractors and employees must all undergo the induction and must be made aware of any sensitive areas to be avoided (water resources).	Pre-construction phase	Health and Safety Officer, Environmental Officer	Compliance to the training	Ongoing
Management outcome: Erosion				
Speed limits must be put in place to reduce erosion. Soil surfaces must be wetted as necessary to reduce the dust generated by the project activities. Speed bumps and signs must be erected to enforce slow speeds.	Life of operation	Project manager, Environmental Officer	Water Runoff from road surfaces	Ongoing
Only existing access routes and walking paths may be made use of.	Life of operation	Project manager, Environmental Officer	Routes used within the area	Ongoing
Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events etc.	Life of operation	Project manager, Environmental Officer	Re-establishment of indigenous vegetation	Progressively

Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
A stormwater management plan must be compiled and implemented if necessary.	Life of operation	Project manager, Environmental Officer	Management plan	Before construction phase: Ongoing
Precautions must be taken against the erosion damage that would be caused by unplanned pipe leaks or leaching in general. This involves the installation of leak warning and detection systems, as well as the planting of dense indigenous pioneer grass seeds across all bare earth areas.	Closure Phase/Rehabilitation phase	Environmental Officer & Contractor	Erosion Management and Control/ Leaks	During Phase and Ongoing Monitoring

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9.7 Dust Fallout Monitoring Plan

A concern was raised at the public participation meetings regarding cumulative air quality impacts from several projects in the vicinity of Riverlea. To assess the air quality impacts of particulate emissions from the Valley Silts Expansion project, ongoing dust fallout monitoring must be undertaken. Four monitoring stations, approximately equally distant from each other, is the minimum required by ASTM D1739 (ASTM, 2017) for each area or zone to be monitored.

It is recommended that a monitoring network of six dustfall samplers be installed on the boundary of the project area. The samplers must be operated in accordance with the National Dust Control Regulations (Government Notice No. R827, 2013) and the proposed revised regulations once these are promulgated. The dustfall monitoring should be used as an indicator as to the extent of the impacts from the Valley Silts Project and whether the mitigation measures are sufficiently effective.

The proposed dustfall monitoring locations are presented below:

Table 9-9: Dustfall monitoring locations

Name	Latitude	Longitude
VSD1	26° 13' 10.154" S	27° 59' 8.085" E
VSD2	26° 13' 23.639" S	28° 0' 2.981" E
VSD3	26° 13' 33.323" S	28° 0' 23.486" E
VSD4	26° 13' 43.424" S	27° 59' 52.518" E
VSD5	26° 13' 18.385" S	27° 58' 54.118" E
VSD6	26° 13' 28.695" S	27° 59' 11.613" E

As part of this monitoring programme, monthly reports must be produced. If the measured dustfall shows a marked increase from pre-operational phase levels, and the new dustfall rates exceed the regulated dustfall rate (Table 9-10), continuous PM_{10} monitoring in the residential area may be used to give a direct indication of health impacts experienced by the community. Furthermore, wet suppression or chemical stabilisation of all unpaved roads must be undertaken immediately to further mitigate emissions until dustfall rates are brought back into compliance with the National Dust Control Regulations. This emphasises the importance of monitoring (both in summer and in winter) prior to commencement of reclamation activities, as the development of a baseline will make it possible to more accurately evaluate the project's actual contribution to dustfall levels and by inference to ambient concentrations of PM. Currently, only the Stockwell monitoring station is close enough to give an indication of the impact of dust emissions from the Valley Silts Expansion area.

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Table 9-10: National Dust Control Regulations (Government Notice No. 517, 2018).

Level	Dustfall Rate (d) (mg/m^2/day) (30-days average)	Permitted Frequency of exceeding Dustfall Rate
Residential area	D < 600	Two within a year, not sequential months.
Non-residential area	D ≤ 1 200	Two within a year, not sequential months.

* The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be the latest version of ASTM D1739.

