

Stockpile Areas and Geotechnical Assessments for the Proposed Extension of Rand Street, George, Western Cape.

Aquatic Biodiversity Assessment



Prepared for HilLand Environmental and SMEC

by

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1. INTRODUCTION

Confluent Environmental Pty (Ltd) was appointed by HilLand Environmental to compile an Aquatic Biodiversity Assessment for preliminary work required to inform the proposed extension of Rand Street between the areas of Thembaletu and Pacaltsdorp in George, Western Cape. The road consists of two sections. A north-south section from PW Botha Boulevard across the N2 Highway towards Pacaltsdorp. And an east-west section known as the Rosedale Main Extension. These are new roads that mostly traverse greenfield sites on municipal land. The erven are mostly large land parcels which connect to higher density residential areas (Figure 1). While the proposed extension of Rand Street is the subject of a separate application in process, the preliminary work required is the subject of this report, which will be submitted as part of a Basic Assessment and Water Use Authorisation.

This assessment will focus on areas proposed as stockpile sites, haul roads, geotechnical test pits, and water level monitoring boreholes (Figure 1). No water will be taken from the latter. These are for water chemistry tests and water level monitoring only. Locations proposed for these activities are indicated relative to delineated watercourses and the Rand Street extension route in Figure 1.

Water quality in the Skaapkop River is known to be very poor with major impacts associated with wastewater, both domestic and industrial. It is therefore critical for the road project to understand the corrosive potential of the water for proposed road structures which can only be achieved through monitoring boreholes.

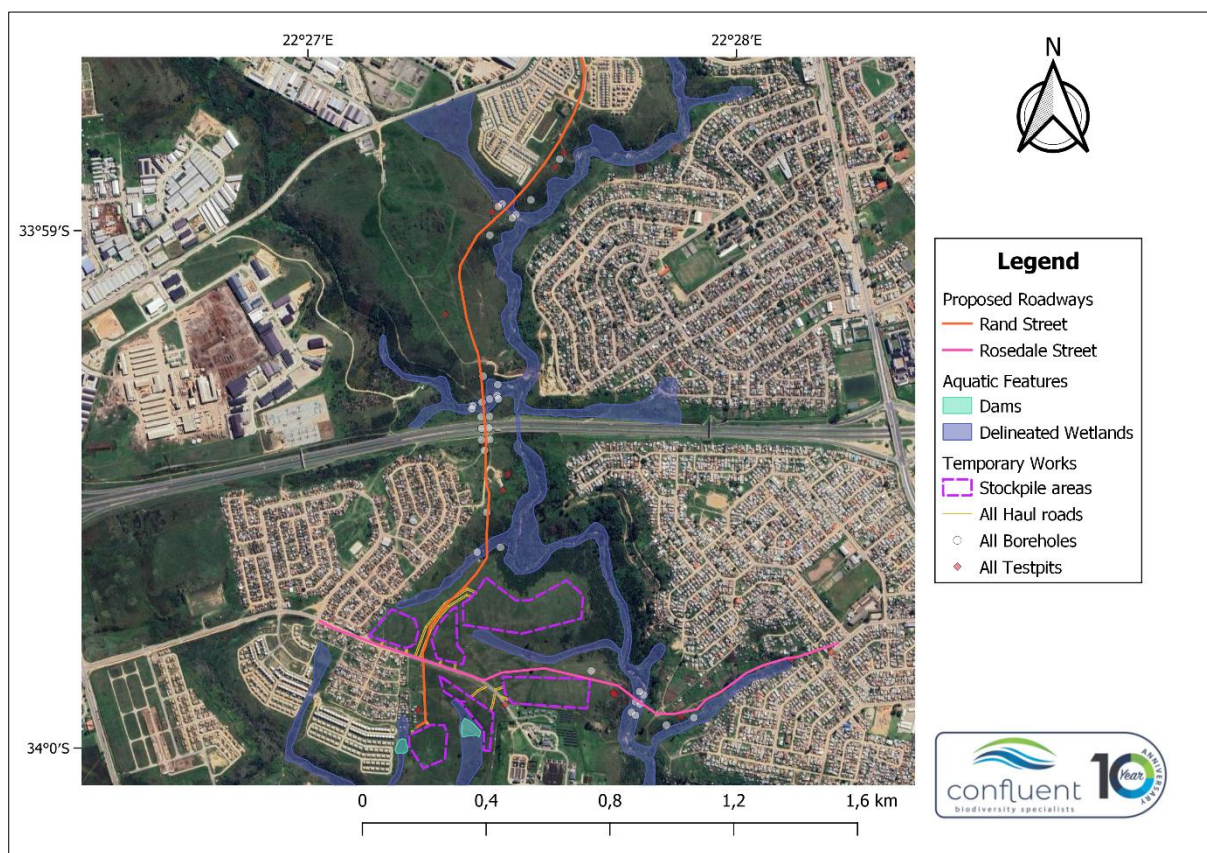


Figure 1. Layout of proposed preliminary activities required for the Rand Street extension.

1.1 Description of Preliminary Works

Watercourses mapped in Figure 1 have already been delineated by the present author as part of the initial Site Sensitivity Verification (SSV) for Aquatic Biodiversity (J. Dabrowski, Confluent Environmental) for the proposed road route. The SSV aimed to better inform the alignment of the road relative to sensitive aquatic and other biodiversity features. The current layout is indicated in Figure 1 along with the proposed preliminary works required. These are explained in more detail below.

1.1.1 Stockpile Areas & Haul Roads

George Municipality would like to finalise the project stockpile areas in the short-term because they have active projects around the city producing fill from excavations that could be used for the Rand Street Ext. project, but there is nowhere to store it. Hence, they would like to commence storing materials with the necessary approvals while the applications for approval for the proposed road extensions proceed.

A total of 6 possible stockpile areas were provided for this assessment (Figure 2). The stockpile areas were delineated by the engineering team at a desktop level, and represent a greater area than necessary, providing the opportunity to refine these areas based on environmental sensitivities observed during fieldwork.

Associated haul roads all lead off Rosedale Main which currently ends in the Outeniqua Wastewater Treatment Works.

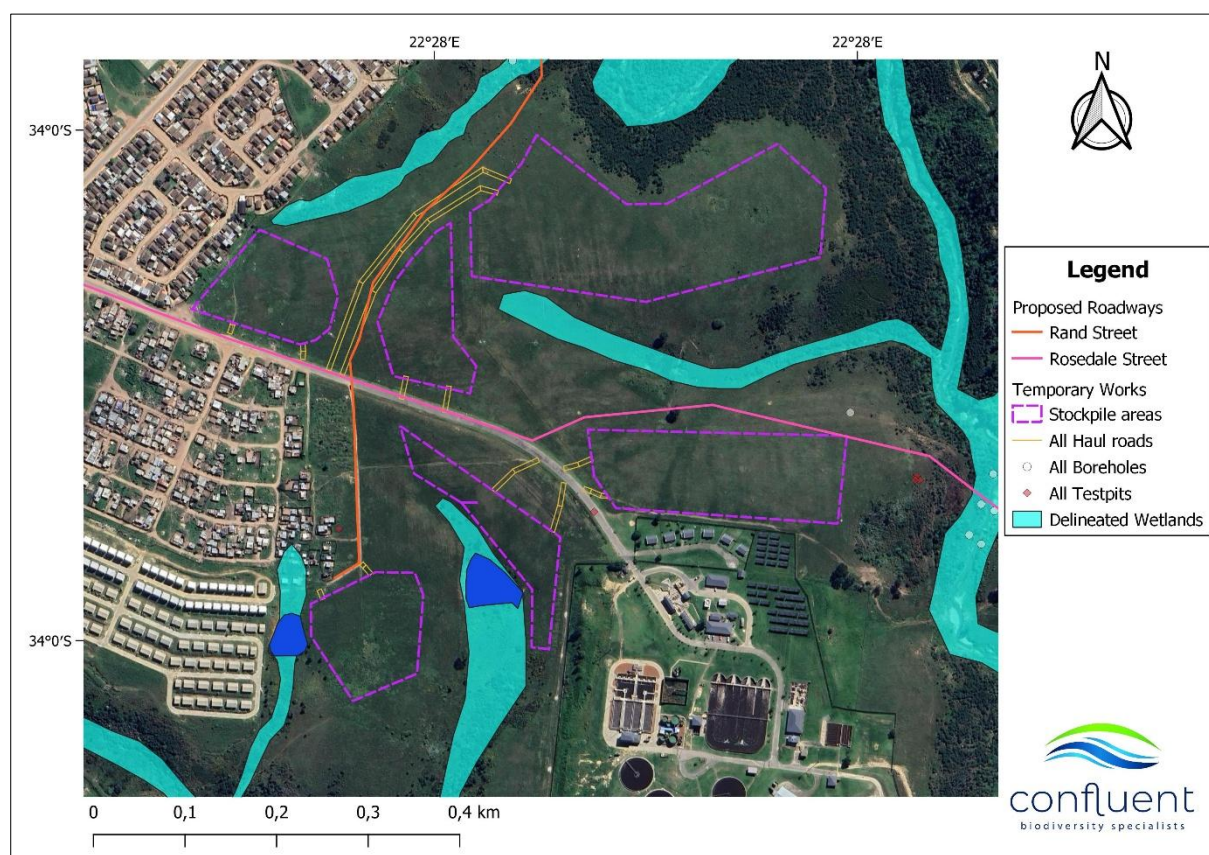


Figure 2. Enlargement of the areas proposed for stockpiling for the Rand Street Extension.

1.1.2 Geotechnical Site Investigations

The consulting engineers, SMEC, provided a detailed method statement for the geotechnical site investigations (Appendix 1). This covers the methods for both test pits and rotary core drilling (monitoring boreholes). The locations of each borehole and test pit proposed are provided in Figure 3. From this layout some of the boreholes and test pits will be drilled in, or close to parts of the delineated wetland areas. While most of the boreholes align with the Rand St. Extension, those to the south of the Outeniqua Wastewater Treatment Works are required for realignment of sewerage infrastructure necessary to accommodate the road extension.

To access investigation sites, existing roads and tracks will be used wherever possible. Where no existing access roads are available, sites will be accessed through routes agreed to with the municipality. Where access is on steep slopes, the route will generally follow natural contours to ensure easier accessibility.

For both the monitoring boreholes and the test pits, an area of 5m x 5m is likely to be disturbed. Some boreholes will be used for monitoring groundwater levels and collecting water samples over 12 months, while others will be for the assessment of soil cores. In both cases, no water is going to be abstracted from the boreholes and they will be closed once monitoring / sample collection has concluded.

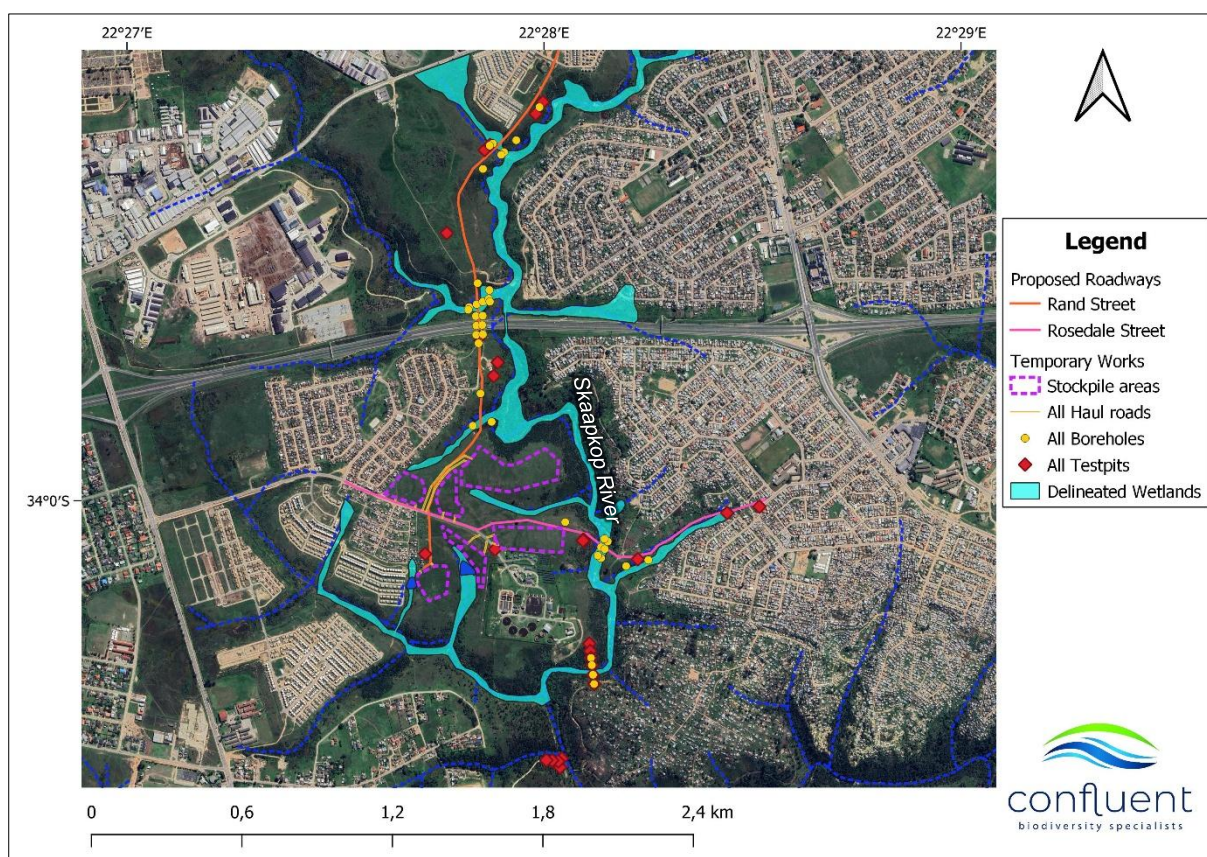


Figure 3. Enlargement of locations for geotechnical investigations.

