# APPENDIX 39C

## ANNEXURES TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE EXPANSION OF THE CAPE WINELANDS AIRPORT.

ANNEXURE

ANNEXURE 10 - STORMWATER MANAGEMENT PLAN
ANNEXURE 11 - BIRD AND WILDLIFE HAZARD MANAGEMENT PLAN
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ANNEXURE 13 - ARCHITECTURAL DESIGN GUIDELINES
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ANNEXURE 20 - PERMITS AND LICENSE

# ANNEXURE 10: STORMWATER MANAGEMENT PLAN

# Concept Stormwater Management Plan

## Cape Winelands Airport

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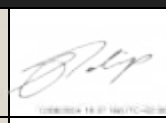
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# 1 Introduction

Zutari has been tasked with the development of a Concept Stormwater Management Plan advising the Cape Winelands Airport company (CWA) on the management of stormwater for the proposed development and to engage the City of Cape Town's Catchment, Stormwater & River Management (CSRM) officials regarding the various submission requirements associated with stormwater management on the site.

This Concept Stormwater Management Plan discusses the proposed stormwater management systems for the Cape Winelands Airport development and details the stormwater infrastructure and interventions proposed to achieve the requirements stipulated in the applicable policies and guidelines.

Accordingly, this development is subject to the City of Cape Town's Stormwater Policy (Management of Urban Stormwater Impacts Policy – C58/05/09) which states criteria for compliance when considering the quality and quantity of stormwater run-off from the post-developed site.

Considerations for the implementation of stormwater management measures for the proposed development will occur in the following manner:

1. Assess status quo and existing stormwater infrastructure.
2. Assess policy requirements and engage in high-level discussion with City of Cape Town officials.
3. Prepare a Concept Stormwater Management Plan for recommending high-level interventions to be implemented to ensure compliance to the Policy.
4. Prepare at a later stage a detailed Stormwater Management Plan to recommend measures to mitigate the hydrology-, hydraulic-, and pollution-related effects of surface water released into the municipal stormwater network, and to illustrate how the proposed Cape Winelands Airport development will comply with the relevant policies.

The submission of this Concept Stormwater Management Plan for the proposed Cape Winelands Airport development will address points 1) to 3) listed above with any comments received from CoCT being incorporated into the submission of the detailed Stormwater Management Plan to follow.

Zutari will also develop and submit a detailed Stormwater Management Plan for the development (which will address point 4) at a later stage as described later in this report.

## 1.1 Location and Nature of the Development

The proposed Cape Winelands Airport development is located within the jurisdictional area of the City of Cape Town, Northern Region, Kraaifontein District and is located at the following coordinates: 33°46'13.84"S, 18°44'24.20"E. The proposed Cape Winelands Airport site is to be located on portions of Erven: PA724-0, PA724-10, PA474-4, PA474-23,PA474-4, PA474-0 and MA942-7, while the general location in relation to the surrounding areas can be seen below in Figure 1.

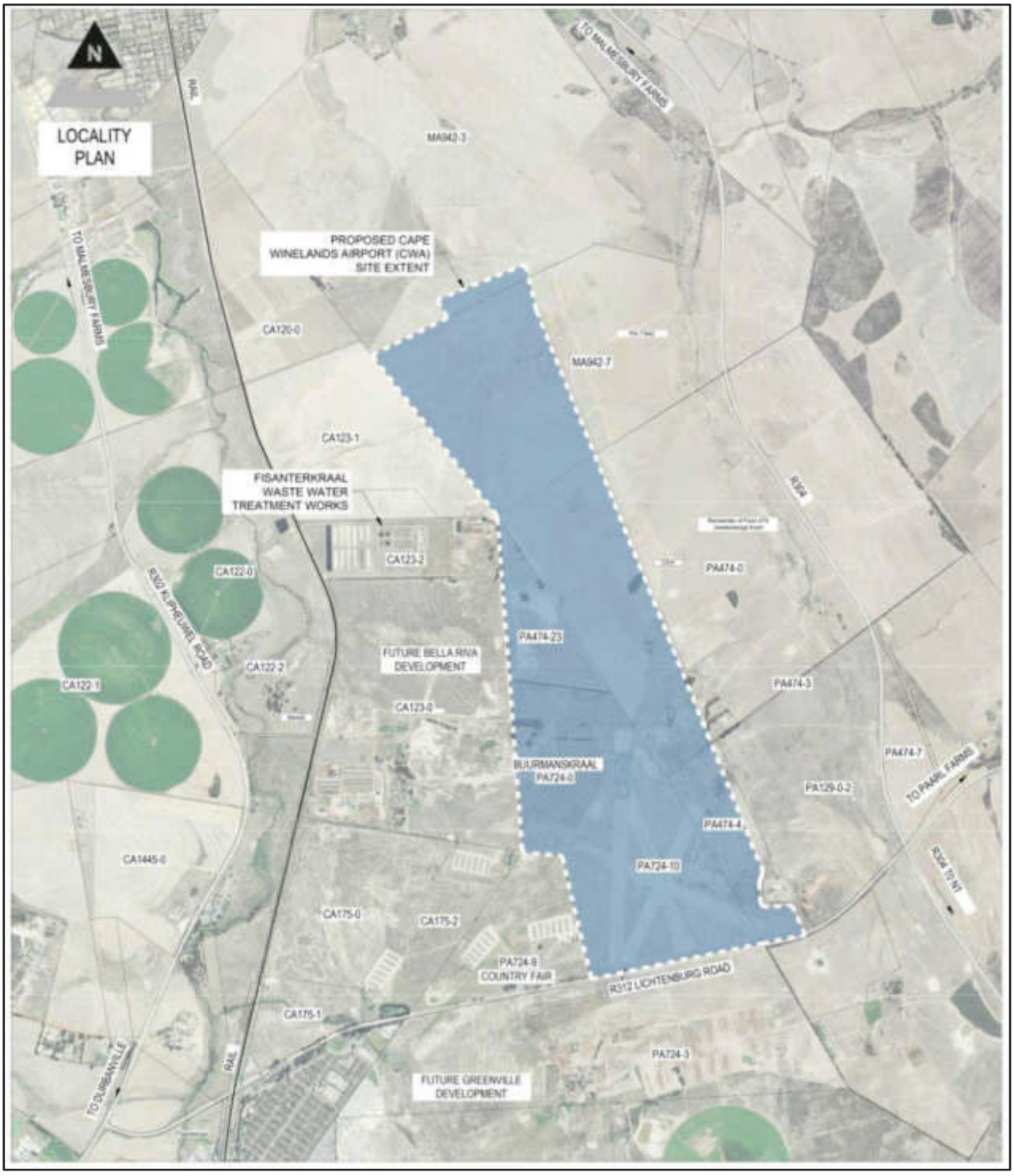



Figure 1: Site Locality Map

The current Site Development Plan and stormwater drawings used to compile this Concept Stormwater Management Plan may be referenced in Appendix A – Drawings.

## 1.2 Objectives of the report

This Concept Stormwater Management Plan for the Cape Winelands Airport has the following objectives:

- To identify measures to comply with the Council's Management of Urban Stormwater Impacts Policy (C58/05/09) (City of Cape Town (CCT), 2009).
- To identify measures to comply with Council's Floodplain and River Corridor Management Policy (C58/05/09) (City of Cape Town (CCT), 2009).
- To propose methods (structural controls) for removing, reducing, or retarding runoff flows, and preventing targeted stormwater runoff constituents, pollutants, and contaminants from reaching receiving water bodies.

The purpose of this Concept Stormwater Management Plan is to stipulate a framework consisting of minimum Best Management Practices (BMP's) required for implementation. The current proposal is that Cape Winelands Airport is constructed in two (2) phases and the intention of this report is to specify minimum requirements which need to be adhered to for the ultimate scheme to satisfy various statutory requirements. When detailed design commences, the developer will be required to submit a detailed Stormwater Management Plan for each phase which satisfies the requirements stated in this overarching Concept Stormwater Management Plan. If there is any deviation from this Concept Stormwater Management Plan, the developer must first submit an amended Concept Stormwater Management Plan for approval.

# 2 Status Quo and Existing Infrastructure

## 2.1 Existing Site Conditions and Topography

The existing property is currently mainly used for agricultural purposes with approximately 90% of the surface areas being green permeable spaces and the remainder consisting of the existing Cape Winelands Airport (previously known as the Fisantekraal Aerodrome), basic farm roads and small holdings. The existing site topography can be summarised as follows:

- The proposed Cape Winelands Airport site is approximately 430 hectares in size.
- Site slopes:
    - A ridge is formed along the centre of the site splitting the flows in easterly and westerly directions. The stormwater then drains towards the Klapmuts River and the Mosselbank River respectively.
    - In addition, there are low points situated along the site boundary resulting in numerous outfalls discharging from the Cape Winelands Airport development site boundary.
- The vegetation is generally defined by agricultural farmlands.
- The existing site topography consists of varying slopes that range between 0.25% and 6%
- The stormwater from the existing site quarry daylights into the adjacent property, the proposed Bella Riva development, and flows overland towards the Mosselbank River.
- Clearly defined watercourses are noted along the eastern and western boundaries of the site.

The pre-development scenario has been modelled in PCSWMM and the actual Topographical LIDAR Survey (DTM at 5m Grid Interval), received from Geospatial Project Services in January 2021, was used to create the topographic height illustration seen below in Figure 2: General Topography and Natural Overland Flow Direction.

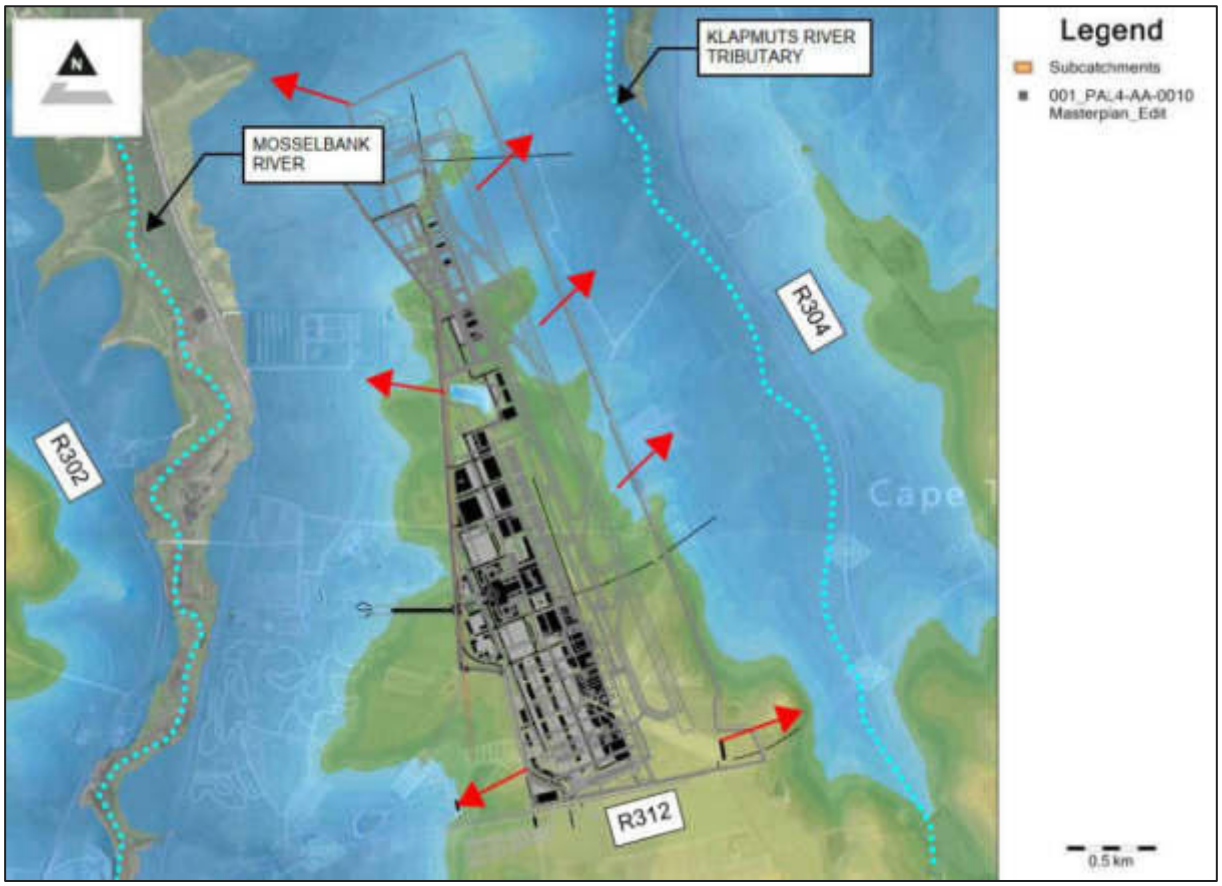



Figure 2: General Topography and Natural Overland Flow Direction

The general topography and overland flow direction of the site can be clearly seen. The spine of the development is the highest point positioned along the centre of the site in a south to north direction, with a portion of the overland runoff flowing towards the western boundary and into the Mosselbank River and the remaining portion of the runoff towards the eastern boundary and into the Klapmuts River.

## 2.2 Geotechnical Investigation

A detailed geotechnical investigation was carried out by GEOSS South Africa (Pty) Ltd. This investigation found that the materials on site are generally classified as “soft” to “intermediate” excavation in accordance with SANS 1200D. The soil type used for characterising soil infiltration in the hydrological model is that of Sand.

The proposed Cape Winelands Airport site is approximately 430 hectares and therefore the site was divided into five (5) main geotechnical zones which exhibit similar soil profile characteristics based on the descriptions of the material encountered in the trail pits, considering the several methods of investigation carried out. The general ground profiles are defined in five (5) geotechnical zones on site and can be seen in Figure 3 below:

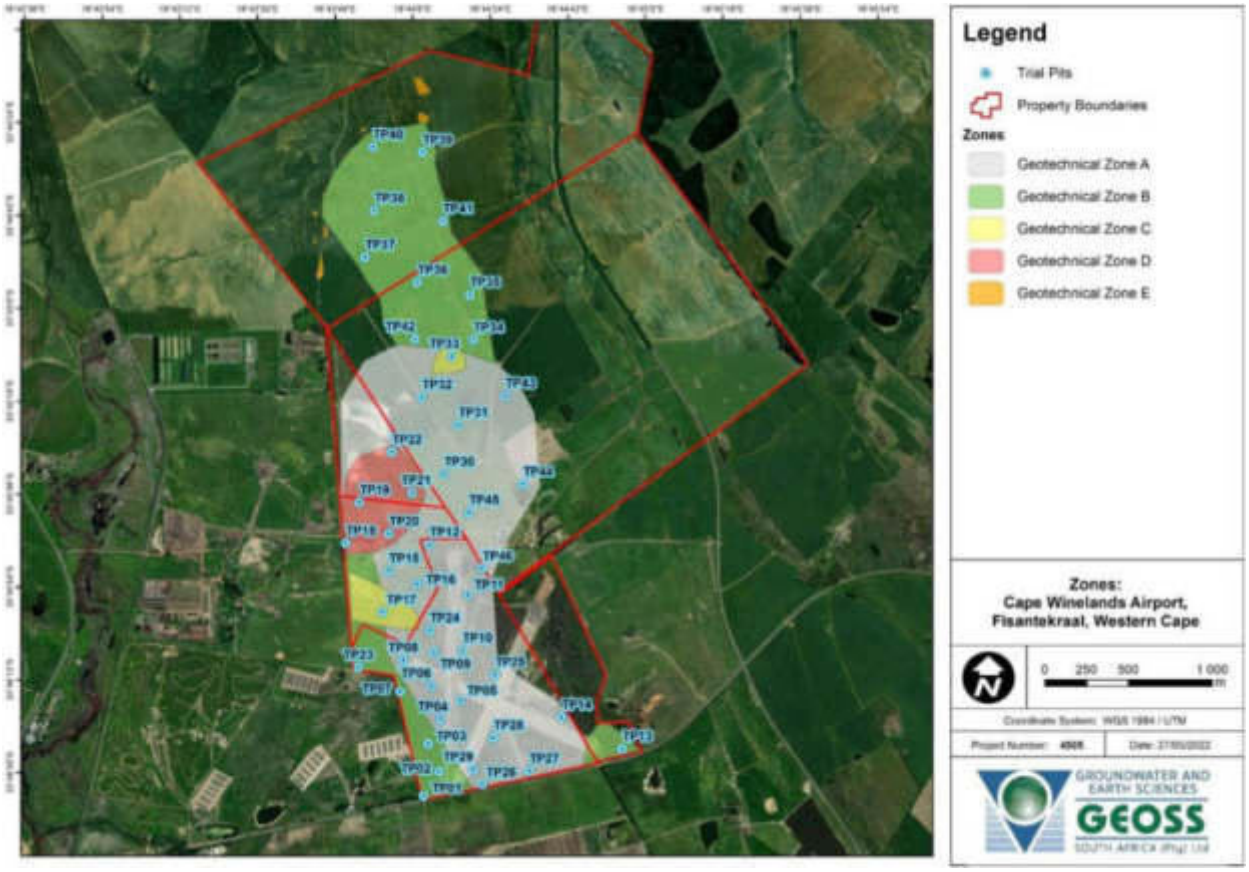



Figure 3: Geotechnical Investigation Zones

The predominant ground profiles present on site are summarized as:

- The upper layer of soils generally consists of a between 500mm and 900mm of slightly voided very loose to medium dense sand to gravelly sand (Transported/hillwash).
- The pedogenic materials encountered are described as medium dense to very dense partially cemented nodular to hardpan ferricrete in a sandy matrix.
- The sandy fine gravel materials encountered are described as a very loose to medium dense sandy fine gravel.
- The residual material encountered is generally described as a silty clay, medium dense to very dense silty sand or gravelly silty sand.
- A relatively shallow water table is expected, and it is likely that water seepage may be encountered during the wet season.

The Geotechnical Investigation can be found attached hereto as Appendix B – Geotechnical Investigation Report (GEOSS). The detailed stormwater management plan for each phase of the development should consider the specific geotechnical properties of each of the identified zones.

## 2.3 Existing Stormwater Infrastructure

There are no formal existing municipal stormwater infrastructure connections along the immediate boundaries of the site. The Cape Winelands Airport development is situated on a high point and a ridge is formed along the centre of the site splitting the flows in easterly and westerly directions resulting in various low points situated along the site boundary. Due to the natural low points situated across the site, it was necessary to maintain the eight natural outfall locations which discharge stormwater from the Cape Winelands Airport site.

The clearly defined watercourses noted along the eastern and western boundaries of the site were assessed as part of the Flood Risk Assessment which is attached hereto as Appendix C – Flood Risk Assessment Report.

The proposed future Bella Riva development is situated to the west of the proposed Cape Winelands Airport. After assessing the SWMP prepared for the Bella Riva development we can confirm that the Bella Riva development will account for a portion of the Cape Winelands pre-development flows – for further detail pertaining to the Bella Riva Stormwater Management Plan reference can be made to Appendix D. It is proposed that the Cape Winelands Airport development discharges stormwater from the detention pond (Pond 2 / Outfall 2) into the future proposed Bella Riva stormwater infrastructure as can be seen on Figure 4 below. Furthermore, reference can be made to Figure 7 below for an overview of the Pond / Outfall numbers.

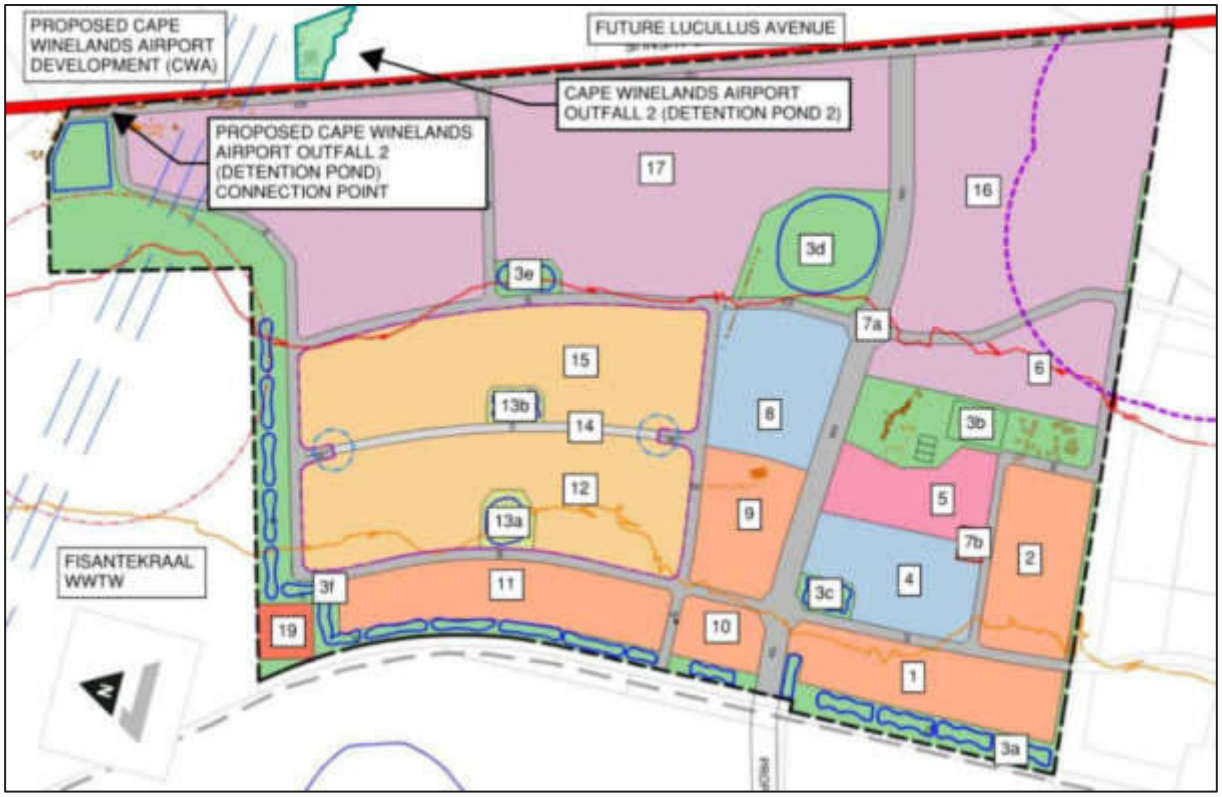



Figure 4: Bella Riva Future Development Layout

The detailed Cape Winelands Airport Stormwater Management Plan will include further detail pertaining to the measures and mitigations required to ensure the protection of the existing environment and avoid erosion.

## 2.4 Environmental Authorisations

The Cape Winelands Airport company has appointed independent environmental consultants to undertake an environmental process and the associated public participation requirements, as stipulated in the Environmental Conservation Act, 1989 (Act No. 73 of 1989) (ECA) and the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) for the authorisation of the Cape Winelands Airport (CWA) development.

The Environmental Impact Assessment (EIA) for the proposed Cape Winelands Airport development is currently in the Pre-application Scoping Phase and the initial 30 day public participation period has closed. The required public meeting was concluded. Upon completion of the Concept Stormwater Management Plan, a formal application will be lodged, and the statutory in-process Scoping Phase will commence.

A Water Use Licence Application (WULA) is also required in terms of the Water Act of 1998, for the storage of water, construction of infrastructure within wetlands and rivers, storage of stormwater and discharge of stormwater from the Cape Winelands Airport development.