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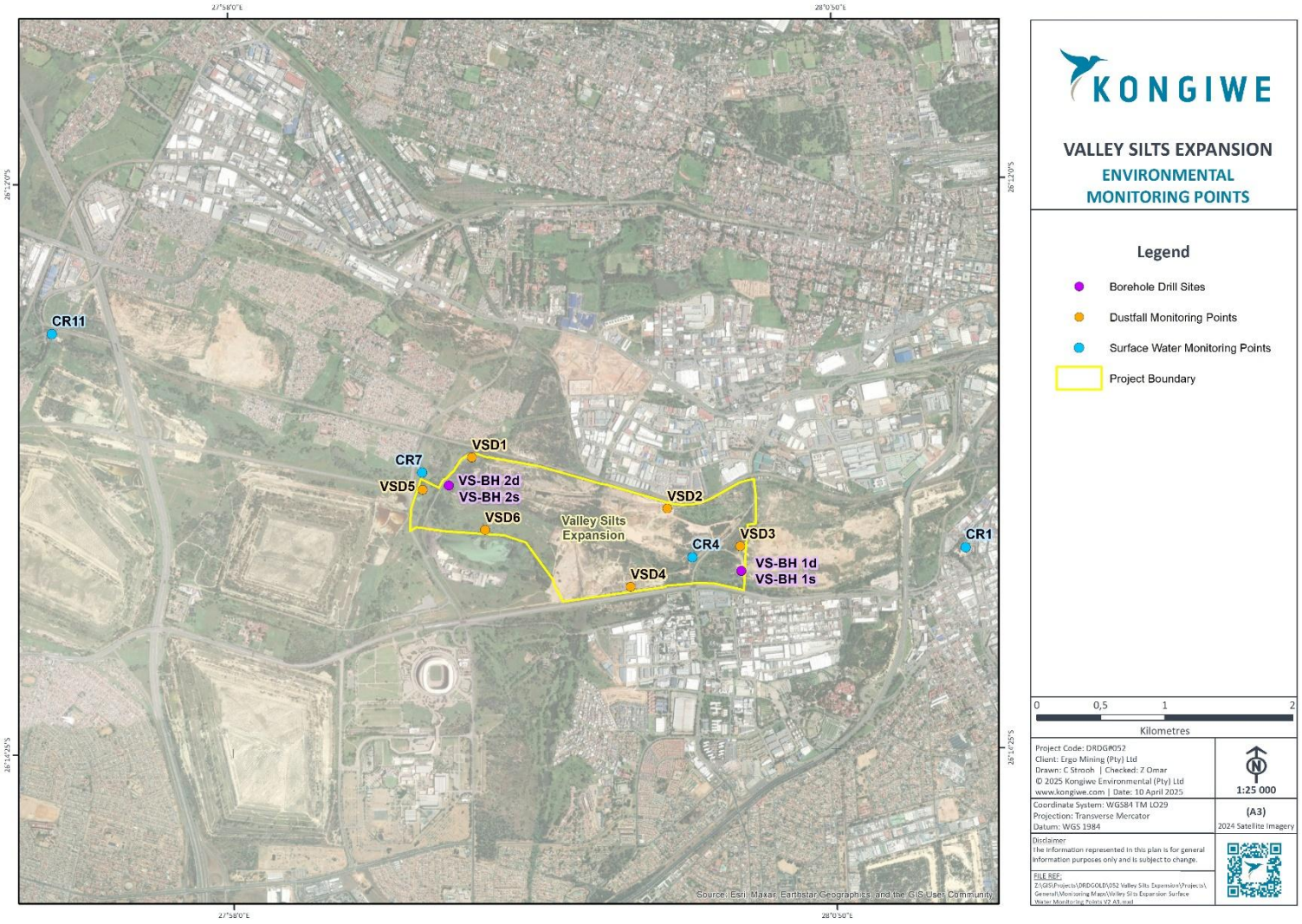


Figure 9-2: Environmental monitoring locations

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9.8 Heritage Management Plans

The project will encompass a range of activities during the construction phase, including ground clearance and infrastructure development associated with the project.