1.2 Scope of Work

According to the protocols specified in GN 320 (Protocol for the specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity) of the National Environmental Management Act (NEMA; Act No. 107 of 1998), assessment and reporting requirements for aquatic biodiversity are associated with a level of environmental sensitivity identified by the national web-based environmental screening tool (screening tool). Sensitivity for the proposed road extension route was rated as Very High for Aquatic Biodiversity (Figure 4). An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of:

- **Very High** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment; or
- **Low** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Compliance Statement.

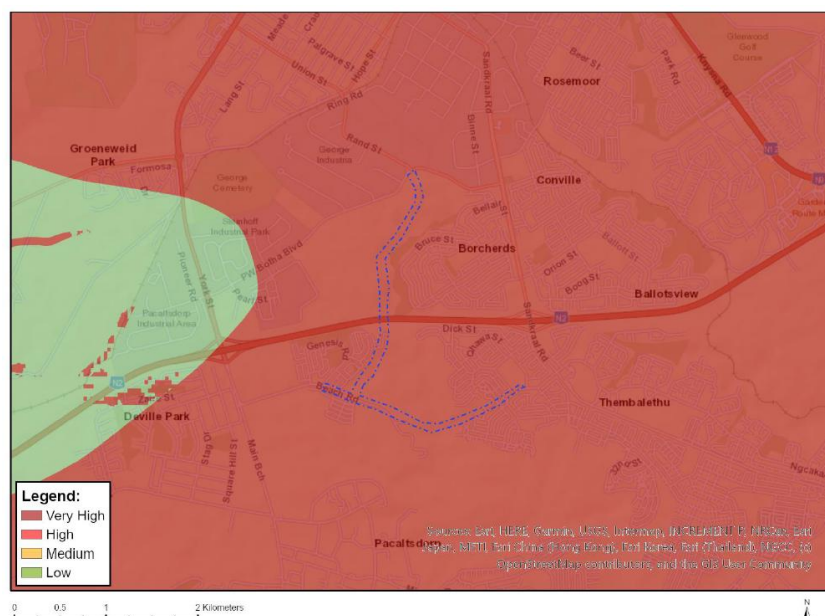


Figure 4. Results of the DFFE Screening Tool which indicate Very High Sensitivity of the Aquatic Biodiversity theme for the proposed road route.

The DFFE screening tool highlighted the following features as reasons for the Very High Sensitivity finding:

- Critical Biodiversity Area 1 (CBA1) Aquatic
- Strategic Water Source Area (SWSA) Outeniqua
- Wetlands (River)
- Wetlands: Eastern Fynbos-Renosterveld Bioregion (Valley-bottom).

Interrogation of available desktop resources including:

- DWS spatial layers (1:50 000 rivers)
- National Freshwater Ecosystem Priority Areas (NFEPA) spatial layers (Nel *et al.*, 2011)
- National Wetland Map 5 and Confidence Map (CSIR, 2018)

- Western Cape Biodiversity Spatial Plan (WCBSP, 2017).

Conduct a site visit to determine the site sensitivity:

- Identification and classification of watercourses within and adjacent to the site according to methods detailed by Ollis *et al.* (2013);
- Determine the watercourse Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) using an appropriate method (if watercourses are present).
- Delineate wetland / riparian areas following methods prescribed by DWAF (2015).
- Determine an appropriate buffer for wetland areas using the site-specific buffer tool developed by Macfarlane and Bredin (2016).

This report will also need to comply with GN4167 of the National Water Act (NWA; Act 36 of 1998) if the proposed development will take place in the area defined as the Regulated Area. In the case of wetlands, this is a development that takes place within 500m of a wetland. In this case, a Risk Matrix must be compiled by a SACNASP-registered aquatic scientist to determine the level of risk posed by the development to the wetland assuming full implementation of all mitigation measures. If the risk is 'Low' then the activities can be Generally Authorised, but if the risk is 'Medium' or 'High' then a Water Use License Application will be required.

1.3 Assumptions, Exclusions and Limitations

- Several of the borehole and test-pit locations were visited during the site assessment in March 2026, but not all of them. This is because the methods to access and execute these activities are largely the same, with minimal variation in site specific differences. Mitigation measures recommended were based on range of different sites assessed and extrapolated to sites that were not investigated directly.
- Further to the above limitation, almost every location of a test pit or borehole has been previously visited during a site visit for the Site Sensitivity Verification which was undertaken on 4 December 2024. It was therefore deemed unnecessary to visit each point for assessment.
- Access to some areas was compromised by poor security features with sites located in remote areas surrounded by informal settlement with no direct vehicle access.

2. CATCHMENT CONTEXT

2.1 Catchment Features

The road extension is in quaternary catchment **K30C** which primarily drains in a south-easterly direction to the Skaapkop River (Figure 5). Mean annual rainfall for the catchment is 842 mm which can occur year-round with bimodal peaks in spring (October) and autumn (March).

The mapped soil types are derived from the Cape Granite Suite and are described as having a distinct clay accumulation resulting in a textural contrast between surface and sub-soils. These are locally referred to as duplex soils and are rated as having a **Very High Erodibility** (0.74). The upper layer of soil is well drained with high water infiltration rates. But the clay accumulation has very low permeability which results in rapid saturation of upper soil layers, followed by high rates of surface runoff during heavy rainfall. Coupled with low vegetation

cover and/or slopes this can result in serious erosion. Furthermore, rainfall intensity in this area is mapped as Very High, which is the highest category in South Africa. High volumes of rainfall can fall within very short time periods, leading to flash flooding. It is therefore important that any land use that can concentrate stormwater runoff be carefully planned to mitigate the impacts of stormwater on receiving landscapes and aquatic ecosystems. This is most relevant for the proposed stockpile areas as they would be subject to continual movement of materials with little surface protection on sloping areas. This is less relevant to the monitoring boreholes and test pits which would only require temporary disturbance of vegetation and would result in minimal areas of exposed soil post-completion.

The project area is located within the Southern Coastal Belt ecoregion which is characterised by undulating hills and moderately undulating plains on the coastal forelands (Ecoregion Level 2:22.02).

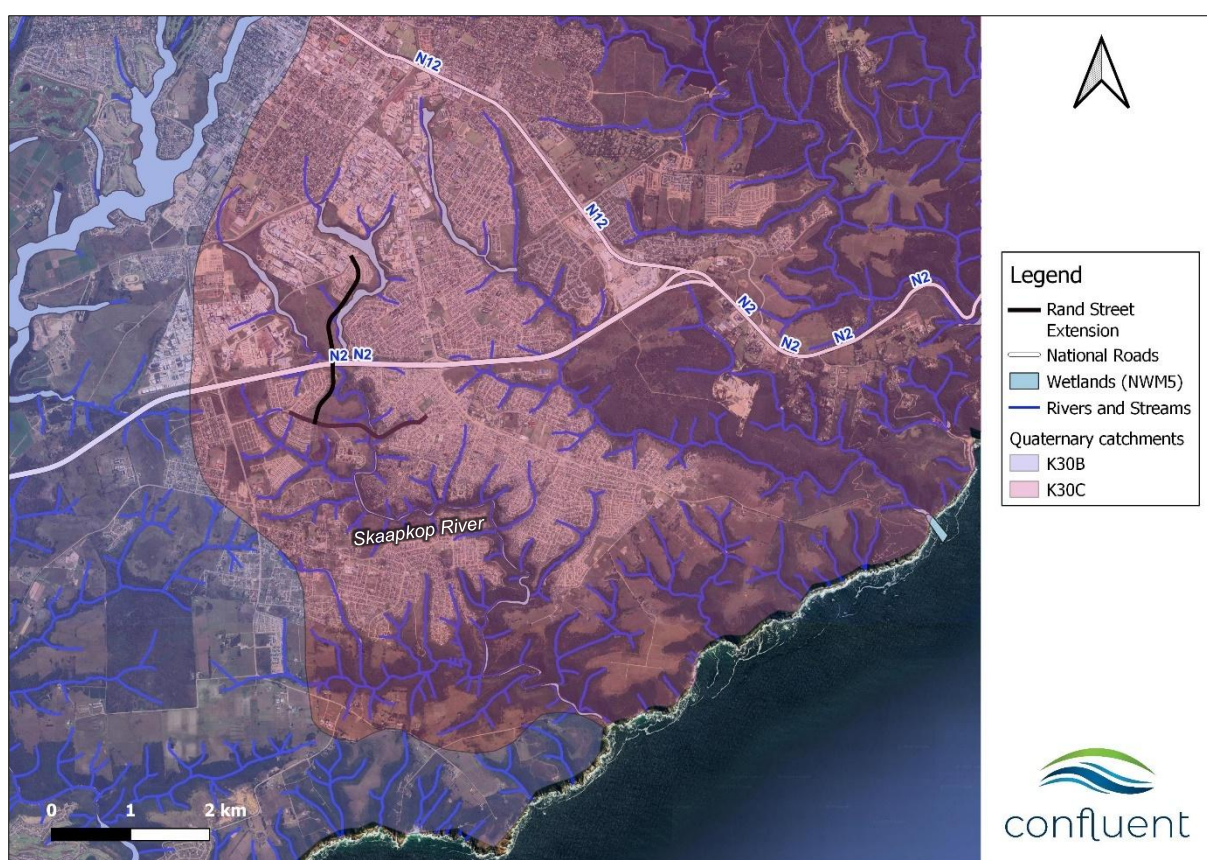


Figure 5: Location of Rand Street Extension within Quaternary Catchment K30C.

2.2 Vegetation

Vegetation along the proposed route is mapped as Garden Route Granite Fynbos (National Vegetation Map (NVM), 2024) which is classified as Critically Endangered. Watercourses within this vegetation type are poorly described in the NVM, with the only distinct vegetation type associated with watercourses named Cape Lowland Alluvial Vegetation, which is classified as Critically Endangered. While poorly mapped and described, this is the closest nationally recognised vegetation type for the valley-bottom wetlands of George. Important taxa are reproduced from the vegetation type description as follows:

Important Taxa (^CEndemic to Capensis, ^PSharing with Pondoland) **Riparian thickets** Small Trees: *Salix mucronata* subsp. *mucronata* (d), *Virgilia divaricata*^C, *Podocarpus elongatus*^C. Tall Shrubs: *Buddleja saligna*, *B. salviifolia*, *Cliffortia strobilifera*, *Freylinia lanceolata*, *Rhus angustifolia*. Low Shrubs: *Cliffortia odorata* (d), *Senecio halimifolius* (d), *Cliffortia ferruginea*^C. **Flooded grasslands & herblands** Tall Shrub: *Melianthus major* (d). Megagraminoids: *Prionium serratum*^P (d), *Calopsis paniculata*, *Cyperus thunbergii*. Graminoids: *Cynodon dactylon* (d), *Cyperus congestus*, *C. denudatus*, *C. textilis*, *Eragrostis sarmentosa*, *Ficinia distans*, *Fuirena hirsuta*, *Hemarthria altissima*, *Isolepis cernua*, *I. prolifera*, *Juncus capensis*, *J. lomatophyllus*, *Leersia hexandra*, *Merxmuellera cincta*, *Paspalum distichum*, *Pennisetum macrourum*. Herbs: *Conyza scabrida*, *Helichrysum helianthemifolium*^C, *Laurembergia repens*, *Persicaria decipiens*. Geophytic Herbs: *Wachendorfia thyrsiflora*^C (d), *Triglochin bulbosa* complex, *Watsonia galpinii*^C, *Zantedeschia aethiopica*. **Open water** Aquatic Herb: *Myriophyllum spicatum*.

2.3 Conservation and Catchment Management

2.3.1 Western Cape Biodiversity Spatial Plan (WCBSP)

The Western Cape Biodiversity Spatial Plan (WCBSP; 2023) indicates that most of the proposed boreholes and test pits are in Critical Biodiversity Area 2 (CBA2) aquatic and terrestrial areas (Figure 6). The stockpile areas are located in terrestrial areas indicated as CBA1.