## 2.5 Interaction with Freshwater Ecologist

A Freshwater Ecology Impact Assessment Report was compiled by FEN Consulting (Pty) Ltd as part of the Environmental Impact Assessment (EIA) and Water Use Authorisation (WUA) processes for the proposed Cape Winelands Airport development.

This assessment identified numerous freshwater ecosystems within the proposed Cape Winelands Airport's development extent as well as the investigation area (defined as a 500m radius around the proposed Cape Winelands Airport development). These freshwater ecosystems include a combination of seep wetlands; and channelled valley bottom (CVB) wetlands as can be seen below on Figure 5.

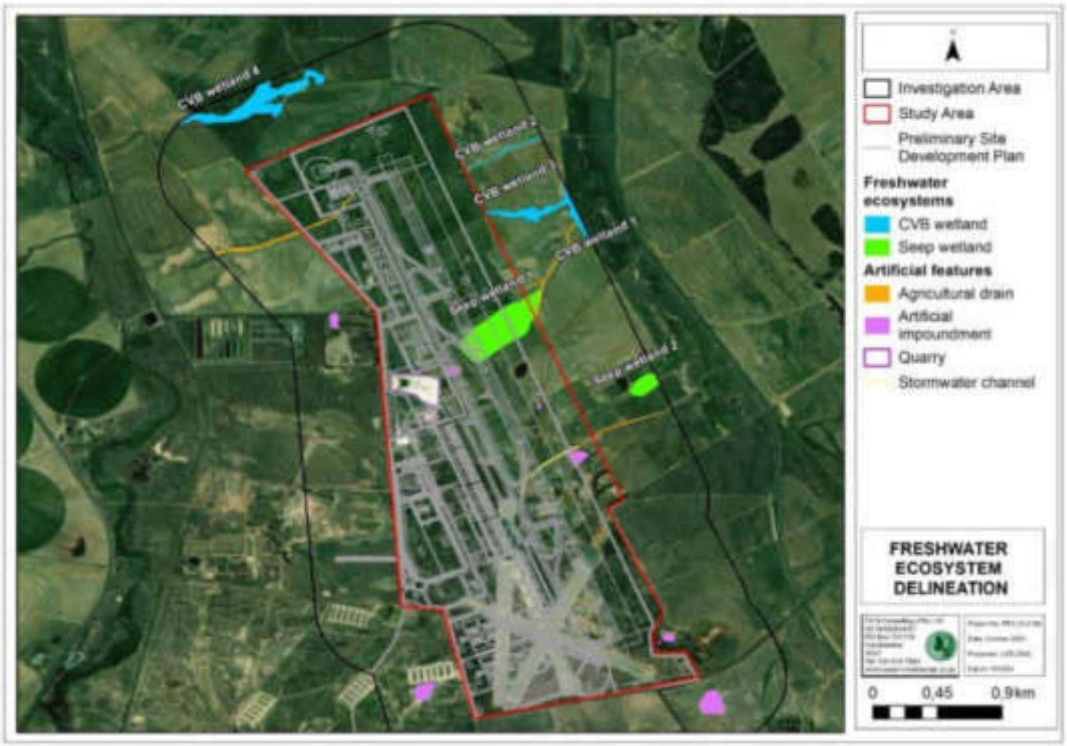



Figure 5: Aquatic Ecosystem Layout

Further to the above, the Freshwater Ecologist's Impact Assessment Report details the potential design, construction and operational impacts of the development and corresponding recommended monitoring and mitigation measures required to limit the impact of the development on the aquatic ecosystem.

The recommendations and rehabilitation measures summarised below are contained in the Freshwater Ecologists Impact Assessment report in order to reduce the risks of the development to a low negative significance:

- Construction work, particularly within the 15 m construction conservation buffer of the wetlands, must as far as possible be restricted to the dry, summer season. Channelled valley bottom Wetlands 2 and 3 and the remainder of Seep Wetland 1 where development will not occur, as well as the wetlands' 15 m construction phase conservation buffers must be marked as a no-go areas during the construction phase of the proposed development.
- Sediment trapping devices must be utilised downstream of where works are to be undertaken within seep wetland 1.
- Under no circumstances must linear infrastructure be trenched within the channelled valley bottom Wetlands 2 and 3 or their conservation buffers. Design plans must reconsider the layout of the water pipelines and fences to avoid these wetlands.
- Any fences which are to traverse the channelled valley bottom Wetlands 2 and 3 must be installed in such a way that hydro pedological processes are not impeded within these systems. It is recommended that the erection of fence posts within the channelled valley bottom Wetlands 2 and 3 are avoided.
- Stormwater attenuation ponds must be designed and landscaped in accordance with a Stormwater Management Plan with input from a Landscape and Open Space Planning consultant as well as a Freshwater Ecologist. All stormwater infrastructure must be incorporated into the Stormwater Management Plan.
- For the construction of the maintenance road along the eastern boundary of the study area, it is recommended that culverts be installed to allow the passage of water from the upstream portions of the channelled valley bottom Wetlands 2 and 3 to the downgradient portions. Any disturbed areas within these wetlands must be rehabilitated on completion of construction of the road. Cobbles are to be placed downstream of the maintenance road to trap sediment and reduce flow velocity of surface water entering the wetlands. The maintenance road should ideally avoid seep wetland 1 and circumvent it to avoid further fragmentation of the wetland. Should this not be possible, the road must be designed in such a manner as to allow hydraulic and hydro pedological process connectivity in the landscape while also allowing fauna to traverse the roadway.
- Disturbed areas related to the maintenance road and fences which will traverse the channelled valley bottom Wetlands 2 and 3 must be rehabilitated once construction activities have ceased.
- Control measures related to trenching and stockpiling activities must be strictly implemented.
- A monitoring programme must be implemented to detect and prevent the pollution of soils, surface water and groundwater.
- Wetlands that will be impacted by the proposed Cape Winelands Airport development must be monitored and where possible improved. An offset plan is being compiled by FEN Consulting which will outline an appropriate monitoring approach.
- A Service Infrastructure Management Plan is to be compiled which details the frequency in which service infrastructure, particularly the sewer and water treatment plants and sewer conveyance infrastructure must be serviced. This will assist in the prevention of leakages and bursting of the sewer infrastructure.
- An emergency plan must be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of a pipeline or overtopping of sewage at the treatment plant.

This Concept Stormwater Management Plan therefore incorporates the recommendations pertaining to stormwater from both the freshwater ecologist and the environmental representatives and were used as such to shape the design of the stormwater system and control measures. For further context and detail to the above listed measures the Freshwater Ecologists Impact Assessment Report should be read in conjunction with this Concept Stormwater Management Plan. Due to the length of the Freshwater EIA Report, a draft version can be made available upon request.

## 2.6 Site Development Plan

The Cape Winelands Airport development is a commercial airport which entails the redevelopment of the existing Fisantekraal Aerodrome. The proposed Site Development Plan that informs this Concept Stormwater Management Plan is shown below in Figure 6. The proposed development consists of combination of interconnecting roads leading to the runways, taxiways, terminal building, hangers, workshops, hotels, administration buildings and commercial buildings.

The latest Site Development Plan is attached hereto as part of Appendix A – Drawings.




Figure 6: Site Development Plan (PAL 4 Ultimate Scheme)

## 2.7 Proposed Phasing

The proposed Cape Winelands Airport development is envisaged to be constructed in two phases based on conceptual information available at this stage. When the detailed design commences, the developer will be required to submit a detailed Stormwater Management Plan for each phase demonstrating compliance with the Concept Stormwater Masterplan and the CoCT policy requirements are achieved and satisfied.

The detailed Cape Winelands Airport Stormwater Management Plan will include further detail pertaining to the development phasing plan once layouts are made available.

# 3 Policy Requirements and City of Cape Town Engagement

## 3.1 Background

This concept Stormwater Management Plan describes the approach used for the design of the stormwater infrastructure for the Cape Winelands Airport development. The purpose is to describe how the proposed stormwater management infrastructure will achieve the requirements stipulated in the applicable policies. Urbanisation typically impacts on natural waterway health in two key areas:

- The quantity of stormwater runoff is increased as the proportion of impervious area within a catchment is increased, leading to larger peak flows and more frequent runoff which may have detrimental effects on river health and can cause flooding in downstream areas.
- The quality of runoff is also negatively impacted with additional pollutant loads in the form of gross pollutants, suspended sediments, and various other pollutants such as nitrogen, phosphorus, and heavy metals.

The Management of Urban Stormwater Impacts Policy has been prepared by the CCT CSRM Branch to address these stormwater impacts and ensures that new developments incorporate Water Sensitive Urban Design elements.

## 3.2 Policy Requirements

The Cape Winelands Airport site is categorised as a Brownfields Development. To achieve the stormwater management objectives mentioned above, the CCT recommends the following criteria for a Brownfields Development Site (> 50 000m$^2$) by means of on-site facilities:

A. Improve quality of runoff
    - Design storm event: 0.5-year Recurrence Interval (RI), 24-hour storm.
    - Pollutants removal target: SS – 80%, TP – 45%.

B. Control quantity and rate of runoff
    - 24 hour extended detention of 1-year Recurrence Interval (RI), 24-hour storm.
    - Up to 10-year RI storm peak flow reduced to pre-development level.
    - Up to 50-year RI storm peak flow reduced to existing development level.
    - Evaluate the effects of the 100-year RI storm event.

C. Encourage natural groundwater recharge
    - As and where possible and appropriate on the development site.

## 3.3 Interaction with City of Cape Town officials and departures from Policy

A number of interactions have taken place between Zutari and the CCT officials since commencement of the development of this Concept Stormwater Management Plan. These include:

- 9th April 2024 – An introductory meeting between Zutari's Carshif Talip, Ashley van der Nest, Marno Pretorius and the CCT's Johann Terblanche, Willem Burger, Motlatsi Nkhoesa, Kloey Bam, Willie Liebenberg, and Stefan De Villiers.
    - This meeting was arranged to provide an introductory overview of the project, objectives, concept, and proposed timelines of the project to Mr Johann Terblanche. This platform was also used to discuss various pertinent items regarding stormwater management within the catchment as well as other project related matters.

# 4 Proposed Stormwater Management Measures

## 4.1 Design Overview

The proposed stormwater drainage network is based on a dual stormwater system, consisting of a major and a minor network, conveying stormwater generated on site via pipes and overland flow routes into seven (7) dry attenuation ponds with engineered layerworks and one (1) wet detention pond, positioned at strategic locations along the proposed Cape Winelands Airport development site boundary.

The basic stormwater design principles used to inform the concept design of stormwater infrastructure for the Cape Winelands Airport site can be best described as follows:

- The natural drainage direction of stormwater of the site will remain unchanged as the site generally falls in a south to north direction with outfalls positioned strategically along the eastern and western boundaries.
- The minor system will comprise of open drains, an underground piped network complete with channels, inlet catchpits, oil separators, manholes and outlet structures sized to accommodate stormwater runoff from the roads, buildings, and other hard surfaced area for at least minor storm events up to the 1:5-year RI storm.
- The major system will comprise of roads and on-site overland flow paths which will operate in conjunction with the minor system to accommodate stormwater runoff from roofs and other hard surfaced areas for major storm events up to and including the 1:50-year RI storm.
    - The design levels allow for on-site overland flow routes in the event of a blockage or failure of the minor system.
- Where no on-site overland flow paths exist to accommodate run-off from major storm events, the underground piped network will be sized to accommodate run-off for major storm events (up to the 1:50 year).
- The overland flow routes on the Cape Winelands Airport site are designed to safely convey the 1:100-year storm event towards the ponds situated along the boundary of the site. From there formal overland escape routes, in the form of pond overflows, will be designed to convey peak runoff from the 1:100-year storm which cannot be handled by the above proposed stormwater system before discharging into the adjacent infrastructure.

## 4.2 Required Site Area

The adopted rainfall depths used were extrapolated from the CCT rainfall grids. The 24-hour 0.5-year RI storm rainfall is 20.1mm with the area of the Cape Winelands Airport site equating to ±430 ha for the calculation. The calculated Water Quality Volume (WQv) is calculated to be approximately 37.82ML. See 4.5.2 below for the detailed calculations.

To accommodate the required treatment of this volume, the following Low Impact Developments (LID's) will be implemented as detailed in Table 1 below:

| BMP's | BMP | Approximate Surface Area ($m^2$) | Depth (m) | Recurrence Interval (Years) | Attenuation Volume ($m^3$) |
|---|---|---|---|---|---|
| Pond 1 | Dry Attenuation Pond | 7,000 | 2.0 | 1:50 Year RI | 10,800 |
| Pond 2 | Wet Detention Pond | 28,000 | 5.0 | 1:50 Year RI | 95,000 |
| Pond 3 | Dry Attenuation Pond | 5,700 | 2.0 | 1:50 Year RI | 9,600 |
| Pond 4 | Dry Attenuation Pond | 1,800 | 1.5 | 1:50 Year RI | 2,100 |

| | | | | | |
|---|---|---|---|---|---|
| Pond 5 | Dry Attenuation Pond | 6,300 | 2.0 | 1:50 Year RI | 10,800 |
| Pond 6 | Dry Attenuation Pond | 500 | 1.0 | 1:50 Year RI | 350 |
| Pond 7 | Dry Attenuation Pond | 1,150 | 1.5 | 1:50 Year RI | 1,550 |
| Pond 8 | Dry Attenuation Pond | 2,700 | 2.0 | 1:50 Year RI | 4,200 |
| Swale 9 | Dry Swales | 15,000 | 1.0 | 1:50 Year RI | 9,000 |

Table 1: Proposed Low Impact Developments (LID)

The proposed areas identified for the low impact developments (LID's) can be seen in Figure 7 below.

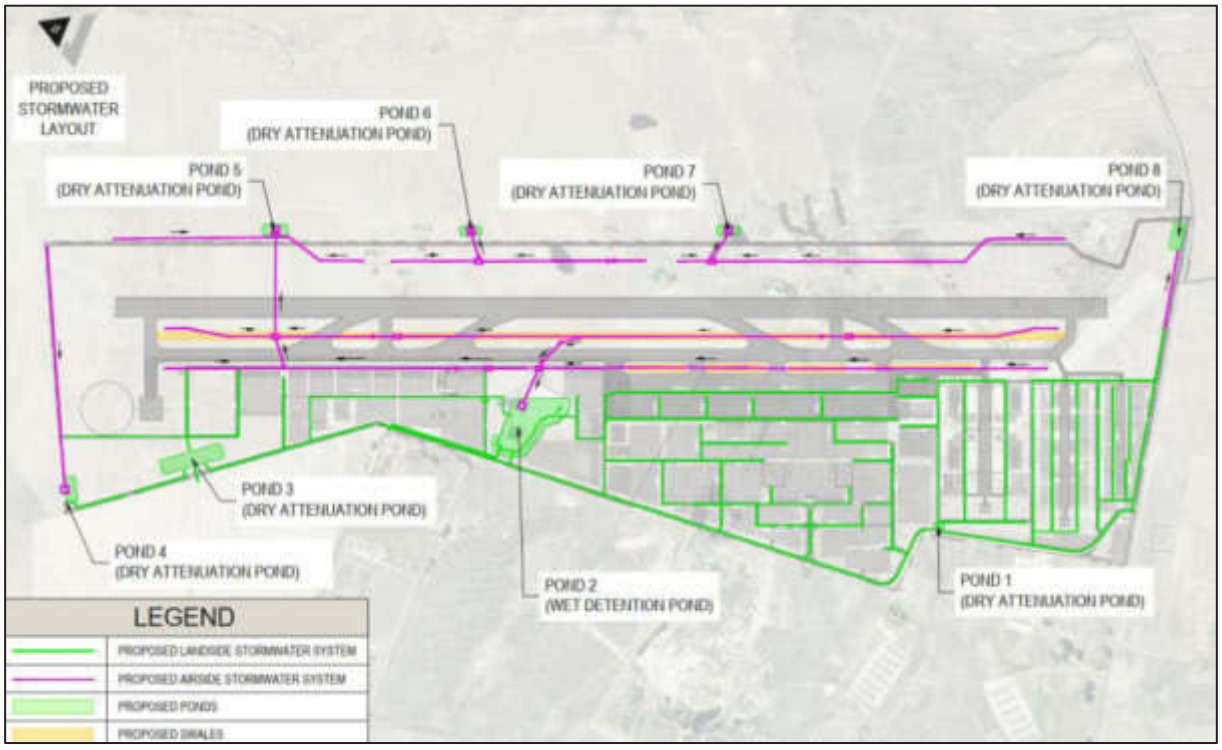



Figure 7: Proposed Areas Identified for LIDs

## 4.3 Best Management Practices (BMP's)

### 4.3.1 Dry Attenuation Pond with Engineered Layerworks

As previously mentioned, it is proposed that all stormwater generated on the Cape Winelands Airport site be conveyed into seven (7) dry attenuation ponds and one (1) wet detention pond strategically positioned around the development. These ponds will be designed to attenuate up to the 1:50-year post development flows. Treatment of stormwater run-off conveyed to the ponds will mainly be achieved through the dry pond infiltration layerworks relying on filtration to reduce waterborne pollutant concentration through sedimentation, filtration, and plant uptake of nutrients.

According to Armitage *et.al.* (2013), the potential pollutant removal rate for a dry attenuation pond with engineered layerworks is:

- Nutrient Removal Rate (TP): 40% - 50%
- Sediment Removal Rate (TSS): 50% - 80%

The proposed dry attenuation pond with engineered layerworks consists of the following:

- **Filter Media:** A mix of sand and loam which removes the runoff pollutants and supports the vegetation on the surface. This layer will be 100mm deep.
- **Transition Layer:** Located under the filter media, contains coarse sand which prevents the movement of finer particles from the top layer to pass through to the drainage layer. This layer also aids in preventing clogging of the drainage layer. This may be replaced with a Geotextile wrapping as approved by the Engineer. This layer will have a depth of 300mm.
- **Drainage Layer:** This layer is in fact a system which consists of a 19mm stone layer and a 110mm perforated sub-soil pipe that collects and conveys water into the proposed stormwater variable outlet structure. This layer will have a depth of 200mm.

Typical details of the dry attenuation pond engineered layerworks can be seen below in Figure 8: Typical Dry Attenuation Pond Engineered Layerworks.

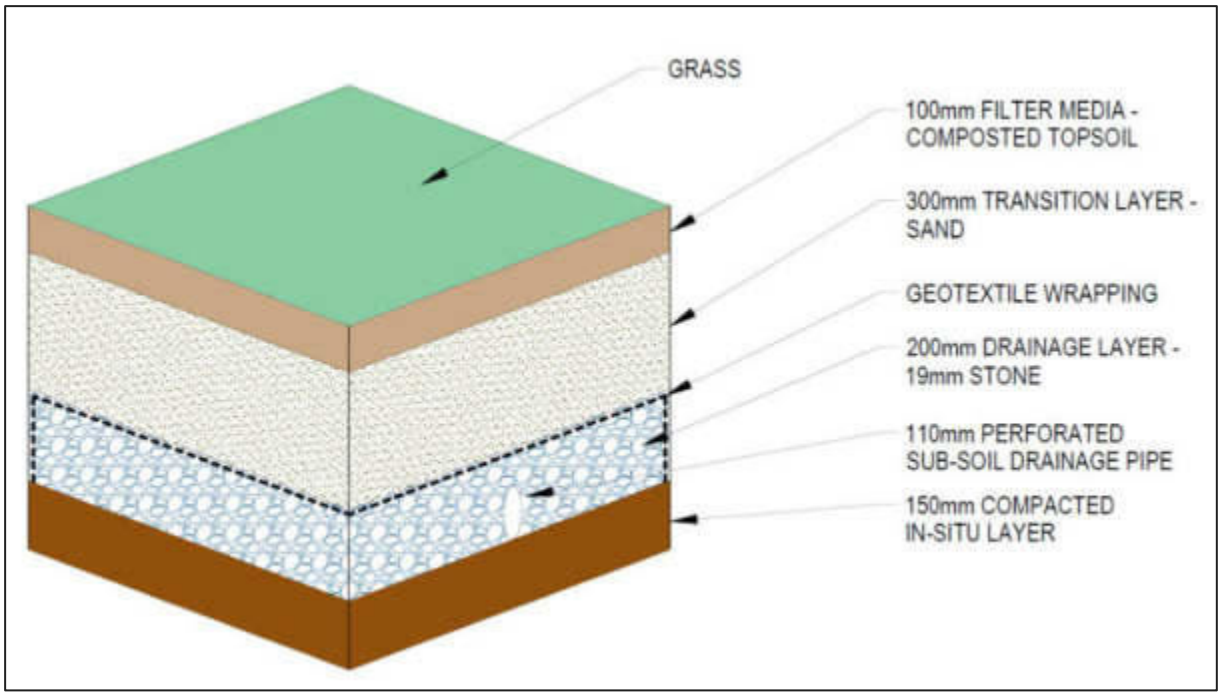



Figure 8: Typical Dry Attenuation Pond Engineered Layerworks

### 4.3.2 Dry Swale with Engineered Layerworks

Runoff from the Cape Winelands Airport runway and taxiways will be directed overland to landscaped areas. As can be seen on Figure 7 above, selected landscaped areas will consist of landscaped swales which then drain towards localised detention ponds and wetland areas.

The swales provide both stormwater treatment and conveyance functions, combining a bioretention system installed in the base of the swale which is designed to convey stormwater. The swale component provides pre-treatment of stormwater to remove coarse to medium sediments while the bioretention system removes finer particulates and associated contaminants.

The swales also provide a form of flow retardation for frequent storm events and are particularly efficient at removing nutrients. The swale treatment process operates by filtering stormwater runoff through surface of the swale and then percolating the runoff through a prescribed filter media, forming the bioretention component which provides treatment through fine filtration, extended detention treatment and some biological uptake.

Typically, the swale is underlain by a formalised piped drainage network which usually conveys stormwater from within the development to a swale outfall, as shown in Figure 9 below.