It is possible that cultural material will be exposed during construction and may be recoverable, keeping in mind delays can be costly during construction, and as such must be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, however foundation holes do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project, and these must be catered for. Temporary infrastructure developments, such as construction camps and laydown areas, are often changed or added to the project as required. In general, these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following chance find procedure should be implemented

9.8.1 Chance Find Procedure

- A heritage practitioner / archaeologist should be appointed to develop a heritage induction program and conduct training for the EO as well as team leaders in the identification of heritage resources and artefacts during the implementation of the EMPr.
- An appropriately qualified heritage practitioner / archaeologist must be identified to be called upon in the event that any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated, and construction activities halted.
- The qualified heritage practitioner / archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and the impact on the heritage resource.
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the materials and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the heritage practitioner / archaeologist

9.8.2 Possible Finds during Construction and Operation

The study area occurs within a greater historical and archaeological site as identified during the desktop and fieldwork phase. Soil clearance for infrastructure as well as the proposed reclamation activities, could uncover the following:

- Historical structures and foundations
- Unmarked burial grounds and graves

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9.8.3 Timeframes

It must be kept in mind that mitigation and monitoring of heritage resources discovered during construction activity will require permitting for collection or excavation of heritage resources and lead times must be worked into the construction time frames. Table 9-11 gives guidelines for lead times on permitting.

Table 9-11: Lead times for permitting and mobilisation

Action	Responsibility	Timeframe
Preparation for field monitoring and finalisation of contracts	The contractor and service provider	1 month
Application for permits to do necessary mitigation work	Service provider – Archaeologist and SAHRA	3 months
Documentation, excavation and archaeological report on the relevant site	Service provider – Archaeologist	3 months
Handling of chance finds – Graves/Human Remains	Service provider – Archaeologist and SAHRA	2 weeks
Relocation of burial grounds or graves in the way of the development	Service provider – Archaeologist, SAHRA, local government and provincial government	6 months

Table 9-12: Heritage Management Plan for EMPr implementation

Area and site no.	Mitigation measures	Phase	Timeframe	The responsible party for implementation	Monitoring Party (frequency)	Target	Performance indicators (Monitoring tool)
General project area	Implement chance find procedures in case where possible heritage finds are uncovered	Construction and operation	During construction and operation	Applicant Heritage Specialist	(monthly / as or when required)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	Monthly Checklist/Report
VS1 – historical mine compound complex	In the event that the site cannot be excluded from the planned reclamation activities, further research into the site must include: ❖ Exposing the structure through archaeological excavation ❖ Archival research on the structure ❖ Analysis of any artefacts recovered during the excavations ❖ If it is found that after mitigation the site is not conservation worthy an application for destruction must be lodged under s35 of the NHRA. If the site is to be retained after mitigation a site-specific heritage management plan for the site must be	Construction through to operation	Prior to and during construction	Applicant	Applicant	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	Monthly Checklist/Report

Area and site no.	Mitigation measures	Phase	Timeframe	The responsible party for implementation	Monitoring Party (frequency)	Target	Performance indicators (Monitoring tool)
	developed and submitted for approval to the SAHRA.						
VS2 – Burial ground	All burial grounds and graves must be retained and avoided with a buffer zone of 50 m as per SAHRA guidelines. If this is not possible, the graves should be relocated after completion of a detailed grave relocation process, that includes a thorough stakeholder engagement component, adhering to the requirements of Section 36 of the NHRA and its regulations as well as the National Health Act and its regulations and any provincial legislation.	Construction through to Operational	Prior to and during construction	Applicant Heritage specialist	Applicant	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	Monthly Checklist/Report
Possible graves	Undertake archaeological monitoring at earth clearance stage If any human remains are uncovered, contact SAHRA and appoint a qualified heritage specialist to undertake appropriate mitigation (usually exhumation and relocation).	Construction through to Operational	During Construction and Operation	Applicant	Applicant	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	Monthly Checklist/Report

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9.9 Social Management Plans

The following chapter sets out the framework for the Social Management Plan which is established to assure that the proposed mitigation measures as included in the SIA are effectively implemented during the life of the project and are continually refined and modified as necessary on the basis of actual field conditions and circumstances which may not have been anticipated at the time of the SIA preparation.