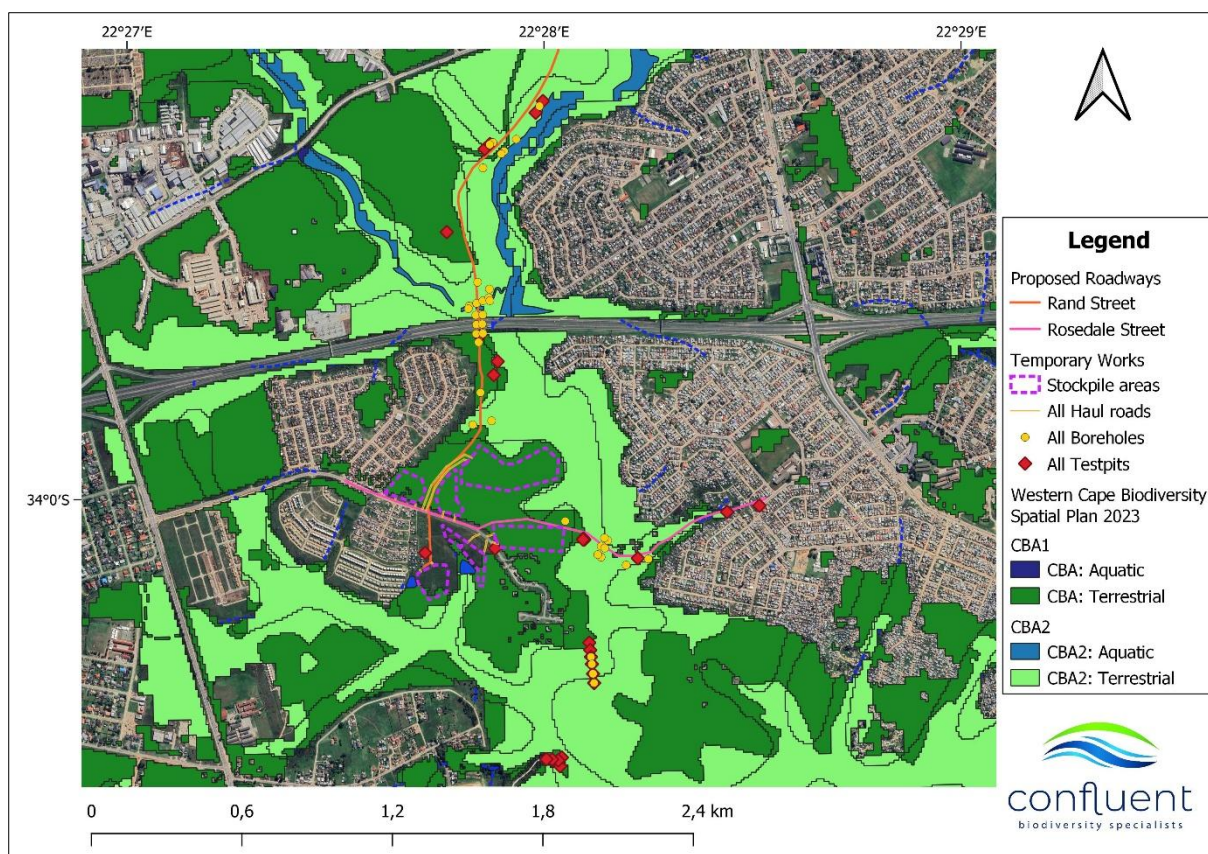


Figure 6. Preliminary investigation sites and stockpile areas for the Rand St. Extension with mapped biodiversity priority areas of the Western Cape Biodiversity Spatial Plan (WCBSP; 2023).

Necessary actions in relation to the WCBSP are to ensure that the aims and objectives for the management of BPAs are not compromised. Although their location, embedded within very high density urban development, means that pressure for development of these areas (formal or informal) will always be high.

The proposed activities (boreholes, test pits, stockpile areas) should not result in negative impacts on the ecological structure and function of the Skaapkop River and associated tributaries as these are mostly CBA2 areas. It seems feasible that the proposed activities could ensure the objectives are met for the river and tributaries for CBA2 with careful planning and mitigation for each activity (Table 1). It is also important to note that the objectives of CBA2 and include restoration/rehabilitation, acknowledging the degraded condition of the river, which should form part of the development plan.

Table 1. Definitions and objectives for conservation categories identified in the Western Cape Biodiversity Spatial Plan (WCBSP, 2023).

WCBSP Category	Definition	Management Objective
Critical Biodiversity Area 1 (CBA1)	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.
Critical Biodiversity Area 2 (CBA2)	Areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure	Maintain in a functional, natural or near-natural state, with no further loss of natural habitat. These areas should be rehabilitated.

2.3.2 NFEPA

According to the National Freshwater Ecosystem Priority Atlas (NFEPA; Nel *et al.*, 2011) the sub-quaternary reach (SQR 9144) is not classified as a Freshwater Ecosystem Priority Areas (FEPA). This SQR incorporates the entire length of the Skaapkop River and tributaries.

2.3.3 Resource Quality Objectives

Resource Quality Objectives (RQOs) are defined as clear goals (numerical or descriptive statements) relating to the quality of a water resource and are set in accordance to the management class for the resource to ensure the water resource is protected. The purpose of RQOs is to set clear objectives for the resource against which WULs and the related impacts can be evaluated and managed to achieve a balance between the need to protect and utilise the resource.

The Breede-Gouritz Catchment Management Agency provides an assessment of major rivers in the Water Management Area (DWS, 2018). The Skaapkop River and tributaries were not included in this assessment.

2.3.4 Strategic Water Source Area

Aquatic biodiversity within the site has been identified as Very High on the basis that the site falls within the Outeniqua Strategic Water Source Area for surface water (SWSA-sw). SWSAs are defined as areas of land that supply a disproportionate (ie. Relatively large) quantity of mean annual runoff in relation to their size and are therefore considered nationally relevant (Le Maitre *et al.*, 2018). A key objective in the management of SWSAs is to ensure the quantity

and quality of water within and flowing from SWSAs is protected from developments that cause unacceptable and irreparable impacts.

While the quantity (much greater than natural) and quality (very poor) of water being delivered through the Skaapkop River is already impacted by a wide range of urban land-uses, it is important to ensure that future development and the associated proposed activities do not further compromise this river system so that rehabilitation efforts can be supported.

2.4 Mapped Watercourses

Wetlands, rivers and streams are mapped in the National Wetland Map (Version 5) and DWS 1: 50 000 flow paths respectively (Figure 7). Wetlands were ground-truthed and the delineation thereof updated as part of the initial Site Sensitivity Verification to inform the road layout. These features along with the 1m contours obtained from George Municipality are indicated in Figure 7.

The test pits and boreholes are located on a mix of steeply sloping areas and more level areas (Figure 7). Where test pits and boreholes are clustered around the watercourse, they are aligned with proposed road crossing points associated with the road extensions. The stockpile areas are located on gently sloping ground which all gradually increases in gradient towards valley bottom wetlands.

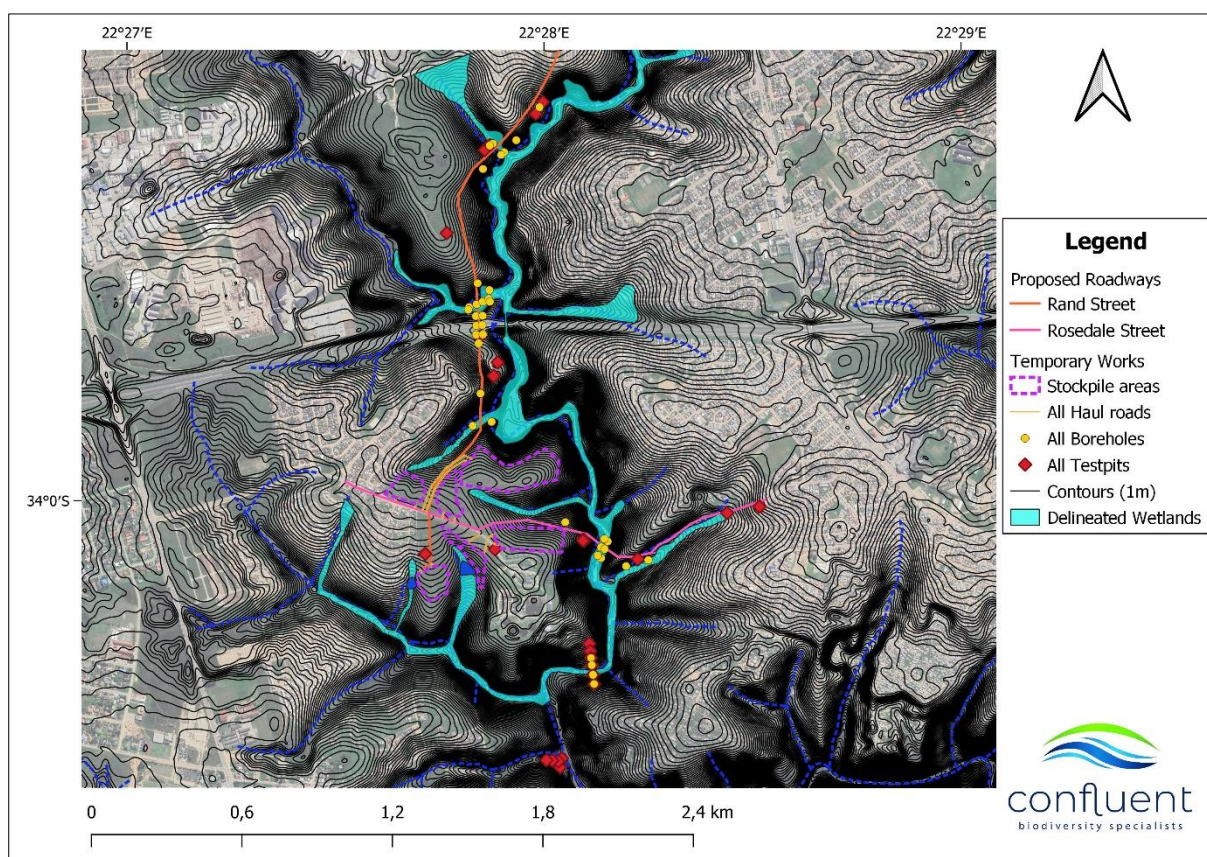


Figure 7. Mapped 1:50 000 drainage lines and delineated wetlands in relation to 1m contours.

2.5 Historical Assessment

Historical imagery was sourced from Google Earth and the CD:NGI.

In the last two decades new areas of development in the catchment of the Skaapkop River and tributaries has occurred, and existing areas of development have expanded. The latter mostly due to informal housing extensions to formal low-cost housing areas. This pattern is evident in both the northern and southern sections of the proposed road extension and associated preliminary works (Figure 8 & Figure 9). In these images the extent of riparian vegetation appears fairly similar along the Skaapkop River, although it appears to be more dominated by bushy vegetation in 2003. The latter may have been alien vegetation that has been cleared. A distinct channel is evident along the watercourse in 2003 and 2024.



Figure 8: Comparison between the northern road section in 2003 and 2024 using satellite imagery.



Figure 9: Comparison between the southern road section in 2003 and 2024 using satellite imagery.
This is the area where all of the stockpile areas are proposed.

The stockpile areas appear to have been burned or cleared in a linear fashion during 1957, and grazing was a likely land use. Now predominantly grassy fields, there is increasing development around them, and the original extent of wetland vegetation has receded, while woody alien vegetation has become dominant (Figure 10).

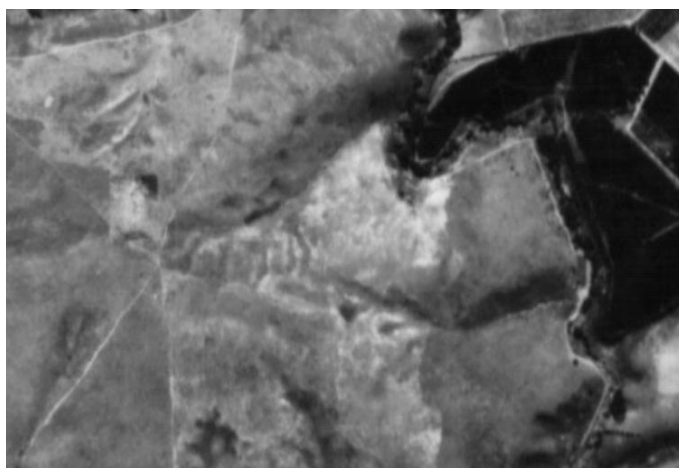




Figure 10. Stockpile areas compared between 1957 (top), 2003 (left) and 2025 (right).

Earlier aerial photos of the site were sourced from the CD:NGI from 1936, 1974 and 1998 (Figure 11). In the 1936 image there is no distinct channel associated with the Skaapkop River or tributaries, and it appears to have been more like an unchanneled valley-bottom wetland. In 1974, modifications are already visible, with more extensive agricultural fields established. The vegetation appears to have changed through the watercourse to a more woody / bushy type, possibly indicating an early invasion of alien vegetation. This is quite likely due to the establishment of a plantation type land use on the eastern side of the river opposite the proposed stockpile areas.