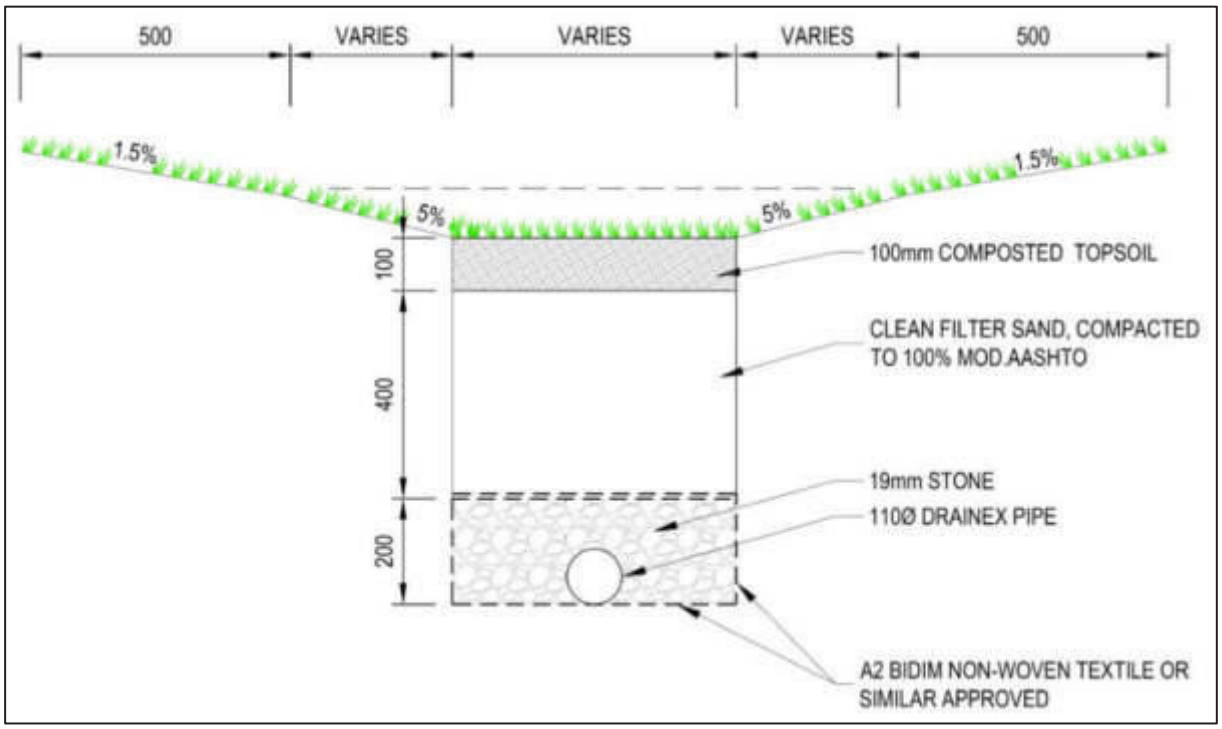



Figure 9: Typical Cross-Section of Dry Swale

### 4.3.3 Wet Detention Pond

Stormwater runoff generated by the catchment areas situated to the West of the site, which is not infiltrated into the dry swales, will be conveyed to the wet detention pond (Pond 2 / Outfall 2). The wet detention pond will operate in a similar manner to the dry swales when it comes to treatment of runoff, however besides treatment, the wet detention pond will serve a key function for attenuation on the site. Pond 2 / Outfall 2 has been designed with a formalised variable outlet structure which will release peak flows from the various Recurrence Interval storms.

The design of the wet detention pond is based on the following:

- The bottom of the existing Quarry is to be filled up to an invert level of 105.00masl
- The permanent water level is assumed to be at 107.5masl (Which equates to an initial depth of 2.5m from the new invert of the pond)
- Inlet headwall is at 108.25masl
- Variable outlet structure
    - Orifice 1 = 108.00masl
    - Orifice 2 = 108.25masl
    - Orifice 3 = 108.75masl
    - Orifice 4 = 109.50masl
- Overflow level into the proposed Lucullus Road extension is at 110.30masl

The conceptual design of the proposed wet detention pond at Outfall 2 can be seen shown in Figure 10 below:

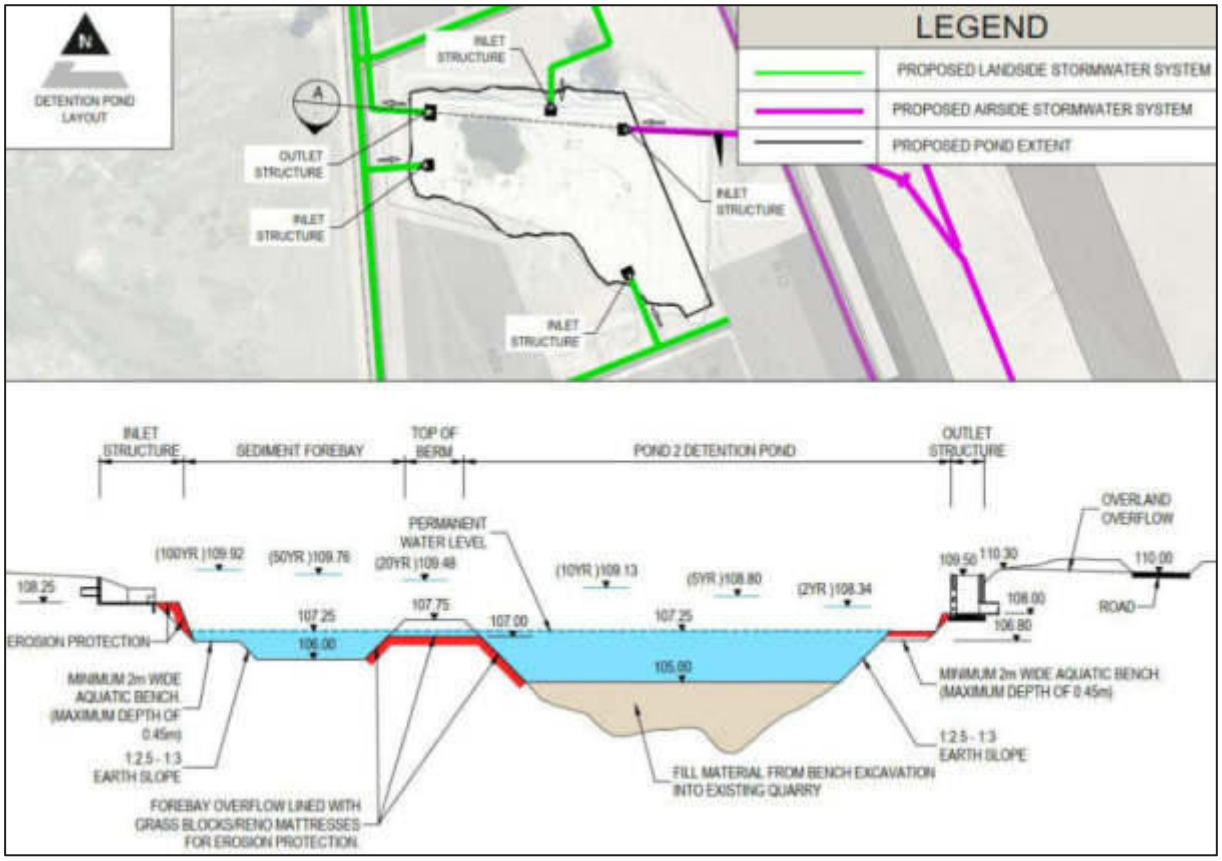



Figure 10: Typical Cross section of the Wet Detention Pond

Figure 11 below depicts a typical inlet structure for the Cape Winelands Airport and Figure 12 shows a typical variable outlet structure discharging flow from the pond.

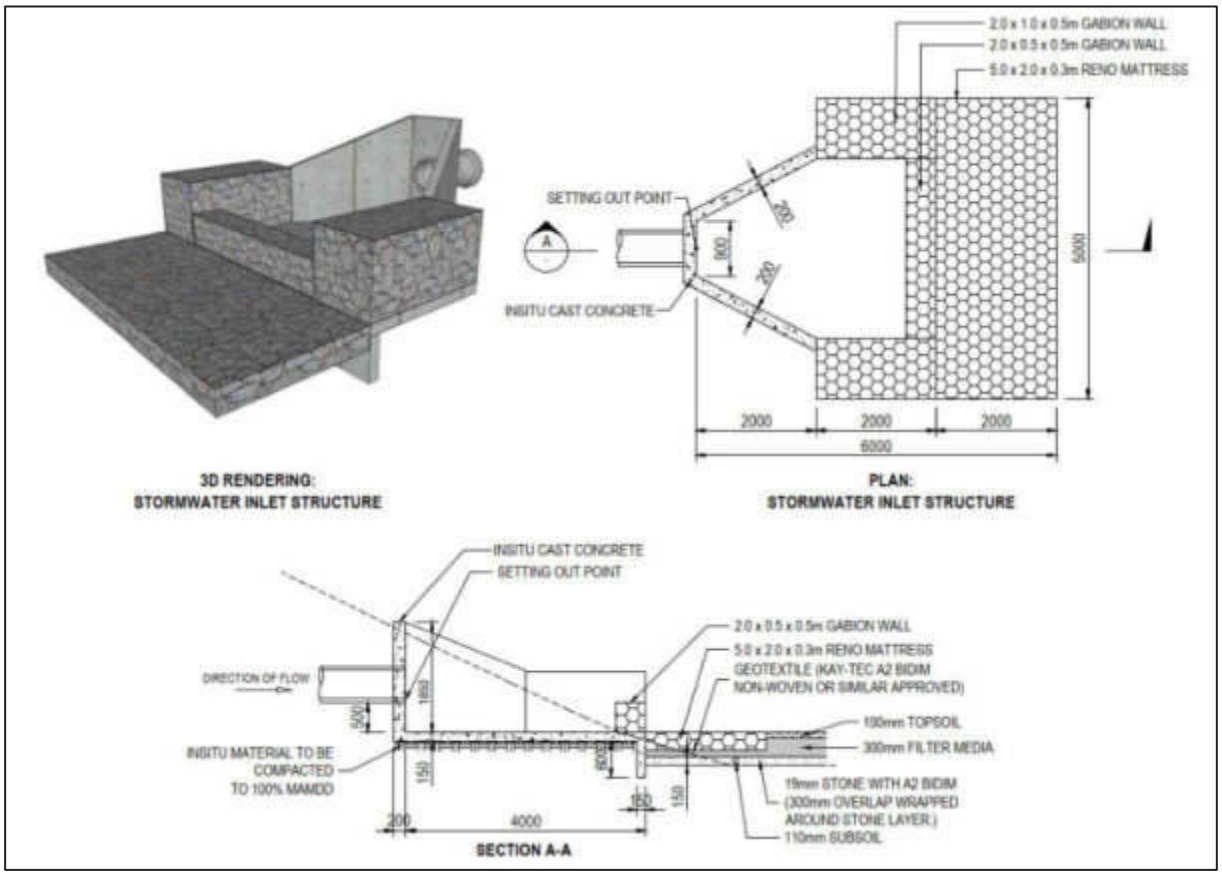



Figure 11: Wet Detention Pond – Typical Pond Inlet Structure

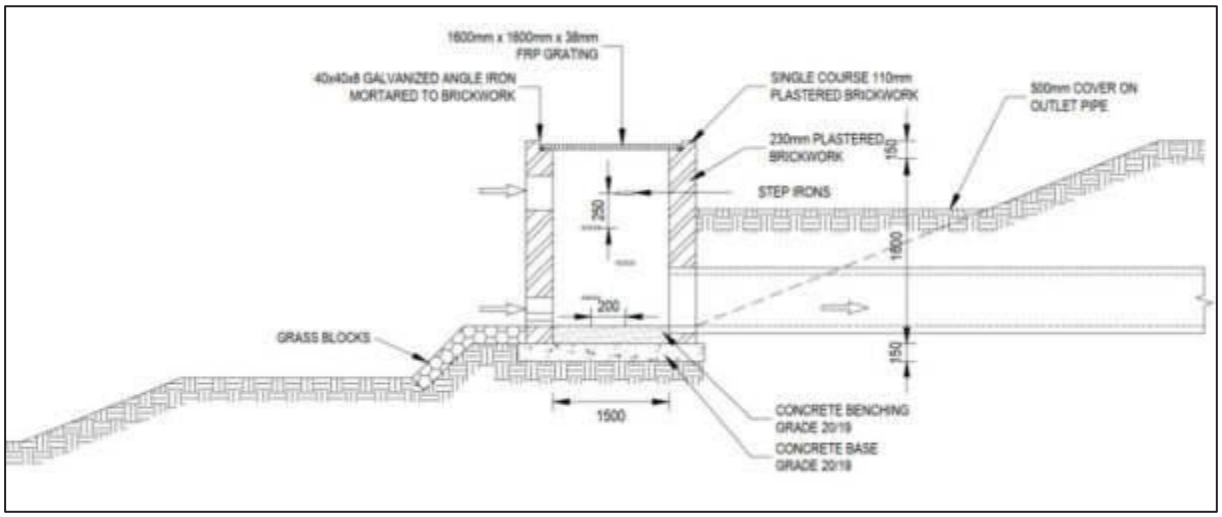



Figure 12: Wet Detention Pond – Typical Variable Outlet Structure

## 4.4 Calculation of Stormwater Runoff

The stormwater management concepts were investigated using the Personal Computer Stormwater Management Model (PCSWMM) software. The modelling was used to develop pre-development and post-development models to compare the status quo with the proposed Cape Winelands Airport site's ultimate state, and to interpret and analyse the stormwater management interventions considered.

The overall site is categorized as a Brownfields Development. Although the generation of additional hard surfaces is expected due to the development, a combination of stormwater management control systems will ensure that the peak runoff volumes discharged from the Cape Winelands Airport is below pre-development levels to mitigate any negative impacts on adjacent properties.

Three scenarios were modelled:

- 0.5-year storm event – to address treatment requirements.
- 1-year extended detention – to address attenuation requirements.
- Larger storm events – to address attenuation requirements.

Stormwater runoff was calculated using the "PCSWMM 2017 2D Professional" software package.

An extract of the relevant PCSWMM model simulation output data is attached hereto as Appendix E – PCSWMM Model Simulation Output Results. Additional data is available on request.

### 4.4.1 Rainfall Data and Simulation of Storm Events

Various design storms (South Africa, 24h SCS Type 2) were created and simulated based on the rainfall data and storm distributions as shown in Table 2: City of Cape Town Rainfall Depths from CCT Climate Grid below. Rainfall data from the City of Cape Town's Rainfall Grid RP2 200 Climate Change is used to create storm events for return intervals from 2 year to 100 year storms, while rainfall data for the 0.5 year and 1-year storms were extrapolated from the Rainfall Grid.

| **Source of Rainfall Information** | **Recurrence Interval (years) / Storm Rainfall (mm)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **0.5yr** | **1yr** | **2yr** | **5yr** | **10yr** | **20yr** | **50yr** | **100yr** |
| **CCT Rainfall Grid RP2 200 (15% Added for Climate Change)** | 20.1 | 32.9 | 44.9 | 60.3 | 71.4 | 83.0 | 99.4 | 112.7 |

Table 2: City of Cape Town Rainfall Depths from CCT Climate Grid

### 4.4.2 Pre-Development Runoff

To simulate the stormwater runoff for the various storm-events, sub-catchment parameters were determined for pre-development simulations as can be seen below in Figure 13. The sub-catchment parameters are summarised below in Table 3:

| Sub-Catchment Parameters | Cape Winelands Airport (Pre-Development) |
|---|---|
| **Area (ha)** | 430 |
| **Width (m)** | Varies |
| **Length (m)** | Varies |
| **% Impervious Area** | Varies per catchment |
| **"n" Impervious Area** | 0.02 |
| **"n" Pervious Area** | 0.05 |
| **Depression Storage Impervious Area (mm)** | 2 |
| **Depression Storage Pervious Area (mm)** | 5 |
| **Modified Green and Ampt Soil Parameters for Texture Class Sand** (Rawls *et al.*, 1983) | |
| **Suction Head (mm)** | 49.02 |
| **Conductivity (mm/hr)** | 120.34 |
| **Initial Deficit (frac.)** | 0.413 |

Table 3: Typical PCSWMM Pre-development Model Sub-Catchment Parameters

The pre-development peak runoff volumes are summarised in Table 4 below:

| Pre-Development (Brownfields) Peak Volumes ($m^3/s$) - Recurrence Interval (Years) | | | | | |
|---|---|---|---|---|---|
| **Outfall** | **2yr** | **5yr** | **10yr** | **20yr** | **50yr** |
| **Pond 1** | 0.350 | 0.492 | 0.596 | 0.706 | 0.873 |
| **Pond 2** | 1.085 | 1.520 | 1.838 | 2.174 | 2.654 |
| **Pond 3** | 0.243 | 0.334 | 0.400 | 0.469 | 0.567 |
| **Pond 4** | 0.238 | 0.330 | 0.396 | 0.466 | 0.565 |
| **Pond 5** | 0.470 | 0.642 | 0.767 | 0.897 | 1.082 |
| **Pond 6** | 0.289 | 0.396 | 0.473 | 0.553 | 0.668 |
| **Pond 7** | 1.691 | 2.392 | 2.909 | 3.457 | 4.245 |
| **Pond 8** | 0.189 | 0.256 | 0.304 | 0.356 | 0.428 |
| **Cape Winelands Airport Site Overall Total** | **4.555** | **6.362** | **7.683** | **9.078** | **11.082** |

Table 4: Pre-development Peak Runoff Volumes

The Pre-Development Scenario and subdivision of the various sub-catchments can be seen in Figure 13 below:




Figure 13: Pre-Development Scenario

The Pre-Development scenario and sub-catchments parameters can be seen in Table 5 below.

| Pre-Development Scenario (Existing Development) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
| S1 | Pre-Dev | 66.8069 | 445.608 | 1499.2 | 2.8 | 10 | 0.02 | 0.05 | 2 | 5 | 25 |
| S1_1 | Pre-Dev | 32.001 | 206.458 | 1550.0 | 0.5 | 10 | 0.02 | 0.05 | 2 | 5 | 25 |
| S10_1 | Pre-Dev | 98.8727 | 429.881 | 2300.0 | 3.5 | 10 | 0.02 | 0.05 | 2 | 5 | 25 |
| S11_1 | Pre-Dev | 36.311 | 290.488 | 1250.0 | 2.8 | 5 | 0.02 | 0.05 | 2 | 5 | 25 |
| S12_1 | Pre-Dev | 58.7382 | 533.983 | 1100.0 | 2.3 | 5 | 0.02 | 0.05 | 2 | 5 | 25 |
| S16_1 | Pre-Dev | 1.9185 | 38.37 | 500.0 | 1 | 5 | 0.02 | 0.05 | 2 | 5 | 25 |
| S2 | Pre-Dev | 31.6982 | 176.124 | 1799.8 | 2.5 | 5 | 0.02 | 0.05 | 2 | 5 | 25 |
| S5_1 | Pre-Dev | 12.584 | 96.8 | 1300.0 | 2.8 | 10 | 0.02 | 0.05 | 2 | 5 | 25 |
| S6_1 | Pre-Dev | 31.1301 | 222.358 | 1400.0 | 2.5 | 5 | 0.02 | 0.05 | 2 | 5 | 25 |
| S8_1 | Pre-Dev | 20.9606 | 220.638 | 950.0 | 3.5 | 5 | 0.02 | 0.05 | 2 | 5 | 25 |
| S9_1 | Pre-Dev | 32.3893 | 185.082 | 1750.0 | 3.5 | 10 | 0.02 | 0.05 | 2 | 5 | 25 |

Table 5: PCSWMM Pre-Development Model Catchment Parameter Summary

### 4.4.3 Post-Development Runoff

To accurately model run-off from various areas on site for the Post-Development Scenario, the site was subdivided into various sub-catchments. This sub-division was based on surface type and various other geometric constraints. The post development sub-catchment parameters are summarised below in Table 6:

| **Sub-Catchment Parameters** | **Cape Winelands Airport (Post-Development)** |
|---|---|
| **Area (ha)** | 430 |
| **Width (m)** | Varies |
| **Length (m)** | Varies |
| **"n" Impervious Area** | 0.014 (roof)<br>0.014 (asphalt)<br>0.014 (Other – Paved / Concrete Hardstand) |
| **"n" Pervious Area** | 0.05 |
| **Slope (%)** | Varies |
| **Depression Storage Impervious Area (mm)** | 2 |
| **Depression Storage Pervious Area (mm)** | 5 |
| **Modified Green and Ampt Soil Parameters for Texture Sand** (Rawls *et al.*, 1983) | |
| **Suction Head (mm)** | 49.02 |
| **Conductivity (mm/hr)** | 120.34 |
| **Initial Deficit (frac.)** | 0.413 |

Table 6: Typical PCSWMM Post-development Model Sub-Catchment Parameters

The post-development peak un-attenuated runoff volumes for the development are summarised in Table 7 below.

| **Post-Development Peak Un-Attenuated Volumes ($m^3/s$) - Recurrence Interval (Years)** | | | | | |
|---|---|---|---|---|---|
| **Outfall** | **2yr** | **5yr** | **10yr** | **20yr** | **50yr** |
| **Pond 1** | 2.419 | 3.379 | 4.059 | 4.748 | 5.570 |
| **Pond 2** | 8.289 | 11.713 | 14.334 | 17.135 | 21.416 |
| **Pond 3** | 2.116 | 2.959 | 3.582 | 4.235 | 5.212 |
| **Pond 4** | 0.106 | 0.148 | 0.179 | 0.212 | 0.259 |
| **Pond 5** | 1.763 | 2.553 | 3.099 | 3.563 | 3.850 |
| **Pond 6** | 0.099 | 0.144 | 0.177 | 0.213 | 0.265 |
| **Pond 7** | 0.322 | 0.465 | 0.571 | 0.683 | 0.844 |
| **Pond 8** | 0.639 | 0.933 | 1.155 | 1.395 | 1.738 |
| **Cape Winelands Airport Site Overall Total** | **15.753** | **22.294** | **27.156** | **32.184** | **39.154** |

Table 7: Post-development Peak Un-Attenuated Runoff Volumes

The Post-Development Scenario and subdivision of the various sub-catchments can be seen in Figure 14 below:

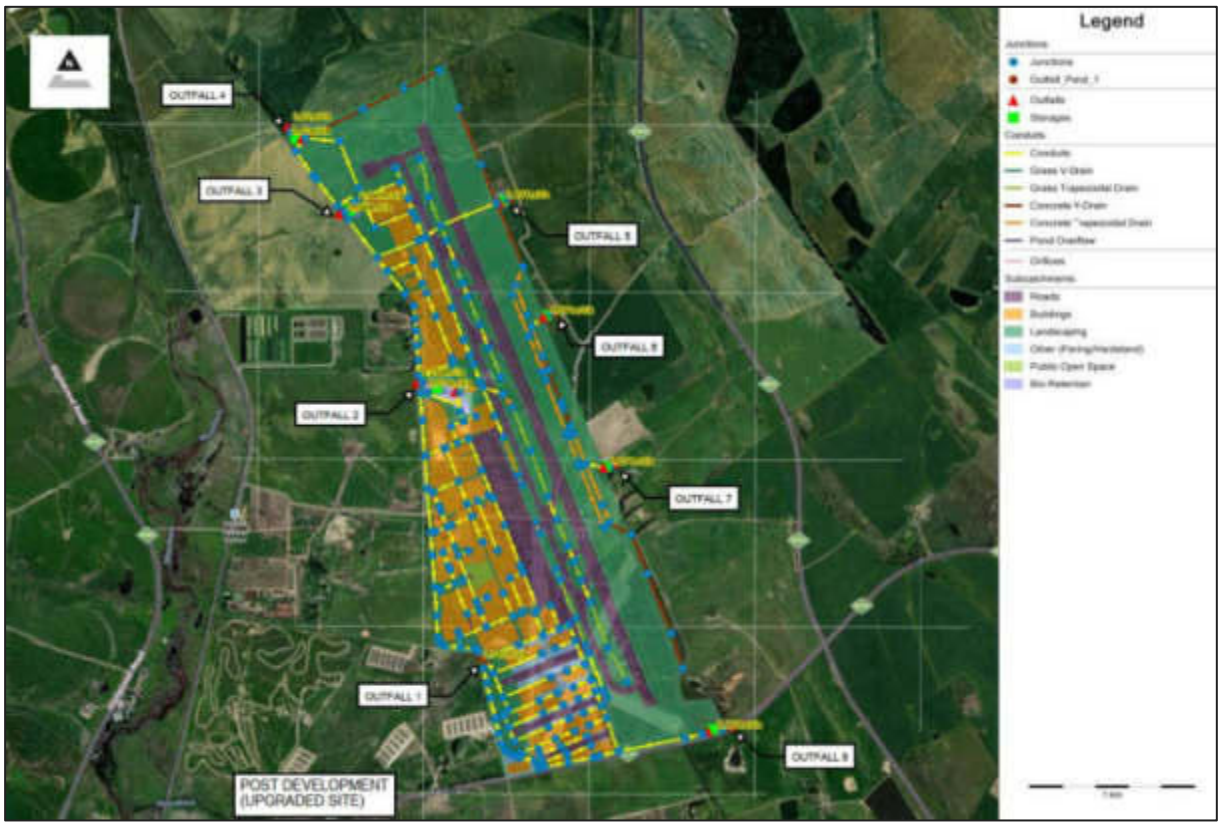



Figure 14: Post-Development Scenario

The Post-Development scenario and sub-catchments parameters can be seen in Table 8 below:

