# **APPENDIX B2:** Geohydrology Impact Assessment

# Geohydrological Assessment for Mossdustria, Mossel Bay, Western Cape

*Water Use Licence Application for Mossel Bay Local Municipality on RE/8/225, Mossel Bay, Western Cape*


14 AUGUST 2026

GEOSS Report No.: 2026/08-08

GEOSS
Groundwater & Geo-Environmental Solutions

# Executive Summary

GEOSS South Africa (Pty) Ltd (GEOSS) was tasked by Nemai Consulting (Pty) Ltd, on behalf of the Mossel Bay Local Municipality, to conduct a geohydrological assessment for the Water Use Licence Application (WULA) in terms of Section 21 (c) and (i) of the National Water Act (Act No. 36 of 1998). The proposed water uses relate to activities that may impede or divert the flow of water in a watercourse and alter the bed, banks, course or characteristics of a watercourse. No groundwater or surface water abstraction is proposed as part of the development.

The study area comprises loam and sandy loam (T-Ql) overlying the Skurweberg Formation, which forms the deeper fractured aquifer. Augering encountered dense clay and very fine sand to approximately 1.7 mbgl. While this may indicate the presence of a low-permeability shallow layer that could locally restrict vertical infiltration and promote surface runoff and shallow water accumulation, the clay may not be laterally continuous and could occur as discrete lenses.

Groundwater recharge is expected to occur primarily through infiltration of the Skurweberg Formation, where it is exposed or where the overburden has a low clay content. Although the area is mainly mapped as having a low vulnerability to surface-based contamination, it is expected that where the Skurweberg Formation outcrops, the vulnerability might be higher as the contaminants could potentially migrate through preferential pathways. Stable isotope results support a predominantly meteoric origin for the groundwater and surface water samples.

It is essential to adopt stringent site-specific management practices to prevent contamination from fuel or hazardous substances. Prompt spill response and monitoring of groundwater and wetland conditions during construction and operation will ensure that potential impacts are identified early and appropriate measures can be implemented to protect the groundwater resource and wetland systems. Incorporating the recommended Groundwater Management guidelines (**Section 1**) into the WULA conditions is advised.

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## Abbreviations

| | |
|---|---|
| bh | Borehole |
| CGS | Council for Geoscience |
| DD | Decimal degrees |
| DO | dissolved oxygen |
| DWA | Department of Water Affairs (pre- 1994) |

| | |
|---|---|
| DWAF | Department of Water Affairs and Forestry (1994 - 2009) |
| DWS | Department of Water and Sanitation (2009 - .......) |
| EC | Electrical Conductivity |
| ha | hectare |
| km | kilometre |
| L/s | litres per second |
| L/day | litres per day |
| m | metres |
| $m^3/a$ | metres cubed per annum |
| mamsl | meters above mean sea level |
| mbgl | metres below ground level |
| m3/ha/a | metres cubed per hectare per annum |
| mg/L | milligrams per litre |
| mm | millimetre |
| mm/a | millimetres per annum |
| mS/m | milliSiemens per meter |
| NGA | National Groundwater Archive |
| SANAS | South African National Accreditation System |
| SANS | South African National Standard |
| TDS | Total dissolved solids |
| WARMS | Water Authorisation Registration Management System |
| WGS84 | World Geodetic System 1984 |

# Glossary of Terms

| | |
|---|---|
| Aquifer: | A geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)]. |
| Borehole: | Includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)]. |
| Electrical conductivity: | The ability of groundwater to conduct electrical current, due to the presence of charged ionic species in solution (Freeze and Cherry, 1979). |
| Fractured aquifer: | Fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures. |
| Groundwater: | Water found in the subsurface in the saturated zone below the water table or piezometric surface, i.e., the water table marks the upper surface of groundwater systems. |

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**SPECIALIST EXPERTISE**

**CURRICULUM VITAE – Jana Oberholzer**

# JANA OBERHOLZER

Hydrogeologist

### Qualifications

BSc (Hons) Earth Science (Geo-Environmental Science)
BSc Earth Science (Geo-Environmental Science)

### Professional registrations

Candidate Natural Scientist – South African Council for Natural Scientific Professions (SACNASP)

### Key Skills

- Groundwater monitoring and management
- GIS Workbench software skills
- Stable isotope and radio-isotope analysis

### Memberships

- Groundwater Division of the Geological Society of South Africa: Mem. No. 3006/26
- South African Council for Natural Scientific Professions (SACNASP): Mem. No. 171408 (Cand. Sci Nat)

### Experience

***GEOSS South Africa (Pty) Ltd (February 2025 – Present)***

- Hydrogeologist (February 2025 – Present)

***GEOSS South Africa (Pty) Ltd (July 2024)***

- Intern Hydrogeologist: TMG Project field work (Kogelberg Nature Reserve)

***M2 Environmental Connections (Pty) Ltd (June 2023)***

- Part-time Environmental Scientist: Ground- and surface water monitoring, SASS5 aquatic assessments (Gauteng)

### Years in the industry

**1 years**

**CURRICULUM VITAE – Lizanne Smit**

# LIZANNE SMIT

## Hydrogeologist

### Summary

Lizanne Smit is an experienced and highly skilled hydrogeologist with a strong background in groundwater assessment, management and resource protection. She has extensive experience in geohydrological assessments, groundwater licensing, municipal and regional supply planning and the integration of groundwater considerations into broader water resource management frameworks.

As a project hydrogeologist at GEOSS South Africa (Pty) Ltd, Lizanne has successfully led and supported numerous high-impact projects focused on ensuring the sustainable use, protection and governance of groundwater resources. Her work spans groundwater reserve determination, licensing, compliance assessments, risk evaluations and the development of practical management approaches for complex groundwater systems. She is particularly proficient in hydrogeological conceptualization and groundwater–surface water interaction assessment.

Her recent contributions to the City of Cape Town's Groundwater Governance and Policy initiative, as well as the Transboundary Groundwater Strategy for the Cubango–Okavango River Basin, reflect her ability to apply technical hydrogeological understanding within broader governance and regional resource management frameworks. Lizanne remains an active contributor to the hydrogeological community through industry courses, conferences and published research on Malmesbury Group aquifers. She is a registered natural scientist with SACNASP and an active member of the Groundwater Division of the Geological Society of South Africa.

### Qualifications

MSc Integrated Water Management
BSc (Hons) Economic Geology
BSc Earth Sciences

### Professional registrations

Professional Natural Scientist – South African Council for Natural Scientific Professions (SACNASP)_126348
Groundwater Division (GWD) of the GSSA – Western Cape Member_ Mem No. 9189

### Specialisation

Project Management; hydrogeology; numerical modelling; environmental impact assessment; groundwater resource management; groundwater governance; sustainability studies

### Years in the industry

**9 years**

### Publications

GSSA Article, 2019. The Malmesbury Group – an aquifer of surprising significance. South African Journal of Geology, Volume: 122.3, Page: 331-342, doi:10.25131/sajg.122.0028

### Courses and symposiums

2019: PEST course with Professor John Doherty
2022: Groundwater Governance Course with Carin Bosman
2023: FEFLOW: Advanced Groundwater Modelling DHI
2023: Presenting at IAH Cape Town Congress
2025: Presenting at Presenting at 7th SADC-GMI Groundwater Conference

### Relevant Experience

- **2025 – OKACOM & SADC-GMI (CORB)**: Served as Senior Hydrogeologist contributing to the development of a transboundary groundwater strategy for the Cubango-Okavango Basin. Provided technical input on hydrogeology, recharge, water quality, and groundwater–surface water interactions, including assessment of data gaps and monitoring frameworks across Angola, Namibia, and Botswana.
- **2021–2023 – DWS BlueScience (F60 & G30 Catchments)**: Led groundwater Reserve Determination components, including conceptualisation of the geohydrological system and analysis of hydrogeological and hydrochemical datasets. Delineated priority aquifer areas and defined groundwater–surface water dependencies to support regional resource management.
- **2023 – WWF-UK / Freshwater Research Centre**: Developed and applied groundwater sustainability indicators within an agricultural water management framework. Facilitated stakeholder engagement with DWS, CMAs, and WUAs to evaluate groundwater use in key export catchments.
- **2023–2024 – HORTGRO Groundwater Study**: Lead hydrogeologist responsible for characterising groundwater availability, use, and recharge across major fruit-growing regions. Developed GIS-based databases and provided management recommendations to support sustainable groundwater use in agriculture.
- **2023–2026 – Western Cape Department of Local Government**: Senior Hydrogeologist and Project Coordinator managing a provincial hydrogeological services contract across multiple municipalities. Led groundwater risk assessments, coordinated geohydrological studies, and oversaw project delivery, reporting, and stakeholder engagement under the framework agreement.

**CURRICULUM VITAE – Julian Conrad**

# JULIAN CONRAD

Hydrogeologist

### Qualifications

MSc Hydrogeology and GIS
BSc (Hons) Engineering geology
BSc Geology

### Professional registrations

Professional Natural Scientist – South African Council for Natural Scientific Professions (SACNASP)

### Specialisation

Hydrogeology; geotechnical geology; groundwater resource management; wellfield development; groundwater exploration and monitoring

### Years in the industry

**34 years**

### Summary

Julian has over 3 decades within the hydrogeological industry with extensive experience in managing groundwater resources and quality. His proficiency is predominantly in groundwater management, encompassing legal compliance, monitoring and management, and impact assessments. He has also worked extensively with local government departments, and his expertise extends to GIS and wellfield development and operations. In 2001, he established GEOSS, which is headquartered in Stellenbosch and currently has a staff of 35 employees focusing on hydrogeological and geotechnical consulting. Currently, Julian serves as the Managing Director of the company. GEOSS South Africa focuses mainly on Hydrogeology and Geotechnical projects within South Africa, but also extends to international projects in countries such as Namibia, Botswana, DRC, Saudi Arabia, Côte d'Ivoire, Sweden, and Denmark.

Julian has achieved both local and international recognition. Julian was elected to the Executive Committee of the International Association of Hydrogeologists (IAH) in 2024 as the Vice President for Finance and Membership. A member of the IAH since 1990, he has served on the IAH-South Africa Executive Committee since 2004 and held key roles, including Chair, Secretary, and International Portfolio lead for the National Executive Committee. He organized and contributed to landmark events such as the IAH2000 Congress and the IAH 50th Congress (2023) and has achieved numerous accolades including the Groundwater Division Lifetime Achievement Award (2023).

As a leader, project collaborator, and awardee, his work has significantly advanced the science and technology of groundwater.

### Relevant Experience

Study the Potential Risks of Constructing Riyadh Lake, KSA, RCRC, 07/2024 - 12/2024, Senior hydrogeologist

Groundwater Exploration and Development, South Africa, Aurecon, 1/2018 - 05/2018, Senior Hydrogeologist

Geological and hydrogeological characterisation of Calitzdorp, South Africa, Aurecon, 12/2019 - 04/2020, Senior Hydrogeologist

Geohydrological Assessment of Merweville Town Water Supply, South Africa, Aurecon, 06/2020 - 11/2021, Senior Hydrogeologist

Feasibility study for managed aquifer recharge at Palla Raod, South Africa, Department of Water and Sanitation, 12/2019 - 02/2022, Senior hydrogeologist

Reserve determination study for surface and groundwater systems within the Berg Olifants Water Management Area, South Africa, Department of Water and Sanitation, 03/2022 - 11/2024, Senior hydrogeologist

Compilation of the 15-year Western Cape Integrated Drought and Water Response Plan, South Africa, Western Cape Government, 02/2022 - 05/2022, Senior Hydrogeologist

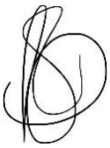
Hydrogeological Impact Assessment for Biesjesvlei Solar Photovoltaic Facility, South Africa, Council for Scientific and Industrial Research, 09/2023 - 06/2024, Senior Hydrogeologist

Hydrogeological baseline study for Wadi Hilo, UAE, Gary Bartsch International, 03/2008-09/2008, Senior Hydrogeologist

## SPECIALIST DECLARATION

We, Jana Oberholzer, Lizanne Smit and Julian Conrad, as the appointed independent specialist(s), hereby declare that we:

- Act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to our specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have and will have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- are fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act and that failure to comply with these requirements may constitute and result in disqualification;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- are aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.



**Jana Oberholzer**
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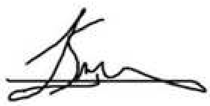
12 August 2026



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12 August 2026

**Julian Conrad**
GEOSS South Africa (Pty) Ltd
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13 August 2026

# 1. Introduction

GEOSS South Africa (Pty) Ltd (GEOSS) was approached by Nemai Consulting (Pty) Ltd, on behalf of the Mossel Bay Local Municipality, to compile a geohydrological assessment for the proposed Mossdustria development on the property, Remainder of Portion 8 of the Farm Rietvalley 225 and Erf 3. The study included a desktop assessment of various groundwater databases, as well as a field visit to assess the potential impact of the proposed development on groundwater systems. The WULA is for Section 21(c) – impeding or diverting the flow of water in a watercourse and Section 21 (i) – altering the bed, banks, course or characteristics of a watercourse. The proposed development is within the 500 m regulated area of wetlands and within 32 m of watercourses, justifying the need for a WULA.

# 2. Scope of Work

The scope of work is to provide groundwater specialist services, including the tasks outlined below:

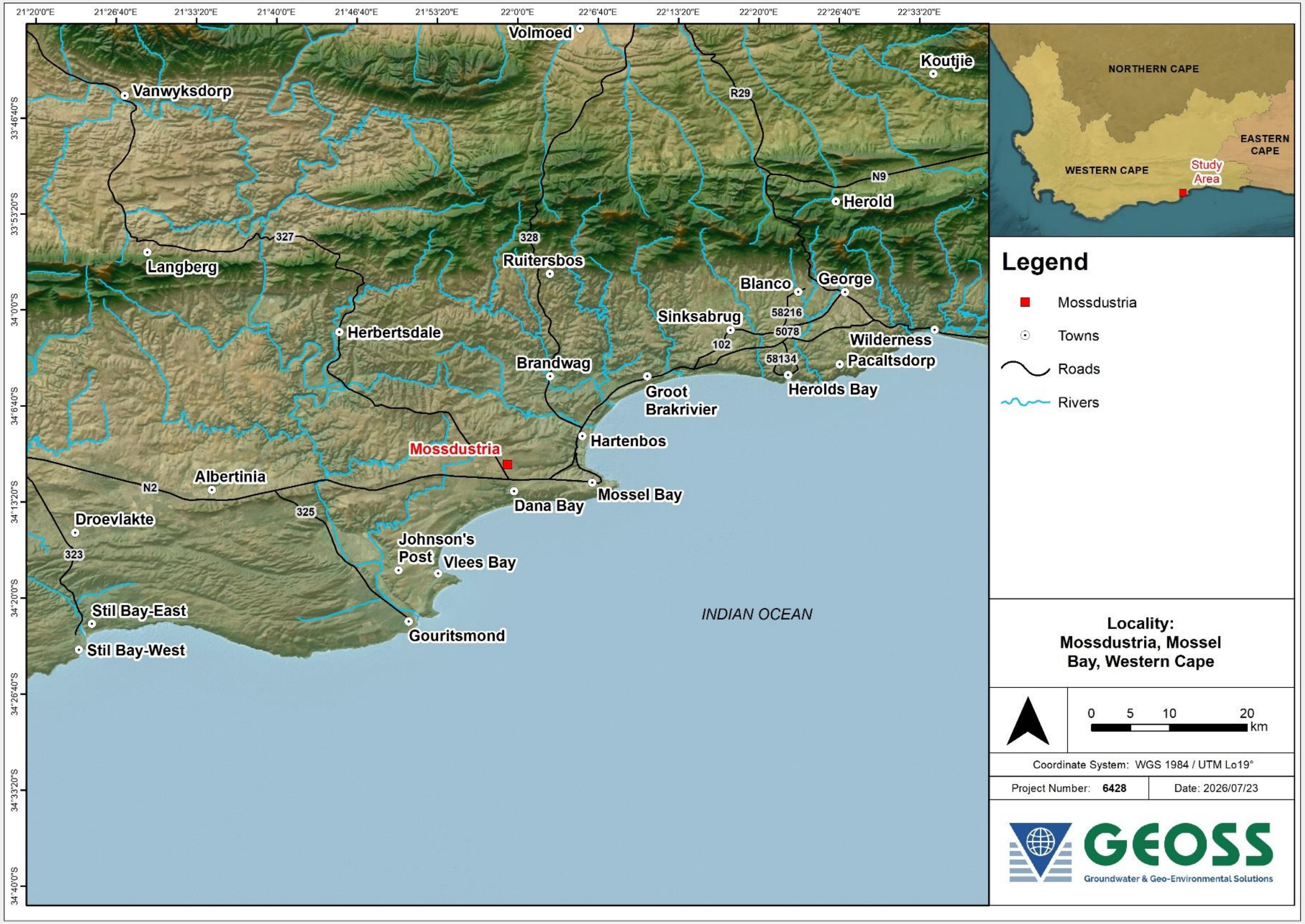
- Review of available literature and other specialist studies pertaining to the study site;
- Complete a geohydrological characterisation of the groundwater in the vicinity of the property;
- Assess the importance and sensitivity of groundwater and surface water resources in the area through a hydrocensus and site investigation;
- Assess the potential interaction between groundwater and surface water features;
- Provide recommendations and mitigation measures to minimise risk and impacts from proposed industrial development; and
- Document the above findings in a format fully compatible with the requirements for a water use licence application (which is to be submitted to the DWS).