9.9.1 Stakeholder Engagement Plan

On-going stakeholder engagement is recommended to understand issues on the ground. To ensure effective consultation with community members during the authorisation, construction, operation and decommissioning phases of Ergo reclamation projects with CoJ, it is recommended that a Community Consultation Forum (Forum) be established. In establishing the Forum, that Ergo needs to take the following into consideration:

- Communities should democratically elect representatives to voluntarily sit on the Forum, which meets quarterly.
- Representatives would be responsible for disseminating project information to community members, and Ergo would be responsible for taking minutes and attendance registers at Forum meetings.
- The composition of the Forum might include the following Committee members:
    - Community members from the communities within the Projects area of interest;
    - Focus should especially be on areas that represents a larger risk in terms of social mobilisation including informal settlements – specifically in Wards 68;
    - Representatives from the Municipal Authorities; and
    - Ergo's representatives from the following divisions: Community Relations; and Environmental Management.
- Forum members would be required to hold meetings with their communities and provide Ergo with copies of the attendance registers and minutes of these meetings.
- Solutions to address service delivery require interventions from the local authorities. However, the applicant can address potential issues that could lead to unrest by ensuring that an effective grievance mechanism is put in place to ensure that stakeholders are provided with a platform to raise their concerns/complaints.
- Collaborate with the unit of the DMRE that deals with illegal mining-related issues and the SAPS to establish standard operating procedures for the control and/or removal of unauthorised individuals.

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9.10 Socio Economic Monitoring Programme

The proposed socio-economic monitoring programme below should be implemented during the construction phase, continue into operations, and throughout the life of the project.

Table 9-13: Proposed Socio-Economic Programme

Item	Parameters	Frequency	Responsible person
Procurement Management Plan	Procurement awards	Ongoing- throughout the life of the project	Ergo: Human Resources Manager/ Finance Manager and the Procurement officer.
Recruitment/retrenchment plan	Number of recruited candidates (sourced locally) Retrenchment-linked with training programme and continued Professional Development of staff	Ongoing- throughout the life of the project	Ergo: Human Resources Manager/ Finance Manager.
Training programmes/Learnerships/Internships	Number of training programmes offered and the effectiveness	Ongoing	Ergo: Human Resources Manager/ Finance Manager.
Health and Safety Plan	Number of reported health and safety incidents	Ongoing-Monthly	Ergo: Human Resources Manager/ Finance Manager, Safety, Health, Environment and Quality Officer
Commitments Register	Fulfilling commitments made in EIA, SIA as well as those made throughout the stakeholder engagement process	Ongoing-annual reviews	Ergo: Human Resources Manager/ Finance Manager/Environmental Manager/Stakeholder

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9.11 Radiation Assessment

Once reclamation of the gold-bearing silts has been undertaken and depending on the desired end land use, it is highly recommended to assess any residual contaminants, including potential radiation from the silts and to identify possible latent environmental impacts remaining. This is important to ensure that once the land is handed over that there is no potential further risk to the landowner.

The National Nuclear Regulator (NNR) has set the level for gamma radiation, for which regulation is not required, below 500 Bq (Becquerel) per kg. Direct radiation originates from uranium, which is a common mineral associated in the reefs that contain gold and is contained within the silts. The Radiation Assessment should measure the gamma radiation emanating from the decaying of the uranium atoms.

In terms of release of radioactively contaminated land, the Safety Standards and Regulatory Practices, under section 5.4, specifies that a site used in the conduct of an authorised action may be released for unrestricted use provided that it is demonstrated that the radioactive contamination and radioactive materials which can reasonably be attributed to the authorised action have been removed from the site, or in the case of naturally occurring radioactive nuclides, have activity concentrations below the levels of exclusion. The end land use will be dependent on the findings of such an assessment and will determine if these sites could be utilised or released for unrestricted use.

Ergo has the required National Nuclear Regulator (NNR) Certificate of Registration (COR) 281 for the operation. This COR is owned by Ergo and authorises them to carry out activities associated with radioactive materials as set out, and on the site as identified, in section 2.1 of the mention authorisation.