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S136_1 | Building | 0.8716 | 87.16 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S136_3 | Building | 0.5861 | 58.61 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S136_4 | Building | 1.1421 | 114.21 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S136_5 | Building | 1.7665 | 176.65 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S824_1 | Building | 0.5428 | 54.28 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S824_2 | Building | 1.3202 | 132.02 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S825 | Building | 1.2328 | 123.28 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S826 | Building | 1.959 | 122.438 | 160.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S827 | Building | 0.044 | 4.4 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S828 | Building | 1.8348 | 131.057 | 140.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S829 | Building | 0.1827 | 30.45 | 60.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S830 | Building | 0.325 | 46.429 | 70.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S831_1 | Building | 0.967 | 96.7 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S831_2 | Building | 0.9844 | 98.44 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S832_1 | Building | 0.7294 | 72.94 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S832_2 | Building | 1.525 | 152.5 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S833 | Building | 3.3216 | 332.16 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S834 | Building | 0.046 | 4.6 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S835_1 | Building | 0.2346 | 23.46 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S835_2 | Building | 0.5313 | 53.13 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S836_1 | Building | 0.5395 | 53.95 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S836_2 | Building | 0.5775 | 57.75 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S837_1 | Building | 0.4918 | 49.18 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S837_2 | Building | 0.4226 | 42.26 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S838_1 | Building | 0.4154 | 41.54 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S838_2 | Building | 0.4921 | 49.21 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S839 | Building | 1.7435 | 174.35 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S840 | Building | 1.4043 | 140.43 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S841 | Building | 0.35 | 35 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S842 | Building | 0.2623 | 43.717 | 60.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S843 | Building | 0.7544 | 94.3 | 80.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S844 | Building | 1.6538 | 165.38 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S845 | Building | 0.1999 | 24.988 | 80.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S846 | Building | 1.1666 | 58.33 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S847 | Building | 0.1725 | 34.5 | 50.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S848 | Building | 0.1843 | 36.86 | 50.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S849 | Building | 0.4468 | 44.68 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S850 | Building | 0.7638 | 63.65 | 120.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S851 | Building | 0.4126 | 41.26 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S852_1 | Building | 1.2712 | 63.56 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S852_2 | Building | 1.1488 | 57.44 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S853 | Building | 0.06 | 30 | 20.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S854 | Building | 0.941 | 94.1 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S855 | Building | 0.2623 | 43.717 | 60.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S856 | Building | 0.1999 | 24.988 | 80.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S857_1 | Building | 0.5944 | 59.44 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S857_2 | Building | 0.4931 | 49.31 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S858_1 | Building | 0.7458 | 74.58 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S858_2 | Building | 0.7087 | 70.87 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S859 | Building | 0.8432 | 84.32 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S860_1 | Building | 2.1968 | 219.68 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S860_2 | Building | 0.8911 | 89.11 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S861 | Building | 1.0992 | 109.92 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S862 | Building | 0.1 | 10 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S863 | Building | 0.1 | 10 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S864 | Building | 0.125 | 12.5 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S865 | Building | 0.125 | 12.5 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S866 | Building | 0.125 | 12.5 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S867 | Building | 0.25 | 25 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S868_1 | Building | 0.481 | 48.1 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S868_2 | Building | 0.4284 | 42.84 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S869_1 | Building | 0.2381 | 23.81 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S869_2 | Building | 0.2438 | 24.38 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S870_1 | Building | 0.5659 | 56.59 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S870_3 | Building | 0.5213 | 52.13 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S870_4 | Building | 0.5905 | 59.05 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S870_5 | Building | 0.6183 | 61.83 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S871_1 | Building | 0.2174 | 21.74 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S871_2 | Building | 0.5041 | 50.41 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S872 | Building | 1.0041 | 100.41 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S873 | Building | 0.64 | 64 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S874 | Building | 0.9996 | 99.96 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S875 | Building | 1.3594 | 135.94 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S876_1 | Building | 0.8486 | 84.86 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S876_2 | Building | 0.619 | 61.9 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S876_3 | Building | 0.4886 | 48.86 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S877_1 | Building | 0.4882 | 48.82 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S877_2 | Building | 0.8587 | 85.87 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S878 | Building | 0.5928 | 59.28 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S879 | Building | 0.5569 | 69.612 | 80.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S880 | Building | 0.9289 | 46.445 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S881 | Building | 0.6308 | 31.54 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S882 | Building | 0.591 | 29.55 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S883_1 | Building | 1.3383 | 133.83 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S883_2 | Building | 1.3698 | 136.98 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S884 | Building | 0.7919 | 79.19 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S885 | Building | 0.622 | 62.2 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S886 | Building | 0.7017 | 70.17 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S887 | Building | 0.7017 | 70.17 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S888 | Building | 0.622 | 62.2 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S889 | Building | 0.7017 | 70.17 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S890 | Building | 0.7017 | 70.17 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S891_1 | Building | 1.1307 | 113.07 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S891_3 | Building | 0.705 | 70.5 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S891_4 | Building | 0.9408 | 94.08 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S892_1 | Building | 1.1103 | 111.03 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S892_3 | Building | 0.7257 | 72.57 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S892_4 | Building | 0.9389 | 93.89 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S893 | Building | 0.6315 | 50.52 | 125.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S894_1 | Building | 0.7528 | 75.28 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S894_2 | Building | 1.1102 | 111.02 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S895 | Building | 0.4636 | 46.36 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S896 | Building | 0.8512 | 85.12 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S897 | Building | 0.5204 | 52.04 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S898 | Building | 0.2987 | 24.892 | 120.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 50 |
| S1_4 | Grass | 0.3307 | 66.14 | 50.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S12_1 | Grass | 0.4631 | 30.873 | 150.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S12_2 | Grass | 0.3307 | 33.07 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S12_3 | Grass | 0.8082 | 36.736 | 220.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S12_5 | Grass | 0.4882 | 32.547 | 150.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S12_6 | Grass | 0.4429 | 31.636 | 140.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S12_7 | Grass | 0.64 | 32 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S12_8 | Grass | 0.3765 | 34.227 | 110.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S13 | Grass | 4.4598 | 222.99 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S15_3 | Grass | 0.6131 | 30.655 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S15_4 | Grass | 0.6073 | 30.365 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S18 | Grass | 2.1429 | 107.145 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S18_6 | Grass | 3.2386 | 323.86 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S183 | Grass | 0.5514 | 55.14 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S184_1 | Grass | 0.0808 | 8.08 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S184_3 | Grass | 0.0804 | 8.04 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S184_4 | Grass | 0.6383 | 63.83 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S185 | Grass | 0.1687 | 16.87 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S186 | Grass | 0.2872 | 28.72 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S187 | Grass | 0.3972 | 39.72 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S189 | Grass | 0.0903 | 9.03 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S19 | Grass | 0.0543 | 5.43 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S190 | Grass | 0.7908 | 79.08 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S191 | Grass | 0.3845 | 38.45 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S193_2 | Grass | 0.423 | 70.5 | 60.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S193_3 | Grass | 0.7555 | 75.55 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S193_4 | Grass | 0.6987 | 87.338 | 80.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S193_5 | Grass | 0.2076 | 34.6 | 60.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S193_6 | Grass | 0.5185 | 74.071 | 70.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S193_7 | Grass | 0.7365 | 92.062 | 80.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S195_1 | Grass | 0.5457 | 54.57 | 100.0 | 0.75 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S195_2 | Grass | 0.9104 | 91.04 | 100.0 | 0.75 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S197_1 | Grass | 0.5532 | 55.32 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S197_3 | Grass | 0.3629 | 36.29 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S197_4 | Grass | 0.2028 | 20.28 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S197_5 | Grass | 0.116 | 11.6 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S197_6 | Grass | 0.3071 | 30.71 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S198_1 | Grass | 0.338 | 33.8 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S198_10 | Grass | 0.0743 | 7.43 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S198_2 | Grass | 0.3601 | 36.01 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S198_3 | Grass | 0.3197 | 31.97 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S198_4 | Grass | 0.1222 | 12.22 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S198_5 | Grass | 0.1467 | 14.67 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S198_6 | Grass | 0.3309 | 33.09 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S198_7 | Grass | 0.1941 | 19.41 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S198_8 | Grass | 0.1324 | 13.24 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S199 | Grass | 0.309 | 30.9 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S200_1 | Grass | 0.3474 | 34.74 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S200_2 | Grass | 0.4685 | 46.85 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S201 | Grass | 0.27 | 24.545 | 110.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S202 | Grass | 0.5447 | 54.47 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S203 | Grass | 0.1518 | 15.18 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S204 | Grass | 0.1672 | 15.2 | 110.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S205 | Grass | 0.162 | 16.2 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S206_1 | Grass | 0.2851 | 23.758 | 120.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S206_2 | Grass | 0.414 | 34.5 | 120.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S206_3 | Grass | 0.2117 | 21.17 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S207 | Grass | 0.453 | 45.3 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S208_1 | Grass | 0.5643 | 70.538 | 80.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S208_2 | Grass | 0.1272 | 12.72 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S208_3 | Grass | 0.312 | 31.2 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S208_4 | Grass | 0.2359 | 23.59 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S209 | Grass | 0.6781 | 67.81 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S21 | Grass | 3.4882 | 348.82 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S210_1 | Grass | 0.2153 | 21.53 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S210_3 | Grass | 0.2828 | 28.28 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S210_4 | Grass | 0.1065 | 10.65 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S210_5 | Grass | 0.2299 | 22.99 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S211_1 | Grass | 0.9571 | 95.71 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S211_2 | Grass | 2.1091 | 210.91 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S212_1 | Grass | 0.2361 | 23.61 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S212_2 | Grass | 1.5663 | 156.63 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S213_1 | Grass | 0.4712 | 47.12 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S213_2 | Grass | 0.1444 | 14.44 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S213_3 | Grass | 1.4522 | 90.762 | 160.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S214 | Grass | 0.1355 | 13.55 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S215 | Grass | 0.3375 | 33.75 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S216 | Grass | 1.1982 | 66.567 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S217_1 | Grass | 0.39 | 39 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S217_2 | Grass | 0.5325 | 44.375 | 120.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S217_3 | Grass | 0.885 | 88.5 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S218 | Grass | 0.2 | 20 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S219 | Grass | 0.1902 | 19.02 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S22 | Grass | 4.487 | 448.7 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S220 | Grass | 0.0274 | 2.74 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S221 | Grass | 0.3031 | 30.31 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S222 | Grass | 0.1232 | 12.32 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S223_1 | Grass | 0.1515 | 18.938 | 80.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S223_2 | Grass | 1.2694 | 79.338 | 160.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S224 | Grass | 0.0499 | 4.99 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S225 | Grass | 0.0297 | 2.97 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S226 | Grass | 0.3987 | 39.87 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S227 | Grass | 0.4756 | 47.56 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S228 | Grass | 0.0537 | 5.37 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S229_1 | Grass | 0.1344 | 13.44 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S229_2 | Grass | 0.1093 | 10.93 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S229_3 | Grass | 0.2684 | 26.84 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S229_4 | Grass | 0.069 | 6.9 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S230_1 | Grass | 0.336 | 33.6 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S230_2 | Grass | 0.2926 | 29.26 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S231 | Grass | 0.1566 | 15.66 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S232 | Grass | 0.0252 | 2.52 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S233 | Grass | 0.0476 | 4.76 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S234 | Grass | 0.0572 | 5.72 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S235 | Grass | 0.302 | 30.2 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S236 | Grass | 0.0157 | 1.57 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S237 | Grass | 0.1674 | 16.74 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S238 | Grass | 0.0874 | 8.74 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S239 | Grass | 0.4724 | 47.24 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S240_1 | Grass | 0.2282 | 25.356 | 90.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S240_2 | Grass | 0.3818 | 42.422 | 90.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S241 | Grass | 0.2344 | 29.3 | 80.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S242 | Grass | 0.8934 | 52.553 | 170.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S28 | Grass | 0.6137 | 61.37 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S29 | Grass | 2.3307 | 116.535 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3 | Grass | 4.463 | 446.3 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_119 | Grass | 1.5332 | 85.178 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_122 | Grass | 1.921 | 80.042 | 240.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_124 | Grass | 3.594 | 94.579 | 380.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_126 | Grass | 2.9847 | 149.235 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_127 | Grass | 3.0986 | 154.93 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_17 | Grass | 2.9314 | 101.083 | 290.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_18 | Grass | 1.1744 | 65.244 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_19 | Grass | 0.9188 | 45.94 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_20 | Grass | 2.9278 | 146.39 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_21 | Grass | 1.662 | 83.1 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_23 | Grass | 1.6534 | 91.856 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_24 | Grass | 1.2164 | 121.64 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_27 | Grass | 2.9873 | 90.524 | 330.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_32 | Grass | 1.3324 | 74.022 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_42 | Grass | 0.4377 | 43.77 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_89 | Grass | 1.38 | 138 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_7 | Grass | 0.2614 | 26.14 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S3_8 | Grass | 1.6619 | 83.095 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32 | Grass | 0.1018 | 10.18 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32_1 | Grass | 0.2138 | 21.38 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32_10 | Grass | 1.0169 | 40.676 | 250.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32_11 | Grass | 0.6588 | 32.94 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32_12 | Grass | 0.548 | 39.143 | 140.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32_13 | Grass | 0.0756 | 7.56 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32_3 | Grass | 0.5271 | 29.283 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32_6 | Grass | 0.5857 | 32.539 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S32_8 | Grass | 0.6524 | 32.62 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S36 | Grass | 3.2245 | 161.225 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S37 | Grass | 0.7418 | 30.908 | 240.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S38 | Grass | 6.0018 | 300.09 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S4 | Grass | 1.1763 | 65.35 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_11 | Grass | 0.166 | 16.6 | 100.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_12 | Grass | 0.1515 | 15.15 | 100.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_14 | Grass | 0.1155 | 9.625 | 120.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_16 | Grass | 0.1027 | 5.706 | 180.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_17 | Grass | 0.1004 | 5.578 | 180.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_19 | Grass | 0.0996 | 9.96 | 100.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_2 | Grass | 0.0706 | 8.825 | 80.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_20 | Grass | 0.0968 | 9.68 | 100.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_22 | Grass | 0.1331 | 7.829 | 170.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_23 | Grass | 0.056 | 11.2 | 50.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_25 | Grass | 0.1246 | 7.788 | 160.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_26 | Grass | 0.1226 | 7.662 | 160.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S45_28 | Grass | 0.1202 | 8.013 | 150.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_29 | Grass | 0.1104 | 7.36 | 150.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_3 | Grass | 0.0707 | 10.1 | 70.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_31 | Grass | 0.1584 | 9.9 | 160.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_32 | Grass | 0.0259 | 6.475 | 40.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_34 | Grass | 0.1121 | 8.623 | 130.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_37 | Grass | 0.0951 | 10.567 | 90.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_38 | Grass | 0.0742 | 8.244 | 90.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_40 | Grass | 0.0654 | 8.175 | 80.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_42 | Grass | 0.2917 | 16.206 | 180.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_43 | Grass | 0.0268 | 6.7 | 40.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_45 | Grass | 0.077 | 9.625 | 80.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_46 | Grass | 0.0261 | 6.525 | 40.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_47 | Grass | 0.0863 | 9.589 | 90.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_48 | Grass | 0.0478 | 9.56 | 50.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_49 | Grass | 0.092 | 4.6 | 200.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_5 | Grass | 0.1644 | 10.96 | 150.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_6 | Grass | 0.1202 | 8.586 | 140.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_7 | Grass | 0.0692 | 8.65 | 80.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S45_8 | Grass | 0.1316 | 10.967 | 120.0 | 1.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S5 | Grass | 1.679 | 167.9 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S51_1 | Grass | 0.3084 | 20.56 | 150.0 | 0.868 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S51_2 | Grass | 0.2899 | 19.327 | 150.0 | 0.868 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S54 | Grass | 7.3951 | 369.755 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S6 | Grass | 3.8232 | 212.4 | 180.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S66_3 | Grass | 7.9683 | 796.83 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S66_4 | Grass | 5.6638 | 566.38 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S66_5 | Grass | 2.4406 | 244.06 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S67 | Grass | 6.2018 | 310.09 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_1 | Grass | 0.5354 | 66.925 | 80.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_11 | Grass | 1.6543 | 82.715 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_12 | Grass | 0.4761 | 23.805 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_3 | Grass | 3.8494 | 192.47 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_39 | Grass | 0.4525 | 22.625 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_4 | Grass | 1.2187 | 121.87 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_41 | Grass | 4.353 | 217.65 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_44 | Grass | 3.2677 | 163.385 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_45 | Grass | 8.0963 | 404.815 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_46 | Grass | 6.3093 | 315.465 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_48 | Grass | 5.241 | 262.05 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_5 | Grass | 1.3015 | 130.15 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_50 | Grass | 6.9122 | 345.61 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_51 | Grass | 2.0226 | 101.13 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_53 | Grass | 7.9924 | 399.62 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_6 | Grass | 0.3656 | 45.7 | 80.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_7 | Grass | 0.5805 | 72.562 | 80.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S7_8 | Grass | 8.4494 | 422.47 | 200.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S70_1 | Grass | 0.0629 | 6.29 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S70_4 | Grass | 2.1595 | 179.958 | 120.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_1 | Grass | 0.1697 | 16.97 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_10 | Grass | 0.2056 | 20.56 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_11 | Grass | 0.5037 | 50.37 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_3 | Grass | 0.2287 | 22.87 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_5 | Grass | 0.5007 | 50.07 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_6 | Grass | 0.9087 | 90.87 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_7 | Grass | 0.4584 | 45.84 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_8 | Grass | 2.0617 | 206.17 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S71_9 | Grass | 1.2004 | 120.04 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S8 | Grass | 2.4899 | 177.85 | 140.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S8_1 | Grass | 0.3446 | 34.46 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S8_2 | Grass | 0.0385 | 3.85 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S8_4 | Grass | 0.4417 | 44.17 | 100.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S9 | Grass | 0.115 | 57.5 | 20.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S10 | Grass | 0.0274 | 13.7 | 20.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S39_1 | Grass | 0.1002 | 5.894 | 170.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S39_2 | Grass | 3.1992 | 188.188 | 170.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S39_4 | Grass | 0.0905 | 5.324 | 170.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S39 | Grass | 0.1296 | 43.2 | 30.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S40 | Grass | 0.0372 | 18.6 | 20.0 | 0.5 | 0 | 0.02 | 0.05 | 2 | 5 | 0 |
| S173_1 | Hardstand | 0.1263 | 12.63 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S173_2 | Hardstand | 0.2799 | 27.99 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S173_3 | Hardstand | 0.2705 | 27.05 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S173_5 | Hardstand | 0.3134 | 31.34 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S173_6 | Hardstand | 0.3854 | 38.54 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S173_7 | Hardstand | 0.6522 | 65.22 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S174_1 | Hardstand | 0.3036 | 30.36 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S174_2 | Hardstand | 0.1225 | 12.25 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S175_1 | Hardstand | 0.6458 | 64.58 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S175_3 | Hardstand | 0.4175 | 41.75 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S175_4 | Hardstand | 0.546 | 54.6 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S176_1 | Hardstand | 0.6518 | 65.18 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S176_3 | Hardstand | 0.4128 | 41.28 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S176_4 | Hardstand | 0.5468 | 54.68 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S177_1 | Hardstand | 0.9674 | 96.74 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S177_2 | Hardstand | 1.3616 | 136.16 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S178_1 | Hardstand | 0.9746 | 97.46 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S178_2 | Hardstand | 1.358 | 135.8 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S179_1 | Hardstand | 0.773 | 77.3 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S179_2 | Hardstand | 0.3155 | 31.55 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S179_3 | Hardstand | 0.2267 | 22.67 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S180 | Hardstand | 0.1434 | 14.34 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S181 | Hardstand | 0.3693 | 36.93 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S182_2 | Hardstand | 0.273 | 27.3 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S182_3 | Hardstand | 0.8996 | 89.96 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S182_4 | Hardstand | 0.6964 | 69.64 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S188_1 | Hardstand | 0.1164 | 11.64 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S188_2 | Hardstand | 0.1918 | 19.18 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S194_1 | Hardstand | 0.1845 | 18.45 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S194_3 | Hardstand | 0.1137 | 11.37 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S194_4 | Hardstand | 0.1485 | 14.85 | 100.0 | 0.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S32_4 | Hardstand | 0.8011 | 106.813 | 75.0 | 1.5 | 75 | 0.014 | 0.05 | 2 | 5 | 25 |
| S_Pond1 | Pond | 0.2098 | 41.96 | 50.0 | 0.5 | 0 | 0.02 | 0.035 | 2 | 5 | 0 |
| S_Pond2 | Pond | 3.2903 | 411.288 | 80.0 | 0.5 | 0 | 0.02 | 0.035 | 2 | 5 | 0 |
| S_Pond3 | Pond | 0.6095 | 76.188 | 80.0 | 0.5 | 0 | 0.02 | 0.035 | 2 | 5 | 0 |
| S_Pond4 | Pond | 0.1253 | 31.325 | 40.0 | 0.5 | 0 | 0.02 | 0.035 | 2 | 5 | 0 |
| S_Pond5 | Pond | 0.4485 | 64.071 | 70.0 | 0.5 | 0 | 0.02 | 0.035 | 2 | 5 | 0 |
| S_Pond6 | Pond | 0.0918 | 45.9 | 20.0 | 0.5 | 0 | 0.02 | 0.035 | 2 | 5 | 0 |
| S_Pond7 | Pond | 0.2703 | 90.1 | 30.0 | 0.5 | 0 | 0.02 | 0.035 | 2 | 5 | 0 |
| S_Pond8 | Pond | 0.2045 | 102.25 | 20.0 | 0.5 | 0 | 0.02 | 0.035 | 2 | 5 | 0 |
| S1 | Road | 0.2934 | 29.34 | 100.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S1_8 | Road | 1.2397 | 35.42 | 350.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11 | Road | 0.0144 | 7.2 | 20.0 | 1 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_1 | Road | 0.1071 | 10.71 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_10 | Road | 0.0881 | 8.81 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_11 | Road | 0.0748 | 7.48 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_12 | Road | 0.1193 | 11.93 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_2 | Road | 0.0842 | 8.42 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_4 | Road | 0.1661 | 16.61 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_5 | Road | 0.1133 | 11.33 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_6 | Road | 0.135 | 13.5 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_7 | Road | 0.1212 | 12.12 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_8 | Road | 0.1291 | 12.91 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S11_9 | Road | 0.0993 | 9.93 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S13_11 | Road | 3.2981 | 194.006 | 170.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S13_12 | Road | 2.8633 | 143.165 | 200.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S13_14 | Road | 2.183 | 128.412 | 170.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S13_2 | Road | 3.7056 | 217.976 | 170.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S13_8 | Road | 2.2906 | 134.741 | 170.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S139_1 | Road | 0.19 | 19 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S139_2 | Road | 0.2501 | 17.864 | 140.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S14 | Road | 0.4324 | 43.24 | 100.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S140_1 | Road | 0.2455 | 20.458 | 120.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S140_2 | Road | 0.1968 | 15.138 | 130.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S141_1 | Road | 0.1978 | 19.78 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S141_2 | Road | 0.1638 | 16.38 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S141_4 | Road | 0.2705 | 27.05 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S141_5 | Road | 0.1037 | 10.37 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S143_1 | Road | 0.1235 | 12.35 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S143_2 | Road | 0.1954 | 15.031 | 130.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S143_3 | Road | 0.1526 | 15.26 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S144_1 | Road | 0.1849 | 23.112 | 80.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S144_3 | Road | 0.3115 | 14.159 | 220.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S144_4 | Road | 0.1335 | 13.35 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S144_5 | Road | 0.152 | 10.133 | 150.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S145_2 | Road | 0.1074 | 10.74 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S147 | Road | 0.4239 | 28.26 | 150.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S148_1 | Road | 0.1977 | 10.983 | 180.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S15 | Road | 0.2072 | 10.36 | 200.0 | 0.521 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S150 | Road | 0.357 | 12.75 | 280.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S152 | Road | 0.0198 | 9.9 | 20.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S153 | Road | 1.2938 | 129.38 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S155 | Road | 0.1133 | 11.33 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S156_1 | Road | 0.1718 | 17.18 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S157 | Road | 0.0807 | 8.07 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S158_1 | Road | 0.0881 | 8.81 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S158_2 | Road | 0.1513 | 10.087 | 150.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S16 | Road | 0.228 | 27.874 | 81.8 | 0.519 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S160_2 | Road | 0.1475 | 10.536 | 140.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S161_1 | Road | 0.0418 | 4.18 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S161_2 | Road | 0.1013 | 10.13 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S161_3 | Road | 0.141 | 9.4 | 150.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S161_5 | Road | 0.094 | 9.4 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S161_6 | Road | 0.1572 | 10.48 | 150.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S163 | Road | 0.172 | 13.231 | 130.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S164_1 | Road | 0.1539 | 9.619 | 160.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S164_3 | Road | 0.1075 | 8.958 | 120.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S164_4 | Road | 0.1032 | 9.382 | 110.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S164_5 | Road | 0.0476 | 7.933 | 60.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S165 | Road | 0.1017 | 10.17 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S166_1 | Road | 0.109 | 9.909 | 110.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S166_3 | Road | 0.1154 | 9.617 | 120.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S166_4 | Road | 0.1912 | 9.56 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S167_1 | Road | 0.1259 | 9.685 | 130.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S167_2 | Road | 0.2613 | 10.887 | 240.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S168_1 | Road | 0.0794 | 8.822 | 90.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S168_2 | Road | 0.116 | 9.667 | 120.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S168_3 | Road | 0.0784 | 8.711 | 90.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S168_4 | Road | 0.1217 | 9.362 | 130.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S17 | Road | 0.1038 | 9.962 | 104.2 | 0.542 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S170_1 | Road | 0.2726 | 27.26 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S170_2 | Road | 0.092 | 9.2 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S170_3 | Road | 0.2656 | 13.28 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S170_4 | Road | 0.5958 | 29.79 | 200.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S170_5 | Road | 0.0917 | 9.17 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S170_7 | Road | 0.173 | 9.105 | 190.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S170_8 | Road | 0.2387 | 23.87 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_1 | Road | 0.1244 | 12.44 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_10 | Road | 0.1248 | 12.48 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_13 | Road | 0.1741 | 17.41 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_14 | Road | 0.137 | 13.7 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_16 | Road | 0.1952 | 19.52 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_17 | Road | 0.1292 | 12.92 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_18 | Road | 0.1467 | 14.67 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_19 | Road | 0.129 | 12.9 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_2 | Road | 0.2101 | 21.01 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_3 | Road | 0.1036 | 10.36 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_4 | Road | 0.1119 | 11.19 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_5 | Road | 0.1779 | 17.79 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_7 | Road | 0.0981 | 9.81 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S171_8 | Road | 0.1416 | 14.16 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S18_3 | Road | 0.1855 | 6.182 | 300.1 | 1 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S192 | Road | 0.0078 | 0.78 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S196_1 | Road | 0.1117 | 9.308 | 120.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S196_2 | Road | 0.0731 | 8.6 | 85.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S196_3 | Road | 0.0649 | 8.113 | 80.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2 | Road | 1.2727 | 36.363 | 350.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_1 | Road | 1.0831 | 28.503 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_11 | Road | 2.2623 | 59.534 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_12 | Road | 0.5442 | 14.321 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_2 | Road | 0.3157 | 8.308 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_21 | Road | 0.8985 | 23.645 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_22 | Road | 1.0928 | 28.758 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_23 | Road | 0.3759 | 9.892 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_24 | Road | 0.9336 | 24.568 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_25 | Road | 0.5713 | 15.034 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_26 | Road | 1.4833 | 39.034 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_27 | Road | 0.8646 | 22.753 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_28 | Road | 0.2321 | 6.108 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_3 | Road | 2.6638 | 70.1 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_4 | Road | 0.5751 | 15.134 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_5 | Road | 1.477 | 38.868 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_6 | Road | 2.6067 | 68.597 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_7 | Road | 0.7242 | 19.058 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S2_8 | Road | 0.7619 | 20.05 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S23_2 | Road | 1.8856 | 58.3 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S23_3 | Road | 0.3537 | 11.053 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S23_4 | Road | 0.089 | 2.781 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S24_2 | Road | 0.391 | 32.583 | 120.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S24_3 | Road | 0.5227 | 34.847 | 150.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S24_4 | Road | 0.4546 | 34.969 | 130.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S3_1 | Road | 0.6254 | 41.693 | 150.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S3_11 | Road | 0.1077 | 10.77 | 100.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S3_3 | Road | 0.1839 | 18.39 | 100.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S3_4 | Road | 0.3978 | 39.78 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S3_5 | Road | 0.6568 | 43.787 | 150.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S43 | Road | 0.2585 | 25.85 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_1 | Road | 0.2575 | 8.583 | 300.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_10 | Road | 0.2034 | 9.245 | 220.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_13 | Road | 0.2098 | 11.656 | 180.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_15 | Road | 0.1595 | 8.861 | 180.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_18 | Road | 0.1365 | 7.583 | 180.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_21 | Road | 0.1326 | 7.367 | 180.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_24 | Road | 0.1626 | 8.558 | 190.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_27 | Road | 0.1501 | 7.9 | 190.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |

| Name | Description | Area (ha) | Width (m) | Flow Length (m) | Slope (%) | Imperv. (%) | N Imperv | N Perv | Dstore Imperv (mm) | Dstore Perv (mm) | Zero Imperv (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S45_30 | Road | 0.1548 | 8.6 | 180.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_33 | Road | 0.2073 | 9.423 | 220.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_36 | Road | 0.1489 | 9.927 | 150.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_39 | Road | 0.1213 | 10.108 | 120.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_4 | Road | 0.0926 | 9.26 | 100.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_41 | Road | 0.0877 | 9.744 | 90.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S45_44 | Road | 0.3679 | 18.395 | 200.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S48_1 | Road | 0.7316 | 40.644 | 180.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S48_2 | Road | 1.2654 | 48.669 | 260.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S49 | Road | 0.3742 | 11.694 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S50 | Road | 0.895 | 89.5 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52 | Road | 0.2688 | 26.88 | 100.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_1 | Road | 0.9801 | 39.204 | 250.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_11 | Road | 1.3274 | 41.481 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_12 | Road | 0.3773 | 11.791 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_13 | Road | 1.5427 | 48.209 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_14 | Road | 0.8432 | 26.35 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_15 | Road | 1.3374 | 41.794 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_17 | Road | 1.4635 | 45.734 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_18 | Road | 0.8291 | 25.909 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_19 | Road | 1.714 | 53.562 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_2 | Road | 1.7186 | 53.706 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_20 | Road | 0.6075 | 18.984 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_21 | Road | 1.5213 | 47.541 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_22 | Road | 1.0859 | 33.934 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_23 | Road | 1.1041 | 34.503 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_3 | Road | 0.6074 | 18.981 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_4 | Road | 1.5055 | 47.047 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_5 | Road | 1.2382 | 38.694 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_8 | Road | 0.9968 | 39.872 | 250.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S52_9 | Road | 1.2407 | 38.772 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S55 | Road | 0.7012 | 18.453 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S56 | Road | 1.0483 | 27.587 | 380.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S7 | Road | 1.3726 | 42.894 | 320.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S7_2 | Road | 0.2068 | 6.893 | 300.0 | 1 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S70 | Road | 1.2429 | 69.05 | 180.0 | 1 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S70_3 | Road | 0.0998 | 24.95 | 40.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S72 | Road | 0.1622 | 32.44 | 50.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S8_6 | Road | 0.0628 | 15.7 | 40.0 | 1.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S12 | Road | 0.0815 | 8.15 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 8 |
| S20 | Road | 5.3601 | 536.01 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S23 | Road | 0.1872 | 18.72 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S24 | Road | 0.1688 | 16.88 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S25 | Road | 0.0688 | 6.88 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S26 | Road | 0.3161 | 31.61 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S27 | Road | 0.0832 | 8.32 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S30 | Road | 0.3277 | 32.77 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S31 | Road | 0.0934 | 9.34 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S33 | Road | 0.162 | 16.2 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S34 | Road | 0.2228 | 22.28 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |
| S35 | Road | 0.0936 | 9.36 | 100.0 | 0.5 | 100 | 0.014 | 0.05 | 2 | 5 | 25 |

Table 8: PCSWMM Post-Development Model Catchment Parameter Summary

### 4.4.4 Extended Detention of the 1-year 24hr Event

When considering the 1-year 24-hour storm event to establish the extent of extended detention achieved by the proposed stormwater control measures, it is important to take note of the following:

- The run-off generated during the 1-year storm event is relatively low and can easily be discharged via the proposed underground stormwater pipe system
- It is not practical for outlet pipes to be sized smaller than 110mm Ø as the probability of blockage is high

It is proposed that variable outlet structures are designed specifically for each of the ponds based on the peak volume inflows. A typical variable outlet structure detail can be seen in Figure 15 below.

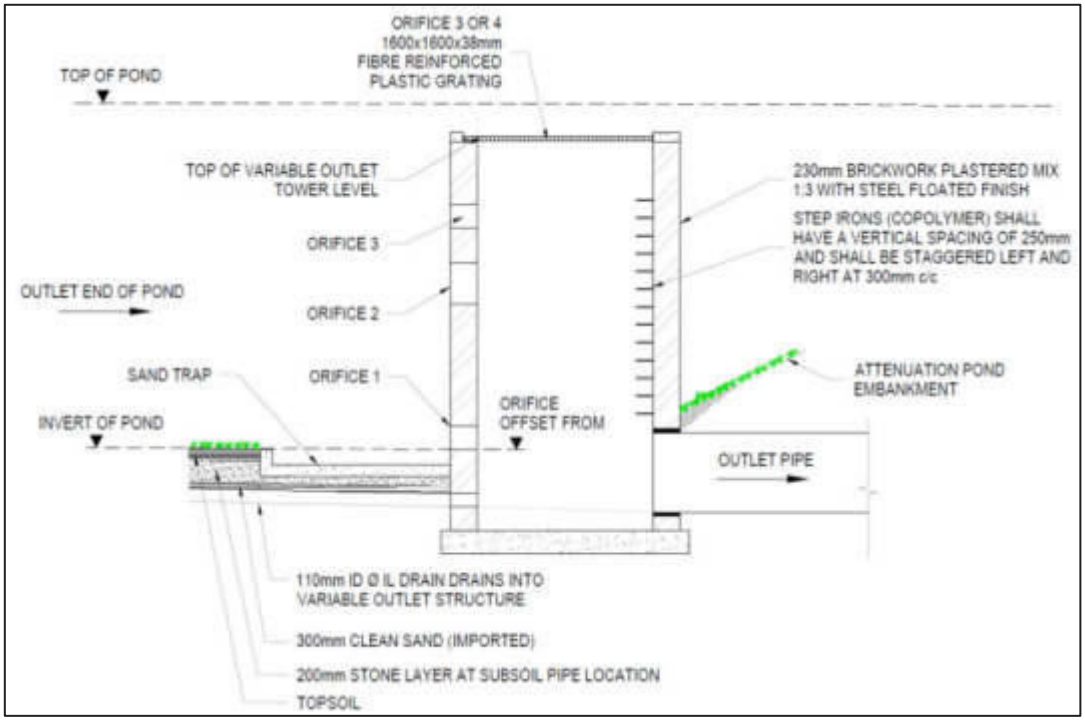



Figure 15: Typical Variable Outlet Structure

The typical variable outlet structure detail depicted above should be read with Table 9 below, where the pond structure and various orifice sizes and numbers indicated with their desired offset from the respective pond invert levels.

| Pond No. | Orifice 1 | | Orifice 2 | | Orifice 3 | | Orifice 4 | |
|---|---|---|---|---|---|---|---|---|
| | Outlet (mm) | Offset (m) | Outlet (mm) | Offset (m) | Outlet (mm) | Offset (m) | Outlet (m) | Offset (m) |
| 1 | 200 | 0 | 250 | 0.5 | 300 | 1 | Grid 1600x1600 | 1.85 |
| 2 | 200 | 3 | 300 | 3.25 | 300 | 3.75 | Grid 1600x1600 | 4.5 |
| 3 | 160 | 0 | 200 | 0.25 | 200 | 0.6 | Grid 1600x1600 | 1.35 |
| 4 | 160 | 0 | 200 | 0.3 | Grid 1600x1600 | 0.85 | | |
| 5 | 200 | 0 | 300 | 0.5 | Grid 1600x1600 | 1.95 | | |
| 6 | 110 | 0 | Grid 1600x1600 | 0.5 | | | | |
| 7 | 160 | 0 | 200 | 0.3 | Grid 1600x1600 | 1 | | |
| 8 | 160 | 0 | 200 | 0.4 | Grid 1600x1600 | 1.65 | | |

Table 9: Variable Outlet Structure Offsets for each Pond

Extended detention achieved by the overall stormwater systems for the post development scenario is in accordance with the CoCT policy requirements for the 1-year 24-hour storm event. The figures below indicate the various pond inflows over 48 hours at the outfall manhole in the pre-development unattenuated scenario (Grey) and the post-development attenuated scenario (Blue).