The assessment has been conducted in accordance with accepted best practice principles.

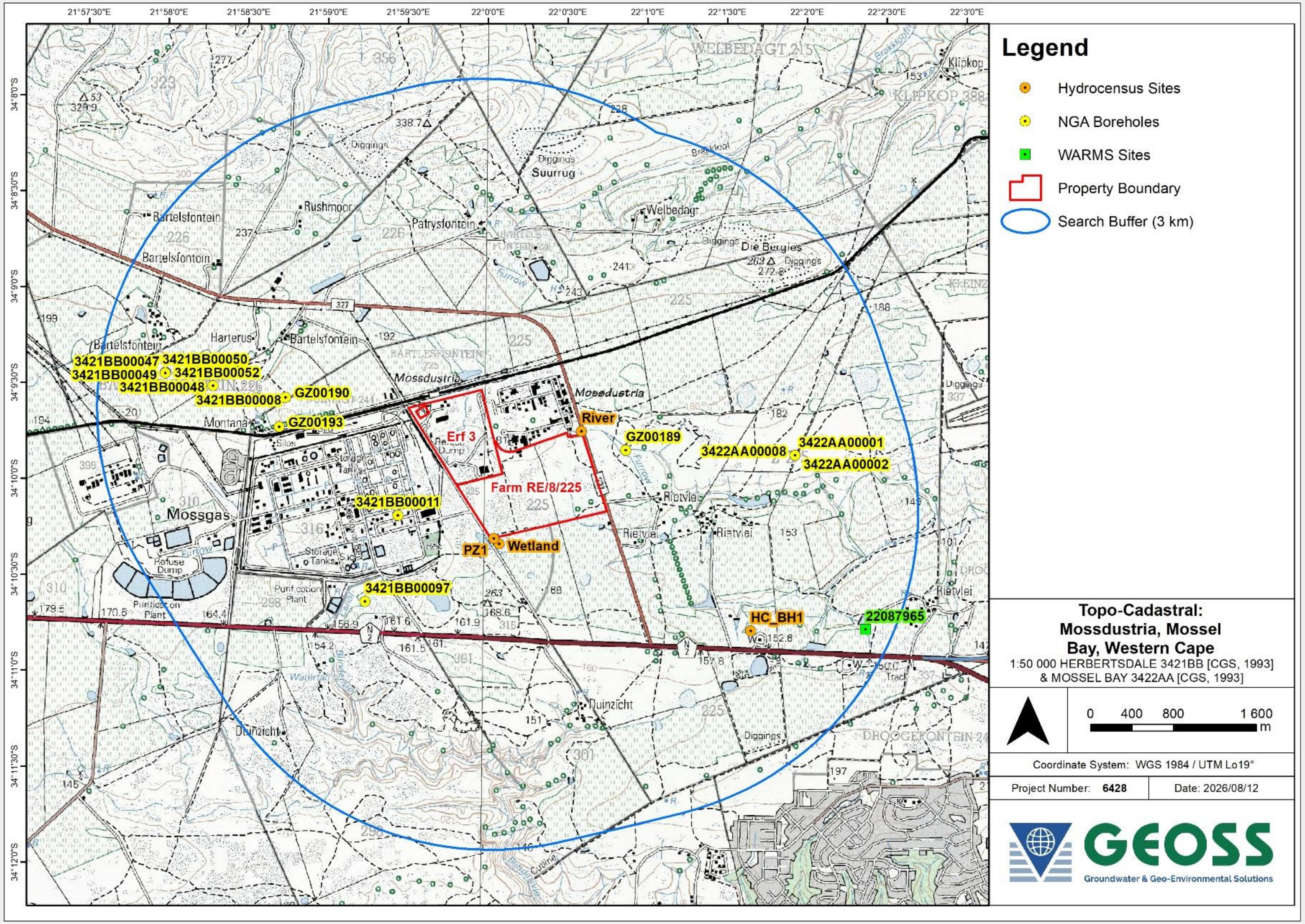
# 3. Methodology

The procedure adopted for this study involved a desktop study, followed by fieldwork. The initial desktop study involved obtaining and reviewing all relevant data for the project site. This included reviewing relevant site plans, reports and geological maps of the area and analysing data from multiple groundwater databases. A site visit was then conducted to collect additional data and verify as much of the existing data as possible. This included a site visit at the relevant wetlands, rivers and boreholes. The field visit included an auger investigation to determine shallow groundwater conditions and to take a groundwater sample. Water samples of relevant surface water bodies were taken to assess the surface water-groundwater interaction through isotopic analysis. All collected data were analysed and interpreted to assess the potential risks associated with the proposed development as they pertain to groundwater. Management recommendations were included to ensure the sustainability of the proposed expansion.

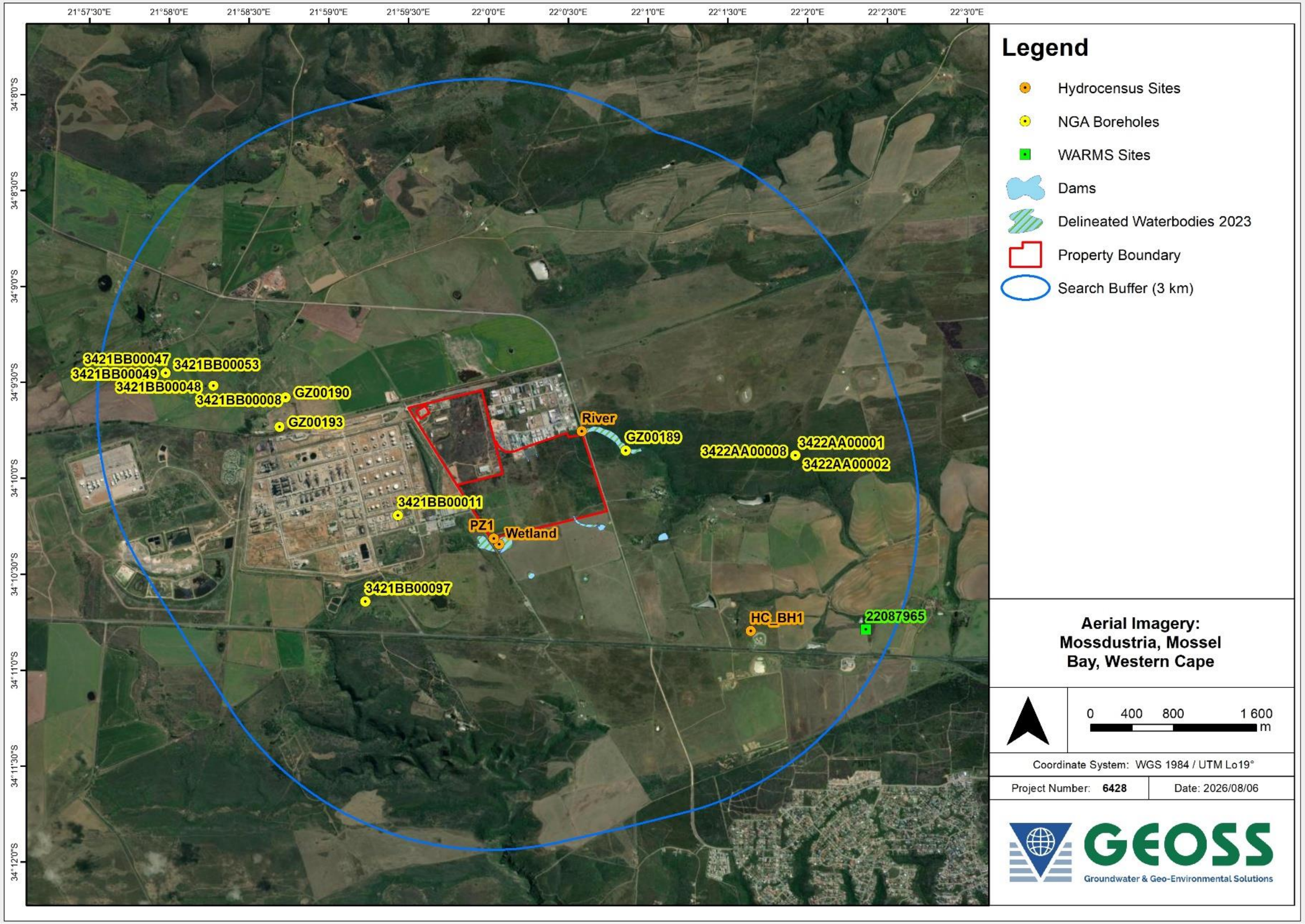
The study area, within a regional context, is shown in **Map 1**. **Map 2** and **Map 3** show more detailed views of the study site with relevant information (borehole positions at and near the property) superimposed on a 1:50 000 topo-cadastral map and satellite image, respectively.




*Map 1: Locality of the Mossdustria Industrial site, Mossel Bay, Western Cape.*




*Map 2: The study site with the property boundary superimposed on a 1:50 000 scale topo-cadastral map (3422AA).*




*Map 3: The study site with the property boundary, the production, hydrocensus, NGA and WARMS boreholes, superimposed on a satellite image.*

# 4. Regional Setting

## 4.1. Site Context

The Remainder Portion 8 of Farm Rietvalley 225 is 90.14 ha in size and Erf 3 is 48.37 ha. These properties are approximately 13 km west of Mossel Bay Central, within the Mossel Bay Local Municipality in the Western Cape province. The proposed site is adjacent to PetroSA and the Gourikwa Power Station. It is located within quaternary catchment K10A. The quaternary catchment is approximately 168.97 km$^2$ in extent. The proposed infrastructure (tracks, solar arrays, internal roads, stormwater attenuation ponds and industrial stands) is within the 500 m regulated area of wetlands and within 32 m of watercourses.

The proposed Mossdustria expansion and motorsport arena is situated on a relatively flat coastal plateau. The site is located approximately 3 km inland from the Indian Ocean shoreline. The elevation of the site ranges between 165 mamsl and 177 mamsl, characterised by gentle slopes that extend towards the coast. The wetlands are located along the southern property boundary, with the site topography generally sloping southwards towards these wetland areas.

## 4.2. Climate

The study area experiences a warm and temperate climate. Mossel Bay's precipitation is distributed relatively evenly throughout the year. Although the highest mean rainfall occurs in October and March, the area experiences rainfall all year round. **Figure 1** illustrates the monthly average minimum and maximum air temperatures and **Figure 2** illustrates the monthly mean rainfall and evaporation distribution for the study area (Schulze, 2009). The study area receives a mean annual precipitation of 463 mm/a. Although potential evaporation exceeds rainfall during most months, the timing, intensity and duration of rainfall events influence the proportion of rainfall available for infiltration and recharge.

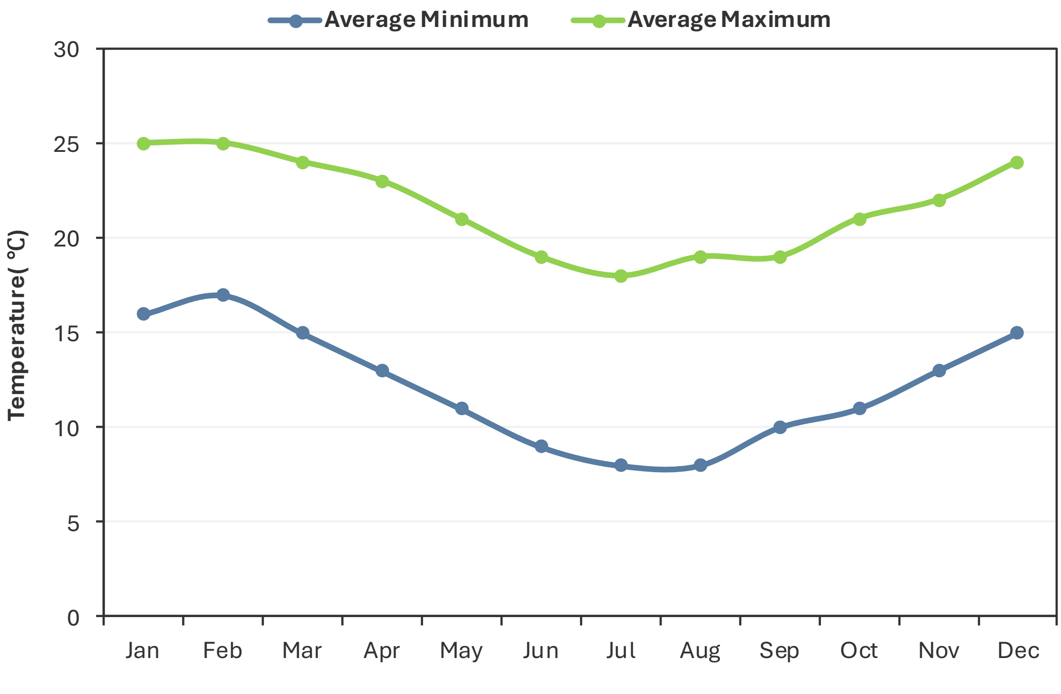



*Figure 1: Monthly average minimum and maximum air temperatures for the study area (Schulze, 2009).*

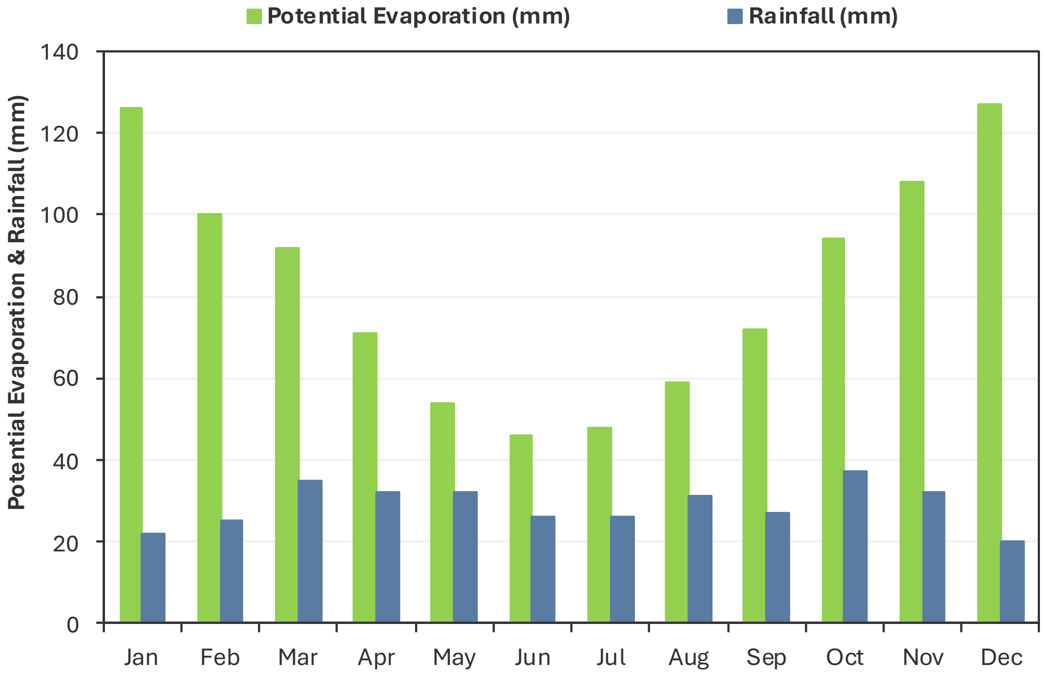



*Figure 2: Monthly average rainfall and evaporation distribution for the study area (Schulze, 2009)*

# 5. Regional Geology

The Geological Survey of South Africa (now the Council for Geoscience (CGS)) has mapped the area at 1:50 000 scale (3421BB Herbertsdale & 3422AA Mossel Bay). As the study area covers the boundary between these two map sheets, the geological interpretation presented in **Map 4** represents a composite of both maps. The geological setting is shown in **Map 4** and the main geology of the area is listed in **Table 1**.