9.11.1 General

The NNR regulatory process requires CoR holders to submit a public Radiation Protection Programme (RPP) for approval by the NNR. The basis for the definition of the public RPP is the outcome of the comprehensive radiological public safety assessment and includes a monitoring programme, a surveillance programme and a control programme.

9.11.2 Monitoring Programme

Table 9-14 summarises the proposed monitoring programme aimed at public radiation protection. The responsibility for the implementation and execution of the monitoring programme lies with the Radiation Protection Function (RP Function) that include legally appointed persons consisting of a Radiation Protection Monitor(s) (RPM), a Radiation Protection Officer (RPO), and a Radiation Protection Specialist (RPS).

Table 9-14: Summary of the environmental monitoring programme proposed for the project aimed at public radiation protection.

Monitoring Element	Comment	Frequency
Surface water	Full-spectrum analysis (U-238, U-235, Th-232 and progeny)	Annually
	Total Uranium and Thorium	Quarterly

Monitoring Element	Comment	Frequency
Sediments	Full-spectrum analysis (U-238, U-235, Th-232 and progeny)	Once every two years
	Total Uranium and Thorium	Biannually
Groundwater	Full-spectrum analysis (U-238, U-235, Th-232 and progeny)	Once every two years
	Total Uranium and Thorium	Biannually
Radon gas	Environmental radon using Radon Gas Monitors (RGMs)	Quarterly for a period of 2 to 3 month

A full-spectrum analysis is suitable for detailed dose analysis but is an expensive procedure with long lead times to perform the analysis, which is why less frequent intervals are proposed. The total uranium and thorium analysis are relatively inexpensive with fast turnaround times. These results will monitor variations in activity concentration over the monitoring period.

Large variations in the activity concentration over a short period are not expected in groundwater, as opposed to surface water, for example. Therefore, a less frequent sampling schedule is proposed for groundwater. The same principle applies to the sediment samples at the same locations as the surface water sample.

The RGMs to monitor the variation in radon gas works in monitoring periods of 2 to 3 month, after which the RGMs are replaced with new RGMs for the next monitoring period.

9.11.3 Proposed Monitoring Points

Most of the monitoring points proposed to be part of the monitoring programme coincide with the monitoring programme for the environmental pathways. The following can be noted:

- The surface water monitoring locations should coincide with the existing or proposed surface water monitoring points. The principle to be applied is that the monitoring locations should be upstream and downstream of the area in potentially affected surface water streams, as well as upstream and downstream of specific discharge points.
- The sediment monitoring locations should coincide with the surface water monitoring points, applying the same principles.
- The groundwater monitoring points should coincide with the existing and proposed groundwater monitoring points. The principle to be applied is that the monitoring locations should be upstream and downstream of the area. The exact location will be determined by the availability of water-bearing boreholes in the specific area.
- The environmental radon monitoring locations do not have to coincide with specific locations. The principle to apply is that it should be around the extraction area and in the dominant wind direction where receptors are located, complemented with monitoring locations in what can be considered as background. The exact location is often influenced by whether a secured location is available to improve the recovery rate of the RGMs.

As part of the rehabilitation, decommissioning and closure, Ergo will need to ensure that the land is cleared of possible radioactive contamination and that all the required clearance and closure certificates have been received. This would require the remaining post reclamation surface (rehabilitated surface) to have a non-

radioactive level of radiation which would need to be in accordance with the requirements stipulated by the NNRA.

9.12 Waste Management Plan

The Waste Management Plan (WMP) plays a key role in achieving sustainable waste management throughout all phases of the project. The plan prescribes measures for the collection, temporary storage and safe disposal of the various waste streams associated with the project and includes provisions for the recovery, re-use and recycling of waste. The purpose of this plan is therefore to ensure that effective procedures are implemented for the handling, storage, transportation and disposal of waste generated from the project activities on site.

This management plan was formulated based on waste stream information available at the time of compilation. Construction and operation activities must be assessed on an ongoing basis to determine the efficacy of the plan and whether further revision of the plan is required. This plan should be updated throughout the life-cycle of the project, as required to ensure that appropriate measures are in place to manage and control waste and to ensure compliance with relevant legislation.