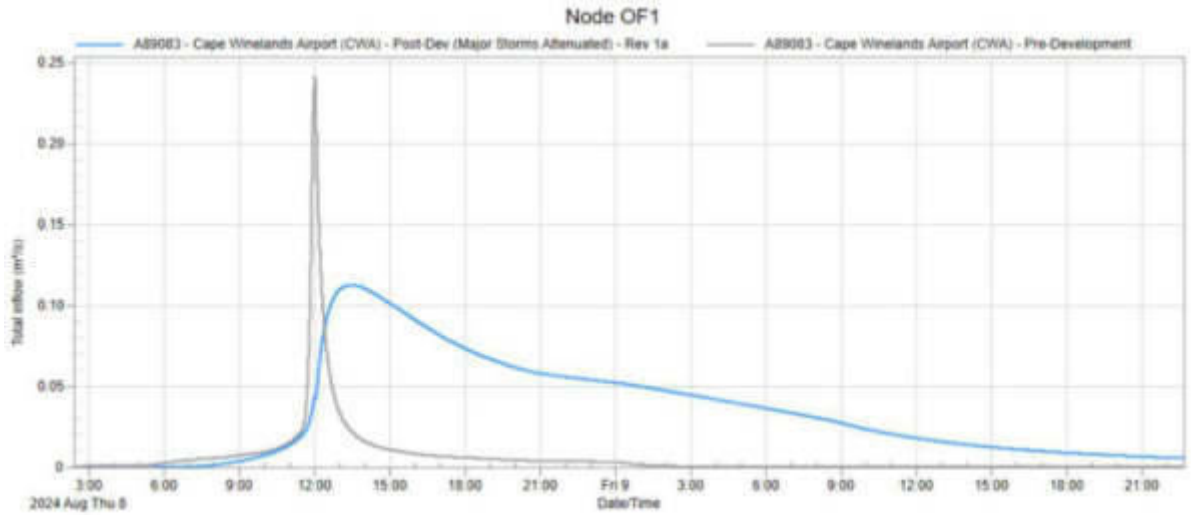



Figure 16: Pond 1 – Outfall Junction showing Extended Detention achieved on Site

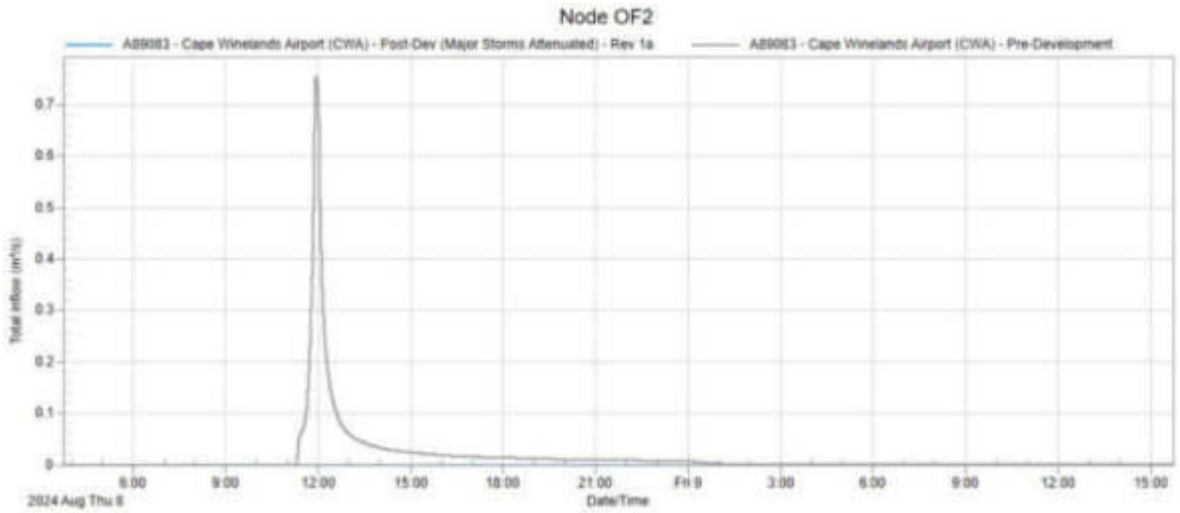



Figure 17: Pond 2 – Outfall Junction showing Extended Detention achieved on Site

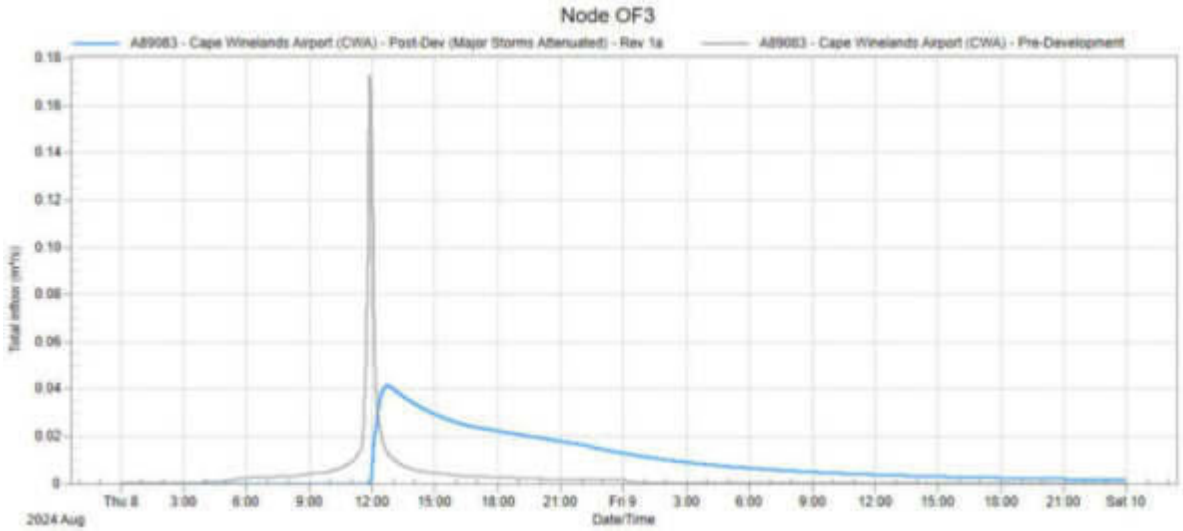



Figure 18: Pond 3 – Outfall Junction showing Extended Detention achieved on Site

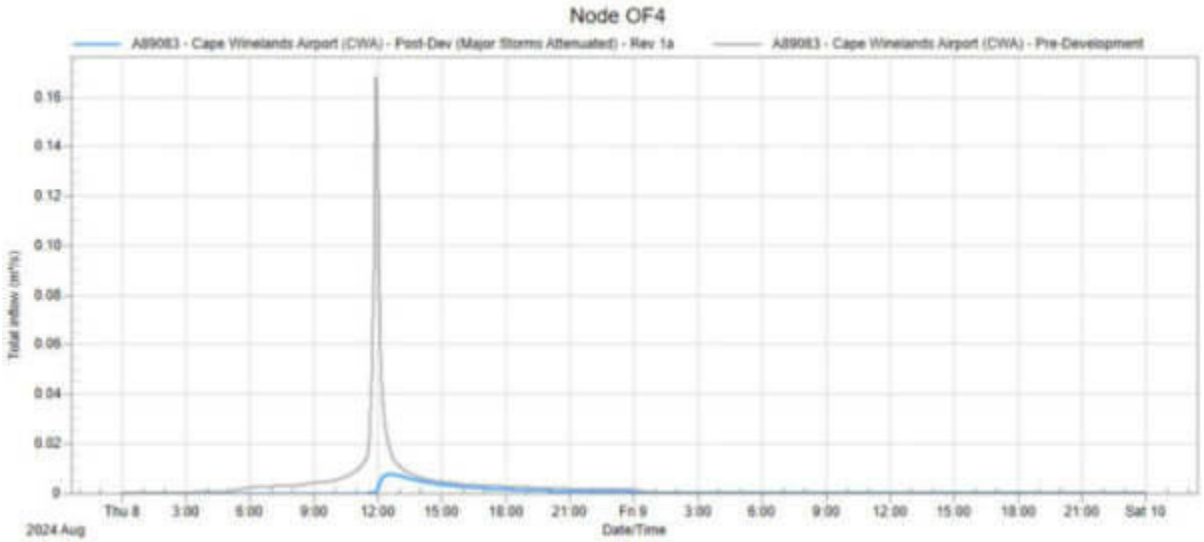



Figure 19: Pond 4 – Outfall Junction showing Extended Detention achieved on Site

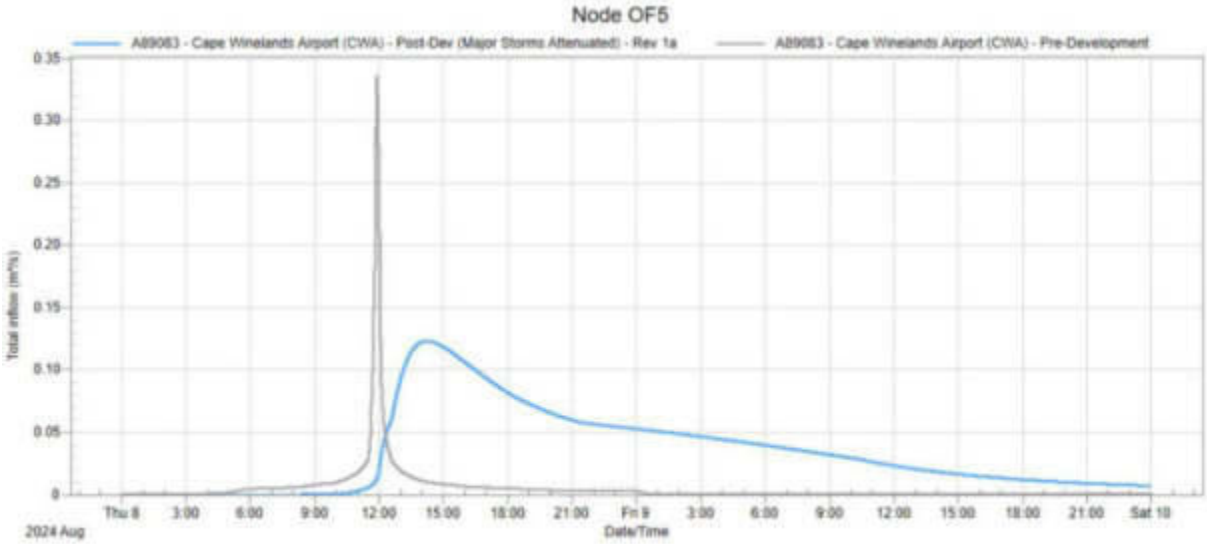



Figure 20: Pond 5 – Outfall Junction showing Extended Detention achieved on Site

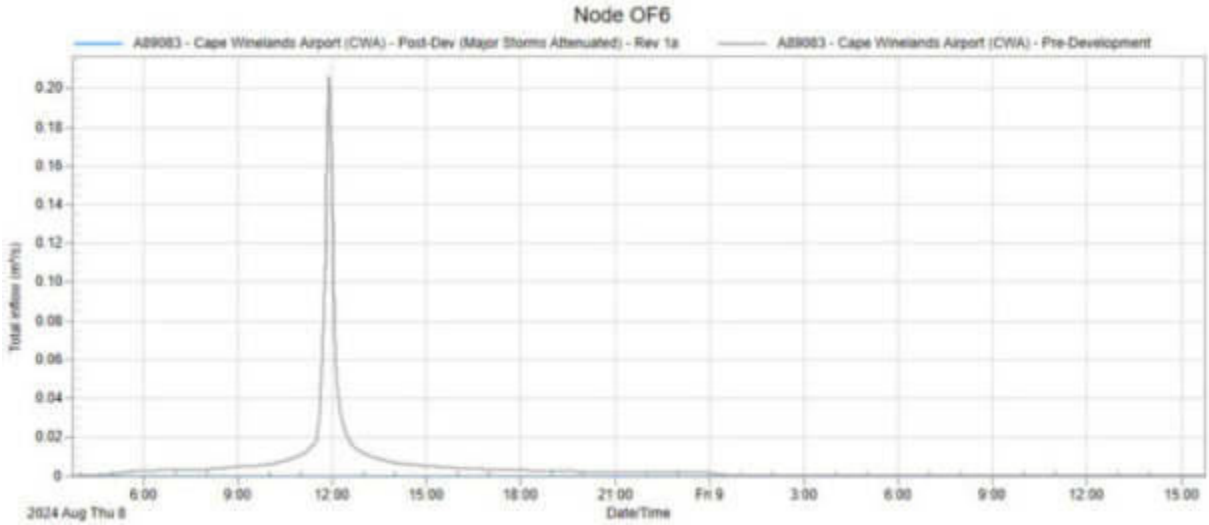



Figure 21: Pond 6 – Outfall Junction showing Extended Detention achieved on Site

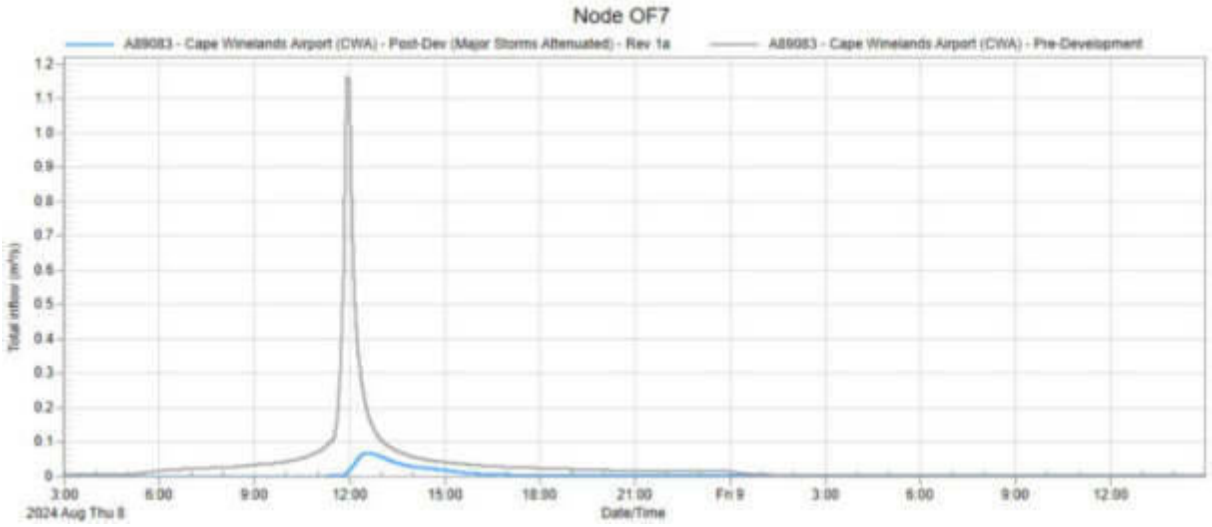



Figure 22: Pond 7 – Outfall Junction showing Extended Detention achieved on Site

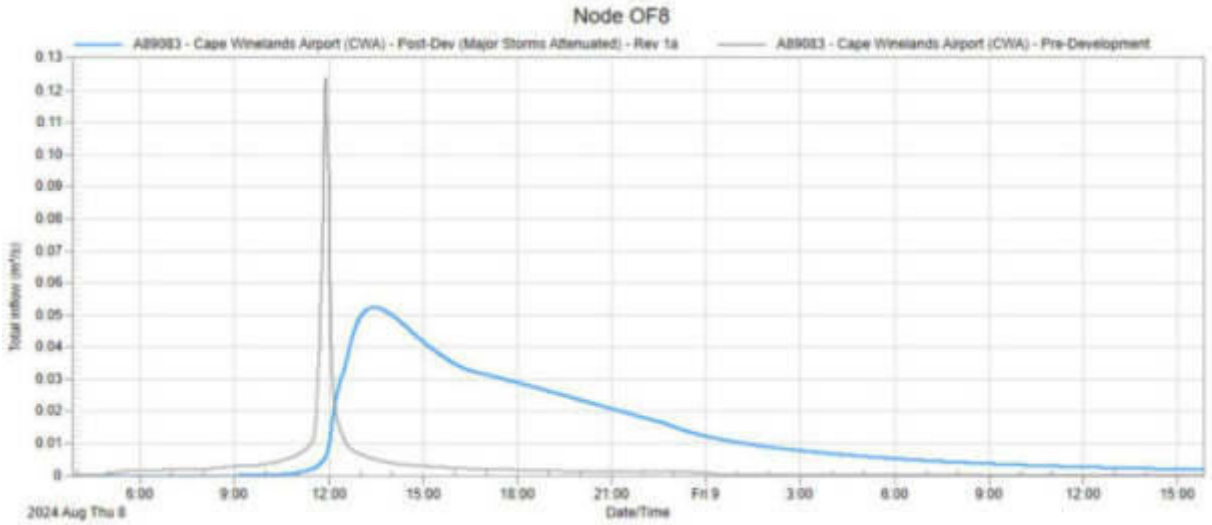



Figure 23: Pond 8 – Outfall Junction showing Extended Detention achieved on Site

## 4.5 Storm Event Management

### 4.5.1 Stormwater Attenuation

The implementation of treatment measures will inherently reduce peak flows as it will include storage capacity while facilitating infiltration, slow down velocities and provide extra storage in the underlying layers. Pre-Development run-offs were modelled to compare the different scenarios with the post-development model. Peak run-off outputs for pre-development and post-development are summarised in the tables below for each of the proposed ponds.

The peak run-off values for stormwater Pond 1 can be seen summarised in Table 10 below.

| Storm Event (24h duration) | Peak Runoff values for the Stormwater Pond 1 at Cape Winelands Airport | | |
|---|---|---|---|
| | Pre-Development | Post-Development (Unattenuated) | Post-Development (Attenuated) |
| **2yr** | 0.350 | 2.419 | 0.168 |
| **5yr** | 0.492 | 3.379 | 0.278 |
| **10yr** | 0.596 | 4.059 | 0.353 |
| **20yr** | 0.706 | 4.748 | 0.411 |
| **50yr** | 0.873 | 5.57 | 0.808 |

Table 10: Pond 1 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 10 above are presented graphically in Figure 24 below:




Figure 24: Pond 1 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 2 can be seen summarised in Table 11 below.

| Storm Event (24h duration) | Peak Runoff values for the Stormwater Pond 2 at Cape Winelands Airport | | |
|---|---|---|---|
| | Pre-Development | Post-Development (Unattenuated) | Post-Development (Attenuated) |
| 2yr | 1.085 | 8.289 | 0.057 |
| 5yr | 1.520 | 11.713 | 0.212 |
| 10yr | 1.838 | 14.334 | 0.365 |
| 20yr | 2.174 | 17.135 | 0.474 |
| 50yr | 2.654 | 21.416 | 2.105 |

Table 11: Pond 2 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 11 above are presented graphically in Figure 25 below:




Figure 25: Pond 2 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 3 can be seen summarised in Table 12 below.

| Storm Event (24h duration) | Peak Runoff values for the Stormwater Pond 3 at Cape Winelands Airport | | |
|---|---|---|---|
| | Pre-Development | Post-Development (Unattenuated) | Post-Development (Attenuated) |
| 2yr | 0.243 | 2.116 | 0.082 |
| 5yr | 0.334 | 2.959 | 0.141 |
| 10yr | 0.400 | 3.582 | 0.177 |
| 20yr | 0.469 | 4.235 | 0.206 |
| 50yr | 0.567 | 5.212 | 0.438 |

Table 12: Pond 3 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 12 above are presented graphically in Figure 26 below:

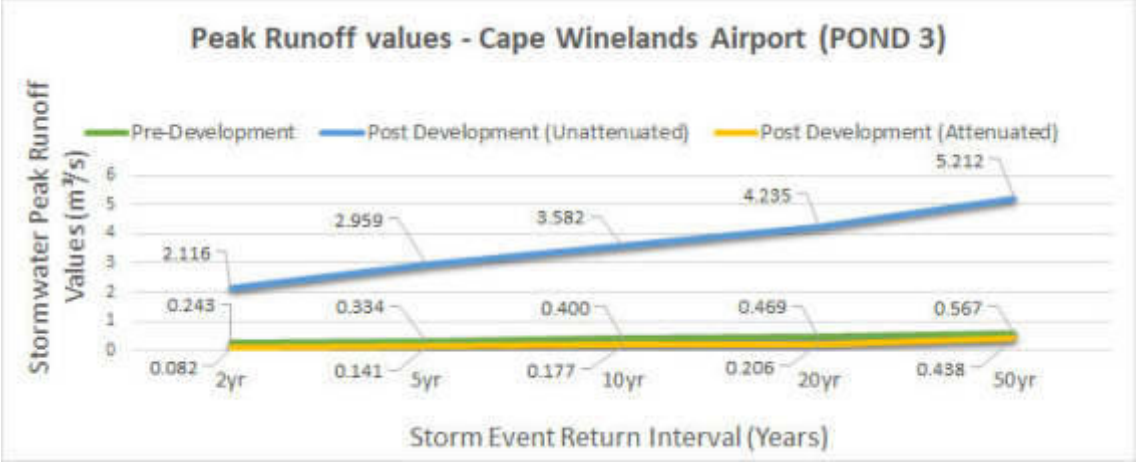



Figure 26: Pond 3 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 4 can be seen summarised in Table 13 below.

| Storm Event (24h duration) | Peak Runoff values for the Stormwater Pond 4 at Cape Winelands Airport | | |
|---|---|---|---|
| | Pre-Development | Post-Development (Unattenuated) | Post-Development (Attenuated) |
| 2yr | 0.238 | 0.106 | 0.014 |
| 5yr | 0.330 | 0.148 | 0.020 |
| 10yr | 0.396 | 0.179 | 0.024 |
| 20yr | 0.466 | 0.212 | 0.027 |
| 50yr | 0.565 | 0.259 | 0.036 |

Table 13: Pond 4 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 13 above are presented graphically in Figure 27 below:

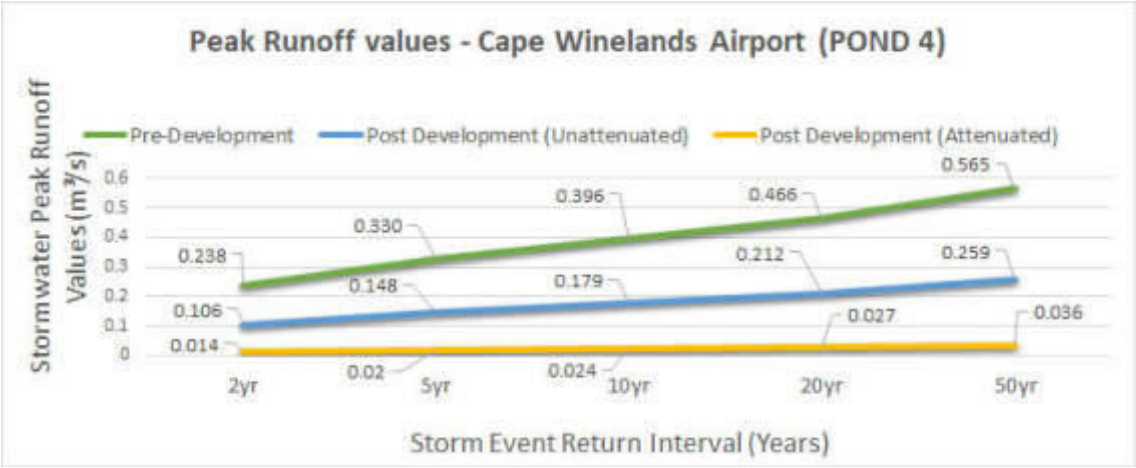



Figure 27: Pond 4 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 5 can be seen summarised in Table 14 below.

| Storm Event (24h duration) | Peak Runoff values for the Stormwater Pond 5 at Cape Winelands Airport | | |
|---|---|---|---|
| | Pre-Development | Post-Development (Unattenuated) | Post-Development (Attenuated) |
| 2yr | 0.470 | 1.763 | 0.205 |
| 5yr | 0.642 | 2.553 | 0.272 |
| 10yr | 0.767 | 3.099 | 0.311 |
| 20yr | 0.897 | 3.563 | 0.346 |
| 50yr | 1.082 | 3.85 | 0.95 |

Table 14: Pond 5 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 14 above are presented graphically in Figure 28 below:

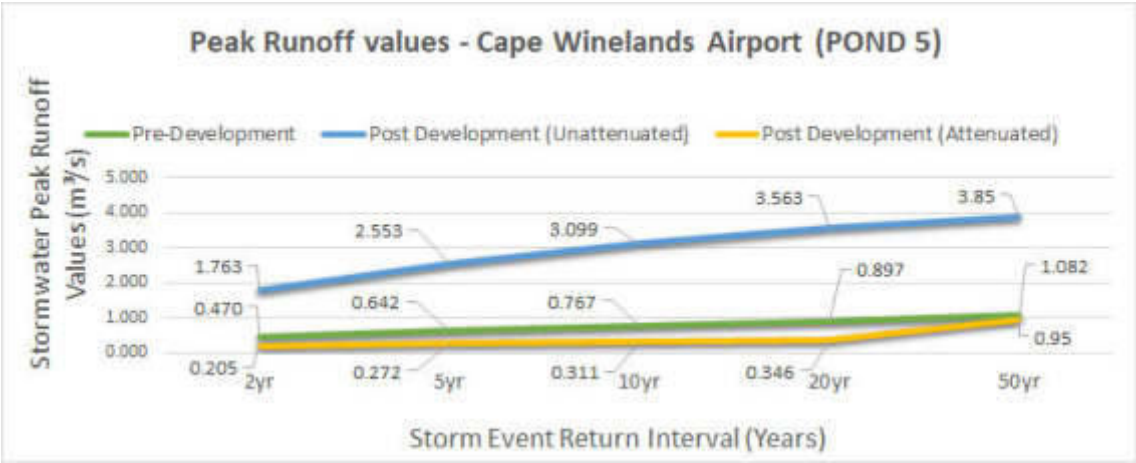



Figure 28: Pond 5 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 6 can be seen summarised in Table 15 below:

| Storm Event (24h duration) | Peak Runoff values for the Stormwater Pond 6 at Cape Winelands Airport | | |
|---|---|---|---|
| | Pre-Development | Post-Development (Unattenuated) | Post-Development (Attenuated) |
| 2yr | 0.289 | 0.099 | 0.000 |
| 5yr | 0.396 | 0.144 | 0.001 |
| 10yr | 0.473 | 0.177 | 0.001 |
| 20yr | 0.553 | 0.213 | 0.002 |
| 50yr | 0.668 | 0.265 | 0.004 |

Table 15: Pond 6 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 15 above are presented graphically in Figure 29 below:




Figure 29: Pond 6 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 7 can be seen summarised in Table 16 below:

| Storm Event (24h duration) | Peak Runoff values for the Stormwater Pond 7 at Cape Winelands Airport | | |
|---|---|---|---|
| | Pre-Development | Post-Development (Unattenuated) | Post-Development (Attenuated) |
| 2yr | 1.691 | 0.322 | 0.094 |
| 5yr | 2.392 | 0.465 | 0.120 |
| 10yr | 2.909 | 0.571 | 0.237 |
| 20yr | 3.457 | 0.683 | 0.412 |
| 50yr | 4.245 | 0.844 | 0.649 |

Table 16: Pond 7 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 16 above are presented graphically in Figure 30 below:




Figure 30: Pond 7 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 8 can be seen summarised in Table 17 below:

| Storm Event (24h duration) | Peak Runoff values for the Stormwater Pond 8 at Cape Winelands Airport | | |
|---|---|---|---|
| | Pre-Development | Post-Development (Unattenuated) | Post-Development (Attenuated) |
| 2yr | 0.189 | 0.639 | 0.088 |
| 5yr | 0.256 | 0.933 | 0.116 |
| 10yr | 0.304 | 1.155 | 0.131 |
| 20yr | 0.356 | 1.395 | 0.146 |
| 50yr | 0.428 | 1.738 | 0.163 |

Table 17: Pond 8 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 17 above are presented graphically in Figure 31 below:




Figure 31: Pond 8 – Peak Run-off Values for Various Storm Events

When comparing the pre-development and post-development peak flow rates for Cape Winelands Airport as demonstrated in the figures above, it can be seen that the post development attenuated peak flows are reduced to below pre-development levels.

The focus of the proposed concept design was to ensure that peak run-offs for the post-development scenario are sufficiently reduced to mitigate damage to existing stormwater infrastructure, downstream properties and receiving water bodies from the post development flows.

### 4.5.2 Water Quality Targets

The CoCT policy requires treatment of the runoff from the 0.5-year, 24-hour storm (design storm), which is the Water Quality Volume (WQv). In terms of the CCT's "Management of Urban Stormwater Impacts Policy", acceptable improvement in the quality of stormwater runoff may be achieved through the removal of pollutants by a combination of reducing and / or disconnecting impervious areas from the drainage system and the use of LIDS (Low impact drainage systems) that infiltrate and / or capture and treat stormwater runoff. Sub-catchment types and impervious areas used in the calculations are summarised in Table 18 below.

| Sub-Catchment Type | Total Area (ha) | Impervious (%) | Impervious Area (ha) | Pervious Area (ha) |
|---|---|---|---|---|
| **Pond/Bioretention Area** | 5.25 | 0% | 0.00 | 5.25 |
| **Roads** | 97.59 | 100% | 97.59 | 0.00 |
| **Buildings** | 75.97 | 100% | 75.97 | 0.00 |
| **Other (Development)** | 15.59 | 75% | 11.69 | 3.90 |
| **Grassed/Public Open Spaces** | 235.19 | 0% | 0.00 | 235.19 |
| **Total** | **429.59** | | **185.26** | **244.34** |
| **Resultant Impervious Percentage (%)** | | **43.1%** | | |

Table 18: Water Quality Volume Calculations

The Calculation of the WQv is calculated from the following formula (Atlanta Regional Commission, 2016)

$$\mathrm{WQv} = \frac{P.R_v.\mathrm{A}}{1000}$$

Where:

$WQv$ = Water Quality Volume (Ml)
P = ½ year, 24-hour storm, precipitation (mm)
$Rv$ =Volumetric runoff coefficient
$A$ = Site area ($m^2$)

The Volumetric runoff coefficient is calculated as follows:

$$R_v = 0.05 + 0.009(I)$$

Where:

$I$ = Site impervious percentage

Therefore, the Volumetric runoff coefficient $R_v$ can be calculated as: $R_v = 0.05 + 0.009(43.1) = 0.438$

The Water Quality Volume calculation is therefore as follows:

$$\mathrm{WQv} = \frac{(20.1).(0.438).(4295930)}{(1000)}$$

$$\mathrm{WQv} = 37820.5m^3$$

The WQv calculated above was used to size the bottom of pond area.