*Table 1: Geological formations within the study area.*

| Symbology | Formation | Group/Suite | Lithology |
|---|---|---|---|
| Qg | Non-shelly sand | Quaternary | Loam and sandy loam |
| Qb | Brackish calcareous sand, silt and clay | Quaternary | Calcareous sand, silt, clay |
|  | Alluvium | Quaternary | Sand, gravel, silt, clay |
| T-Qt | Gritty sand/debris | Tertiary-Quaternary | Poorly sorted gritty sand, rock debris |
| T-Ql | Loam and sandy loam soil | Tertiary-Quaternary | Sandy loam, clay-rich soil |
| T-Qr | River terrace: sand and gravel | Tertiary-Quaternary | Sand and gravel |
| Qc | Calcrete | Quaternary | Hardened calcrete crust |
| Tw | Wankoe Formation | Bredasdorp Group | Grey-weathering, massive or large-scale cross-bedded calcarenite and calcareous sandstone |
| Tgg | High-level terrace gravel and soil | Cenozoic duricrust | Gravel and soil |
| Tgf | Ferricrete | Cenozoic duricrust | Hardened ferruginous crust |
| Tgs | Grahamstown Formation | Cenozoic duricrust | Silcrete, ferricrete |
| J-Kk | Kirkwood Formation | Uitenhage Group | Variegated (reddish-brown and greenish) silty mudstone and sandstone, subordinate grey shale and sandstone |
| Je | Enon Formation | Uitenhage Group | Conglomerate, subordinate lenticular sandstones and claystones |

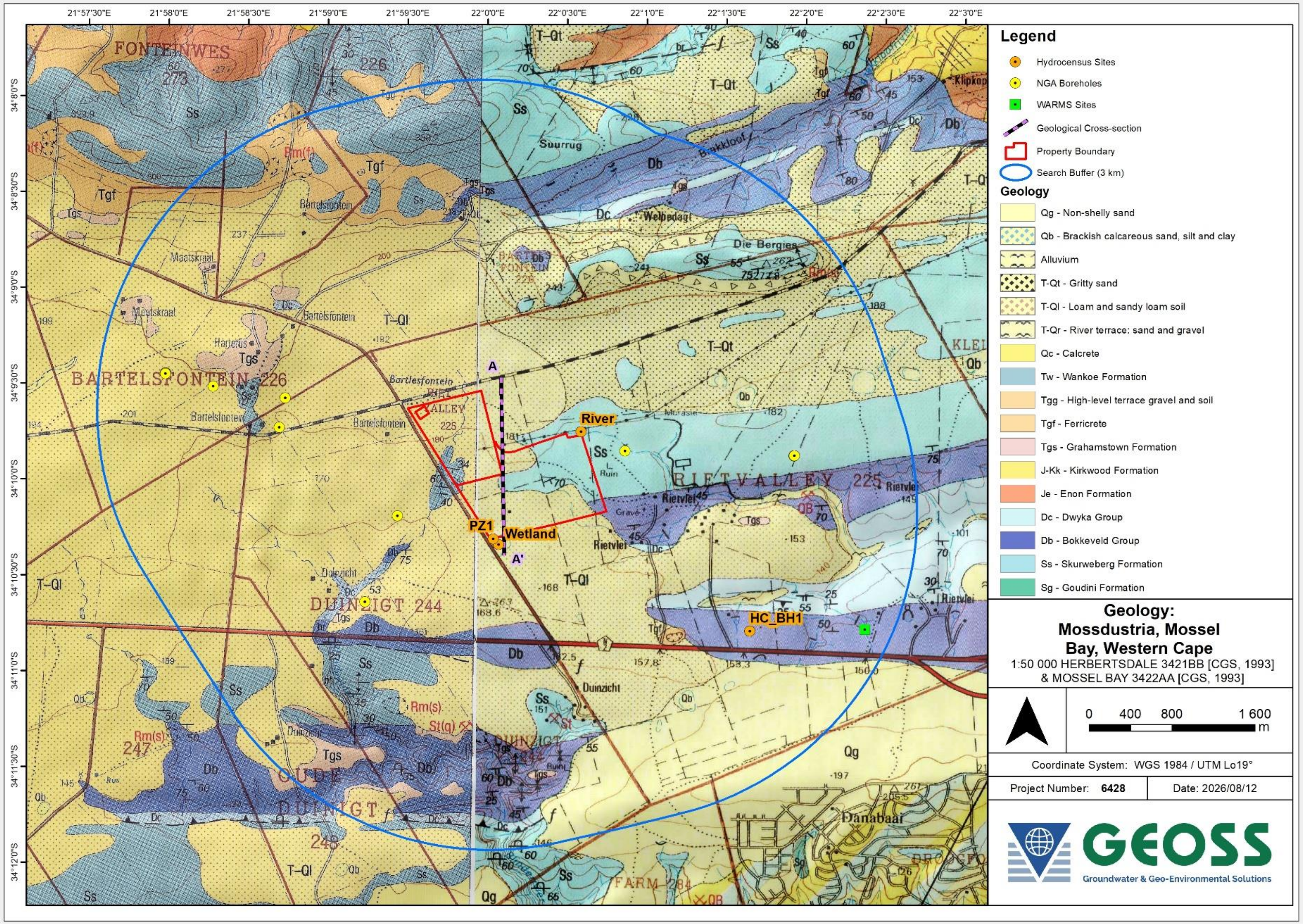
| Symbology | Formation | Group/Suite | Lithology |
|---|---|---|---|
| Dc | Dwyka Group | Karoo Supergroup | Diamictite/tillite |
| Db | Bokkeveld Group | Cape Supergroup | Shale, siltstone, minor sandstone |
| Ss | Skurweberg Formation | Nardouw Subgroup | Thick-bedded quartzitic sandstone with minor conglomerate |
| Sg | Goudini Formation | Nardouw Subgroup | Brownish-weathering, quartzitic sandstone, subordinate shale and siltstone |

The proposed Mossdustria development is situated within the southern Cape Fold Belt of the Western Cape Province. The regional geology comprises sedimentary rocks of the Cape Supergroup, locally overlain by younger sedimentary deposits of the Karoo Supergroup, Uitenhage Group, Bredasdorp Group and unconsolidated Tertiary to Quaternary sediments. The regional geological succession ranges in age from Ordovician Table Mountain Group quartzitic sandstones to unconsolidated Quaternary deposits associated with coastal and alluvial environments.

The property is mapped predominantly as T-Ql (loam and sandy loam soil), representing unconsolidated residual and transported surficial deposits of Tertiary to Quaternary age. These soils comprise sandy loam with varying clay content and form a shallow cover over the underlying bedrock. Although these deposits may locally store shallow groundwater within intergranular pore spaces following recharge, they are generally of limited thickness and groundwater storage potential.

A prominent ridge of the Skurweberg Formation (Ss) of the Nardouw Subgroup, Table Mountain Group (Cape Supergroup) extends across the central to eastern portion of the property. The Skurweberg Formation comprises thick-bedded quartzitic sandstone with minor conglomerate and forms the principal bedrock aquifer in the area. Groundwater occurrence within this formation is controlled primarily by secondary permeability associated with fractures, joints, bedding plane discontinuities and weathered zones, as the quartzitic sandstone possesses negligible primary porosity. The Skurweberg Group is widely known as a more permeable sandstone and therefore a prime target during groundwater exploration.

The Bokkeveld Group (Db) of the Cape Supergroup, mapped in the southeast corner of the property, comprises predominantly mudrock (feldspatic and shale) and sandstone, which gives the formation a less permeable characteristic. This impermeable layer leads to the tendency of wetlands to occur in the area. The surrounding area includes additional geological units that form part of the regional geological succession, which include the Dwyka Group (Dc) of the Karoo Supergroup; the Enon Formation (Je) and Kirkwood Formation (J-Kk) of the Uitenhage Group, comprising conglomerate, sandstone and mudstone; the Wankoe Formation (Tw) and Grahamstown Formation (Tgs) of the Bredasdorp Group, representing coastal calcarenites and silcrete, respectively. These units occur outside the property boundary but contribute to the regional geological framework.




*Map 4: Geological setting of the study site and the production borehole (CGS, 3421BB Herbertsdale and 3422AA Mossel Bay).*

# 6. Regional Hydrogeology

The regional hydrogeology of the study area is controlled primarily by the lithology and structural characteristics of the underlying geological formations. Groundwater occurs within both primary intergranular aquifers associated with unconsolidated sediments and secondary fractured-rock aquifers developed within the consolidated sedimentary rocks of the Cape Supergroup.

The principal bedrock aquifer within the study area is associated with the Skurweberg Formation. These quartzitic sandstones have negligible primary porosity; therefore, groundwater occurrence is mainly controlled by secondary permeability through fractures, joints and weathered zones.

## 6.1. Aquifer Yield

According to the 1:1 000 000 scale hydrogeological map (DWAF, 2000), the study area hosts a fractured aquifer with an average borehole yield of 0.5–2.0 L/s (**Map 5**). Areas to the west of the site are classified as fractured aquifers with expected yields of 0.1-0.5 L/s, while isolated areas to the northeast are classified with expected yields of 0.0–0.1 L/s. The mapped groundwater yields indicate that the study area is underlain by a fractured bedrock aquifer of generally low to moderate groundwater potential.

Groundwater occurrence within the study area is controlled mainly by secondary permeability of the fractured aquifer. A fractured aquifer is defined as a formation that contains sufficient fissures, fractures, cracks, joints and faults that yields economic quantities of water to boreholes and springs. Groundwater will then move along these fractures and joints. Borehole yields are therefore expected to vary depending on the density and interconnectedness of fractures encountered during drilling. Although the property is mainly underlain by unconsolidated T-Ql (loam and sandy loam soil), these surficial deposits are expected to contain only shallow, localised groundwater where saturated and do not constitute a significant groundwater resource. The principal groundwater is therefore expected to occur within the Skurweberg Formation.

## 6.2. Aquifer Quality

Electrical conductivity (EC) is a measure of the ability of the groundwater to conduct electricity. EC is directly related to the concentration of dissolved ions in the water and this parameter is used as an indication of groundwater quality. The groundwater map indicates that the aquifer underlying the site has EC values in the range of 70 – 300 mS/m (**Map 6**) (DWAF, 2000). This is classified as “marginal” water quality. The areas to the north-west and south are classified within the 300 – 1 000 mS/m EC range, indicating more mineralised groundwater with increased dissolved solids. In terms of drinking water standards (DWAF, 1998), water quality in the area ranges from “moderate” (70 – 300 mS/m) to “poor” (300 – 1000 mS/m).

Historical groundwater quality data obtained from the National Groundwater Archive (NGA) indicate EC values ranging between approximately 1 030 and 1 570 mS/m in nearby boreholes, suggesting locally saline groundwater conditions. Groundwater quality measurements obtained during the site investigation indicate the on-site piezometer (depth of 1.7 mbgl) recorded an EC of approximately 115 mS/m, indicating relatively fresh shallow groundwater. In addition, the borehole (depth of 150 mbgl) sampled at 100 mbgl during the site investigation recorded a field EC of approximately 1 005.4 mS/m.

## 6.3. Aquifer Vulnerability Classification

The national scale groundwater vulnerability map, which was developed according to the DRASTIC methodology (Conrad and Munch, 2007), indicates that the study site has a "very low" groundwater vulnerability zone, with the eastern portion of the property classified as "low/medium" (**Map 7**). The DRASTIC method considers the following factors:

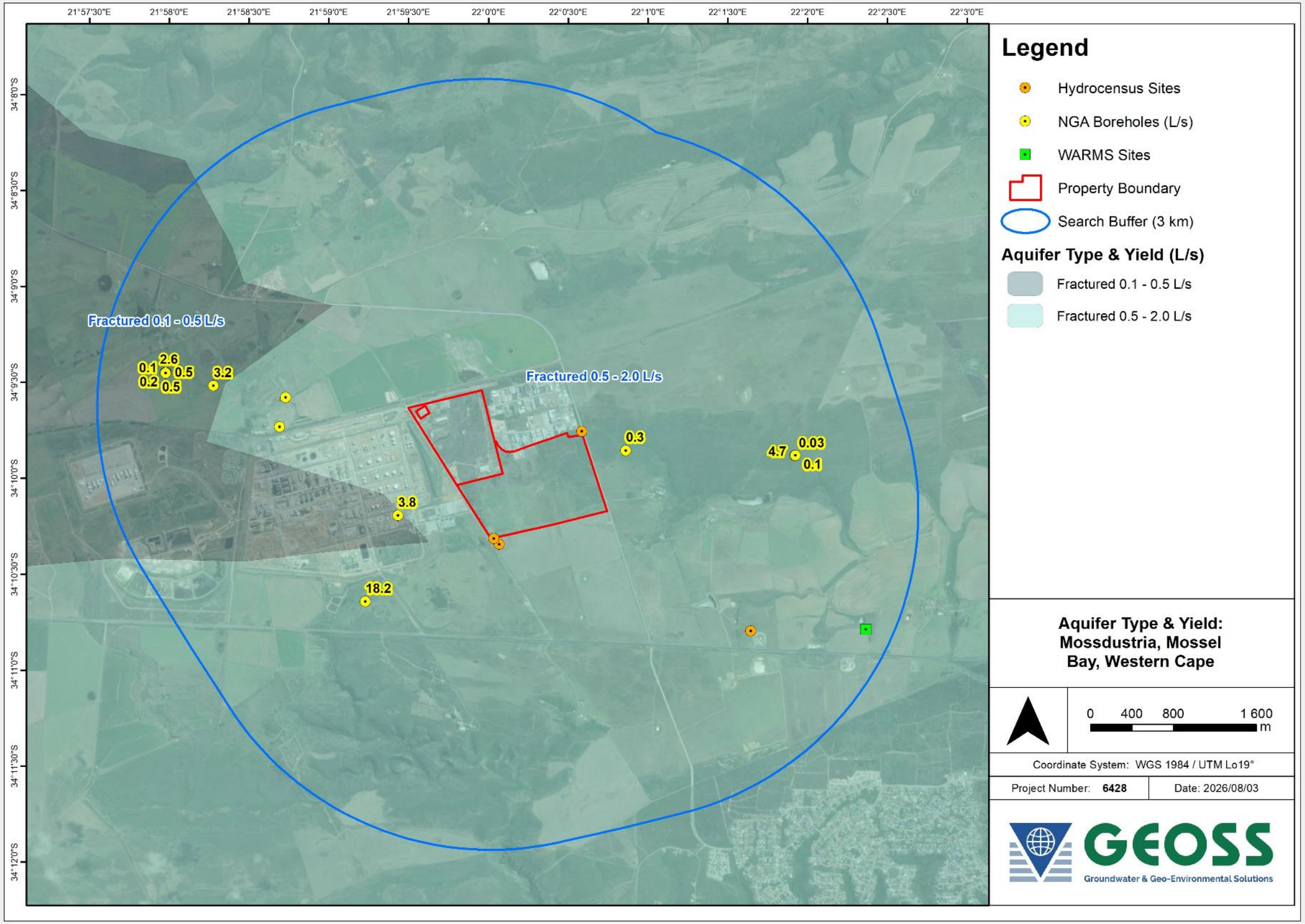
| | | | |
|---|---|---|---|
| D | = | depth to groundwater | (5) |
| R | = | recharge | (4) |
| A | = | aquifer media | (3) |
| S | = | soil type | (2) |
| T | = | topography | (1) |
| I | = | impact of the vadose zone | (5) |
| C | = | conductivity (hydraulic) | (3) |

The number indicated in parentheses after each factor description is the weighting or relative importance of each factor, according to the "DRASTIC" methodology, with higher weighting indicating a greater influence on groundwater vulnerability.