Prior to the commencement of construction, a detailed Waste Management Method Statement for the site should be compiled by the Contractor.

9.12.1 Waste Management Principles

An integrated approach to waste management is needed on site. It is important to ensure that waste is managed with the following objectives in mind during all phases of the project:

- Reducing volumes of waste is the greatest priority;
- If reduction is not feasible, the maximum amount of waste is to be recycled; and
- Waste that cannot be recycled is to be disposed of in the most environmentally responsible manner

9.12.2 Project Phase Waste Management

A plan for the management of waste during all phases of the project is detailed below.

9.12.2.1 Waste Inventory

- The Environmental Officer (EO), or designated staff member, must develop, implement and maintain a waste inventory reflecting all waste generated during the project life cycle for both general and hazardous waste streams.
- Construction methods and materials should be carefully considered in view of waste reduction, re-use, and recycling opportunities, to be pro-actively implemented.
- Once a waste inventory has been established, targets for the recovery of waste (minimisation, re-use, recycling) should be set.
- The EO must conduct waste classification and rating in terms of SANS 10288 and Government Notice 634 published under the NEM: WA.

9.12.2.2 Waste Collection, Handling and Storage

- Waste manifests and waste acceptance approvals (i.e. receipts) from designated waste facilities must be kept on file at the site office, to record and prove continual compliance for future auditing.
- Portable toilets must be monitored by the EO or responsible subcontractor and maintained regularly.
- Waste collection bins and hazardous waste containers must be provided by the principal contractor and subcontractors and placed at strategic locations around the site for the storage of organic, recyclable and hazardous waste.
- A dedicated waste area must be established on site for the storage of all waste streams before removal from site. The storage period must not trigger listed waste activities as per the NEMWA, GN 921 of November 2013.
- Signage/ colour coding must be used to differentiate disposal areas for the various waste streams (i.e. paper, cardboard, metals, food waste, glass etc.).
- The SHE Manager must develop, implement and maintain a waste inventory reflecting all waste generated during operation for both general and hazardous waste streams.
- Adequate waste collection bins at site must be supplied. Separate bins should be provided for general and hazardous waste.
- Recyclable waste must be removed from the waste stream and stored separately.
- All waste must be stored in appropriate temporary storage containers (separated between different operation wastes, and contaminated or wet waste).
- Waste storage shall be in accordance with all best-practice guidelines and under no circumstances may waste be burnt on site.
- Waste generated on site must be removed on a regular basis throughout the operation phase.
- Waste must be removed by a suitably qualified contractor and disposed of at an appropriately licensed landfill site. Proof of appropriate disposal must be provided by the contractor and kept on site.

9.12.2.3 Record Keeping

The success of waste management practices is determined by measuring criteria such as waste volumes, cost recovery from recycling and cost of disposal. Recorded data can indicate the effect of training and education, or the need for education. It will provide trends and benchmarks for setting goals and standards. It will provide clear evidence of the success or otherwise of the plan.

- Documentation (waste manifest, certificate of issue or safe disposal) must be kept detailing the quantity, nature, and fate of any regulated waste for audit purposes.
- Waste management must form part of the monthly reporting requirements in terms of volumes generated, types, storage and final disposal.

9.12.2.4 Monitoring of Waste Management Activities

Records must be kept of the volumes/ mass of the different waste streams that are collected from the site throughout the life of the project. The appointed waste contractor is to provide monthly reports to the operator containing the following information:

- Monthly volumes/ mass of the different waste streams collected;
- Monthly volumes/ mass of the waste that is disposed of at a landfill site;
- Monthly volumes/ mass of the waste that is recycled;
- Data illustrating progress compared to previous months.

This report will aid in monitoring the progress and relevance of the waste management procedures that are in place. This report must from part of the EO's reports on a monthly basis.

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10 COMPLIANCE MONITORING MECHANISM

Table 10-1 depicts the monitoring and management plan for the management measures and actions identified in the impact assessment. Where specific monitoring and management plans are required, these are detailed in Section 9.