Dense invasion by woody alien trees alone can result in channel incision in a wetland, as the trees remove water from the soil and create armouring along what becomes a preferential flow-path, and then a channel during heavy rains. Increasing urban development in the catchment in the ensuing decades has discharged large volumes of stormwater runoff to this catchment which would have seriously exacerbated this impact, creating the large channel and altered state of the watercourse seen today.

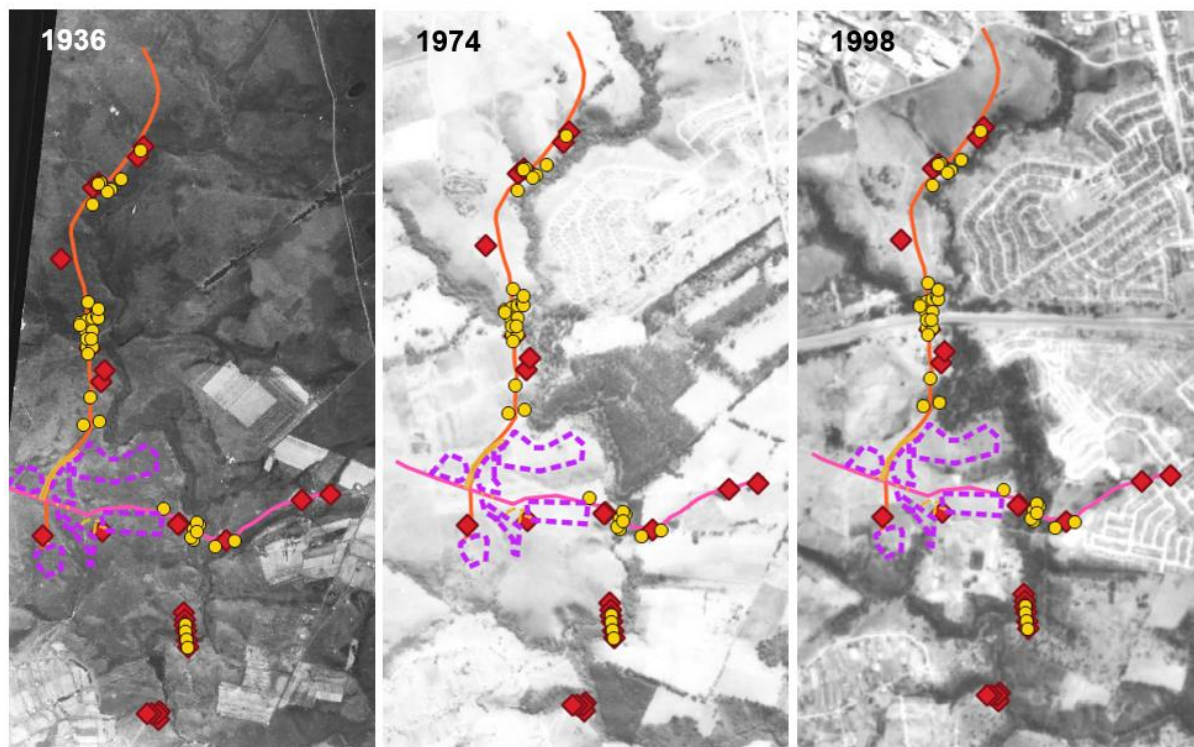


Figure 11. Historical aerial photographs with the superimposed road route, stockpile areas and geotechnical investigation sites.

3. SITE ASSESSMENT

3.1 Site Visit

The road route was assessed on 4 December 2024 as part of the initial site sensitivity verification. Subsequently, the site was re-assessed on 26 March 2026 for the proposed boreholes, test pits and stockpile areas. The preceding weather on both occasions had been hot and relatively dry with limited rainfall in the preceding weeks. Nonetheless, a steady stream of water was flowing through the Skaapkop River and tributaries. However, the quality of this water appeared highly impacted, and this river system is known to be heavily polluted by sewage and industrial waste (Figure 12).

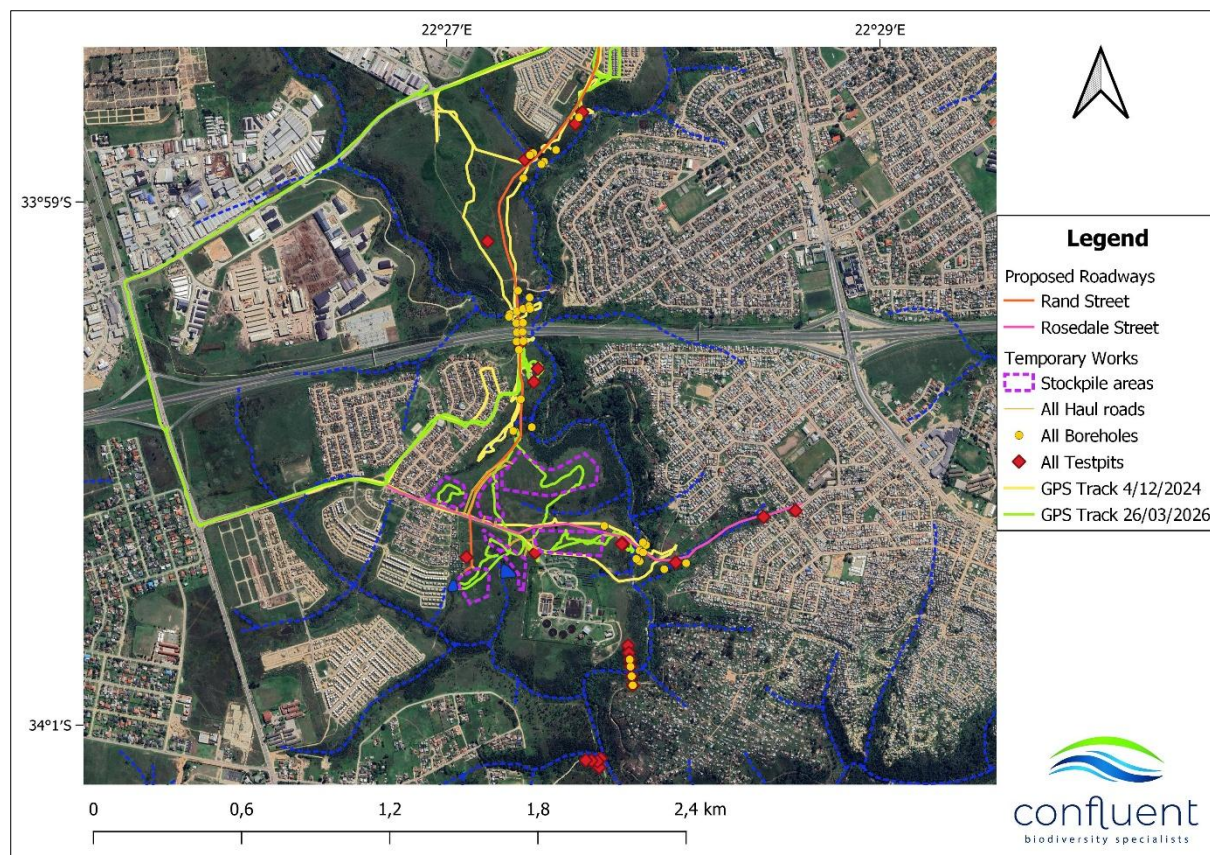


Figure 12. Map showing the GPS tracks taken during the first and second site assessment.

3.2 Watercourse Classification

Watercourses in the vicinity of the road were classified following the system determined by Ollis *et al.* (2013). All the watercourses encountered occurred in the bottom of valleys, with varying degrees of confinement. Almost all wetlands are channelised at present although their historical condition is thought to be unchanneled valley-bottom wetlands.

3.3 Wetland Delineation

Wetlands and riparian zones were delineated following standardised methods established by DWAF (2005). To a large extent, wetland delineation relied on georeferenced historical and current satellite imagery along with 1m contours because the wetland areas are extensive, located in secluded areas where security can be an issue, and are often inaccessible due to steep or eroded slopes, and dense vegetation.

Delineations also used field observations of vegetation and soil. Points at which the road will cross watercourses with the associated need for geotechnical investigations were the primary focus, along with the proposed stockpiling areas (Figure 13). In most cases, historical areas of wetland vegetation have been replaced with more terrestrial vegetation (riparian zones) with moderate to high densities of alien vegetation. The present appearance of the Skaapkop River and many tributaries is that of a river with riparian vegetation, but as previously explained this is not the natural condition of this watercourse, which historically had no channel. The main channels flowing through the system were included in the delineation, along with any operating

or broken dams. Two broken dam walls are present on wetlands in the southern section of the proposed road.

Vegetation on many of the southern slopes is in most cases indicative of high moisture levels and in some cases represents the best remaining indigenous vegetation along the route. In some cases, these areas were included in the wetland delineation because they contain species indicative of temporary soil saturation and high moisture levels such as *Watsonia angusta*, *Morella quercifolia* and *Pteridium aquilinum*.

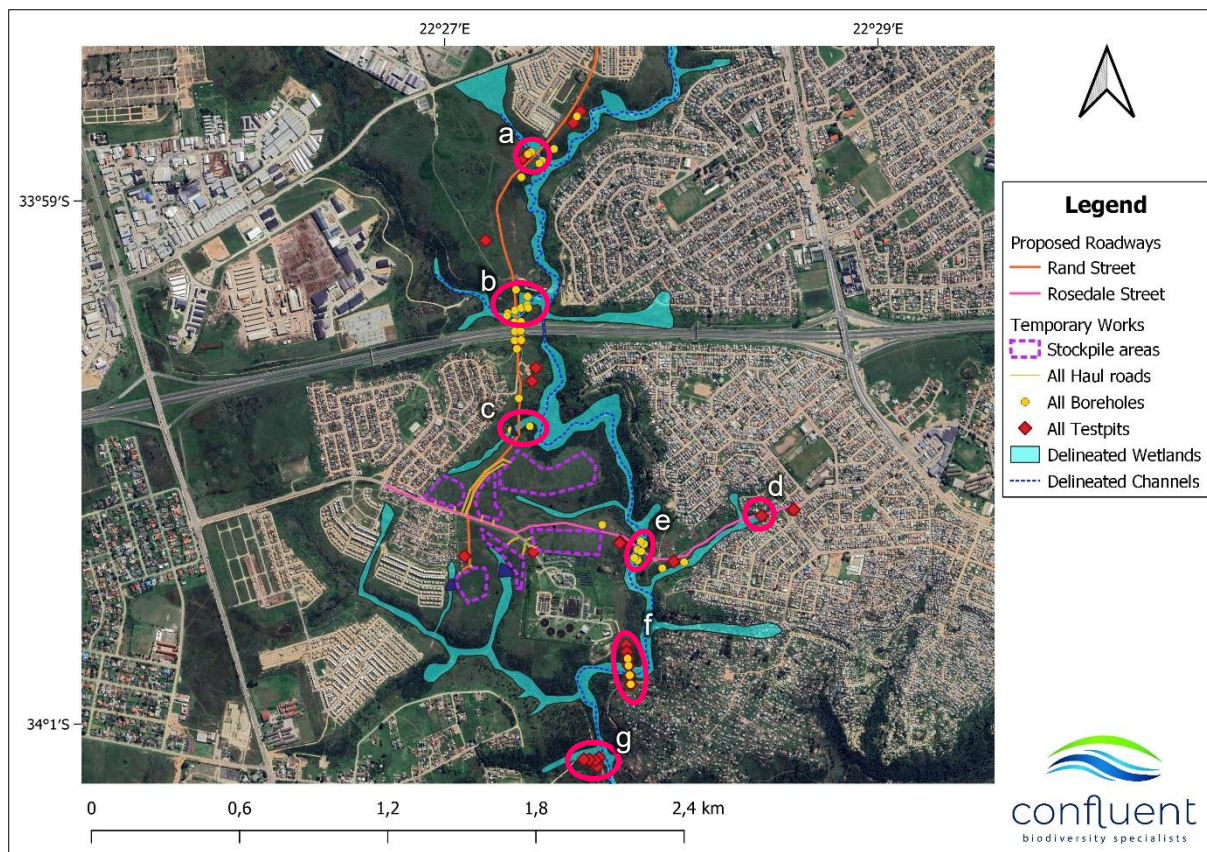


Figure 13. Delineated wetlands in proximity to the proposed road route for the Rand Street extension. Pink encircled areas correspond to high watercourse interaction points.

3.4 Site Observations

Of the 38 boreholes and 27 test pits, several are in, or very close to delineated wetlands / watercourses. These have been indicated as 'Areas' in Figure 13. The proposed stockpile areas are predominantly located on gently to steeply sloping land. The latter all eventually descend to valley-bottom wetlands on the slopes below. Photos taken during site visits are presented in Figure 14 with additional photos from more terrestrial areas provided in Appendix 2. Vehicle access to most areas would be straightforward on ground that is generally grassy and level. But some of the watercourses access points cover steeper ground with densely vegetated slopes.



Figure 14. Photos of stockpile, borehole and test pit areas.

3.5 Present Ecological State (PES)

The assessment of Present Ecological State (PES) was completed using WET-Health Level 1B (Macfarlane et al., 2020). Results of the WET-Health assessment are assigned an ecological category for hydrology, geomorphology, water quality, and vegetation. Scores are then combined to assign an overall ecological category from A which describes a natural condition, through to F where wetland function has been critically modified (Table 2).