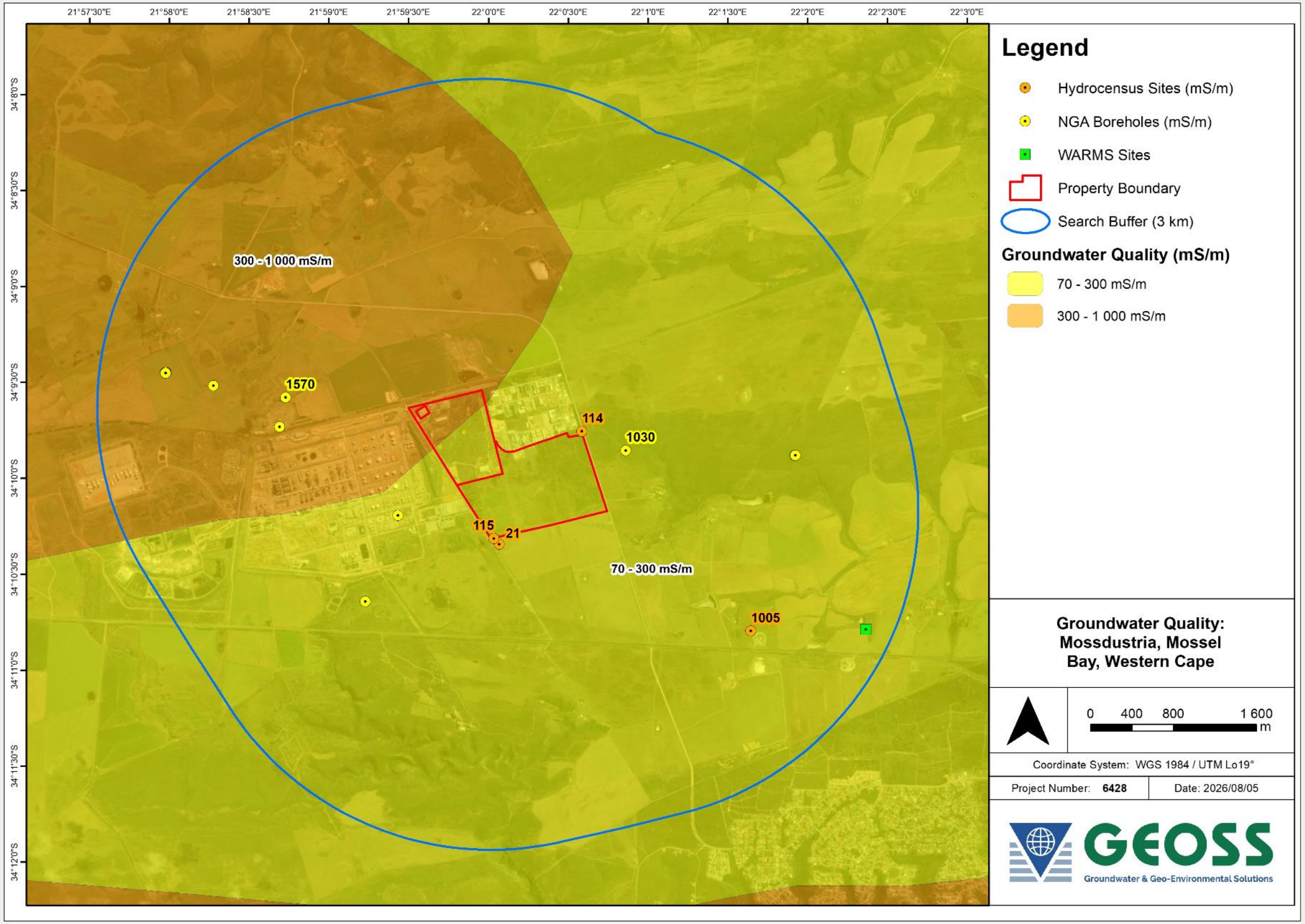
The "**very low**" rating suggests that the underlying groundwater system has a relatively low susceptibility to contamination from surface-derived pollutants. This classification is consistent with the site geology and hydrogeological setting, where competent clay-rich loam and sandy loam soils (T-Ql) overlie fractured sedimentary bedrock. The low-permeability material is expected to reduce vertical infiltration and provide a degree of natural protection to the underlying aquifer. The eastern portion of the property is mapped as having a "**low/medium**" groundwater vulnerability. Although this indicates a slightly greater susceptibility to contamination, the vulnerability remains relatively low on a regional scale.

It is worth noting that the vulnerability could be higher in the areas where the Skurweberg Formation outcrops, due to the fractured nature of the aquifer. However, this depends on the connectivity of the fractures and whether the fractures occur at the surface level. While the "**low**" rating applies to the deeper groundwater, **<u>the shallow groundwater and wetland systems exhibit inherently higher vulnerability to surface contamination</u>**.

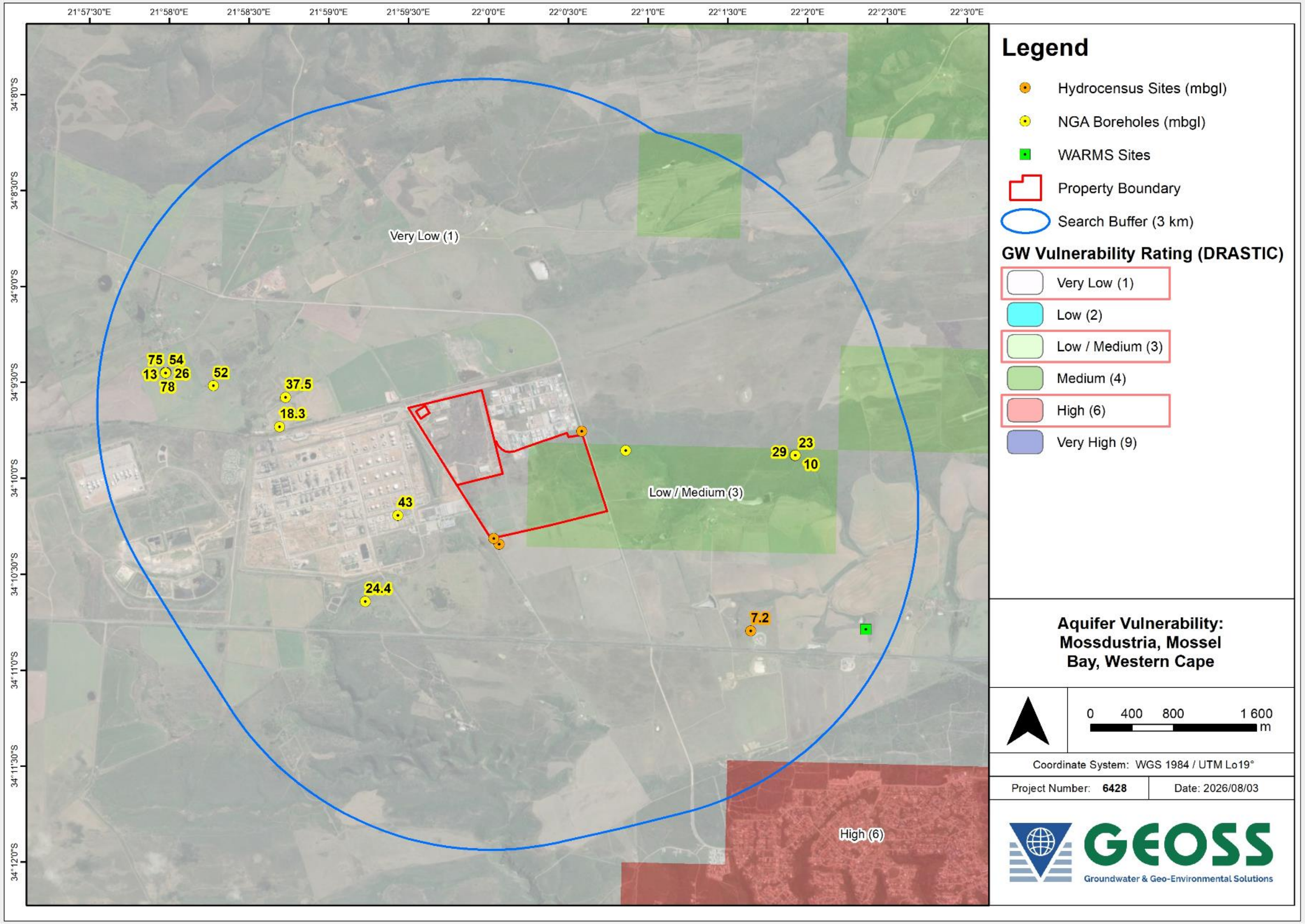
Despite the generally low vulnerability, appropriate environmental management measures should be implemented during both the construction and operational phases of the proposed development. Potential contaminant sources, including fuels, lubricants, chemicals and other hazardous substances, should be stored and handled in accordance with best practices to minimise the risk of accidental spillage.




*Map 5: Regional aquifer yield (L/s) (DWAF, 2000).*




*Map 6: Regional groundwater quality (EC in mS/m) from DWAF (2002).*




*Map 7: Vulnerability rating (DWAF, 2005) and groundwater depths (mbgl).*

# 7. Purpose of Water Use

The proposed Water Use Licence Application (WULA) pertains to water uses as defined under Section 21 (c) and (i) of the National Water Act (NWA) (Act No. 36 of 1998). No groundwater or surface water abstraction is proposed as part of this application; therefore, no water volumes are associated with the proposed water uses.

The application relates only to non-consumptive water uses triggered by the proposed development footprint reaching and altering delineated aquatic features. Specifically, authorisation is required for:

- Section 21 (c): Impeding or diverting the flow of water in a watercourse.
- Section 21 (i): Altering the bed, banks, course, or characteristics of a watercourse.

The purpose of these specific water uses is to facilitate the construction and operation of the proposed Mossdustria expansion. Activities triggering the water use include:

- The infilling and physical alteration of existing wetland areas to accommodate the construction of the motorsport arena, industrial stands and alternative energy (Solar PV) platforms.
- The construction of stormwater attenuation ponds and associated discharge outfalls within watercourses or within the regulated wetland zones.
- The installation of internal access roads, electrical services and bulk water and sewer pipelines that traverse the delineated watercourses or their regulated buffer zones.

Although the proposed project does not include groundwater abstraction, the activities associated with the project have the potential to influence the local hydrogeological regime. The geohydrological assessment therefore evaluates the potential effects of surface hardening, stormwater attenuation and potential hydrocarbon or industrial spills on the underlying groundwater system. Particular consideration is given to the potential interaction between the fractured bedrock aquifer, the interpreted shallow perched groundwater system and the wetlands within and surrounding the development footprint.

# 8. Site Specific Information

## 8.1. Desktop Assessment (Existing Groundwater Information)

To determine whether there are any groundwater users in the area that may be affected by activities on site, a database search was conducted using a 3-km radius around the property boundary. This portion of the study was completed by studying and querying existing databases that contain groundwater information. A search was conducted on a number of databases, namely the National Groundwater Archive (NGA) and the Water Use Authorisation and Registration Management System (WARMS). These resources provide data on borehole positions, groundwater chemistry and yield, when available. Based on the desktop assessment of the various databases, it is evident that there are a large number of groundwater users in the area surrounding Remainder of Portion 8 of the Farm Rietvalley 225 and Erf 3.

### 8.1.1. National Groundwater Archive (NGA)

Assessment of the NGA database, which provides data on borehole positions, groundwater chemistry and yield, indicated that there are 30 boreholes located within a 3-km search area of the site. The NGA sites are shown on **Map 3** and summarised in **Table 2**. It should be noted that the NGA database includes historical records and may no longer reflect current groundwater conditions or borehole status. Additionally, the spatial accuracy of the borehole locations may not always be accurate.

From the data obtained on the NGA sites, it was clear that borehole yields vary greatly (0.03 – 18.17 L/s), although the majority of the recorded yields are less than 3 L/s, which is consistent with the regional classification of low- to moderate-yield fractured-rock aquifer. The higher recorded yields are likely associated with boreholes intersecting well-developed fracture zones.

This area has been mapped as having an expected water quality between 70 and 300 mS/m (DWAF, 2000). Although the field water quality data are limited, a review of the water quality data from the NGA database reveals significant variability in the area's water quality, ranging from 178 to 1 1792 mS/m. These variations in EC values likely reflect the influence of local lithology, aquifer type and potential sources of contamination.

Water level data were only available for some boreholes, but indicated shallow (10 mbgl) to deep water level depths (100 mbgl). The lithological data suggest that the surficial loam and sandy loam soil is most likely underlain by the Skurweberg Formation, due to the occurrence of quartzitic sandstone in nearby borehole logs.