Table 10-1: Monitoring and Management Plan

Impact Management Action	Monitoring / Management Action	Monitoring Frequency	Roles and Responsibilities	Compliance Mechanism	Compliance Reporting Frequency	Monitoring trigger response criteria
Groundwater						
Groundwater level	Groundwater levels	6 Monthly	Ergo/EO	-	6 Monthly	Variations by more than 3m for 2 consecutive months should be investigated.
Water quality analysis	❖ All boreholes and surface water monitoring positions listed in the Groundwater impact assessment Monitoring ❖ No privately owned boreholes in the project area.	6 Monthly	Ergo/EO	South African National Standards (SANS241) and Klip River catchment guideline limits;	6 Monthly	Variations in concentrations by more than 15% for major cations and anions and more than 7% for metal concentrations for more than 2 consecutive months should be investigated. Any result that exceeds specified water quality objectives must be investigated when it occurs.
Rainfall	Rain depth (mm)	daily	Ergo/EO		6 Monthly	none
Surface Water						
Surface water quality monitoring	The DWS Best Practice Guideline G3: Water Monitoring Systems	Quarterly (or as suggested by the DWS) prior to the commencement of construction	Ergo/EO	❖ DWS best practice guidelines G3: Water Monitoring Systems. ❖ South African National Accreditation System (SANAS) accredited laboratory for analysis. ❖ Compare against baseline quality.	Quarterly	A continued decrease in water quality below the standards listed on a continual basis. If there is a clear reduction in water quality due to the activities.
		Quarterly (or as suggested by the DWS) basis during the life of the project	Ergo/EO		Quarterly	
		Quarterly (or as suggested by the DWS) until the project has completely and successfully been rehabilitated.	Ergo/EO		Quarterly	
Stormwater infrastructure	Stormwater management infrastructure	Monthly Basis during the dry season. Weekly basis during the wet season	Ergo/EO		Monthly	Any storm events. Or flooding due to mismanagement and improper maintenance
		Monitored immediately after a stormwater event	Ergo/EO/Maintenance Manager		Immediately	
Reporting	Monitoring reports to include trend analyses. Sampling of water quality from upstream monitoring points must be compared to downstream monitoring points	Monitoring reports submitted to DHSWS.	Ergo/EO		Quarterly (or as recommended by the DHSWS)	
Air Quality						
Dust: / Wet suppression/ Chemical stabilization of unpaved roads	Visually	Daily	❖ Project Site manager ❖ Contractor EO ❖ Contractor EO	Internal audit by Ergo in house specialists	Monthly	Visual observation of heavy dust generated by traffic or activities. Any formal complaints received by local communities.
	Dust Fallout Monitoring	Starting as far prior to construction as possible. Monthly during construction,	Ergo/EO	❖ Internal audit by Ergo in house specialists	Monthly	Table 9-10: National Dust Control Regulations (Government Notice No. 517, 2018).

Impact Management Action	Monitoring / Management Action	Monitoring Frequency	Roles and Responsibilities	Compliance Mechanism	Compliance Reporting Frequency	Monitoring trigger response criteria
		operational and decommissioning phases		❖ National Dust Control Regulations.		
Heritage						
Possible finds	Chance find procedure	Prior to site clearance During construction and operation	❖ Ergo ❖ Project EO ❖ Heritage Specialist	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35 and 38 of NHRA	Monthly Checklist/Report	If any form of heritage is discovered or unearthed on site. If any graves are discovered.
Radiation						
Refer to Section 9.11.2 for the radiological monitoring programme						
Social						
Refer to section 9.9 for the social related management						

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11 OATH UNDERTAKING

The EAP hereby confirms:

- The correctness, to the best of their knowledge, of the information provided in the specialist reports and on information provided by Ergo. The information was accepted as being as reliable as information generated during an EIA and a feasibility study, and provided in good faith, can be;
- The inclusion of comments and inputs from stakeholders and I&APs;
- The inclusion of inputs and recommendations from the specialist reports where relevant; and
- The acceptability of the project in relation to the finding of the assessment and level of mitigation proposed.

Kongiwe Environmental (Pty) Ltd	
Company Name	
Ripfumelo Macevele	
Name of the Environmental Assessment Practitioner	**Signature**
2025/06/03	
Date	