Table 2. Descriptions of the Ecological Categories used for WET-Health assessment with applicable range of impact scores and PES scores for each category.

ECOLOGICAL CATEGORY	DESCRIPTION	IMPACT SCORE*	PES SCORE (%)*
A	Unmodified, natural.	0-0.9	90-100
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	80-89
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	60-79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	40-59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39
F	Critically modified. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	0-19

The PES assessment focussed primarily on the Skaapkop River given that it is the receptor environment for all tributaries in the immediate catchment. Water quality is poor in the river given the observation of manholes leaking sewage in the catchment, along with well-known overflow issues at the sewage pump station on the river. In addition to sewage, the river catchment has an industrial and warehousing sector which discharges high stormwater volumes of questionable quality. Vegetation along the river has been seriously impacted by dense invasions by alien plant species, resulting in little indigenous vegetation remaining. Furthermore, the eroded and incised channel that has replaced the once unchanneled valley-bottom now has a completely different, more terrestrial plant assemblage than would have occurred under reference conditions. **Overall, the PES for the Skaapkop River is rated as a D, which is considered Largely Modified** (Table 3).

Table 3. Summary of the WET-Health Level 1B assessment for the Skaapkop River.

Final (adjusted) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5.8	2.8	3.3	6.0
PES Score (%)	42.4 %	71.5 %	66.9 %	40.0 %
Ecological Category	D	C	C	E
Trajectory of change	-	-	-	-
Confidence (revised results)	Not rated	Not rated	Not rated	Not rated
Combined Impact Score	4.6			
Combined PES Score (%)	53 %			
Combined Ecological Category	D			

4. LEGISLATIVE IMPLICATIONS

4.1 Site Sensitivity Verification: NEMA

In terms of GN 320 (Protocol for the specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity) of the National Environmental Management Act (NEMA; Act No. 107 of 1998), the desktop and field assessment determined a **Very High Sensitivity** for Aquatic Biodiversity. This finding is on the basis that several points along the Skaapkop River and tributaries will be directly affected by the access required to excavate test pits and drill boreholes. An impact assessment is required to address these impacts and provide mitigation measures. The stockpile areas are not located in wetland areas and can be adjusted to ensure they are > 32m from the wetland edge.

4.2 NWA Water Uses

Possible water uses considered for the proposed geotechnical investigations and stockpiling sites included Section 21 c) and i) which are defined as follows:

21c): Impeding or diverting the flow of water in a watercourse;

21i): Altering the bed, banks, course or characteristics of a watercourse;

The 21c) and i) water uses relate to construction and operation of infrastructure in general in the regulated area of the watercourse. In GN4167 the regulated area of the watercourse is defined as:

“In respect of a wetland: A 500m radius around the delineated boundary (extent) of any wetland”. Given that several of the test pit and borehole points are located in watercourses, and the stockpile areas are within 500m of wetland areas, this assessment area is considered to be in the regulated area of the watercourse.

A Risk Matrix must therefore be compiled to determine the level of risk posed provided all recommended control / mitigation measures are implemented. If the risk is Low, then a General Authorisation is applicable, but if the risk is Moderate or High then a Water Use License will be required.

5. IMPACT ASSESSMENT

The impact assessment is fundamentally guided by the mitigation hierarchy, which seeks to avoid and minimise impacts as the first priority (Figure 15). Every effort must be made to avoid and minimise impacts and rehabilitate affected areas. Offsets are the final option in the mitigation hierarchy. The impact assessment includes not only direct and indirect impacts, but also cumulative impacts, which are additive.

Residual impacts are negative impacts that remain after all reasonable and practical changes have been made to location, siting, scale, layout, technology, and design of the proposed development. Provided the residual impacts are Very Low or Low, no offset is required. However, if the residual impacts are Medium or High, then an offset is required. Very High residual impacts represent fatal flaws and cannot be offset. Such activities are unlikely to be authorised.

Cumulative impacts must not cause irreversible decline to the conservation status of species and the presence of special habitats or cause a significant loss in ecosystem services. Methods for the impact assessment are provided in Appendix 3.

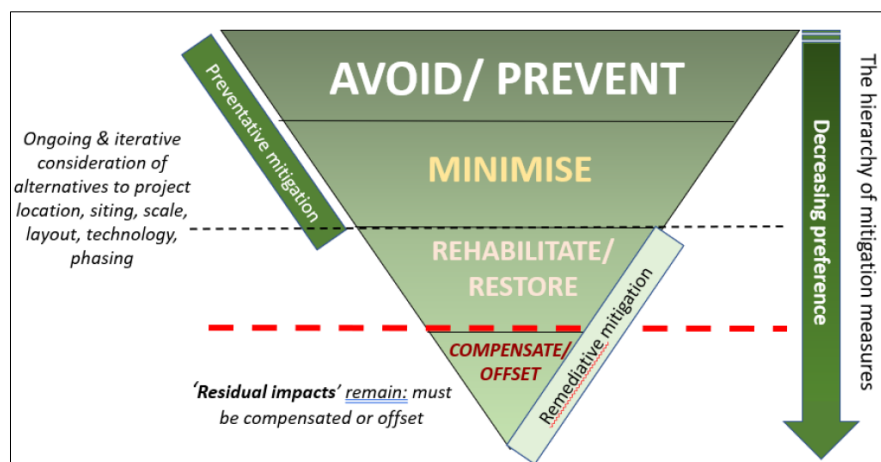


Figure 15. Successive steps shown in the mitigation hierarchy which can only be considered once the previous step has been exhausted (EWT, 2023).

It is important to note that while the activities described in this report are unlikely to create significant residual impacts on their own, the future development of the Rand Street extension project will be subject to a separate impact assessment where this aspect will be considered once again.

5.1 No-Go Development

The No-Go Development scenario would result if approval were not granted for stockpiling areas and geotechnical investigations. In this instance, further planning and layouts for the Rand Street extension would be compromised and it would be unlikely that the project to create this additional road link between Thembaletu and Pacaltsdorp could go ahead. The road project is therefore contingent on approval of the stockpiling areas and geotechnical investigations.

5.2 Design and Layout Phase

5.2.1 Boreholes and Test Pits

The location of proposed monitoring boreholes and test pits was provided by the consulting engineers and aligns with proposed infrastructure related to the road extension and associated realignment of sewer lines. There are no design modifications applicable, and the layout is aligned with proposed infrastructure. Therefore, no recommendations are made for this phase of the impact assessment.

5.2.2 Stockpiling Areas

Layout of the stockpiling areas is an aspect considered in terms of this impact assessment. This is because the stockpiling areas provided by the municipality at present mostly include steep slopes that would drain to valley-bottom watercourses.

Potential Impacts

- If stockpiling areas include steep sloping land, then materials could wash off downslope into the watercourse, increasing turbidity and introducing pollutants.
- Furthermore, the disturbance could interfere with wildlife utilising watercourses as corridors for movement, through extensive reduction of green space close to wetlands or riparian areas.
- Stockpiling sites are temporary, and it is uncertain what the fate of this land will be once concluded. Given the improved road access and existing surrounding development, it is conceivable that formal development could be proposed on the stockpile sites in future. Therefore, it is important that the area of transformation be limited to what might be developed in future.

Mitigation Measures

- The primary mitigation measure is to reduce the stockpiling areas to align with areas of lower gradient situated at least 50m from delineated wetland areas (Figure 16 & Figure 17).
- It is recommended that all haul roads be realigned to enter the adjusted stockpiling areas (Figure 16) outside of the 50m wetland buffers. The haul road to the 2.91 ha field could be moved out of the buffer, or could connect via the 1.3 ha area, which could also be joined to the 2.91 ha area.
- If any area could be further reduced or removed, the 0.7 ha stockpile area would be recommended for removal given the practical difficulty of aligning it out of the buffer.

Note The George Municipality agreed to adopt these mitigation measures and revised the proposed layout of the stockpile areas and haul roads in accordance (Figure 18).



Figure 16. Proposed alternative stockpiling areas in relation to 50m wetland buffers and 1m contours.

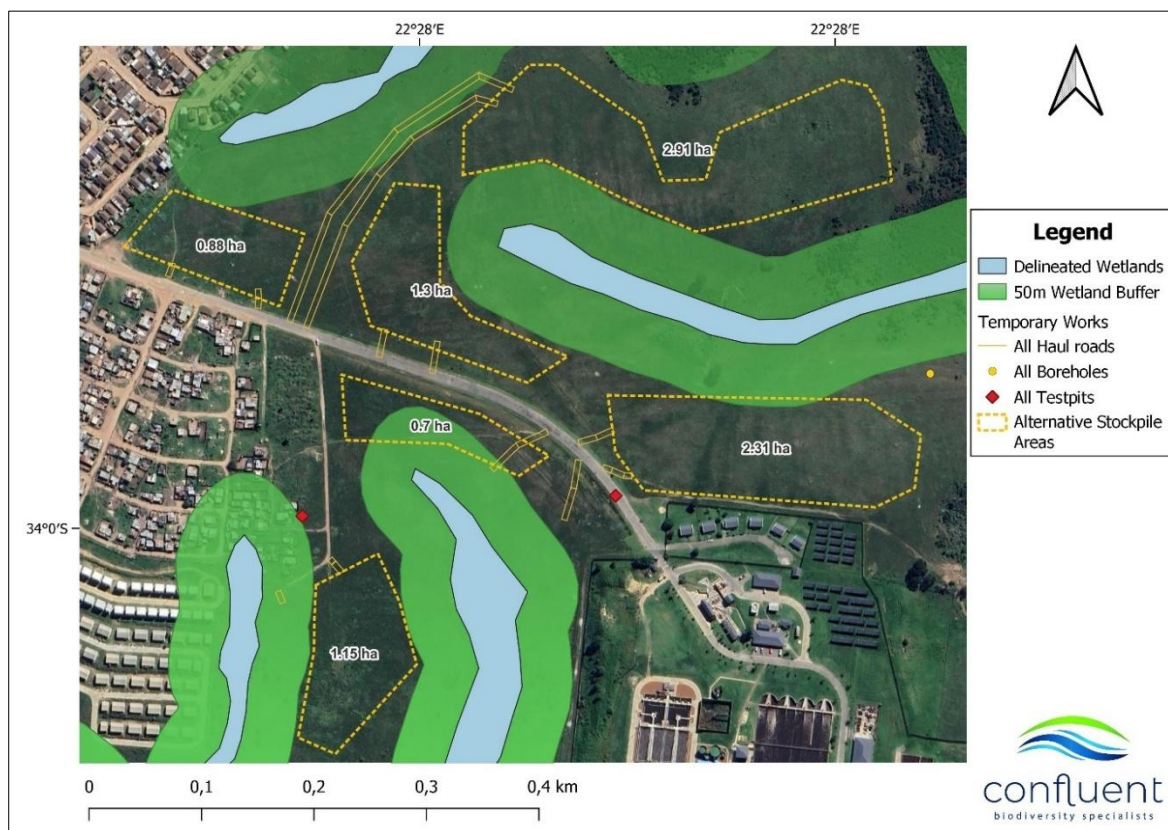


Figure 17. Simplified layout of the proposed alternative stockpiling areas. Haul roads to the 2.91 ha field would need to be moved out of the buffer.

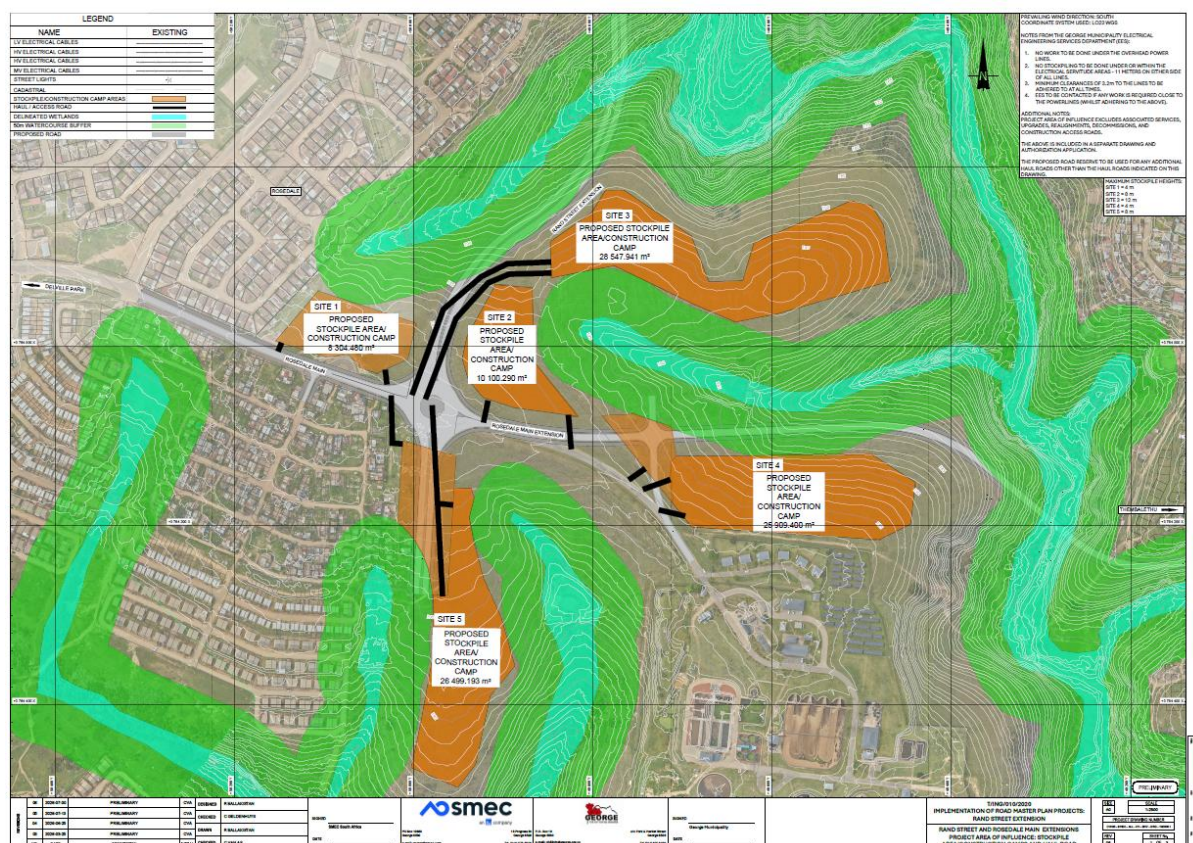


Figure 18. Revised layout of the stockpile areas and associated haul road provided by SMEC for the George Municipality in response to recommended mitigation measures in this report.