*Table 2: Summary of NGA boreholes.*

| Site ID | Type | Latitude (DD, WGS84) | Longitude (DD, WGS84) | Date | WL (mbgl) | Yield (L/s) | EC (mS/m) | pH | Depth (m) | Lithology |
|---|---|---|---|---|---|---|---|---|---|---|
| 3421BB00008 | Borehole | -34.1585 | 21.9716 | 1984/06/24 | 52 | - | - | - | 115.15 | - |
| 3421BB00011 | Borehole | -34.1696 | 21.9911 | 1979/11/27 | 43 | - | - | - | 94 | 7.0m-soil<br>94.0m-quartzite |
| 3421BB00026 | Borehole | -34.1224 | 21.9599 | 1900/01/01 | 100 | - | 178 | - | 130 | 130.0m – conglomerate |
| 3421BB00034 | Borehole | -34.201 | 21.9658 | 1900/01/01 | 52 | - | - | - | 62 | 0.01m – limestone |
| 3421BB00047 | Borehole | -34.1574 | 21.9666 | 1975/01/23 | 54 | - | - | - | 89 | 89.0m – sandstone |
| 3421BB00048 | Borehole | -34.1574 | 21.9666 | 1974/03/07 | 78 | - | - | - | 123 | 15.5m – clay<br>123.0m – sandstone |
| 3421BB00049 | Borehole | -34.1574 | 21.9666 | 1974/01/03 | 75 | - | - | - | 95.5 | 15.5m – clay<br>95.5m – sandstone |
| 3421BB00050 | Borehole | -34.1574 | 21.9666 | 1973/04/16 | 13 | - | - | - | 48 | 6.0m – clay<br>48.0m – sandstone |
| 3421BB00051 | Borehole | -34.1574 | 21.9666 | 1973/03/23 | 26 | - | - | - | 35 | 35.0m – sandstone |
| 3421BB00052 | Borehole | -34.1574 | 21.9666 | 1970/08/14 | 14.02 | - | - | - | 92.04 | 23.77m – sandstone<br>92.04m – shale |
| 3421BB00053 | Borehole | -34.1574 | 21.9667 | 1970/07/16 | 12.19 | - | - | - | 73.15 | 51.81m – clay<br>57.91m – sandstone<br>73.15m – shale |
| 3421BB00054 | Borehole | -34.1574 | 21.9666 | 1970/04/09 | 21.33 | - | - | - | 54.86 | 54.86m – sandstone |
| 3421BB00055 | Borehole | -34.1574 | 21.9666 | 1970/02/09 | - | - | - | - | 54.86 | 6.4m – boulders<br>54.86m – sandstone |
| 3421BB00061 | Borehole | -34.1299 | 21.9672 | 1985/06/18 | 100 | - | - | - | 143 | 21.0m – conglomerate<br>143.0m – quartzite |
| 3421BB00062 | Borehole | -34.1299 | 21.9672 | 1973/01/04 | 64 | - | - | - | 110 | 7.0m – boulders<br>104.0m – sandstone<br>108.0m – shale<br>110.0m – sandstone |

| Site ID | Type | Latitude (DD, WGS84) | Longitude (DD, WGS84) | Date | WL (mbgl) | Yield (L/s) | EC (mS/m) | pH | Depth (m) | Lithology |
|---|---|---|---|---|---|---|---|---|---|---|
| 3421BB00063 | Borehole | -34.1299 | 21.9672 | 1972/10/11 | - | - | - | - | 54 | 8.0m – boulders<br>54.0m – sandstone |
| 3421BB00064 | Borehole | -34.1299 | 21.9672 | 1972/07/31 | - | - | - | - | 10.97 | 1.52m – boulders<br>10.97m – sandstone |
| 3421BB00065 | Borehole | -34.1299 | 21.9672 | 1972/02/21 | - | - | - | - | 54.86 | 54.86m – sandstone |
| 3421BB00066 | Borehole | -34.1299 | 21.9672 | 1972/01/31 | 60.96 | - | - | - | 112.16 | 112.16m – sandstone |
| 3421BB00097 | Borehole | -34.1771 | 21.9877 | 1926/07/07 | 24.38 | - | - | - | 34.44 | 7.62m – sandstone<br>34.44m – quartzite |
| 3422AA00001 | Borehole | -34.164 | 22.0325 | 1979/04/05 | 23 | - | - | - | 134 | 5.0m – clay<br>134.0m – sandstone |
| 3422AA00002 | Borehole | -34.164 | 22.0325 | 1977/03/23 | 10 | - | - | - | 110 | 13.0m – clay<br>110.0m – shale |
| 3422AA00008 | Borehole | -34.164 | 22.0325 | 1980/10/22 | 29 | - | - | - | 59 | 5.0m – soil<br>59.0m – sandstone |
| GZ00189 | Borehole | -34.1638 | 22.0148 | 2006/01/16<br>11:30 | - | - | 1 030 | 5.83 | - | - |
| GZ00190 | Borehole | -34.1594 | 21.9792 | 1970/01/01 | 37.5 | - | 1 570 | 5.99 | 6.5 | - |
| GZ00191 | Borehole | -34.1309 | 21.9645 | 2006/01/16<br>13:40 | 100 | - | 1 792 | 6.38 | 100 | - |
| GZ00193 | Borehole | -34.162 | 21.9786 | 2006/01/17<br>9:44 | 18.31 | - | - | 6.54 | 6.5 | - |
| GZ00194 | Borehole | -34.121 | 21.9842 | 2001/01/24 | 54.9 | - | - | 6.08 | 6.5 | - |
| GZ00356 | Borehole | -34.1966 | 21.9795 | Jul-07 | - | - | - | - | 250 | 250.0m – Shale |
| GZ00359 | Borehole | -34.1974 | 21.9797 | Jul-07 | - | - | - | - | 151 | 38.0m – Sandstone<br>81.0m – Shale |

### 8.1.2. Water Use Authorisation and Registration Management System (WARMS) Database

Assessment of the Water Use Authorisation and Registration Management System (WARMS) revealed that there is one (1) registered borehole within 3 km of the study site. Only registered and active sites were considered. The borehole is listed in **Table 3**.

*Table 3: Summary of the WARMS dataset.*

| Site ID | Latitude (DD, WGS84) | Longitude (DD, WGS84) | Resource Type | Registered volume ($m^3/a$) |
|---|---|---|---|---|
| 22087965 | -34.179097 | 22.040068 | Borehole | 155 520 |
| | | | **Total** | **155 520** |

## 8.2. Hydrocensus

A site visit was conducted on the 29th of July 2026 to assess groundwater use within the study area and conduct surface water as well as groundwater sampling. The results of the field investigation are spatially represented on **Map 3**. During the hydrocensus, two boreholes were identified (only one could be accessed) and one piezometer was augered. Samples were taken at the wetland, river, piezometer and borehole to be analysed for isotopes. An inorganic water quality sample was also taken at the borehole. All information obtained is presented in **Table 4**.

*Table 4: Hydrocensus data.*

| Site ID | Water source | Latitude (DD, WGS84) | Longitude (DD, WGS84) | Depth (mbgl) | General comments | Water Level (mbgl) | Picture |
|---|---|---|---|---|---|---|---|
| HC_BH1 | Borehole | -34.179108 | 22.027788 | 150 | Very smelly water. Borehole was drilled about 4 years ago and is not currently in use. Water quality and isotope samples were taken.<br>EC = 1 005.4 mS/m<br>TDS = >6 000ppm<br>pH = 7.0 | 7.16 |  |
| Wetland | Wetland | -34.171999 | 22.001667 | N/A | An isotope sample was taken.<br>EC = 21 mS/m<br>TDS = 110 ppm<br>pH = 6.2 | N/A |  |

| Site ID | Water source | Latitude (DD, WGS84) | Longitude (DD, WGS84) | Depth (mbgl) | General comments | Water Level (mbgl) | Picture |
|---|---|---|---|---|---|---|---|
| PZ1 | Piezometer | -34.17151 | 22.001099 | 1.7 | Competent clay-rich muds interbedded with very fine sand. Refusal was reached at approximately 1.7 mbgl.<br>EC = 115 mS/m<br>TDS = 570 ppm<br>pH = 6.3 | 0.48 |  |
| River | River | -34.162123 | 22.010161 | N/A | An isotope sample was taken. Rubble and rubbish lying in water.<br>EC = 114 mS/m<br>TDS = 570 ppm<br>pH = 7.1 | N/A |  |

## 8.3. Water Quality

A groundwater sample was collected from the HC_BH1 hydrocensus borehole at the time of the site visit and submitted for inorganic chemical analyses to a SANAS-accredited laboratory (Vinlab) in the Western Cape. The certificate of analysis for the sample is presented in **Appendix A**.

The chemistry results for this site have been classified according to the SANS241-1: 2015 standards for drinking water (**Table 5**). **Table 7** presents the water chemistry analysis results, colour-coded according to the SANS241-1: 2015 drinking water assessment standards.

*Table 5: Classification table for the specific limits (SANS241-1: 2015 ).*

| Acute Health | Aesthetic | Chronic Health | Operational | Acceptable |
|---|---|---|---|---|

The chemistry results have also been classified according to the DWAF (1998) standards for domestic water (**Table 6). Table 8** presents the water chemistry analysis results colour-coded according to the DWAF domestic water assessment standards.

*Table 6: Classification table for the groundwater results (DWAF, 1998).*

| Class | Water quality | Description |
|---|---|---|
| Class 0 | Ideal | Suitable for lifetime use. |
| Class I | Good | Suitable for use, rare instances of negative effects. |
| Class II | Marginal | Conditionally acceptable. Negative effects may occur. |
| Class III | Poor | Unsuitable for use without treatment. Chronic effects may occur. |
| Class IV | Dangerous | Totally unsuitable for use. Acute effects may occur. |

### 8.3.1. Water Quality Results

It is important to note that no groundwater abstraction is planned as part of the proposed development. The results from the chemical analysis are intended to establish a pre-development baseline for local groundwater quality.

Based on the chemical results presented in **Table 7** and **Table 8**, the groundwater sampled from HC_BH1 is highly mineralised and not safe for human consumption without treatment. While the pH is neutral (7.28), the EC is elevated, exceeding the SANS241 aesthetic limit and is classified as dangerous according to DWAF (1998). The extreme salinity is further reflected in the Total Dissolved Solids (TDS) value of 7 220.70, which drastically exceeds the SANS241 aesthetic limit. Several other macro-elements also exceed maximum allowable limits, of which most notably are sodium (2 078 mg/L) and chloride (3 426 mg/L). Trace metals such as manganese (0.634 mg/L) and arsenic (0.014 mg/L) exceed the chronic health SANS241 limits. The measured iron concentration (0.705 mg/L) exceeds the aesthetic SANS 241 limit, which will affect the taste, smell and colour of the water. Potassium (40 mg/L) and calcium (122 mg/L) are classified as “Class I – Good water quality” according to the DWAF (1998) standards, while magnesium falls in the “Class II – Marginal water quality” category.

*Table 7: Groundwater quality analysis results according to SANS 241-1:2015.*

| Analyses | HC_BH1 | SANS 241-1:2015 |
|---|---|---|
| Date Sampled | 31 Jul 2026 | |
| pH (at 25 °C) | 7.28 | ≥5 - ≤9.7 Operational |
| Conductivity (mS/m) (at 25 °C) | 1 065.00 | ≤170 Aesthetic |
| Total Dissolved Solids (mg/L) | 7 220.70 | ≤1 200 Aesthetic |
| Turbidity (NTU) | 12.10 | ≤1 Operational ≤5 Aesthetic |
| Colour (mg/L as Pt) | <15 | ≤15 Aesthetic |
| Langelier Saturation Index (at 25 °C) | 0.24 | |
| Sodium Adsorption Ratio (at 25 °C) | 29.38 | |
| Sodium (mg/L as Na) | 2 078.00 | ≤200 Aesthetic |
| Potassium (mg/L as K) | 40.00 | |
| Magnesium (mg/L as Mg) | 156.00 | |
| Calcium (mg/L as Ca) | 122.00 | |
| Chloride (mg/L as Cl) | 3 426.09 | ≤300 Aesthetic |
| Free Chlorine (mg/L as Cl) | 0.02 | ≤5 Chronic Health |
| Sulphate (mg/L as $SO_4$) | 466.05 | ≤250 Aesthetic ≤500 Acute Health |
| Combined Nitrate & Nitrite Nitrogen (as a ratio) | 0.08 | ≤1 Acute Health |
| Nitrate Nitrogen (mg/L as N) | <0.70 | ≤11 Acute Health |
| Nitrite Nitrogen (mg/L as N) | <0.05 | ≤0.9 Acute Health |
| Ammonia Nitrogen (mg/L as N) | 1.34 | ≤1.5 Aesthetic |
| Total Alkalinity (mg/L as $CaCO_3$) | 351.00 | |
| Total Hardness (mg/L as $CaCO_3$) | 944.60 | |
| Fluoride (mg/L as F) | 1.00 | ≤1.5 Chronic Health |
| Aluminium (mg/L as Al) | 0.106 | ≤0.3 Operational |
| Chromium (mg/L as Cr) | <0.01 | ≤0.05 Chronic Health |
| Manganese (mg/L as Mn) | 0.634 | ≤0.1 Aesthetic ≤0.4 Chronic Health |
| Iron (mg/L as Fe) | 0.705 | ≤0.3 Aesthetic ≤2 Chronic Health |
| Nickel (mg/L as Ni) | <0.05 | ≤0.07 Chronic Health |
| Copper (mg/L as Cu) | <0.05 | ≤2 Chronic Health |
| Zinc (mg/L as Zn) | <0.05 | ≤5 Aesthetic |
| Arsenic (mg/L as As) | 0.014 | ≤0.01 Chronic Health |
| Selenium (mg/L as Se) | 0.035 | ≤0.04 Chronic Health |
| Cadmium (mg/L as Cd) | <0.003 | ≤0.003 Chronic Health |
| Antimony (mg/L as Sb) | <0.013 | ≤0.02 Chronic Health |
| Mercury (mg/L as Hg) | <0.001 | ≤0.006 Chronic Health |
| Lead (mg/L as Pb) | <0.01 | ≤0.01 Chronic Health |
| Uranium (mg/L as U) | <0.028 | ≤0.03 Chronic Health |
| Cyanide (mg/L as CN-) | <0.01 | ≤0.2 Acute Health |
| Boron (mg/L as B) | 1.772 | ≤700 Chronic Health |
| Barium (mg/L as Ba) | 0.057 | ≤2 400 Chronic Health |
| Total Organic Carbon (mg/L as C) | 6.80 | ≤10 Chronic Health |
| Charge Balance (%) | -0.81 | ≥-5 - ≤5 Recommended |

*Table 8: Classified groundwater sample results according to DWAF (1998).*

| Analyses | HC_BH1 | Class 0 | Class I | Class II | Class III | Class IV |
|---|---|---|---|---|---|---|
| pH (at 25 °C) | 7.28 | 5 – 9.5 | 4.5 – 5 & 9.5 – 10 | 4 – 4.5 & 10 – 10.5 | 3 – 4 & 10.5 – 11 | <3 & >11 |
| Conductivity (mS/m) (at 25 °C) | 1 065.00 | <70 | 70 – 150 | 150 – 370 | 370 – 520 | >520 |
| Turbidity (NTU) | 12.10 | <0.1 | 0.1 – 1 | 1 – 20 | 20 – 50 | >50 |
| Total Dissolved Solids (mg/L) | 7 220.70 | <450 | 450 – 1 000 | 1 000 – 2 400 | 2 400 – 3 400 | >3 400 |
| Sodium (mg/L as Na) | 2 078.00 | <100 | 100 – 200 | 200 – 400 | 400 – 1 000 | >1 000 |
| Potassium (mg/L as K) | 40.00 | <25 | 25 – 50 | 50 – 100 | 100 – 500 | >500 |
| Magnesium (mg/L as Mg) | 156.00 | <70 | 70 – 100 | 100 – 200 | 200 – 400 | >400 |
| Calcium (mg/L as Ca) | 122.00 | <80 | 80 – 150 | 150 – 300 | >300 | |
| Chloride (mg/L as Cl) | 3 426.09 | <100 | 100 – 200 | 200 – 600 | 600 – 1 200 | >1 200 |
| Sulphate (mg/L as $SO_4$) | 466.05 | <200 | 200 – 400 | 400 – 600 | 600 – 1 000 | >1 000 |
| Fluoride (mg/L as F) | 1.00 | <0.7 | 0.7 – 1 | 1 – 1.5 | 1.5 – 3.5 | >3.5 |
| Manganese (mg/L as Mn) | 0.634 | <0.1 | 0.1 – 0.4 | 0.4 – 4 | 4 – 10 | >10 |
| Iron (mg/L as Fe) | 0.705 | <0.5 | 0.5 – 1 | 1.0 – 5.0 | 5 – 10 | >10 |
| Copper (mg/L as Cu) | <0.05 | <1 | 1-1.3 | 1.3 – 2 | 2 – 15 | >15 |
| Zinc (mg/L as Zn) | <0.05 | <20 | >20 | | | |
| Arsenic (mg/L as As) | 0.014 | <0.01 | 0.01 – 0.05 | 0.05 – 0.2 | 0.2 – 2 | >2 |
| Cadmium (mg/L as Cd) | <0.003 | <0.003 | 0.003 – 0.005 | 0.005 – 0.02 | 0.02 – 0.05 | >0.05 |
| Total Hardness (mg/L as $CaCO_3$) | 944.60 | <200 | 200 – 300 | 300 – 600 | >600 | |
| Charge Balance (%) | -0.81 | ≥-5 - ≤5 Recommended | | | | |

### 8.3.2. Chemical Diagrams

A chemical diagram has been plotted for the groundwater sample. This is useful for chemical characterisation of the water. The Stiff Diagram (**Figure 3**) is a graphical representation of the equivalent concentrations of the cations (positive ions) and anions (negative ions). This diagram shows concentrations of cations and anions relative to each other and direct reference can be made to specific salts in the water.