The total treated volume which entered the LID's for the 0.5-year RI 24-hour storm event is 73.79ML as can be seen in Table 19 below. This total run-off volume infiltrated the engineered layerworks before discharging into the downstream system through the sub-surface drains.

| Name | Description | Area (ha) | Infiltration (mm) | Runon (mm) | Runoff Depth (mm) | Precipitation (mm) | Total Volume Treated (ML) |
|---|---|---|---|---|---|---|---|
| S1_4 | Grass | 0.3307 | 20.1 | 0 | 0 | 20.1 | 0.0665 |
| S12_1 | Grass | 0.4631 | 20.1 | 0 | 0 | 20.1 | 0.0931 |
| S12_2 | Grass | 0.3307 | 20.1 | 0 | 0 | 20.1 | 0.0665 |
| S12_3 | Grass | 0.8082 | 20.1 | 0 | 0 | 20.1 | 0.1624 |
| S12_5 | Grass | 0.4882 | 20.1 | 0 | 0 | 20.1 | 0.0981 |
| S12_6 | Grass | 0.4429 | 20.1 | 0 | 0 | 20.1 | 0.0890 |
| S12_7 | Grass | 0.64 | 20.1 | 0 | 0 | 20.1 | 0.1286 |
| S12_8 | Grass | 0.3765 | 20.1 | 0 | 0 | 20.1 | 0.0757 |
| S13 | Grass | 4.4598 | 20.1 | 0 | 0 | 20.1 | 0.8964 |
| S15_3 | Grass | 0.6131 | 20.1 | 0 | 0 | 20.1 | 0.1232 |
| S15_4 | Grass | 0.6073 | 20.1 | 0 | 0 | 20.1 | 0.1221 |
| S18 | Grass | 2.1429 | 22.44 | 2.34 | 0 | 20.1 | 0.4809 |
| S18_6 | Grass | 3.2386 | 20.1 | 0 | 0 | 20.1 | 0.6510 |
| S183 | Grass | 0.5514 | 20.1 | 0 | 0 | 20.1 | 0.1108 |
| S184_1 | Grass | 0.0808 | 20.1 | 0 | 0 | 20.1 | 0.0162 |
| S184_3 | Grass | 0.0804 | 20.1 | 0 | 0 | 20.1 | 0.0162 |
| S184_4 | Grass | 0.6383 | 20.1 | 0 | 0 | 20.1 | 0.1283 |
| S185 | Grass | 0.1687 | 20.1 | 0 | 0 | 20.1 | 0.0339 |
| S186 | Grass | 0.2872 | 20.1 | 0 | 0 | 20.1 | 0.0577 |
| S187 | Grass | 0.3972 | 20.1 | 0 | 0 | 20.1 | 0.0798 |
| S189 | Grass | 0.0903 | 20.1 | 0 | 0 | 20.1 | 0.0182 |
| S19 | Grass | 0.0543 | 20.1 | 0 | 0 | 20.1 | 0.0109 |
| S190 | Grass | 0.7908 | 20.1 | 0 | 0 | 20.1 | 0.1590 |
| S191 | Grass | 0.3845 | 20.1 | 0 | 0 | 20.1 | 0.0773 |
| S193_2 | Grass | 0.423 | 20.1 | 0 | 0 | 20.1 | 0.0850 |
| S193_3 | Grass | 0.7555 | 20.1 | 0 | 0 | 20.1 | 0.1519 |
| S193_4 | Grass | 0.6987 | 20.1 | 0 | 0 | 20.1 | 0.1404 |
| S193_5 | Grass | 0.2076 | 20.1 | 0 | 0 | 20.1 | 0.0417 |
| S193_6 | Grass | 0.5185 | 20.1 | 0 | 0 | 20.1 | 0.1042 |
| S193_7 | Grass | 0.7365 | 20.1 | 0 | 0 | 20.1 | 0.1480 |
| S195_1 | Grass | 0.5457 | 20.1 | 0 | 0 | 20.1 | 0.1097 |
| S195_2 | Grass | 0.9104 | 20.1 | 0 | 0 | 20.1 | 0.1830 |
| S197_1 | Grass | 0.5532 | 20.1 | 0 | 0 | 20.1 | 0.1112 |
| S197_3 | Grass | 0.3629 | 20.1 | 0 | 0 | 20.1 | 0.0729 |
| S197_4 | Grass | 0.2028 | 20.1 | 0 | 0 | 20.1 | 0.0408 |
| S197_5 | Grass | 0.116 | 20.1 | 0 | 0 | 20.1 | 0.0233 |
| S197_6 | Grass | 0.3071 | 20.1 | 0 | 0 | 20.1 | 0.0617 |
| S198_1 | Grass | 0.338 | 20.1 | 0 | 0 | 20.1 | 0.0679 |
| S198_10 | Grass | 0.0743 | 20.1 | 0 | 0 | 20.1 | 0.0149 |
| S198_2 | Grass | 0.3601 | 20.1 | 0 | 0 | 20.1 | 0.0724 |
| S198_3 | Grass | 0.3197 | 20.1 | 0 | 0 | 20.1 | 0.0643 |
| S198_4 | Grass | 0.1222 | 20.1 | 0 | 0 | 20.1 | 0.0246 |
| S198_5 | Grass | 0.1467 | 20.1 | 0 | 0 | 20.1 | 0.0295 |
| S198_6 | Grass | 0.3309 | 20.1 | 0 | 0 | 20.1 | 0.0665 |
| S198_7 | Grass | 0.1941 | 20.1 | 0 | 0 | 20.1 | 0.0390 |
| S198_8 | Grass | 0.1324 | 20.1 | 0 | 0 | 20.1 | 0.0266 |
| S199 | Grass | 0.309 | 20.1 | 0 | 0 | 20.1 | 0.0621 |
| S200_1 | Grass | 0.3474 | 20.1 | 0 | 0 | 20.1 | 0.0698 |
| S200_2 | Grass | 0.4685 | 20.1 | 0 | 0 | 20.1 | 0.0942 |
| S201 | Grass | 0.27 | 20.1 | 0 | 0 | 20.1 | 0.0543 |
| S202 | Grass | 0.5447 | 20.1 | 0 | 0 | 20.1 | 0.1095 |
| S203 | Grass | 0.1518 | 20.1 | 0 | 0 | 20.1 | 0.0305 |
| S204 | Grass | 0.1672 | 20.1 | 0 | 0 | 20.1 | 0.0336 |
| S205 | Grass | 0.162 | 20.1 | 0 | 0 | 20.1 | 0.0326 |
| S206_1 | Grass | 0.2851 | 20.1 | 0 | 0 | 20.1 | 0.0573 |
| S206_2 | Grass | 0.414 | 20.1 | 0 | 0 | 20.1 | 0.0832 |
| S206_3 | Grass | 0.2117 | 20.1 | 0 | 0 | 20.1 | 0.0426 |
| S207 | Grass | 0.453 | 20.1 | 0 | 0 | 20.1 | 0.0911 |
| S208_1 | Grass | 0.5643 | 20.1 | 0 | 0 | 20.1 | 0.1134 |
| S208_2 | Grass | 0.1272 | 20.1 | 0 | 0 | 20.1 | 0.0256 |
| S208_3 | Grass | 0.312 | 20.1 | 0 | 0 | 20.1 | 0.0627 |
| S208_4 | Grass | 0.2359 | 20.1 | 0 | 0 | 20.1 | 0.0474 |
| S209 | Grass | 0.6781 | 20.1 | 0 | 0 | 20.1 | 0.1363 |
| S21 | Grass | 3.4882 | 20.1 | 0 | 0 | 20.1 | 0.7011 |
| S210_1 | Grass | 0.2153 | 20.1 | 0 | 0 | 20.1 | 0.0433 |
| S210_3 | Grass | 0.2828 | 20.1 | 0 | 0 | 20.1 | 0.0568 |
| S210_4 | Grass | 0.1065 | 20.1 | 0 | 0 | 20.1 | 0.0214 |
| S210_5 | Grass | 0.2299 | 20.1 | 0 | 0 | 20.1 | 0.0462 |
| S211_1 | Grass | 0.9571 | 20.1 | 0 | 0 | 20.1 | 0.1924 |
| S211_2 | Grass | 2.1091 | 20.1 | 0 | 0 | 20.1 | 0.4239 |
| S212_1 | Grass | 0.2361 | 20.1 | 0 | 0 | 20.1 | 0.0475 |
| S212_2 | Grass | 1.5663 | 20.1 | 0 | 0 | 20.1 | 0.3148 |

| Name | Description | Area (ha) | Infiltration (mm) | Runon (mm) | Runoff Depth (mm) | Precipitation (mm) | Total Volume Treated (ML) |
|---|---|---|---|---|---|---|---|
| S213_1 | Grass | 0.4712 | 20.1 | 0 | 0 | 20.1 | 0.0947 |
| S213_2 | Grass | 0.1444 | 20.1 | 0 | 0 | 20.1 | 0.0290 |
| S213_3 | Grass | 1.4522 | 20.1 | 0 | 0 | 20.1 | 0.2919 |
| S214 | Grass | 0.1355 | 20.1 | 0 | 0 | 20.1 | 0.0272 |
| S215 | Grass | 0.3375 | 20.1 | 0 | 0 | 20.1 | 0.0678 |
| S216 | Grass | 1.1982 | 20.1 | 0 | 0 | 20.1 | 0.2408 |
| S217_1 | Grass | 0.39 | 20.1 | 0 | 0 | 20.1 | 0.0784 |
| S217_2 | Grass | 0.5325 | 20.1 | 0 | 0 | 20.1 | 0.1070 |
| S217_3 | Grass | 0.885 | 20.1 | 0 | 0 | 20.1 | 0.1779 |
| S218 | Grass | 0.2 | 20.1 | 0 | 0 | 20.1 | 0.0402 |
| S219 | Grass | 0.1902 | 20.1 | 0 | 0 | 20.1 | 0.0382 |
| S22 | Grass | 4.487 | 20.1 | 0 | 0 | 20.1 | 0.9019 |
| S220 | Grass | 0.0274 | 20.1 | 0 | 0 | 20.1 | 0.0055 |
| S221 | Grass | 0.3031 | 20.1 | 0 | 0 | 20.1 | 0.0609 |
| S222 | Grass | 0.1232 | 20.1 | 0 | 0 | 20.1 | 0.0248 |
| S223_1 | Grass | 0.1515 | 20.1 | 0 | 0 | 20.1 | 0.0305 |
| S223_2 | Grass | 1.2694 | 20.1 | 0 | 0 | 20.1 | 0.2551 |
| S224 | Grass | 0.0499 | 20.1 | 0 | 0 | 20.1 | 0.0100 |
| S225 | Grass | 0.0297 | 20.1 | 0 | 0 | 20.1 | 0.0060 |
| S226 | Grass | 0.3987 | 20.1 | 0 | 0 | 20.1 | 0.0801 |
| S227 | Grass | 0.4756 | 20.1 | 0 | 0 | 20.1 | 0.0956 |
| S228 | Grass | 0.0537 | 20.1 | 0 | 0 | 20.1 | 0.0108 |
| S229_1 | Grass | 0.1344 | 20.1 | 0 | 0 | 20.1 | 0.0270 |
| S229_2 | Grass | 0.1093 | 20.1 | 0 | 0 | 20.1 | 0.0220 |
| S229_3 | Grass | 0.2684 | 20.1 | 0 | 0 | 20.1 | 0.0539 |
| S229_4 | Grass | 0.069 | 20.1 | 0 | 0 | 20.1 | 0.0139 |
| S230_1 | Grass | 0.336 | 20.1 | 0 | 0 | 20.1 | 0.0675 |
| S230_2 | Grass | 0.2926 | 20.1 | 0 | 0 | 20.1 | 0.0588 |
| S231 | Grass | 0.1566 | 20.1 | 0 | 0 | 20.1 | 0.0315 |
| S232 | Grass | 0.0252 | 20.1 | 0 | 0 | 20.1 | 0.0051 |
| S233 | Grass | 0.0476 | 20.1 | 0 | 0 | 20.1 | 0.0096 |
| S234 | Grass | 0.0572 | 20.1 | 0 | 0 | 20.1 | 0.0115 |
| S235 | Grass | 0.302 | 20.1 | 0 | 0 | 20.1 | 0.0607 |
| S236 | Grass | 0.0157 | 20.1 | 0 | 0 | 20.1 | 0.0032 |
| S237 | Grass | 0.1674 | 20.1 | 0 | 0 | 20.1 | 0.0336 |
| S238 | Grass | 0.0874 | 20.1 | 0 | 0 | 20.1 | 0.0176 |
| S239 | Grass | 0.4724 | 20.1 | 0 | 0 | 20.1 | 0.0950 |
| S240_1 | Grass | 0.2282 | 20.1 | 0 | 0 | 20.1 | 0.0459 |
| S240_2 | Grass | 0.3818 | 20.1 | 0 | 0 | 20.1 | 0.0767 |
| S241 | Grass | 0.2344 | 20.1 | 0 | 0 | 20.1 | 0.0471 |
| S242 | Grass | 0.8934 | 20.1 | 0 | 0 | 20.1 | 0.1796 |
| S28 | Grass | 0.6137 | 20.1 | 0 | 0 | 20.1 | 0.1234 |
| S29 | Grass | 2.3307 | 22.93 | 2.83 | 0 | 20.1 | 0.5344 |
| S3 | Grass | 4.463 | 20.1 | 0 | 0 | 20.1 | 0.8971 |
| S3_119 | Grass | 1.5332 | 20.1 | 0 | 0 | 20.1 | 0.3082 |
| S3_122 | Grass | 1.921 | 23.16 | 3.06 | 0 | 20.1 | 0.4449 |
| S3_124 | Grass | 3.594 | 26.53 | 6.43 | 0 | 20.1 | 0.9535 |
| S3_126 | Grass | 2.9847 | 20.1 | 0 | 0 | 20.1 | 0.5999 |
| S3_127 | Grass | 3.0986 | 29.55 | 9.45 | 0 | 20.1 | 0.9156 |
| S3_17 | Grass | 2.9314 | 27.12 | 7.02 | 0 | 20.1 | 0.7950 |
| S3_18 | Grass | 1.1744 | 20.1 | 0 | 0 | 20.1 | 0.2361 |
| S3_19 | Grass | 0.9188 | 20.1 | 0 | 0 | 20.1 | 0.1847 |
| S3_20 | Grass | 2.9278 | 31 | 10.9 | 0 | 20.1 | 0.9076 |
| S3_21 | Grass | 1.662 | 29.39 | 9.29 | 0 | 20.1 | 0.4885 |
| S3_23 | Grass | 1.6534 | 20.1 | 0 | 0 | 20.1 | 0.3323 |
| S3_24 | Grass | 1.2164 | 20.1 | 0 | 0 | 20.1 | 0.2445 |
| S3_27 | Grass | 2.9873 | 20.1 | 0 | 0 | 20.1 | 0.6004 |
| S3_32 | Grass | 1.3324 | 30.22 | 10.12 | 0 | 20.1 | 0.4027 |
| S3_42 | Grass | 0.4377 | 20.1 | 0 | 0 | 20.1 | 0.0880 |
| S3_69 | Grass | 1.38 | 20.1 | 0 | 0 | 20.1 | 0.2774 |
| S3_7 | Grass | 0.2614 | 20.1 | 0 | 0 | 20.1 | 0.0525 |
| S3_8 | Grass | 1.6619 | 20.1 | 0 | 0 | 20.1 | 0.3340 |
| S32 | Grass | 0.1018 | 20.1 | 0 | 0 | 20.1 | 0.0205 |
| S32_1 | Grass | 0.2138 | 20.1 | 0 | 0 | 20.1 | 0.0430 |
| S32_10 | Grass | 1.0169 | 20.1 | 0 | 0 | 20.1 | 0.2044 |
| S32_11 | Grass | 0.6588 | 20.1 | 0 | 0 | 20.1 | 0.1324 |
| S32_12 | Grass | 0.548 | 20.1 | 0 | 0 | 20.1 | 0.1101 |
| S32_13 | Grass | 0.0756 | 20.1 | 0 | 0 | 20.1 | 0.0152 |
| S32_3 | Grass | 0.5271 | 20.1 | 0 | 0 | 20.1 | 0.1059 |
| S32_6 | Grass | 0.5857 | 20.1 | 0 | 0 | 20.1 | 0.1177 |
| S32_8 | Grass | 0.6524 | 20.1 | 0 | 0 | 20.1 | 0.1311 |
| S36 | Grass | 3.2245 | 20.1 | 0 | 0 | 20.1 | 0.6481 |
| S37 | Grass | 0.7418 | 20.1 | 0 | 0 | 20.1 | 0.1491 |
| S38 | Grass | 6.0018 | 24.36 | 4.26 | 0 | 20.1 | 1.4620 |
| S4 | Grass | 1.1763 | 43.58 | 23.48 | 0 | 20.1 | 0.5126 |

| Name | Description | Area (ha) | Infiltration (mm) | Runon (mm) | Runoff Depth (mm) | Precipitation (mm) | Total Volume Treated (ML) |
|---|---|---|---|---|---|---|---|
| S4S_11 | Grass | 0.166 | 20.1 | 0 | 0 | 20.1 | 0.0334 |
| S4S_12 | Grass | 0.1515 | 20.1 | 0 | 0 | 20.1 | 0.0305 |
| S4S_14 | Grass | 0.1155 | 20.1 | 0 | 0 | 20.1 | 0.0232 |
| S4S_16 | Grass | 0.1027 | 20.1 | 0 | 0 | 20.1 | 0.0206 |
| S4S_17 | Grass | 0.1004 | 20.1 | 0 | 0 | 20.1 | 0.0202 |
| S4S_19 | Grass | 0.0996 | 20.1 | 0 | 0 | 20.1 | 0.0200 |
| S4S_2 | Grass | 0.0706 | 20.1 | 0 | 0 | 20.1 | 0.0142 |
| S4S_20 | Grass | 0.0968 | 20.1 | 0 | 0 | 20.1 | 0.0195 |
| S4S_22 | Grass | 0.1331 | 20.1 | 0 | 0 | 20.1 | 0.0268 |
| S4S_23 | Grass | 0.056 | 20.1 | 0 | 0 | 20.1 | 0.0113 |
| S4S_25 | Grass | 0.1246 | 20.1 | 0 | 0 | 20.1 | 0.0250 |
| S4S_26 | Grass | 0.1226 | 20.1 | 0 | 0 | 20.1 | 0.0246 |
| S4S_28 | Grass | 0.1202 | 20.1 | 0 | 0 | 20.1 | 0.0242 |
| S4S_29 | Grass | 0.1104 | 20.1 | 0 | 0 | 20.1 | 0.0222 |
| S4S_3 | Grass | 0.0707 | 20.1 | 0 | 0 | 20.1 | 0.0142 |
| S4S_31 | Grass | 0.1584 | 20.1 | 0 | 0 | 20.1 | 0.0318 |
| S4S_32 | Grass | 0.0259 | 20.1 | 0 | 0 | 20.1 | 0.0052 |
| S4S_34 | Grass | 0.1121 | 20.1 | 0 | 0 | 20.1 | 0.0225 |
| S4S_37 | Grass | 0.0951 | 20.1 | 0 | 0 | 20.1 | 0.0191 |
| S4S_38 | Grass | 0.0742 | 20.1 | 0 | 0 | 20.1 | 0.0149 |
| S4S_40 | Grass | 0.0654 | 20.1 | 0 | 0 | 20.1 | 0.0131 |
| S4S_42 | Grass | 0.2917 | 20.1 | 0 | 0 | 20.1 | 0.0586 |
| S4S_43 | Grass | 0.0268 | 20.1 | 0 | 0 | 20.1 | 0.0054 |
| S4S_45 | Grass | 0.077 | 20.1 | 0 | 0 | 20.1 | 0.0155 |
| S4S_46 | Grass | 0.0261 | 20.1 | 0 | 0 | 20.1 | 0.0052 |
| S4S_47 | Grass | 0.0863 | 20.1 | 0 | 0 | 20.1 | 0.0173 |
| S4S_48 | Grass | 0.0478 | 20.1 | 0 | 0 | 20.1 | 0.0096 |
| S4S_49 | Grass | 0.092 | 20.1 | 0 | 0 | 20.1 | 0.0185 |
| S4S_5 | Grass | 0.1644 | 20.1 | 0 | 0 | 20.1 | 0.0330 |
| S4S_6 | Grass | 0.1202 | 20.1 | 0 | 0 | 20.1 | 0.0242 |
| S4S_7 | Grass | 0.0692 | 20.1 | 0 | 0 | 20.1 | 0.0139 |
| S4S_8 | Grass | 0.1316 | 20.1 | 0 | 0 | 20.1 | 0.0265 |
| S5 | Grass | 1.679 | 20.1 | 0 | 0 | 20.1 | 0.3375 |
| S51_1 | Grass | 0.3084 | 20.1 | 0 | 0 | 20.1 | 0.0620 |
| S51_2 | Grass | 0.2899 | 20.1 | 0 | 0 | 20.1 | 0.0583 |
| S54 | Grass | 7.3951 | 20.1 | 0 | 0 | 20.1 | 1.4864 |
| S6 | Grass | 3.8232 | 20.1 | 0 | 0 | 20.1 | 0.7685 |
| S66_3 | Grass | 7.9683 | 20.1 | 0 | 0 | 20.1 | 1.6016 |
| S66_4 | Grass | 5.6638 | 20.1 | 0 | 0 | 20.1 | 1.1384 |
| S66_5 | Grass | 2.4406 | 20.1 | 0 | 0 | 20.1 | 0.4906 |
| S67 | Grass | 6.2018 | 20.1 | 0 | 0 | 20.1 | 1.2466 |
| S7_1 | Grass | 0.5354 | 20.1 | 0 | 0 | 20.1 | 0.1076 |
| S7_11 | Grass | 1.6543 | 20.1 | 0 | 0 | 20.1 | 0.3325 |
| S7_12 | Grass | 0.4761 | 20.1 | 0 | 0 | 20.1 | 0.0957 |
| S7_3 | Grass | 3.8494 | 20.1 | 0 | 0 | 20.1 | 0.7737 |
| S7_39 | Grass | 0.4525 | 20.1 | 0 | 0 | 20.1 | 0.0910 |
| S7_4 | Grass | 1.2187 | 20.1 | 0 | 0 | 20.1 | 0.2450 |
| S7_41 | Grass | 4.353 | 23.71 | 3.61 | 0 | 20.1 | 1.0321 |
| S7_44 | Grass | 3.2677 | 20.1 | 0 | 0 | 20.1 | 0.6568 |
| S7_45 | Grass | 8.0963 | 23.56 | 3.46 | 0 | 20.1 | 1.9075 |
| S7_46 | Grass | 6.3093 | 23.76 | 3.66 | 0 | 20.1 | 1.4991 |
| S7_48 | Grass | 5.241 | 23.59 | 3.49 | 0 | 20.1 | 1.2364 |
| S7_5 | Grass | 1.3015 | 20.1 | 0 | 0 | 20.1 | 0.2616 |
| S7_50 | Grass | 6.9122 | 20.1 | 0 | 0 | 20.1 | 1.3894 |
| S7_51 | Grass | 2.0226 | 20.1 | 0 | 0 | 20.1 | 0.4065 |
| S7_53 | Grass | 7.9924 | 23.7 | 3.6 | 0 | 20.1 | 1.8942 |
| S7_6 | Grass | 0.3656 | 20.1 | 0 | 0 | 20.1 | 0.0735 |
| S7_7 | Grass | 0.5805 | 20.1 | 0 | 0 | 20.1 | 0.1167 |
| S7_8 | Grass | 8.4494 | 20.1 | 0 | 0 | 20.1 | 1.6983 |
| S70_1 | Grass | 0.0629 | 20.1 | 0 | 0 | 20.1 | 0.0126 |
| S70_4 | Grass | 2.1595 | 20.1 | 0 | 0 | 20.1 | 0.4341 |
| S71_1 | Grass | 0.1697 | 20.1 | 0 | 0 | 20.1 | 0.0341 |
| S71_10 | Grass | 0.2056 | 20.1 | 0 | 0 | 20.1 | 0.0413 |
| S71_11 | Grass | 0.5037 | 20.1 | 0 | 0 | 20.1 | 0.1012 |
| S71_3 | Grass | 0.2287 | 20.1 | 0 | 0 | 20.1 | 0.0460 |
| S71_5 | Grass | 0.5007 | 20.1 | 0 | 0 | 20.1 | 0.1006 |
| S71_6 | Grass | 0.9087 | 20.1 | 0 | 0 | 20.1 | 0.1826 |
| S71_7 | Grass | 0.4584 | 20.1 | 0 | 0 | 20.1 | 0.0921 |
| S71_8 | Grass | 2.0617 | 20.1 | 0 | 0 | 20.1 | 0.4144 |
| S71_9 | Grass | 1.2004 | 20.1 | 0 | 0 | 20.1 | 0.2413 |
| S8 | Grass | 2.4899 | 20.1 | 0 | 0 | 20.1 | 0.5005 |
| S8_1 | Grass | 0.3446 | 20.1 | 0 | 0 | 20.1 | 0.0693 |
| S8_2 | Grass | 0.0385 | 20.1 | 0 | 0 | 20.1 | 0.0077 |
| S8_4 | Grass | 0.4417 | 20.1 | 0 | 0 | 20.1 | 0.0888 |
| S9 | Grass | 0.115 | 20.1 | 0 | 0 | 20.1 | 0.0231 |