Potential impacts for watercourses associated with the layout phase for stockpiling areas are rated as Minor provided the mitigation measures as fully implemented (Table 4).

Table 4. Impact assessment for the design and layout phase for stockpiling areas.

Impact	Intensity	Duration	Extent	Probability	Significance	Significance Rating	Reversibility	Irreplaceability	Confidence
Design and Layout Phase: Stockpiling Areas									
Impact: Stockpiling on steep slopes increases risk of contaminants entering a watercourse									
Without Mitigation	High	Medium term	Limited	Almost certain	-66	Minor	Medium	Low	High
With Mitigation	Moderate	Short term	Very limited	Likely	-40	Minor	Medium	Low	High
Impact: Disturbance associated with stockpile areas could impact wildlife movement through watercourse corridors									
Without Mitigation	High	Medium term	Limited	Almost certain	-66	Minor	Medium	Low	High
With Mitigation	Moderate	Medium term	Limited	Likely	-50	Minor	Medium	Low	High
Impact: Stockpiling footprint may be proposed for development in future due to the degrading effect of this land use									
Without Mitigation	High	Permanent	Local	Almost certain	-90	Moderate	Low	Low	Medium
With Mitigation	Moderate	Permanent	Limited	Likely	-65	Minor	Low	Low	Medium

5.3 Construction Phase

5.3.1 Boreholes & Test Pits

A similar approach to drilling boreholes and excavating test pits will take place in terms of vehicle access. Vehicle access would be more likely to create impacts than the activity of borehole drilling or excavation of the test pit. Some of the geotechnical investigation points are in terrestrial areas with easy access across grassy fields, or existing dirt tracks. However, some of the points are located in/adjacent to watercourses with dense vegetation that must be traversed. In most cases existing tracks can be used to get to within 20m or so of the target site.

Potential Impacts

- Where slopes are steep and well vegetated, vehicles or personnel could take a route through natural, dense vegetation to access the watercourse area. Riparian or wetland vegetation may be temporarily or permanently disturbed during this process.
- Alien vegetation could become established post-disturbance, increasing the extent of alien vegetation in this already invaded system.
- The disturbance footprint could become larger than necessary if an access route is not carefully selected with minimisation of damage in mind. This may result in soil erosion.

Mitigation Measures

- Appoint an Environmental Control Officer (ECO) to inspect watercourse areas indicated in this report (A – E) with the appointed contractor and agree on a site-specific approach following the mitigation measures in this report in each case. The ECO presence can be limited to an initial site investigation, followed by an inspection of sensitive areas at conclusion of the works to ensure agreed actions were followed.
- Disturbance of vegetation can be mitigated by selecting the less vegetated and/or less steep of two slopes above a watercourse. E.g. at Area A, the western slope is less steep with much less dense and sensitive vegetation than the eastern slope. It is therefore recommended that access be obtained from the south-western slopes as far as possible (Figure 19 & Figure 20).
- Disturbance can be further limited by selecting access points using existing tracks and pathways (Figure 21 & Figure 22). The access route selected should always prioritise existing disturbance areas over undisturbed natural vegetation, even if this means travelling over a longer distance.



Figure 19. Google satellite image of Area A indicating the elevation profile (red line) across the valley with more dense vegetation and a steeper slope on the north-eastern side. Access here should be from the south-western slope (yellow arrow).



Figure 20. Example where the southern bank is less vegetated than the northern bank at Area C. In this instance, access should be prioritised from the southern bank.



Figure 21. Area B indicating existing tracks (yellow arrows) from which access can be obtained to geotechnical investigation points.



Figure 22. Area D and Area E showing existing tracks (yellow arrows) and roads that can be used to access geotechnical investigation points.

- Through discussion with a local contractor who provides geotechnical investigation services, it was noted that in areas where vegetation is dense and the site sensitive (ie. In a wetland), test pits can be dug by hand using shovels where practical. Where access options are seriously constrained, this alternative must be considered if the depth of the test pit can still be achieved. This may result in exceeding the 5x5m disturbance footprint, but could be considered preferable by the ECO if the investigation site has less sensitive features than the access route.
- Where feasible, a portable drilling rig should be used, that can be moved from the vehicle's closest 'low disturbance parking point' to the borehole drilling point.
- The contractor must strictly follow the 'last out, first in' system of soil replacement for test pits, as per the provided method statement from SMEC.
- Soil excavated from pits, should be placed onto a tarpaulin to preserve underlying vegetation, and to ensure minimal soil loss, as per the SMEC method statement.

Potential impacts for watercourses associated with the construction phase for test pits and boreholes are rated as Negligible both with and without mitigation measures (Table 5). The mitigation measures provided should be fully implemented to ensure impacts are minimised.

Table 5. Impact assessment for the construction phase for boreholes and test pits.

Impact	Intensity	Duration	Extent	Probability	Significance	Significance Rating	Reversibility	Irreplaceability	Confidence
Construction Phase: Boreholes and Test Pits									
Impact: Access to geotechnical investigation points could create excessive disturbance									
Without Mitigation	Low	Brief	Very limited	Likely	-30	Negligible	High	Low	High
With Mitigation	Very low	Brief	Very limited	Unlikely	-15	Negligible	High	Low	High

5.3.2 Stockpile Areas

The construction phase for stockpile areas essentially consists of preparing the stockpile area for the operational phase and grading associated haul roads. If the stockpile area is not well prepared, then operational phase impacts are likely to be greater than necessary.

Potential Impacts

- Loss of valuable topsoil that could be used in rehabilitation at a later stage.
- Enlargement of the stockpile area through spread of material storage or poorly controlled vehicle access.

Mitigation Measures

- Survey and peg out each of the stockpile areas.
- Install a perimeter fence around the surveyed perimeter of the stockpile area. This fence can be basic (e.g. wire game fence) but may be upgraded depending on the security requirements of the site.
- When installing the above fence, dig in a layer of 70% shade cloth attached to the perimeter fence (e.g. with wire or cable ties) to double up as a silt fence on areas where runoff will exit the site (Figure 23). If it cannot be attached to the perimeter fence for some reason, then it should be dug into place approximately 50cm on the inside of the fenceline with dropper supports. This shade net may be attached along the full length and height of the fence to minimise dust, and provide screening for nearby residents.



Figure 23. Example of silt fence attached to perimeter fence of a construction area.

- Grub the site to remove vegetation and topsoil and create a demarcated topsoil stockpile site. Topsoil must be stored to a maximum of 2m high and retained in a fenced off area to prevent loss or accidental removal during operation of the stockpile area. The topsoil area must be labelled as such and indicated for conservation as it can be used at a later point in rehabilitation.
- Topsoil can be stored in a berm around the edge of the stockpile areas where it must be seeded with Kweek (*Cynodon dactylon*) grass and oats seed to stabilise it and reduce losses. If this can be achieved it would negate the need for the silt fence described in the first point. The entire perimeter of the stockpile area where runoff could occur should have either a topsoil berm or a silt fence. However, if the berm is selected, then careful management of stormwater will be required within the stockpile areas.
- Create level surfaces as far as possible, to avoid the development of preferential flow paths and ponding on the stockpile area following rainfall.
- Establish sufficient road and turning space within the stockpile area that vehicles have adequate room to manoeuvre without needing to move beyond the designated stockpile area.

Provided the recommended mitigation measures are fully implemented, the construction phase impacts for stockpiling areas are rated as negligible (Table 6).

Table 6. Impact assessment for the construction phase for the stockpiling areas.

Impact	Intensity	Duration	Extent	Probability	Significance	Significance Rating	Reversibility	Irreplaceability	Confidence
Construction Phase: Stockpiling Areas									
Impact: Loss of valuable topsoil and spread of other materials from the stockpile area									
Without Mitigation	High	Short term	Limited	Likely	-50	Minor	Medium	Medium	High
With Mitigation	Low	Brief	Very limited	Unlikely	-18	Negligible	High	Medium	High

5.4 Operational Phase

5.4.1 Boreholes & Test Pits

The operational phase of monitoring boreholes and test pits is not relevant because there are no impacts. Test pits will immediately be closed following excavation, while boreholes will be accessed by water quality testing personnel on foot for the periodic collection of samples.

5.4.2 Stockpile Areas

The operational phase of the stockpile area is associated with the storage and operation of heavy vehicles, storage of materials, and accommodation of various personnel on site in temporary site offices (e.g. security guards and foreman).

Potential Impacts

- Inadequate storage of hazardous waste may result in the loss or runoff of material downslope into the natural environment, or into a watercourse.
- Continued operation of heavy vehicles, especially during wet weather, can result in severe soil compaction, development of preferential flow paths, exacerbating runoff containing silt from the stockpile area.
- Poor waste disposal facilities may result in personnel disposing of litter or human waste in the surrounding natural environment.

Mitigation Measures

- Delineate areas for the storage of hazardous waste such as fuel (ie. Petrochemicals, bitumen, oil, cement, lime). Bitumen should be kept in a large container such as a plastic water tank which is stored on a plastic-lined sandbag bunded dam.
- Diesel would be kept in tanks which need to be protected in a bund wall constructed of bricks with enough capacity to contain the full tank volume should it fail.

- Vehicles must be checked for fuel leaks, and all leaks must be immediately repaired to prevent environmental pollution.
- The site office/store should maintain a constant store of sandbags, a roll of hessian, bidim fabric and wooden droppers. All of which can be used to contain materials, prevent material loss from the site, and can be used when contaminated water must be contained on the site.
- Bare soil surfaces can be covered with a layer of bark as a means of dust suppression, to reduce soil compaction, and reduce vehicle rutting during wet weather.
- Heavy vehicle use on the stockpile area should be avoided during wet weather to prevent rutting of the soil which can create preferential flow paths.
- Ensure there is a designated area for waste disposal including adequate chemical toilets and rubbish bins, all of which are regularly serviced.
- Larger waste must be disposed of in a skip for transfer to landfill.
- No waste to be discharged beyond the fenced stockpile area.
- Poor security can result in access by vandals or thieves which can compromise environmental safety. E.g. theft or breakage of plastic tank taps has resulted in a bitumen spill at a previous stockpile site. Therefore, the site camp must have a designated full time security guard to prevent unauthorised entry.

The results of the impact assessment for the operational phase for the stockpile areas indicate impacts will range from negligible to minor provided all mitigation measures are implemented (Table 7).

Table 7. Impact assessment for the operational phase for the stockpile areas.

Impact	Intensity	Duration	Extent	Probability	Significance	Significance Rating	Reversibility	Irreplaceability	Confidence
Operational Phase: Stockpiling Areas									
Impact: Inadequate storage of hazardous waste leading to pollution of the environment and watercourses									
Without Mitigation	High	Short term	Limited	Probably	-40	Minor	Medium	Medium	High
With Mitigation	Moderate	Brief	Very limited	Probably	-28	Negligible	High	Medium	High
Impact: Soil compaction leading to increased runoff rates									
Without Mitigation	Very high	Medium term	Limited	Almost certain	-72	Minor	Medium	Medium	High
With Mitigation	Moderate	Medium term	Very limited	Likely	-45	Minor	Medium	Medium	High
Impact: Poor waste disposal leading to pollution of the local environment									
Without Mitigation	Moderate	Short term	Limited	Probably	-36	Minor	High	Medium	High
With Mitigation	Very low	Brief	Very limited	Rare	-10	Negligible	High	Medium	High

5.5 Decommissioning Phase

5.5.1 Boreholes & Pits

No post-operational rehabilitation measures are recommended for either the boreholes or for test pits. Test pits are unlikely to require rehabilitation if topsoil has been replaced as specified. While there may be establishment of alien vegetation, it is acknowledged that the entire catchment area is already extensively invaded by alien plant species, and removal of plants from these particular points will not effectively remediate this issue. Furthermore, these sites are being investigated with a view to development of the Rand Street extension, meaning that they will eventually be disturbed again during construction of the road.