The observed Na-Cl hydrofacies for HC_BH1 in **Figure 3** is consistent with mineralised groundwater and likely reflects the combined effects of prolonged groundwater-rock interaction and the coastal setting of the study area. The elevated chloride concentration may also indicate a degree of marine influence, which is a common occurrence in coastal aquifer systems. The groundwater chemistry is therefore indicative of an evolved groundwater system rather than recently recharged groundwater.

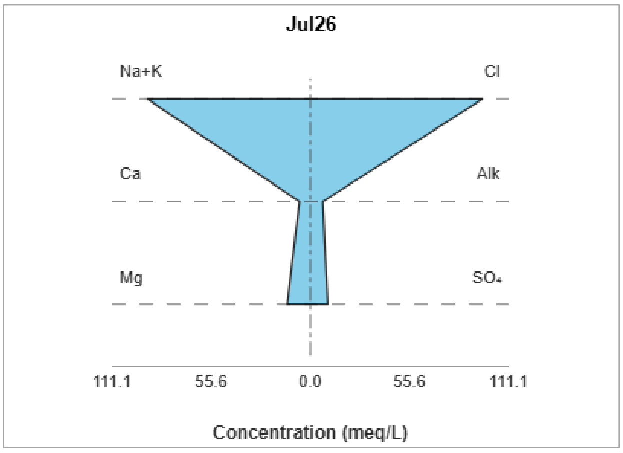



*Figure 3: Stiff diagram of the groundwater sample.*

### 8.3.3. Surface Water-Groundwater Interaction

The stable isotope analysis of oxygen-18 ($\delta^{18}O$) and deuterium ($\delta^{2}H$) assessed potential interactions between surface water and groundwater in the study area. The isotope results were plotted relative to the Global Meteoric Water Line (GMWL; $\delta^{2}H = 8\delta^{18}O + 10$) and the Mossel Bay Local Meteoric Water Line (LMWL; $\delta^{2}H = 7.70\delta^{18}O + 12.10$), as shown in **Figure 4**. The Mossel Bay LMWL is established from weighted monthly rainfall data by Braun *et al.* (2017). The Mossel Bay LMWL provides a locally representative reference for assessing the meteoric origin and potential modification of groundwater and surface water within the study area.

The HC_BH1 groundwater sample plots close to the LMWL, indicating that the groundwater is predominantly derived from meteoric precipitation, with limited evidence of significant evaporation or other isotopic modification prior to recharge. However, this does not necessarily indicate recent recharge. The chemical composition of HC_BH1 indicates highly mineralised groundwater, with a Na-Cl hydrofacies, very high TDS, chloride and sodium concentrations and elevated EC. The groundwater has therefore undergone substantial geochemical evolution following recharge, which may reflect prolonged groundwater-rock interaction, extended residence time and/or mixing with more saline groundwater.

The geological and hydrogeological setting provides a plausible recharge mechanism for the deeper groundwater system. Recharge to the fractured Skurweberg Formation is expected to be more favourable where the formation is exposed or where the overlying T-Ql material has a relatively low clay content and permits greater infiltration. Conversely, clay-rich portions of the T-Ql cover are expected to restrict vertical infiltration and may promote the development of shallow, localised groundwater and wetland conditions. The presence and lateral continuity of clay-rich material are expected to be variable across the site and may locally result in perched or shallow groundwater.

The wetland sample also plots close to the Mossel Bay LMWL, indicating a predominantly meteoric source. PZ1 similarly plots relatively close to the Mossel Bay LMWL, supporting a predominantly meteoric origin for the shallow groundwater. The similar isotopic signatures of the wetland, PZ1 and HC_BH1 indicate that the sampled waters ultimately derive from precipitation but do not demonstrate direct hydraulic connectivity between the shallow and deeper groundwater systems. This distinction is important given the contrasting hydrogeological characteristics of the site. The shallow groundwater and wetland systems are likely to be more directly influenced by local rainfall, surface runoff and shallow infiltration, whereas HC_BH1 appears to intercept the deeper fractured-rock aquifer associated with the Skurweberg Formation.

The river sample plots slightly above the Mossel Bay LMWL, which may reflect some degree of evaporation or other hydrological processes prior to sampling. The available isotope data are therefore consistent with predominantly meteoric sources for both the surface-water and groundwater systems, but are insufficient to establish the direction or degree of groundwater-surface water exchange.

Overall, the isotope results, when considered together with the geological, hydrogeological and chemical data, support a conceptual model in which rainfall provides the ultimate source of recharge to both shallow and deeper groundwater systems. However, the shallow wetland and groundwater system may be locally perched or hydraulically separated from the deeper fractured Skurweberg aquifer by low-permeability clay-rich material. The highly mineralised nature of HC_BH1 further indicates that the deeper groundwater is not representative of recently infiltrated rainfall, despite its predominantly meteoric isotopic signature. Additional sampling of shallow groundwater and seasonal isotope monitoring would be required to better define recharge pathways and assess the degree of hydraulic connectivity between the shallow and deeper groundwater systems.

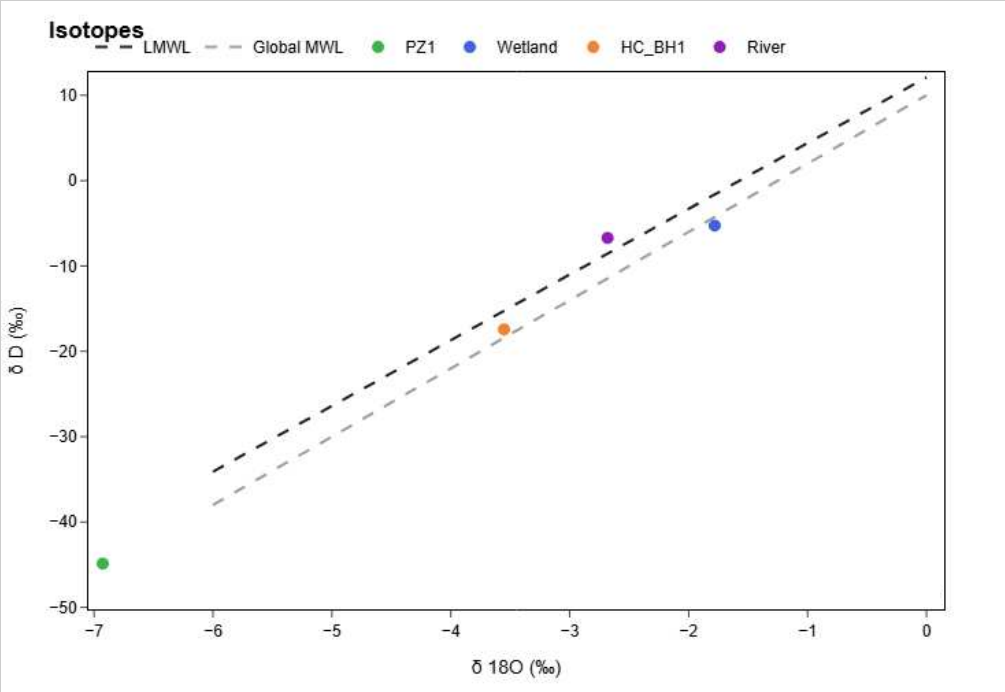



*Figure 4: Stable Isotope graph for the samples.*

# 9. Conceptual Model

## 9.1. Auger results

During the site visit, a hand auger was used to auger close to the wetland on-site to provide additional information on the shallow subsurface conditions.

Augering encountered very fine-grained material comprising dense, stiff clay/mud with very fine sand. The material became increasingly difficult to penetrate and augering could only be advanced to approximately 1.7 mbgl. The limited penetration depth is considered indicative of the relatively dense and competent nature of the shallow material.

The shallow material encountered during the auger investigation is consistent with the T-Ql (loam and sandy loam soil) mapped across the property. The presence of this fine-grained layer encountered during augering is important from a hydrogeological perspective, as clay-rich material generally has low hydraulic conductivity and may therefore restrict vertical infiltration and groundwater movement. Rainfall and surface runoff may accumulate above the clay-rich layer and potentially contribute to the shallow perched water and wetland areas in the vicinity of the property.

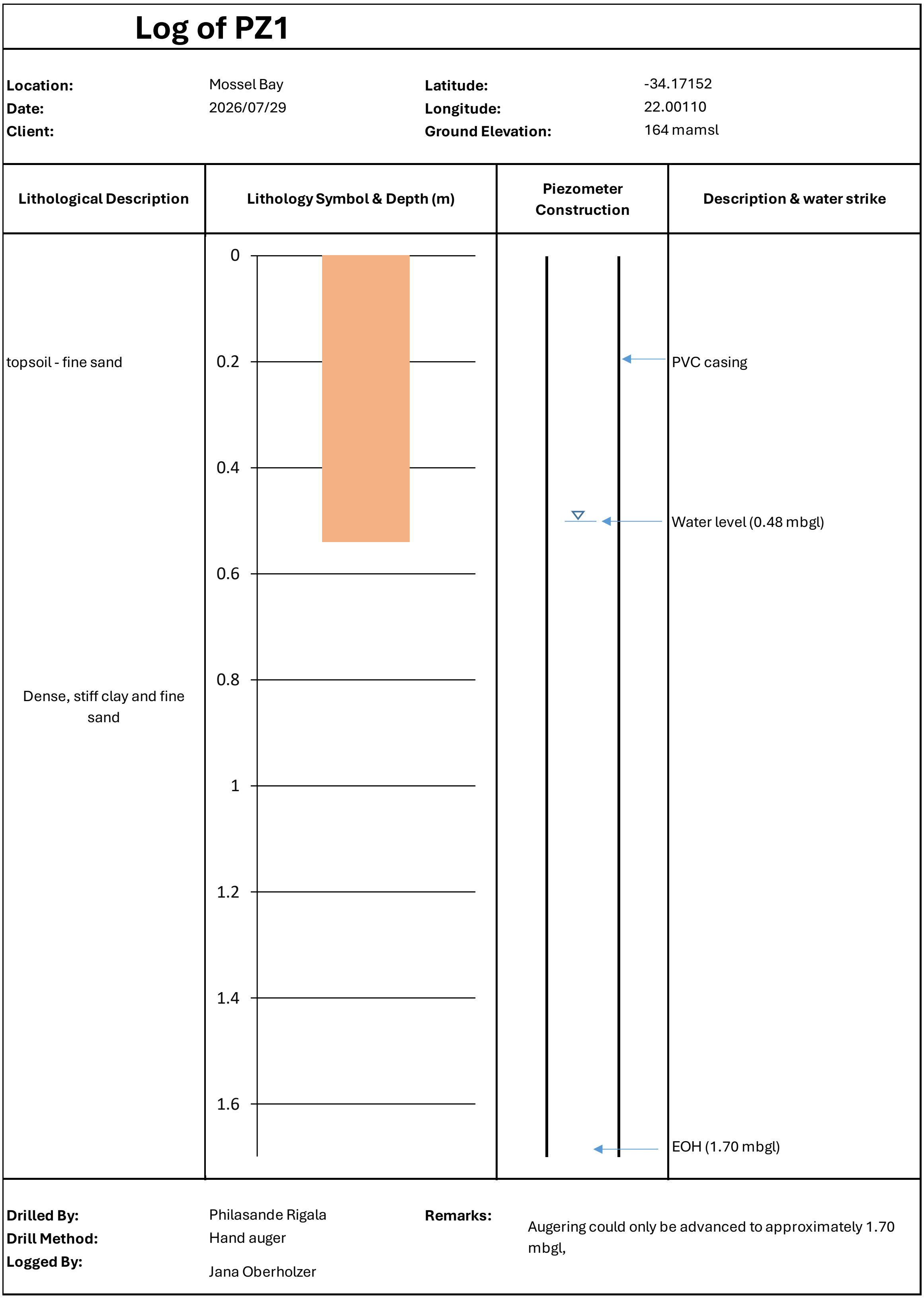



*Figure 5: Lithological log of PZ1.*

## 9.2. Geological Cross-Section

A north-south geological cross-section was developed to illustrate the relationship between the mapped geological units and the topography across the study area. The cross-section indicates that the area is predominantly underlain by the Skurweberg Formation (Ss), which forms the main bedrock unit beneath the site and surrounding area. The Skurweberg Formation is overlain by variable thicknesses of loam and sandy-loam soil. In the southernmost part of the section, brackish calcareous sand, silt and clay are mapped within the lower-lying environment.

Recharge to the underlying groundwater system is considered to occur primarily through infiltration of precipitation into the fractured Skurweberg Formation, particularly where the formation is exposed to the relatively thin overlying soil cover. In contrast, the fine-grained and relatively dense clayey material is expected to have a lower permeability and therefore restrict vertical recharge to the deeper fractured aquifer. Precipitation falling onto these areas may therefore result in increased surface runoff, temporary ponding and shallow lateral flow. This provides a plausible explanation for the presence of wetlands and other surface water features in the lower-lying areas.

Once recharge enters the fractured Skurweberg Formation, groundwater is expected to flow in general from the higher elevation areas towards the lower-lying areas, following the regional topographic gradient and the hydraulic gradients within the fractured-rock system. Regionally, groundwater flow is expected to trend towards the coastal environment, where discharge to the ocean and associated coastal systems may occur.

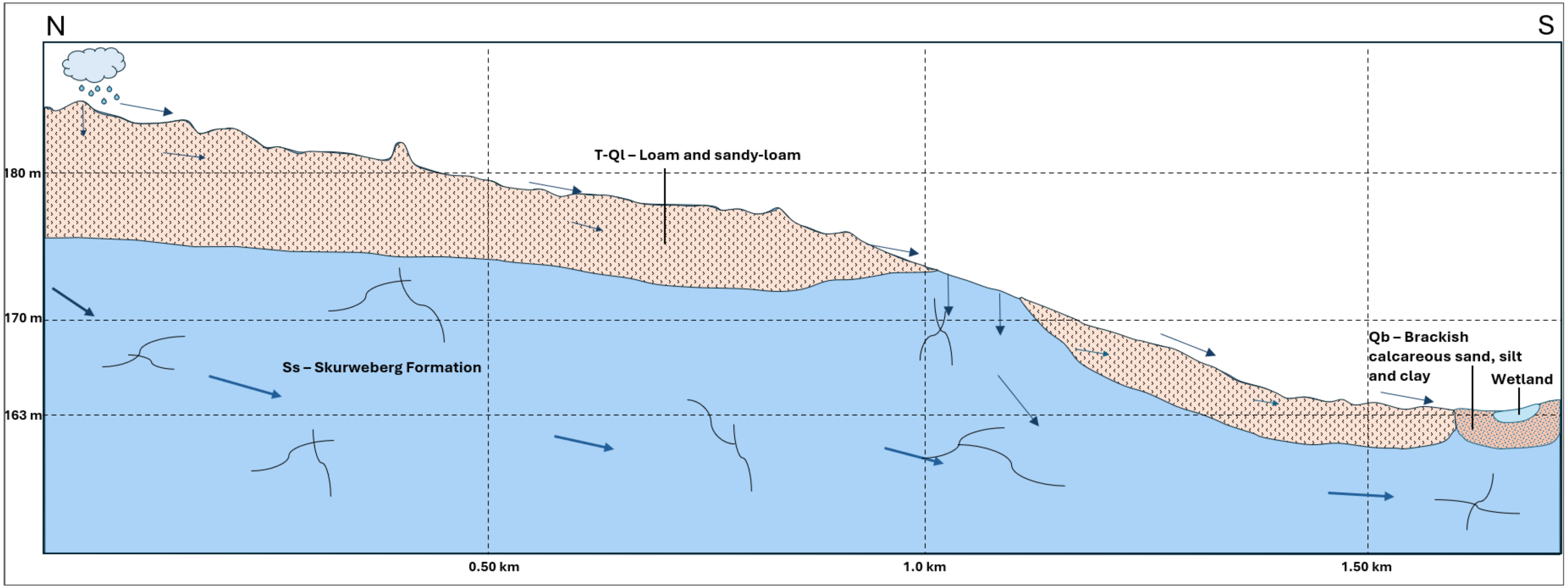



*Figure 6: A north-south geological cross-section of the property.*

# 10. Risk Impact Assessment

The site is underlain by the Skurweberg Formation, which forms the principal fractured aquifer in the area. The shallow subsurface is locally covered by loam and sandy loam (T-Ql) and includes dense clay-rich material (based on the auger investigation) that may restrict vertical infiltration and promote surface runoff and shallow water accumulation. The groundwater vulnerability assessment indicates that the area has a "**low**" vulnerability classification, indicating a relatively low susceptibility of the groundwater system to contamination from anthropogenic activities. This low vulnerability classification most likely refers to the deeper aquifer. Where the Skurweberg Formation is exposed or the cover has limited clay content, vulnerability may be higher due to the fractured nature of the aquifer. The shallow groundwater and flow towards the wetlands are also more vulnerable to surface-based contaminants.

No groundwater or surface water abstraction is proposed as part of the WULA. The impact assessments included in this section therefore address the potential impacts associated with the proposed Section 21(c) and (i) water uses, with particular consideration of the interaction between the proposed development, surface water features, shallow groundwater and the deeper groundwater system.

The impact assessments address the following identified risks:

- The risk of alteration of wetland flow and deterioration of wetland water quality as a result of changes to runoff, drainage and construction-related sediment or contaminant inputs;
- The risk of groundwater quality deterioration within the deeper Skurweberg Formation as a result of construction-related contamination; and
- The risk of interception or alteration of shallow groundwater flow as a result of excavation and construction of below-ground infrastructure.

The risk assessment includes the identification and rating of the potential risks associated with the proposed development, together with appropriate mitigation and management measures. Each risk is quantitatively assessed based on the available geological, hydrogeological and site-specific information. The risk rating is measured according to the criteria in **Appendix B**.

## 10.1. Impact on wetland flow and water quality

Construction activities within or in proximity to the delineated wetland may alter the existing surface-water and shallow subsurface flow regime. The dense clayey material is expected to have relatively low permeability, resulting in increased surface runoff and slow infiltration. Site clearing, compaction and construction of infrastructure may therefore alter the direction and volume of runoff reaching the wetland. In addition, construction activities may introduce suspended sediment, hydrocarbons and other pollutants to runoff, potentially affecting wetland water quality. The wetland may also receive shallow lateral flow or perched water associated with the low-permeability clay layer, which means that changes to the local drainage system could affect the hydrological functioning of the wetland. The risk assessment is presented in **Table 9**.

It is recommended to maintain natural drainage pathways towards the wetland and implement appropriate stormwater, erosion and sediment-control measures during construction. Construction materials, fuels and other potential contaminants must be stored and handled appropriately, with spills prevented and promptly contained. Regular monitoring of the wetland should be undertaken during construction to identify changes in flow, sedimentation or water quality.

*Table 9: Impact table assessing the risk of reduced flow and water quality due to construction.*

| **Impact on wetland flow and water quality** | |
|---|---|
| Potential impact and risk: | Negative – reduced runoff and alteration of shallow flow pathways and contaminant mobilisation during construction could affect wetland hydrology and water quality. |
| Nature of impact: | Direct |
| Extent and duration of impact: | Local, short- to medium-term, primarily during construction, with potential long-term effects. |
| Consequence of impact or risk: | Moderate |
| Probability of occurrence: | Probable |
| Degree to which the impact may cause irreplaceable loss of resources: | The impact is unlikely to cause any irreplaceable loss of the wetland if appropriate mitigation measures are implemented. |
| Degree to which the impact can be reversed: | The impact is largely reversible. |
| Consequence of impact or risk: | Alteration of wetland hydrological functioning and potential deterioration of water quality. |
| Cumulative impact prior to mitigation: | Moderate – multiple construction activities and increased hardened surfaces may collectively alter runoff patterns and increase sediment and contaminant loads to the wetland. |
| **Significance rating of impact prior to mitigation** | **Moderate** |
| Degree to which the impact can be avoided: | Partially avoidable |
| Degree to which the impact can be managed: | Fully manageable |
| Degree to which the impact can be mitigated: | Fully mitigatable |
| Proposed mitigation: | Natural drainage pathways towards the wetland must be maintained where practicable. Appropriate stormwater, erosion and sediment-control measures must be implemented during construction. Fuels, chemicals and other potentially contaminating materials must be appropriately stored and handled and spills must be promptly contained and remediated. The wetland should be regularly inspected during construction for changes in flow, sedimentation and water quality, with corrective measures implemented where required. |
| Residual impacts: | Localised alteration of wetland flow and water quality may remain during ongoing operation. |
| Cumulative impact post mitigation: | If appropriately managed, the cumulative impact is expected to be low, with limited alteration to wetland hydrological functioning and water quality. |
| **Significance rating of impact after mitigation** | **Very low** |

## 10.2. Impact on groundwater quality in the deeper Skurweberg Formation

The deeper groundwater system hosted within the fractured Skurweberg Formation represents the more significant regional groundwater resource and is considered to receive recharge mainly through infiltration of precipitation where the formation is exposed or has a relatively thin cover. Although the proposed development does not involve groundwater abstraction, construction activities may introduce potential contaminants to the subsurface, including hydrocarbons, chemicals, sewage and other construction-related pollutants. These contaminants could potentially migrate through preferential pathways associated with fractures in the Skurweberg Formation and affect groundwater quality. The risk is considered lower where the dense clayey shallow material provides a degree of protection. This protection may, however, be locally reduced where the clay is thin or absent. The risk assessment is presented in **Table 10**.

Good construction practices and due diligence should be followed to prevent the release of hydrocarbons, chemicals and other potential contaminants. Groundwater quality monitoring should be taken at suitable boreholes to establish and maintain a baseline and identify any significant changes in groundwater quality during construction and operation.

*Table 10: Risk assessment for the groundwater quality deterioration.*

| **Impact of groundwater quality in the deeper Skurweberg formation** | |
|---|---|
| Potential impact and risk: | Negative – accidental spills or releases of hydrocarbons, chemicals or other contaminants during construction could infiltrate through the subsurface and potentially affect groundwater quality within the fractured Skurweberg Formation. |
| Nature of impact: | Direct |
| Extent and duration of impact: | Local to regional, Long term >15 years but less than <30. |
| Consequence of impact or risk: | Moderate |
| Probability of occurrence: | Unlikely |
| Degree to which the impact may cause irreplaceable loss of resources: | The impact is highly unlikely to cause any irreplaceable loss of resources. |
| Degree to which the impact can be reversed: | The impact is partially reversible. |
| Consequence of impact or risk: | Potential deterioration of groundwater quality within the deeper fractured-rock aquifer. |
| Cumulative impact prior to mitigation: | Moderate – repeated or multiple small contaminant releases during construction and operation could cumulatively affect groundwater quality if not appropriately managed. |
| **Significance rating of impact prior to mitigation** | **Moderate** |
| Degree to which the impact can be avoided: | Fully avoidable |
| Degree to which the impact can be managed: | Fully manageable |
| Degree to which the impact can be mitigated: | Fully mitigatable |
| Proposed mitigation: | Good construction practices and due diligence must be |

| | |
|---|---|
| | followed to prevent the release of hydrocarbons, chemicals and other potential contaminants. Hazardous substances should be stored appropriately and spill response equipment should be available on site |
| Residual impacts: | Decreased groundwater quality. |
| Cumulative impact post mitigation: | If the impacts are mitigated as detailed in this report, the cumulative impact would be negligible with little to no impact on availability of groundwater resources. |
| **Significance rating of impact after mitigation** | **Very low** |

## 10.3. Interception or alteration of shallow groundwater

Excavation, foundations, underground services, roads and other below-ground infrastructure may locally intersect shallow groundwater or perched water associated with the interface between the relatively low-permeability clayey materials and the underlying more permeable or fractured geological materials. Such excavations could locally intercept or divert shallow groundwater and alter existing subsurface flow paths towards the wetland and other surface-water features. The presence of dense clayey material at shallow depth, as observed during the site visit, suggests that shallow water may also occur temporarily above or within the low-permeable layer following rainfall events. Interception or disturbance of this shallow groundwater system could alter the groundwater seepage towards the wetland.

Excavation and below-ground infrastructure should be designed to minimise disruption of shallow groundwater and perched flow towards the wetland. Where shallow groundwater is encountered, natural drainage pathways should be maintained or reinstated following construction and any required dewatering should be appropriately managed. Areas surrounding major excavations should be inspected for changes in seepage, ponding or wetland flow, with remedial measures implemented if significant changes are observed. The risk assessment is presented in **Table 11**.

*Table 11: Risk assessment for interception or alteration of shallow groundwater flow.*

| **Interception or alteration of shallow groundwater flow** | |
|---|---|
| Potential impact and risk: | Negative – excavation and below-ground infrastructure may intercept or divert shallow groundwater and perched water, potentially altering the flow of water towards nearby wetlands and drainage features. |
| Nature of impact: | Direct |
| Extent and duration of impact: | Local, short- to medium-term during construction. |
| Consequence of impact or risk: | Moderate |
| Probability of occurrence: | Possible |
| Degree to which the impact may cause irreplaceable loss of resources: | The impact is unlikely to cause irreplaceable loss of groundwater or wetland resources if shallow groundwater pathways are appropriately managed. |
| Degree to which the impact can be reversed: | The impact is partially reversible. |

| Interception or alteration of shallow groundwater flow | |
|---|---|
| Consequence of impact or risk: | Localised alteration of shallow groundwater flow and potential reduction of groundwater contribution to nearby wetland areas. |
| Cumulative impact prior to mitigation: | Moderate – multiple excavations, roads, services and other infrastructure may collectively alter shallow subsurface drainage pathways and reduce natural connectivity between recharge areas and wetland features. |
| **Significance rating of impact prior to mitigation** | **Moderate** |
| Degree to which the impact can be avoided: | Partially avoidable |
| Degree to which the impact can be managed: | Partially manageable |
| Degree to which the impact can be mitigated: | Partially mitigatable |
| Proposed mitigation: | Excavations and below-ground infrastructure must be designed to minimise disruption of shallow groundwater flow. Where shallow groundwater is encountered, natural flow pathways must be maintained or reinstated following construction. Unnecessary disturbance of low-permeable clay layers should be avoided and any required dewatering should be avoided where possible. Areas surrounding the major excavations should be inspected for changes in groundwater levels and wetland flow. Remedial measures should be implemented where significant changes are observed. |
| Residual impacts: | Localised alteration of shallow groundwater flow may remain in areas directly affected by permanent infrastructure. |
| Cumulative impact post mitigation: | If the impacts are mitigated as detailed in this report, the cumulative impact would be negligible with little to no impact on shallow groundwater flow and wetland hydrological functioning. |
| **Significance rating of impact after mitigation** | **Moderate to Low** |

# 11. Groundwater Management Plan

Although no groundwater abstraction is proposed as part of the Section 21(c) and (i) WULA, a groundwater management plan is recommended to ensure that potential impacts of the proposed development on the groundwater environment are appropriately managed. The management plan should focus on protection of the deeper groundwater system, as well as the shallow groundwater that may occur above the dense clay-rich materials encountered during the auger investigation. The following measures are recommended:

1. Existing suitable boreholes and the on-site piezometer should be incorporated into a groundwater monitoring programme to establish baseline conditions and identify any changes in groundwater quality associated with construction and operation.
2. Where suitable monitoring points are available, groundwater levels should be monitored to identify any significant changes in groundwater levels or groundwater-flow conditions.
3. Fuels, oils, chemicals, hazardous materials and construction-related waste must be stored, handled and disposed of appropriately to prevent infiltration of contaminants into the subsurface.
4. Appropriate spill-response equipment should be available on site and any spills or leaks must be contained, cleaned up and recorded promptly.
5. Excavations should be monitored for the occurrence of shallow groundwater. If groundwater is encountered, the flow conditions and potential connection to nearby wetland areas should be assessed.
6. Areas contributing to recharge of the fractured Skurweberg Formation should be protected from unnecessary contamination and excessive disturbance. Particular care should be taken where the formation is exposed or where the protective shallow cover is thin.
7. Clean and contaminated stormwater should be appropriately separated and managed to prevent uncontrolled infiltration of potentially contaminated water.
8. Any significant deterioration in groundwater quality or unexpected groundwater interception during construction should trigger an investigation and, where necessary, additional monitoring and remedial measures.
9. Monitor wetland water levels, flow and water quality during construction and operation, with significant changes investigated.

The proposed groundwater monitoring parameters are mentioned in **Table 12**. It is recommended to analyse the specified parameters monthly during construction, and thereafter, during the operational phase, to monitor the groundwater quarterly.

*Table 12: Proposed groundwater monitoring parameters.*

| Parameter | Frequency |
|---|---|
| Groundwater Level | Monthly* |
| **Chemical parameters** | |
| pH (at 25 ºC) | Monthly (Field Chemistry) |
| Conductivity (mS/m) (at 25 ºC) | Monthly (Field Chemistry) |
| Total Dissolved Solids (mg/L) | Monthly (Field Chemistry) |
| Sodium (mg/L as Na) | Monthly* |
| Potassium (mg/L as K) | Monthly* |

| Parameter | Frequency |
|---|---|
| Magnesium (mg/L as Mg) | Monthly* |
| Calcium (mg/L as Ca) | Monthly* |
| Chloride (mg/L as Cl) | Monthly* |
| Sulphate (mg/L as $SO_4$) | Monthly* |
| Nitrate & Nitrite Nitrogen (mg/L as N) | Monthly* |
| Nitrate Nitrogen (mg/L as N) | Monthly* |
| Nitrite Nitrogen (mg/L as N) | Monthly* |
| Ammonia Nitrogen (mg/L as N) | Monthly* |
| Total Petroleum Hydrocarbons (TPH) | Monthly* |
| *Monthly during construction, thereafter quarterly | |

# 12. Assumptions and Limitations

During this study, certain assumptions limited the accuracy of the data acquired and the outcome of this report.

- The geological interpretation is based on the available 1:50 000 geological mapping and the information available for the study area. Geological contacts and subsurface conditions may vary locally from those depicted on the regional geological map.
- Available data was sourced from the relevant groundwater databases and sources. The aquifer vulnerability, yield and quality data are predominantly accurate, albeit mapped at a regional scale.
- The presence of dense clay-rich material encountered during augering is interpreted to potentially restrict vertical infiltration and promote shallow runoff, ponding and perched water. However, the extent of the cover across the site is not confirmed.
- The groundwater quality was derived from one set of test results. Seasonal changes may occur in the chemistry of the water from the borehole and this has not been accounted for.
- It was not possible to collect a rainfall sample as part of the isotope investigation; therefore, site-specific precipitation isotopes were not available for comparison.
- The coordinates of the NGA boreholes are sometimes found to be inaccurate. Hence, it was difficult to incorporate the NGA data accurately into the field hydrocensus.
- Limited water level data could be obtained through the NGA database as well as through the hydrocensus and assumptions had to be made without this data available.
- The stable isotope dataset comprises a limited number of samples and therefore provides an indication of water sources and potential interaction but cannot conclusively establish groundwater-surface water flow directions or hydraulic connectivity.
- The assessment of potential impacts is based on the proposed development footprint and activities available at the time of the investigation. Changes to the development layout, excavation depths, stormwater infrastructure or below-ground services may require the geohydrological assessment to be revisited.

# 13. Conclusion

GEOSS was approached by Nemai Consulting (Pty) Ltd, on behalf of the Mossel Bay Local Municipality, to compile a geohydrological assessment for their Water Use Licence Application (WULA). No groundwater abstraction is planned as part of the Mossdustria expansion, but the proposed expansion area is within 500 m of wetlands and 35 m of a watercourse, which triggers the need to apply for a WULA by the NWA Section 21 (c) and (i).

The investigation entailed a desktop study of the local geology, climate, aquifer type, groundwater quality and surface water-groundwater interaction.