5.5.2 Stockpile Areas

When the stockpile areas are no longer required, there may be waste remaining on the site, and the soil is likely to be highly compacted.

Potential Impacts

- Compacted soils have high surface runoff rates which can result in preferential flow paths downslope that exacerbate erosion.
- Soil that is left exposed and bare is likely to be colonised by alien vegetation. This must be managed because these areas currently have no alien invasive vegetation.
- Indigenous vegetation cover may be slow to recover due to soil compaction and poor soil conditions.

Mitigation Measures

- All solid waste must be removed from the site and disposed of appropriately depending on whether it is hazardous or not.
- No liquid or solid waste can be disposed of in the local environment.
- Any spilled hazardous waste or materials must be cleaned up and disposed of appropriately.
- The subsoil should first be ripped to alleviate compaction, followed by resspreading the conserved topsoil which should be replaced to cover the entire site.
- Once topsoil has been replaced, the area should be completely seeded with a moderate to dense coverage of *Cynodon dactylon* (Kweek) grass seed. This should be thoroughly watered to ensure establishment of the grass.
- Once the grass seed has germinated, the perimeter fencing should be removed from the site.
- The stockpile sites should be inspected 3-months and 6-months post-closure to remove any alien plants that have established.

Table 8. Impact assessment for the rehabilitation phase for the stockpiling areas.

Impact	Intensity	Duration	Extent	Probability	Significance	Significance Rating	Reversibility	Irreplaceability	Confidence
Rehabilitation Phase									
Impact: Compacted and exposed soil will attract alien plant invasion and be vulnerable to erosion.									
Without Mitigation	High	Long term	Local	Likely	-65	Minor	Moderate	Low	High
With Mitigation	Low	Short term	Limited	Unlikely	-24	Negligible	High	Low	High

6. RISK MATRIX

The Risk Matrix undertakes the assessment of risks to watercourses by impacts in their mitigated state. In other words, assuming full implementation of all control (mitigation) measures as outlined in the previous section, associated with geotechnical investigations and stockpiling areas.

The Risk Matrix was completed in terms of GN4167 of the General Authorisation for Section 21c) and i) water uses. The outcome of the Risk Matrix is used to determine the applicable level of water use authorisation required for Section 21 c) and i) water uses. Risks are considered and rated in their mitigated form, assuming full implementation of all mitigation or control measures. If all the risks of activities are rated as Low Risk, then a General Authorisation is applicable. If the risk is rated Moderate or High, then a Water Use License is required.

The Risk Matrix was compiled with the assumption that mitigation measures detailed in the previous impact assessment section would be fully implemented. Based on this assumption, the risk ratings for all impacts were rated as Low (Table 9). This implies that the proposed geotechnical investigations and stockpiling areas can be Generally Authorised.

Table 9. Risk Assessment Matrix for impacts associated with all phases of development for proposed geotechnical investigations for the Rand Street Extension.

RISK ASSESSMENT MATRIX for Section 21 (c) and (i) Water Use activities (version 2.0): SUMMARY			
[ASSUMING THAT ALL PROPOSED IMPACT CONTROL MEASURES (AS STIPULATED IN PROJECT SPECS) ARE EFFECTIVELY IMPLEMENTED]			
Phase	Activity	Impact	Risk Ratings
PRE-CONSTRUCTION (DESIGN)	Establishment of stockpiling areas in the vicinity of several mapped wetlands.	Materials could wash downslope into watercourses increasing turbidity and introducing pollutants.	L
		Stockpile areas could physically interfere with wildlife use of wetlands as corridors for habitat, feeding and breeding in the landscape.	L
		Future development may be aligned with stockpiling footprints, with larger footprints potentially creating more significant impacts.	L
CONSTRUCTION	Construction or establishment of borehole monitoring points and excavation of test pits for geotechnical investigations.	Temporary or permanent disturbance to riparian / wetland vegetation due to access by a vehicle or personnel.	L
		Alien invasive plant growth in disturbed areas.	L
		Larger than necessary disturbance footprint that could result in soil erosion.	L
	Clearance of vegetation and establishment of the stockpiling areas.	Loss of topsoil that could be used for rehabilitation later could exacerbate runoff from the site in future, affecting watercourses.	L
		Enlarging the stockpile area footprint can exacerbate water quality and vegetation impacts associated with watercourses.	L
OPERATIONAL	Operation of the stockpiling areas including material stockpiling, hazardous material handling, personnel facilities, and accommodation of large vehicles.	Hazardous materials (e.g. petrochemicals) could wash off the site downslope and impact watercourses in the valley-bottom.	L
		Operation of heavy vehicles in wet weather may exacerbate runoff of sediment-laden water from the stockpiling areas.	L
		Inadequate waste disposal for personnel may lead to littering and human waste disposal in the surrounding environment.	L
DECOMMISSIONING	Decommissioning of the stockpiling areas would require removal of all materials and waste, removal of fencing and rehabilitation of disturbed areas with topsoil and vegetation.	Compact, bare soil has high runoff rates that could result in erosion and sedimentation in receiving watercourses.	L
		Bare soil may become invaded with alien vegetation, expanding the area already invaded by alien plants.	L

7. CONCLUSIONS

The proposed geotechnical investigations to drill water quality monitoring boreholes and excavate and then refill test pits are aligned with the proposed future extension of Rand Street, and associated sewage infrastructure that must be realigned. Several of the investigation sites are in or adjacent to watercourses, and access to the sites could result in disturbance to habitat, vegetation and water quality in the regulated area of the watercourse. Proposed stockpiling areas are located mostly on flat land, but all generally slope towards valley-bottom wetlands, creating a risk that water quality, geomorphology, habitat and fauna could be affected if this is not well managed.

Mitigation measures were recommended for each anticipated impact associated with the proposed work, and the outcome of the impact assessment was that all impacts could be mitigated to a Minor or Negligible rating. The outcome of the Risk Matrix was that all risks could be rated as Low provided all the mitigation (control) measures are fully implemented.

The geotechnical investigations required to inform the proposed extension of Rand Street are not, on their own, considered likely to have a great impact on any watercourses. The impacts of the stockpiling area can also be mostly mitigated, and no direct impacts to any watercourses are anticipated. However, combined with the impacts of constructing the road itself, these impacts may be significant at the catchment level, although this will be dealt with in a separate application for the extension of Rand Street.

Based on the Low-Risk outcome of the Risk Matrix, the proposed geotechnical investigations and stockpiling areas could be Generally Authorised in terms of the NWA.

8. REFERENCES

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9. APPENDICES

9.1 SMEC Method Statement for Geotechnical Investigations (Updated Aug 2026)



Method Statement for Geotechnical Site Investigation

Purpose

This method statement deals with the method to be followed for test pits and rotary core drilling during geotechnical investigations undertaken for the Rand Street project.

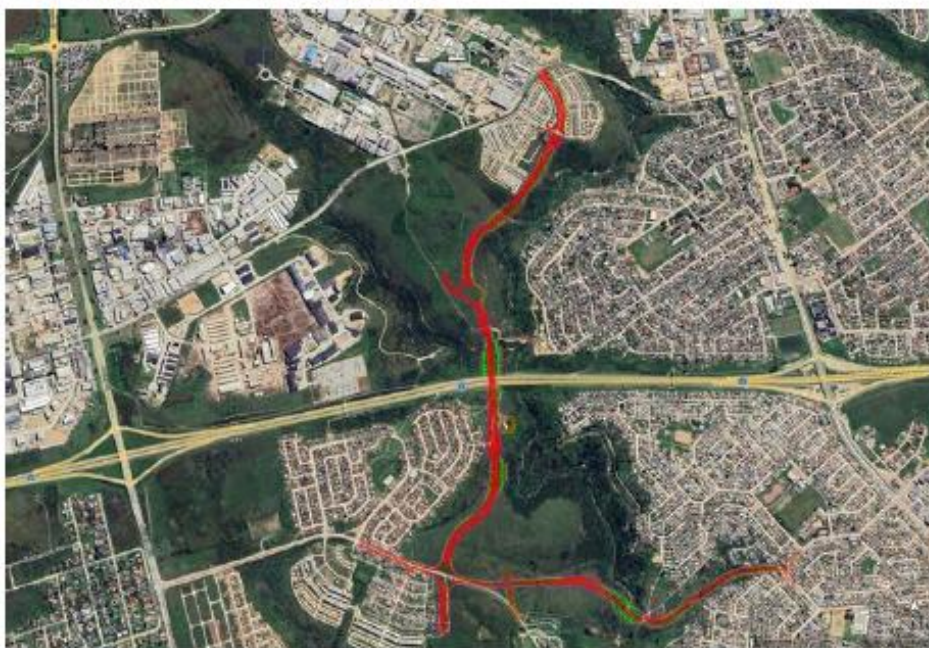
Scope

This method statement is applicable to test along the project area.

Should any situation arise that is not covered below, this method statement shall be revised to include such situation.

Location

The site is in George, Western Cape Province.



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References

Site Investigation Code of Practice, 1st Edition. South African Institution of Civil Engineering (SAICE) - Geotechnical Division, (2010).

Responsible Persons

- a) SMEC
- b) Geotechnical Contractor

Access

The following is required for access:

- a) Access to work areas shall be via existing roads/paths.
- b) If no road/paths exist, a route to the test position must be agreed upon with the "property owner" and the Employer. Only this route must be followed to and from the test position. Due to the steep slopes on site, the selected route will generally follow the natural contours to ensure easier accessibility.
- c) All routes of proposed access tracks shall be marked with suitable stakes or stones for approval.
- d) A photographic record of the proposed route or track shall be prepared prior to the use of the route or track.
- e) Fences may not be damaged or removed. Only existing gates will be used and shall be returned as found (open or closed).
- f) Dated and referenced photographs shall be taken of all access points used.

Procedure for Test Pitting

The following is required for excavation of test pits:

- a) The area shall be cleared of excess vegetation, and this area shall be kept to a minimum. In this instance, this will be an area of about 5 m x 5 m.
- b) The layer of topsoil shall be removed first and placed in a separate heap. The Engineering Geologist shall instruct on the depth of topsoil to be removed. (From the previous Geotechnical investigation, it was shown to be an average of 400mm - 500mm thick).
- c) The different layers of soil will be removed and placed in heaps next to the pit in manageable heights.
- d) Heaps shall not be more than 1.5 m high.
- e) Heaps will be placed no closer than 1 meter to the pit to avoid collapse.
- f) Typical test pit setup is shown in the figures below



Figure 1 Example of stockpiling topsoil



Figure 2 Example of stockpiling in-situ material

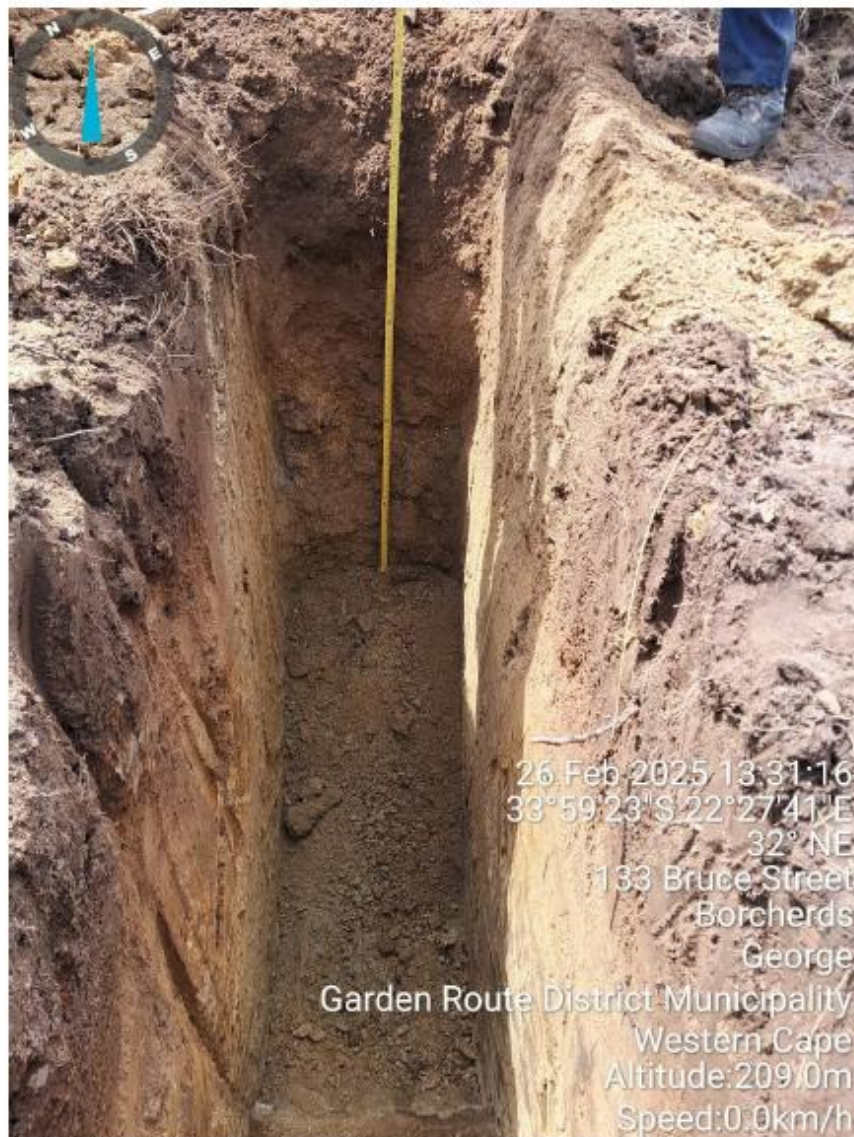


Figure 3 Example of typical test pit

- g) DCPs/DPSH will be undertaken adjacent to the test pits. The test pitting and DCPs/DPSH will not be undertaken at the same time but sequentially.

Expected impacts:

- Damage to vegetation.
- Loss of excavated soils

Impact Prevention:

- Movement around test pit area to be limited.
- Area to be cleared to be kept to a minimum.



- Excavated soils to be placed on heaps not more than 1.5 meters high.
- Soil heaps to be placed in easily reachable position from the excavation on geofabric to prevent further damage of vegetation. Topsoil shall be placed separately. During backfilling, the topsoil will be reinstated last.

Equipment and Machinery

- TLB
- Bakkie
- DCP/DPSH apparatus
- Geofabric
- Sampling bags
- PPE

Procedure for Rotary Core Drilling

The following is required for boreholes:

- a) Identify position of hole.
- b) Where necessary, the area shall be cleared of excess vegetation, and this area shall be kept to a minimum. In this instance, this will be an area of about 5 m x 5 m. A platform will be shaped for equipment to be level during drilling operations.
- c) The layer of topsoil shall be removed first and placed in a separate heap. The Engineering Geologist shall instruct on the depth of topsoil to be removed. (From the previous Geotechnical investigation, it was shown to be an average of 400mm - 500mm thick).
- d) Move all equipment to borehole location and set up rig over borehole position.
- e) Dig sump (0.5m X 0.5m X 0.5m) for return drilling water and line with plastic sheeting or use plastic baths as and when necessary.
- f) Commence by opening guard and attaching core barrel, close guard, start pump and commence drilling. Once the run has been completed, pull back with hydraulics until core barrel coupling is visible, loosen head with pipe wrench, lift hydraulic head up to the top, open guard and remove core barrel by hand.
- g) Next run, lower second core barrel into the hole and add BWY rod to the core barrel and tighten by hand, lower hydraulic head and tighten the head by rotating the head. Close the guard, start the pump and commence drilling. This format will continue until hole has reached depth required.
- h) Place all recovered core/ samples in core boxes. Mark depth on boxes as appropriate.
- i) Record all drilling observations on drillers report.
- j) On completion of hole flush all remaining drilling mud from hole using clean water.
- k) Remove temporary casing if necessary.
- l) Install piezometers at certain boreholes for future monitoring of groundwater.
- m) Backfill boreholes that will not be used for future monitoring and place concrete marker block to engineers' instructions or contract specifications.



- n) Backfill sumps, level ground surface, place the topsoil, and remove all waste from site.
- o) Typical core drill setup is shown in the figures below.



Figure 4 Example of core drill set up



Figure 5 Example of trailer mounted rigging

Expected impacts:

- Damage to vegetation.
- Loss of excavated soils.

Impact Prevention:

- Movement around the drilling position to be limited.
- Area to be cleared to be kept to a minimum.
- Excavated soils to be placed on heaps not more than 1.5 meters high.
- Soil heaps to be placed in easily reachable position from the excavation on geofabric to prevent further damage of vegetation. Topsoil shall be placed separately. During backfilling, the topsoil will be reinstated last.

Equipment and Machinery

- TLB
- Rotary core drilling rig and operating equipment
- Core boxes
- Water pump
- Water reservoir
- Waste water plastic baths for sump
- Bakkie (s)
- PPE



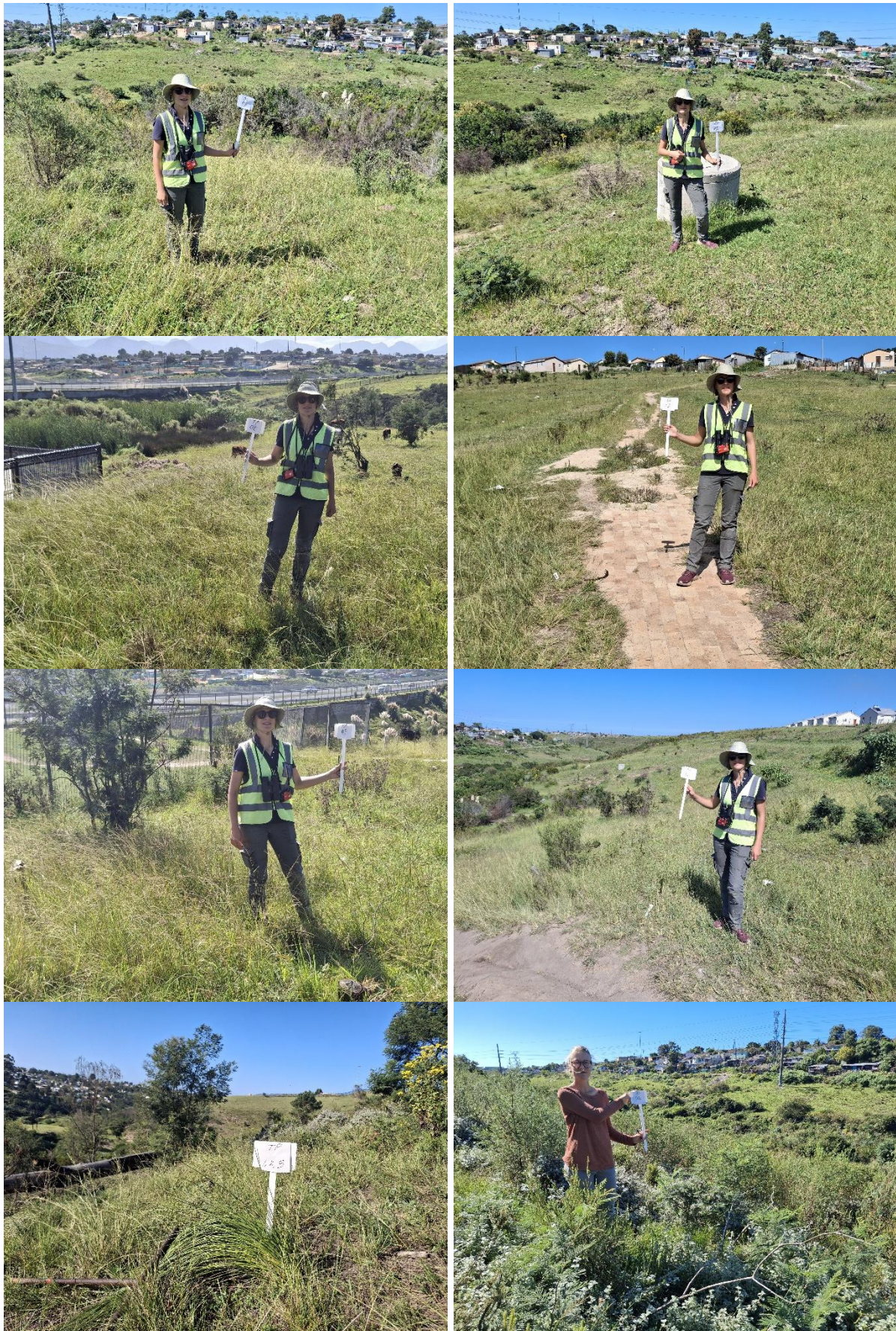
Environmental Practice for Rotary Core Borehole Drilling within 32 m of a Watercourse

Issues	Mitigation
Diversion of the stream	No drilling within the river stream is expected therefore no diversion if required. Drilling operations to be limited to the riverbanks.
Disturbance of vegetation	This will be limited to the 5 m x 5 m area allocated for drilling operations. All equipment such as drill rods and tools to be placed on plastic liners or geofabric.
Water Contamination	Ensure zero discharge of contaminants to the river. Collect and dispose of drilling mud and cuttings in a designated containment tank or drums.
Oil leaks from the drilling rig	Use spill trays and drip pans under all fuel/oil storage and equipment.
Pumping of water from the river	No water to be pumped from the river. Only use from designated water sources provided by the George Municipality such as the wastewater treatment works.

Important notes:

1. A site-specific environmental method statement shall be submitted by the Geotechnical contractor on appointment for review by the environmental agent.
2. A SMEC staff shall always be on site to enforce the environmental compliances when drilling in the riverbank and all positions on site
3. The drilling works shall try to avoid use of any environmentally unfriendly drilling fluids

9.2 Additional Site Photos



9.3 Impact Assessment Methods

Criteria are ascribed for each predicted impact. These include the intensity (size or degree scale), which also includes the type of impact, being either a positive or negative impact; the duration (temporal scale); and the extent (spatial scale), as well as the probability (likelihood). The methodology is quantitative, whereby professional judgement is used to identify a rating for each criterion based on a seven-point scale (Table 10) and the significance is auto-generated using a spreadsheet through application of the calculations.

For each predicted impact, certain criteria are applied to establish the likely significance of the impact, firstly in the case of no mitigation being applied and then with the most effective mitigation measure(s) in place.

These criteria include the intensity (size or degree scale), which also includes the nature of impact, being either a positive or negative impact; the duration (temporal scale); and the extent (spatial scale). These numerical ratings are used in an equation whereby the consequence of the impact can be calculated. Consequence is calculated as follows:

$$\text{Consequence} = \text{type} \times (\text{intensity} + \text{duration} + \text{extent})$$

To calculate the significance of an impact, the probability (or likelihood) of that impact occurring is applied to the consequence.

$$\text{Significance} = \text{consequence} \times \text{probability}$$

Depending on the numerical result, the impact would fall into a significance category as negligible, minor, moderate or major, and the type would be either positive or negative.

Table 10. Assessment criteria for the evaluation of impacts

Criteria	Numeric Rating	Category	Description
Duration	1	Immediate	Impact will self-remedy immediately
	2	Brief	Impact will not last longer than 1 year
	3	Short term	Impact will last between 1 and 5 years
	4	Medium term	Impact will last between 5 and 10 years
	5	Long term	Impact will last between 10 and 15 years
	6	On-going	Impact will last between 15 and 20 years
	7	Permanent	Impact may be permanent, or in excess of 20 years
Extent	1	Very limited	Limited to specific isolated parts of the site
	2	Limited	Limited to the site and its immediate surroundings
	3	Local	Extending across the site and to nearby settlements
	4	Municipal area	Impacts felt at a municipal level
	5	Regional	Impacts felt at a regional level
	6	National	Impacts felt at a national level
	7	International	Impacts felt at an international level
Intensity	1	Negligible	Natural and/ or social functions and/ or processes are negligibly altered
	2	Very low	Natural and/ or social functions and/ or processes are slightly altered
	3	Low	Natural and/ or social functions and/ or processes are somewhat altered
	4	Moderate	Natural and/ or social functions and/ or processes are moderately altered
	5	High	Natural and/ or social functions and/ or processes are notably altered
	6	Very high	Natural and/ or social functions and/ or processes are majorly altered

Criteria	Numeric Rating	Category	Description
Probability	7	Extremely high	Natural and/ or social functions and/ or processes are severely altered
	1	Highly unlikely / None	Expected never to happen
	2	Rare / improbable	Conceivable, but only in extreme circumstances, and/or might occur for this project although this has rarely been known to result elsewhere
	3	Unlikely	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur
	4	Probable	Has occurred here or elsewhere and could therefore occur
	5	Likely	The impact may occur
	6	Almost certain / Highly probable	It is most likely that the impact will occur
	7	Certain / Definite	There are sound scientific reasons to expect that the impact will definitely occur

When assessing impacts, broader considerations are also considered. These include the level of confidence in the assessment rating; the reversibility of the impact; and the irreplaceability of the resource as set out in (Table 11, Table 12, Table 13), respectively.

Table 11. Definition of confidence ratings.

Category	Description
Low	Judgement is based on intuition
Medium	Determination is based on common sense and general knowledge
High	Substantive supportive data exists to verify the assessment

Table 12. Definition of reversibility ratings.

Category	Description
Low	The affected environment will not be able to recover from the impact - permanently modified
Medium	The affected environment will only recover from the impact with significant intervention
High	The affected environmental will be able to recover from the impact

Table 13. Definition of irreplaceability ratings.

Category	Description
Low	The resource is not damaged irreparably or is not scarce
Medium	The resource is damaged irreparably but is represented elsewhere