The site is predominantly mapped as loam and sandy loam (T-Ql) overlying the Skurweberg Formation, which represents the primary target for groundwater exploration in the area. During the site visit, an auger investigation encountered dense, stiff clay and very fine sand to a depth of approximately 1.7 mbgl, indicating the presence of relatively low-permeability shallow material that may restrict vertical infiltration and promote surface runoff. Recharge to the deeper groundwater system is considered to occur mainly through infiltration of precipitation into the Skurweberg Formation, particularly in higher elevation areas where the formation is exposed or has a thin overlying cover. The dense, clay-rich shallow material may locally prevent vertical infiltration and contribute to the presence of wetland features by accumulating surface runoff and shallow lateral flow. However, the extent of this layer across the site is not known.

The HC_BH1 groundwater sample, collected from approximately 100 m depth, indicates that the deeper groundwater is highly mineralised. The water quality should be regarded as the baseline condition against which future monitoring results are compared. The primary concern is the potential deterioration of groundwater quality as a result of construction-related activities or accidental contaminant releases. Appropriate pollution prevention, spill management and groundwater quality monitoring are therefore recommended.

Although the groundwater vulnerability assessment (DRASTIC) indicates “low” vulnerability of the groundwater system to surface-based contamination, the deeper fractured aquifer should be protected from potential contamination where the protective shallow clay-rich material is thin, disturbed or absent. The vulnerability of the wetlands and the shallow groundwater is considered inherently higher, so care must be taken to prevent contamination and alteration of the natural flow pathways during construction and operation. The principal groundwater-related risks associated with the proposed water uses are considered to be alteration of wetland flow and water quality, potential deterioration of deeper groundwater quality and interception of shallow groundwater during construction. These impacts are considered manageable through appropriate stormwater control, protection of natural drainage pathways, pollution prevention measures and groundwater and wetland monitoring.

Continued wetland and groundwater monitoring during construction and operation is recommended to confirm the assumptions made and to identify any unexpected changes in groundwater levels and quality and wetland hydrological functioning. It is recommended that the general Groundwater Management guideline outlined in Section 11 of this report be included in the licence conditions of the WULA.

# 14. References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# 15. Appendix A: Certificate of Analysis

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**2026-08-06**

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# TEST REPORT

## Water

**Geoss South Africa (Pty) Ltd**

Attn: Alison McDuling

P.O.Box 12412
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@VinlabSA

| Sample Details | | | | | |
|---|---|---|---|---|---|
| **SampleID** | W79959 | | | | |
| **Water Type** | Drinking Water | | | | |
| **Water Source** | Borehole | | | | |
| **Sample Temperature** | | | | | |
| **Description** | HC_BH1 | | | | |
| **Batch Number** | HC_BH1 | | | | |
| **PO Number** | 6428_A | | | | |
| **Date Received** | 2026-07-31 | | | | |
| **Condition** | Cold | | | | |

| Water - Routine | Unit | Method | Uncertainty | Limit | Results | Results | Results | Results | Results |
|---|---|---|---|---|---|---|---|---|---|
| pH@25C (Water) | | VIN-05-MW01 | ^^^ | >= 5 to <= 9.7 | 7.28 | | | | |
| Conductivity@25C (Water) | mS/m | VIN-05-MW02 | ^ | <= 170 | 1065 | | | | |
| Turbidity (Water)* | NTU | | | <= 5 | 12.1 | | | | |
| Total dissolved solids (Water)* | mg/L | | | <= 1200 | 7220.70 | | | | |
| Free Chlorine (Water)* | mg/L | | | <= 5 | 0.02 | | | | |
| Ammonia (NH4) as N (Water) | mg/L | VIN-05-MW08 | 8.90% | <= 1.5 | 1.34 | | | | |
| Nitrate as N (Water) | mg/L | VIN-05-MW08 | 11.00% | <= 11 | <0.70 | | | | |
| Nitrite as N (Water) | mg/L | VIN-05-MW08 | 4.50% | <= 0.9 | <0.05 | | | | |
| Chloride (Cl-) - Water | mg/L | VIN-05-MW08 | 10.12% | <= 300 | 3426.09 | | | | |
| Sulphates (SO4) - Water | mg/L | VIN-05-MW08 | 7.56% | <= 500 | 466.05 | | | | |
| Fluoride (F) - Water | mg/L | VIN-05-MW08 | 12.30% | <= 1.5 | 1.00 | | | | |
| Alkalinity as CaCO3 (Water)* | mg/L | | | | 351.00 | | | | |
| True Colour (Water)* | mg/L Pt-Co | | | <= 15 | <15 | | | | |
| Total Organic Carbon (Water)* | mg/L | | | <=10 | 6.80 | | | | |
| Date Tested | | | | | 2026-07-31 | | | | |

| Water - Metals | Unit | Method | Uncertainty | Limit | Results | Results | Results | Results | Results |
|---|---|---|---|---|---|---|---|---|---|
| Calcium (Ca) - Water | mg/L | VIN-05-MW43 | 13.35% | | 122 | | | | |
| Magnesium (Mg) - Water | mg/L | VIN-05-MW43 | 15.85% | | 156 | | | | |
| Sodium (Na) - Water | mg/L | VIN-05-MW43 | 13.31% | <= 200 | 2078 | | | | |
| Potassium (K) - Water | mg/L | VIN-05-MW43 | 6.80% | | 40 | | | | |

Please click here for SANS241-1:2015 drinking water limits



*** Not SANAS Accredited. Results marked "Not SANAS Accredited" in this report are not included in the SANAS Scope of Accreditation for Vinlab.**



^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

Testing Laboratory
T1131

Doc No V75816 VIN 09-01 07-05-2024 Page: 1 of 2 Visit Vinlab H20

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# TEST REPORT

Water

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Zinc (Zn) - Water | mg/L | VIN-05-MW43 | 13.22% | <= 5 | <0.05 | | | | | |
| Antimony (Sb) - Water* | µg/L | | | <=20 | <13.0 | | | | | |
| Arsenic (As) - Water* | µg/L | | | <= 10 | 14 | | | | | |
| Boron (B) Water | µg/L | VIN-05-MW43 | 19.29% | <= 2400 | 1772 | | | | | |
| Cadmium (Cd) Water | µg/L | VIN-05-MW43 | 14.10% | <= 3 | <3 | | | | | |
| Chromium (Cr) - Water | µg/L | VIN-05-MW43 | 11.39% | <= 50 | <10 | | | | | |
| Copper (Cu) - Water | µg/L | VIN-05-MW43 | 11.07% | <= 2000 | <50 | | | | | |
| Iron (Fe) - Water | µg/L | VIN-05-MW43 | 7.63% | <= 2000 | 705 | | | | | |
| Lead (Pb) - Water | µg/L | VIN-05-MW43 | 9.38% | <= 10 | <10 | | | | | |
| Manganese (Mn) - Water | µg/L | VIN-05-MW43 | 10.54% | <= 400 | 634 | | | | | |
| Nickel (Ni) - Water | µg/L | VIN-05-MW43 | 10.61% | <= 70 | <50 | | | | | |
| Selenium (Se) - Water* | µg/L | | | <= 40 | 35 | | | | | |
| Aluminium (Al) - Water | µg/L | VIN-05-MW43 | 13.90% | <= 300 | 106 | | | | | |
| Cyanide (CN) - Water* | µg/L | | | <= 200 | <10.0 | | | | | |
| Mercury (Hg) - Water* | µg/L | | | <= 6 | <1.0 | | | | | |
| Barium (Ba) Water | µg/L | VIN-05-MW43 | 12.56% | <= 700 | 57 | | | | | |
| Uranium (U) - Water* | µg/L | | | <= 30 | <28 | | | | | |
| Date Tested | | | | | 2026-07-31 | | | | | |

**Comments**

W79959
Recheck Arsenic
Arsenic : 15µg/L
Selenium : 36 µg/L

Anions : 112.2
Cations 110.4
%Difference :0.8%

Mistral Page
Senior Analyst
VIN-05-MW01, MW02, MW03, MW04, MW08, MW09, MW10, MW12, MW13, MW14, MW43

Please click here for SANS241-1:2015 drinking water limits



^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

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sanas Testing Laboratory T1131

BIOGRIP
Node for soil and water analysis

Bosman Street
Stellenbosch University
Stellenbosch, 7602 South AFrica
www.sun.ac.za/english/research-innovation/caf
Date of Report: 2026-08-06
Report # 202608002

**Attn: Jana Oberholzer**

GEOSS South Africa

Email: jana@geoss.co.za

## Stable isotope TEST REPORT

Water

| Sample details | |
|---|---|
| **Sample type** | Water |
| **Condition** | Room temperate |
| **# Samples received** | 4 samples |
| | |

| BIOGRIP Sample ID | Client sample ID | Collection Date/Time | EC | Country of Origin |
|---|---|---|---|---|
| W-8455 | HC_BH1 | 30-Jul-26 | 10 054 µS/cm | South Africa |
| W-8456 | PZ1 | 29-Jul-26 | 1 150 µS/cm | South Africa |
| W-8457 | Wetland | 29-Jul-26 | 210 µS/cm | South Africa |
| W-8458 | River | 29-Jul-26 | 1 150 µS/cm | South Africa |

*Please note that BIOGRIP soil and water node is not an Accredited Laboratory.

Page **1** of **2**

BIOGRIP
Node for soil and water analysis

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Date of Report: 2026-08-06
Report # 202608002

**Attn: Jana Oberholzer**

GEOSS South Africa

Email: jana@geoss.co.za

## Stable isotope TEST REPORT

Water

| Water - δ18O and δ2H stable isotope analysis | | | |
|---|---|---|---|
| **BIOGRIP Sample ID** | **Client Sample ID** | **Mean ± SD δ2H ‰** | **Mean ± SD δ18O ‰** |
| W-8455 | HC_BH1 | -17.42 ± 0.58 | -3.553 ± 0.18 |
| W-8456 | PZ1 | -44.87 ± 0.27 | -6.927 ± 0.06 |
| W-8457 | Wetland | -5.26 ± 0.39 | -1.781 ± 0.01 |
| W-8458 | River | -6.71 ± 0.02 | -2.682 ± 0.03 |

*SD – standard deviation

| Quality control (QC1) | | |
|---|---|---|
| | **Mean ± SD δ2H ‰** | **Mean ± SD δ18O ‰** |
| Measured isotopic ratio (n=2) | -72.2 ± 0.5 | -10.01 ± 0.12 |
| Expected isotopic ratio | -72.3 ± 1.5 | -10.10 ± 0.20 |

*SD – standard deviation

| Quality control (QC2) | | |
|---|---|---|
| | **Mean ± SD δ2H ‰** | **Mean ± SD δ18O ‰** |
| Measured isotopic ratio (n=2) | -18.8 ± 0.5 | -4.12 ± 0.07 |
| Expected isotopic ratio | -18.0 ± 1.5 | -4.17 ± 0.20 |

*SD – standard deviation

| Quality control (QC3) | | |
|---|---|---|
| | **Mean ± SD δ2H ‰** | **Mean ± SD δ18O ‰** |
| Measured isotopic ratio (n=2) | 20.5 ± 0.5 | 6.49 ± 0.12 |
| Expected isotopic ratio | 21.6 ± 1.5 | 6.33 ± 0.20 |

*SD – standard deviation

JColling

Janine Colling
(BIOGRIP soil and water node)

# 16. Appendix B: Risk Rating Criteria

| Nature of impact | Description |
|---|---|
| Positive | Impacts would benefit the receiving environment (including people). |
| Negative | Impacts would harm the receiving environment (including people). |
| **Type of impact** | **Description** |
| Direct | Impacts that result directly from the causal activity, usually at the same time and in the same space as that activity |
| Indirect | Secondary impacts may result from direct impacts, generally occurring later in time and may manifest elsewhere in space (e.g. downstream) |
| Induced | Impacts that may happen as a consequence of the Project (e.g., migration of people along newly created access routes) |
| Cumulative | Impacts that add to or magnify existing or reasonably foreseeable future impacts on the same receiving environment or specific resource |
| **Extent Rating** | **Description** |
| Site specific | Impact (and implications) limited to the project site. |
| Local | Impact extends only as far as the activity, limited to the site and its immediate surroundings and local assets/ resources. |
| Regional | Impact extends to a regional scale and affects provincial resources, e.g. District or Province; Western Cape. |
| National | Impact extends to a national scale and affects national resources in South Africa. |
| International | Impact extends across national borders and affects global resources. |
| **Duration Rating** | **Description** |
| Short term | 0 – 5 years |
| Medium term | 5 – 15 years |
| Long term | Where the impact will cease after the operational life of the activity, either because of natural processes or by human intervention. Generally >15 years but <30 years |
| Permanent | Where the impact will, for all intents and purposes, endure in perpetuity. That is, it would be regarded as 'irreversible' |
| **Intensity Rating** | **Description** |
| Low | Where the impact affects the environment in such a way that a small or negligible proportion of resources and/or beneficiaries would be affected. Receptors in the receiving environment are not threatened or vulnerable and affected communities have negligible or very low dependence on affected resources for livelihoods, health and safety. |
| Medium | Where a sizeable proportion of resources and/ or of beneficiaries would be affected and natural, cultural and social functions and processes would continue, albeit in a modified way. Receptors in the receiving environment are moderately threatened or vulnerable, and/ or affected communities have some dependence on affected resources for livelihoods, health and safety; affected resources could be substituted. |
| High | Where most/ a major proportion of resources and/ or beneficiaries would be affected and natural, cultural and social functions or processes are altered to the extent that they would temporarily or permanently cease. Receptors in the receiving environment are highly threatened or vulnerable (i.e. close to environmental or legal thresholds, standards or targets) and affected communities are highly dependent on affected resources for livelihoods, health and safety, and/ or resources are considered to be |

| | |
|---|---|
| | irreplaceable (if lost they could not be substituted, and/ or their loss would undermine achieving targets, standards). |
| **Probability Rating** | **Description** |
| Improbable | Where the possibility of the impact materialising is very low, but it could occur, e.g. in unplanned/upset conditions |
| Possible | Where there is a possibility that the impact will occur during normal operations. |
| Probable | Where the impact is expected to occur during normal operations |
| Definite | Where the impact will undoubtedly occur. |
| **Confidence Rating** | **Description** |
| High | High confidence in predictions. |
| Medium | Some uncertainty in predictions, e.g. due to information gaps, constraints on study |
| Low | Little confidence in predictions, e.g. due to constraints on study, information gaps, inherent uncertainties |
| **Significance Rating** | **Description** |
| **Negligible** | Where the receiving environment (including people) would not be materially affected by the proposed activity(s). *There would be no need for mitigation*. |
| **Very Low** | Where there would be minimal effect on the environment or human wellbeing and impacts would be well within environmental quality standards or targets, or legal requirements. *There would be no need for mitigation*. |
| **Low** | Where there would be little material effect on the environment or human wellbeing and impacts would be well within environmental quality standards or targets, or legal requirements. *Minor mitigation measures may be required*. |
| **Moderate** | Where the activity (s) would have a material effect on the receiving environment (including people), legal requirements would still be met, but thresholds of potential concern with regard to environmental quality may be crossed. *Mitigation measures – avoidance, minimisation and rehabilitation/ restoration and in some cases offsets/ compensation – would be needed to reduce the impact significance.* |
| **High** | Where there would be major effects on the receiving environment to the extent where environmental quality standards or targets may be jeopardised, legal requirements may not be met and the health, safety, livelihoods and/or well-being of affected people could be jeopardised. *Mitigation measures – preferably avoidance/ impact prevention, minimisation, rehabilitation/ restoration and offsets/ compensation – are essential to reduce the impact significance substantially.* |
| **Very High** | Where there would be severe or substantial effects on the receiving environment to the extent where environmental quality standards or targets would be undermined/ exceeded, there would be non-compliance with legal requirements or commitments and the health, safety, livelihoods and/or well-being of affected people would be jeopardised. *Mitigation measures – avoidance or prevention of impacts as a priority would be required, since impacts are unacceptable. Additional measures to minimise, rehabilitate/ restore and offset/ compensate for residual impacts would be essential to reduce the impact significance substantially.* |

(last page)