| Name | Description | Area (ha) | Infiltration (mm) | Runon (mm) | Runoff Depth (mm) | Precipitation (mm) | Total Volume Treated (ML) |
|---|---|---|---|---|---|---|---|
| S10 | Grass | 0.0274 | 20.1 | 0 | 0 | 20.1 | 0.0055 |
| S39_1 | Grass | 0.1002 | 20.1 | 0 | 0 | 20.1 | 0.0201 |
| S39_2 | Grass | 3.1992 | 21.45 | 1.35 | 0 | 20.1 | 0.6862 |
| S39_4 | Grass | 0.0905 | 20.1 | 0 | 0 | 20.1 | 0.0182 |
| S39 | Grass | 0.1296 | 20.1 | 0 | 0 | 20.1 | 0.0260 |
| S40 | Grass | 0.0372 | 20.1 | 0 | 0 | 20.1 | 0.0075 |
| S173_1 | Other | 0.1263 | 5.03 | 0 | 13.99 | 20.1 | 0.0064 |
| S173_2 | Other | 0.2799 | 5.03 | 0 | 13.99 | 20.1 | 0.0141 |
| S173_3 | Other | 0.2705 | 5.03 | 0 | 13.99 | 20.1 | 0.0136 |
| S173_5 | Other | 0.3134 | 5.03 | 0 | 13.99 | 20.1 | 0.0158 |
| S173_6 | Other | 0.3854 | 5.02 | 0 | 13.99 | 20.1 | 0.0193 |
| S173_7 | Other | 0.6522 | 5.02 | 0 | 13.99 | 20.1 | 0.0327 |
| S174_1 | Other | 0.3036 | 5.02 | 0 | 13.99 | 20.1 | 0.0152 |
| S174_2 | Other | 0.1225 | 5.03 | 0 | 13.99 | 20.1 | 0.0062 |
| S175_1 | Other | 0.6458 | 5.02 | 0 | 13.99 | 20.1 | 0.0324 |
| S175_3 | Other | 0.4175 | 5.03 | 0 | 13.99 | 20.1 | 0.0210 |
| S175_4 | Other | 0.546 | 5.02 | 0 | 13.99 | 20.1 | 0.0274 |
| S176_1 | Other | 0.6518 | 5.03 | 0 | 13.99 | 20.1 | 0.0328 |
| S176_3 | Other | 0.4128 | 5.02 | 0 | 13.99 | 20.1 | 0.0207 |
| S176_4 | Other | 0.5468 | 5.03 | 0 | 13.99 | 20.1 | 0.0275 |
| S177_1 | Other | 0.9674 | 5.03 | 0 | 13.99 | 20.1 | 0.0487 |
| S177_2 | Other | 1.3616 | 5.02 | 0 | 13.99 | 20.1 | 0.0684 |
| S178_1 | Other | 0.9746 | 5.02 | 0 | 13.99 | 20.1 | 0.0489 |
| S178_2 | Other | 1.358 | 5.03 | 0 | 13.99 | 20.1 | 0.0683 |
| S179_1 | Other | 0.773 | 5.02 | 0 | 13.99 | 20.1 | 0.0388 |
| S179_2 | Other | 0.3155 | 5.03 | 0 | 13.99 | 20.1 | 0.0159 |
| S179_3 | Other | 0.2267 | 5.02 | 0 | 13.99 | 20.1 | 0.0114 |
| S180 | Other | 0.1434 | 5.02 | 0 | 13.99 | 20.1 | 0.0072 |
| S181 | Other | 0.3693 | 5.03 | 0 | 13.99 | 20.1 | 0.0186 |
| S182_2 | Other | 0.273 | 5.02 | 0 | 13.99 | 20.1 | 0.0137 |
| S182_3 | Other | 0.8996 | 5.03 | 0 | 13.99 | 20.1 | 0.0452 |
| S182_4 | Other | 0.6964 | 5.02 | 0 | 13.99 | 20.1 | 0.0350 |
| S188_1 | Other | 0.1164 | 5.03 | 0 | 13.99 | 20.1 | 0.0059 |
| S188_2 | Other | 0.1918 | 5.03 | 0 | 13.99 | 20.1 | 0.0096 |
| S194_1 | Other | 0.1845 | 5.03 | 0 | 13.99 | 20.1 | 0.0093 |
| S194_3 | Other | 0.1137 | 5.02 | 0 | 13.99 | 20.1 | 0.0057 |
| S_Pond1 | Pond | 0.2098 | 18 | 1730.61 | 1534.45 | 20.1 | 0.0378 |
| S_Pond2 | Pond | 3.2903 | 598.39 | 650.59 | 73.72 | 20.1 | 19.6888 |
| S_Pond3 | Pond | 0.6095 | 440.98 | 517.44 | 98.94 | 20.1 | 2.6878 |
| S_Pond4 | Pond | 0.1253 | 3.18 | 129.35 | 37.43 | 20.1 | 0.0040 |
| S_Pond5 | Pond | 0.4485 | 16.41 | 923.67 | 721.03 | 20.1 | 0.0736 |
| S_Pond6 | Pond | 0.0918 | 0 | 0 | 0 | 20.1 | 0.0000 |
| S_Pond7 | Pond | 0.2703 | 10.25 | 219.76 | 81.94 | 20.1 | 0.0277 |
| S_Pond8 | Pond | 0.2045 | 16.51 | 608.74 | 418.21 | 20.1 | 0.0338 |
| S844 | POS | 1.6538 | 20.1 | 0 | 0 | 20.1 | 0.3324 |
| | | | | | | Total Treated Volume (ML) | 73.79 |

Table 19: LID Control Treatment Achieved during the ½ year 24-hour Storm

Comparing the Water Quality Volume calculated (37.82ML) with the total volume of treated runoff (73.79ML), we see that the 0.5-year RI storm is infiltrated and that the Water Quality Volume is sufficiently treated by the proposed LID's at the Cape Winelands Airport development – There is a total surplus treated volume of 35.97ML.

## 4.6 Effects of the 1:100-Year Storm Event

The combined systems on site have been designed to attenuate up to and including the 1:50-year flood. The stormwater attenuation ponds, positioned strategically across the site, will each have dedicated variable outlet structures as well as overflows sized accordingly to convey the run-off from larger storms in excess of the 1:50 year event towards the overland escape routes as can be seen on Figure 32 below:

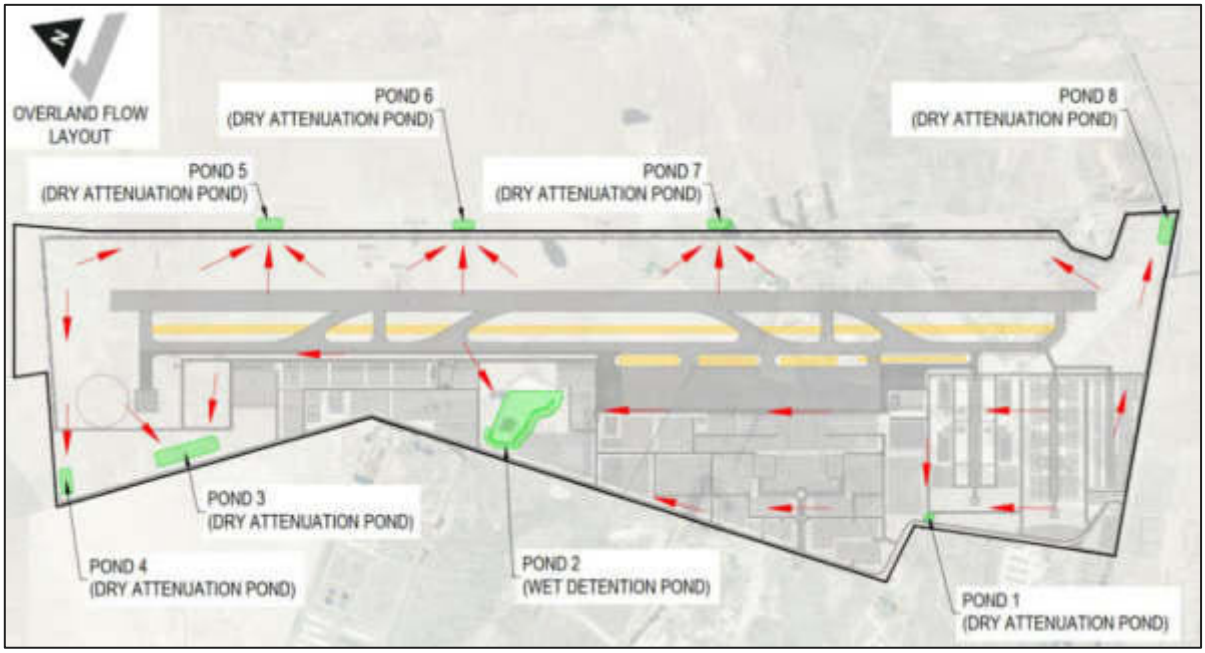



Figure 32: Overland Escape Routes

PCSWMM Simulations of the 1:100-year RI storm event have been modelled to ensure that no flooding occurs across the site and that the overland escape routes can convey the excess runoff away from critical infrastructure on the site towards the adjacent aquatic ecosystems namely the Mosselbank River and the Klapmuts River tributaries.

In the event that there is a blockage or failure within the system, the overland escape routes provided on the site will provide relief and can be seen detailed in Table 20 below.

| Outfall | Description |
|---|---|
| Outfall 1 | Discharges into the future Lucullus Road extension proposed stormwater infrastructure and drains towards Pond 2 / Outfall 2 after which it will be routed into the proposed future Bella Riva development stormwater BMP's. |
| Outfall 2 | Discharges from the detention pond and will be routed into the proposed future Bella Riva development stormwater BMP's. |
| Outfall 3 | Discharges into the delineated catchment situated to the West of the Cape Winelands Airport development ultimately leading into the Mosselbank River |
| Outfall 4 | Discharges into the delineated catchment situated to the West of the Cape Winelands Airport development ultimately leading into the Mosselbank River |
| Outfall 5 | Discharges into the delineated catchment situated to the East of the Cape Winelands Airport development ultimately leading into the Klapmuts River |
| Outfall 6 | Discharges into the delineated catchment situated to the East of the Cape Winelands Airport development ultimately leading into the Klapmuts River |
| Outfall 7 | Discharges into the delineated catchment situated to the East of the Cape Winelands Airport development ultimately leading into the Klapmuts River |
| Outfall 8 | Discharges along the R312 (Lichtenburg Road) open earth drain which will act as an overland channel in the event of system failure and from there into the Klapmuts river tributary |

Table 20: Summary – Overland Escape Routes

In additional to the above, a further hydraulic analysis was carried out in HEC-RAS to review the impact that the post development 1:100-year flood scenario, discharged from the Cape Winelands Airport site, will have on the downstream environment and has been assessed as part of the Flood Risk Assessment Report attached hereto as Appendix B.

## 4.7 Landscaping and Security

Landscaping for the proposed dry attenuation ponds will be as per the CoCT prescribed plant list and best practice. More detail pertaining to the landscaping plan, fencing, security, and erection of safety signage will be provided in the detailed Stormwater Management Plan.

Further to the above, appropriate signage as indicated in Figure 33 below is to be displayed at all stormwater drainage elements to mitigate against the following:

- Hardening of surfaces within the stormwater element area. Hardening of surfaces and the placement of obstructions will reduce the infiltration and treatment capacities and alter the intended attenuation and drainage path.
- Health & Safety risks associated with the element. These risks are associated with both the quality and quantity of water which will fill up when a storm event occurs. In terms of quality the water may be polluted, and consumption of the water will pose health risks. The severity of rainfall events and the subsequent quantities of water which enter the element can lead to unsafe conditions within the element due to the potential rapid rise in flow rates and water levels.
- Another security consideration is the attraction of birds to the wet pond. Birds present a risk to aviation safety and thus preventing birds from gathering at standing water bodies will need to be addressed during the detail design. Measures that may be contemplated included netting placed over the water body or bespoke products to cover the water surface.

The signage will serve as a guide and a warning and must be displayed at all entrances/access points to the ponds on site.

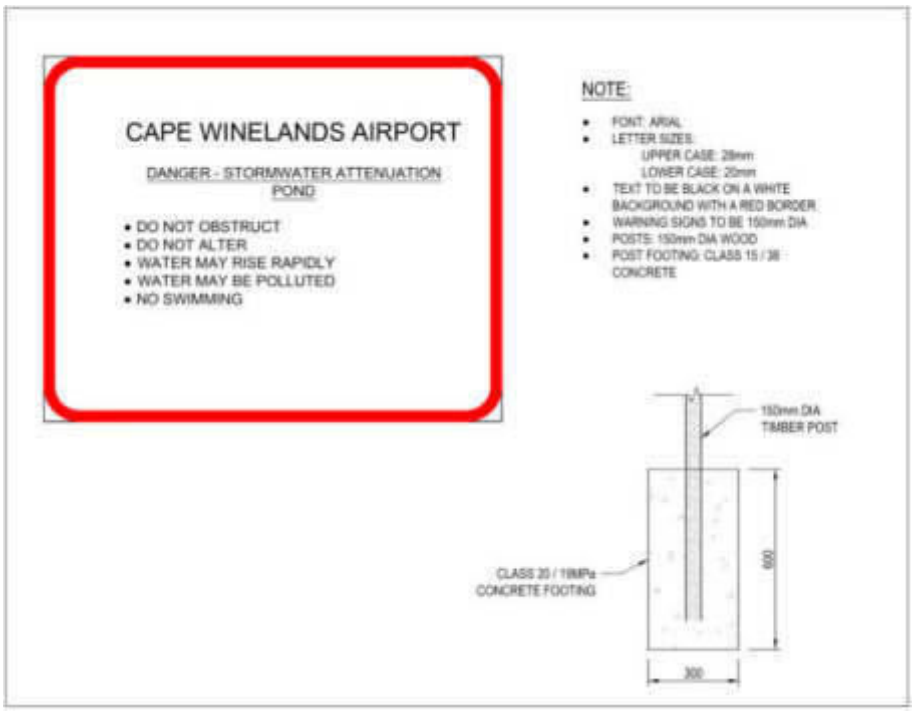



Figure 33: Typical Stormwater Pond Safety Signage

In principle there will be signage erected for safety, warning, and education for each of the dry attenuation ponds and wet detention pond to ensure the safeguarding of all personnel on the property. It is also noted that the site and its stormwater infrastructure is not accessible to the public.

# 5 Operations and Maintenance

Operation and maintenance procedures will be prepared as part of the closeout procedures for the project. The maintenance agreement will require the Cape Winelands Airport to periodically clean the structures, monitor the vegetation and sediment accumulation, and provide occasional watering to preserve the vegetation during the dry season. Once the stormwater system has been completed, the maintenance and monitoring thereof will remain the sole responsibility of the Cape Winelands Airport, who will take financial responsibility for the operations and necessary maintenance of the system.

## 5.1 Dry Attenuation Pond Maintenance Requirements

Adequate maintenance is essential to ensure that the dry attenuation pond operates correctly to prevent poor functionality and poor aesthetics. Typical periodic maintenance activities are provided in (Woods Ballard *et al.*, 2015) and the Cape Winelands Airport will implement the most suitable of these activities for the specific site conditions or as required during the lifecycle of the dry attenuation pond:

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Regular maintenance | Remove litter and debris | Monthly |
| | Manage vegetation | Monthly |
| | Inspect inlets, outlets, and overflows for blockages | Monthly |
| | Inspect inlets and basin for sediment accumulation. Determine appropriate frequencies. | Monthly, then as required |
| | Tidy dead vegetation before growth season | Annually |
| | Manage wetland plants in pools – where provided | Annually |
| Occasional maintenance | Reseed or replant in dilapidated areas | As required |
| | Prune and trim plants where necessary and remove cuttings | Every 2 years or as required |
| | Remove sediment from inlets, outlets and forebays | Annually, or as required |
| Remedial actions | Repair erosion or other damage | As required |
| | Repair or rehabilitate inlets, outlets, and overflows | As required |
| | Relevel uneven surfaces and reinstate design levels | As required |
| | Realign riprap, gabions, and/or Reno mattresses | As required |

Table 21: Typical Operating and Maintenance activities for Dry Attenuation Ponds

In addition to the items listed above, some comments regarding maintenance procedures are provided below:

- Litter clearing: A litter clean-up is to take place monthly or as required.
- Cleaning of kerbs and channels: Sand, litter and refuse should be removed from kerbs and channels monthly or as required.
- Cleaning of pipes: Refuse should be removed from pipes monthly. Sand and silt should also be removed by using high pressure jetting.
- Cleaning of covers and frames: The covers and frames should be inspected monthly and need to be replaced, repositioned, or repaired where necessary.
- Earth embankment inspection: Embankments should be inspected monthly or after each rain. If the embankment is compromised, it should be reshaped to tie in with the original slope.
- Headwalls inspection: The headwalls should be inspected monthly or after each rain. Any blockage should be removed, and the natural vegetation trimmed to allow free drainage of water.

Many of the specific maintenance activities for dry ponds can be undertaken as part of a general landscape management contract and therefore, if landscape management is already required at site, should have marginal cost implications whilst creating local employment opportunities in the long-term.

## 5.2 Dry Swale Maintenance Requirements

Adequate maintenance is essential to ensure that the dry swales operate correctly to prevent poor functionality and poor aesthetics. Typical periodic maintenance activities are provided in (Woods Ballard *et al.*, 2015) and the Cape Winelands Airport will implement the most suitable of these activities for the specific site conditions or as required during the lifecycle of the dry swale:

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Regular maintenance | Remove litter and debris | Monthly |
| | Manage vegetation, retain vegetation to design levels | Monthly |
| | Inspect inlets, outlets, and overflows for blockages | Monthly |
| | Inspect inlets and basin for sediment accumulation. Determine appropriate frequencies. | Monthly, then as required |
| | Tidy dead vegetation before growth season | Annually |
| | Manage wetland plants in pools – where provided | Annually |
| Occasional maintenance | Reseed or replant in dilapidated areas | As required |
| | Prune and trim plants where necessary and remove cuttings | Every 2 years or as required |
| | Remove sediment from inlets, outlets and forebays | Annually, or as required |
| Remedial actions | Repair erosion or other damage | As required |
| | Repair or rehabilitate inlets, outlets, and overflows | As required |
| | Relevel uneven surfaces and reinstate design levels | As required |
| | Realign Riprap, gabions, and/or Reno mattresses | As required |

Table 22: Typical Operating and Maintenance activities for Dry Swales

In addition to the items listed above, some comments regarding maintenance procedures are provided below:

- Litter clearing: A litter clean-up is to take place monthly or as required.
- Embankment inspection: Embankments should be inspected monthly or after each rain. If the embankment is compromised, it should be reshaped to tie in with the original slope.
- Cleaning of headwalls: Refuse should be removed from headwalls within the dry swale monthly. Sand and silt should also be removed by using high pressure jetting.
- Headwalls inspection: The headwalls should be inspected monthly or after each rain. Any blockage should be removed, and the natural vegetation trimmed to allow free drainage of water.

Many of the specific maintenance activities for dry swales can be undertaken as part of a general landscape management contract and therefore, if landscape management is already required at site, should have marginal cost implications whilst creating local employment opportunities in the long term (Woods Ballard *et al.*, 2015).

## 5.3 Wet Pond / Detention Basin Maintenance Requirements

Adequate maintenance is essential to ensure that the detention basin operates correctly to prevent poor functionality and poor aesthetics. Typical periodic maintenance activities are provided in (Woods Ballard *et al.*, 2015) and the Cape Winelands Airport will implement the most suitable of these activities for the specific site conditions or as required during the lifecycle of the detention basin:

| Activity | Typical frequency |
|---|---|
| Remove litter and debris from Inlet and outlet structures | Monthly |
| Mow vegetation (Side slopes) | Monthly |
| Inspect inlets, outlets, and overflows for blockages | Monthly |
| Inspect inlet and forebay for sediment accumulation | Semi-Annually |
| Inspect for invasive vegetation | Semi-Annually |
| Manage wetland plants in pools – where provided | Annually |
| Check for signs of Hydrocarbon buildup and remove appropriately | Inspection |
| Prune and trim plants where necessary and remove cuttings | Every 2 years or as required |
| Remove sediment from inlets, outlets and forebays | Annually, or as required |
| Inspect for damage paying attention to the variable outlet control structure | Annually |
| Remove sediment from forebay | 5 to 7 years or when 50% of forebay capacity is lost |
| Repair undercut or eroded areas | As required |
| Realign riprap, gabions, and/or Reno mattresses | As required |

Table 23: Typical Operating and Maintenance activities for Detention Basins

In addition to the items listed above, some comments regarding maintenance procedures are provided below:

- Irrigation system: It will take some time for the vegetation in the pond to be fully established. As such, it is proposed that an irrigation system or procedure be put in place to ensure the vegetation survive the initial dry seasons. Suitable inspections to identify potential faulty elements should be conducted on the irrigation system to ensure its proper functioning.
- Litter clearing: A litter clean-up is to take place monthly or as required.
- Alien and problem vegetation: It is proposed that the pond must be inspected for invasive alien vegetation routinely by the appointed landscaper. As far as possible all alien vegetation should be manually removed. Where manual removal is not possible, alien vegetation should be treated with an appropriate herbicide using the correct application method and to the manufacturer's directions and specifications. Herbicides should not be applied when conditions are windy, so as to avoid spray drift. No herbicides should be applied when rain is forecast within 2 days. Colour dyes should be used with the herbicides to clearly mark areas that have been treated, taking exceptional care when working near water. It must be recognized that under certain conditions some indigenous vegetation may become problematic and may require intervention.
- Cleaning of silt traps: The sedimentation forebay as well as the apron of the outlet headwalls must be inspected every six months, with one of the inspections taking place just before the first seasonal rains. These must be inspected for build-up of silt, dirt, mud, and similar material. All silt and other material must be removed and disposed of at a suitable landfill site. Care must be taken to ensure that no silt enters the stormwater system during the cleaning process.

Should a situation arise where there are persistent or recurring problems with the pond such as poor water quality, problems with vegetation and similar issues, an aquatic specialist should be consulted for input and advice on the matter. If then required or requested by the specialist, water sampling will be undertaken.

# 6 Conclusion and Recommendations

The proposed stormwater management interventions for the Cape Winelands Airport development align with the City of Cape Town's stormwater management policies. The stormwater management interventions have been designed such that they will manage, control, and treat the stormwater runoff for larger infrequent storm events as well as smaller more frequent storms.

Given the nature of the project and the coordination and integration required across various disciplines, it is noted that there are specialist reports which are on-going, and copies of these reports shall be made available to the City of Cape Town's CSRM branch upon completion to support this Concept Stormwater Management Plan. The ultimate scenario was considered in the current modelling scenarios and the proposed BMP's are capable of addressing the stormwater management for both the medium- and long-term developments. Appropriate energy dissipation structures shall be implemented to ensure that the outflows from the pond across the site have a minimal impact on the surrounding and downstream environments.

The extent to which the Cape Winelands Airport conceptual stormwater interventions complies with the stormwater management policy requirements and targets are summarized in Table 24 below:

| **SuDS Objectives** | | **Requirements** | **Achieved** |
|---|---|---|---|
| **Improve quality of stormwater runoff** | Remove pollutants through a combination of:<br>- Reducing and/or disconnecting impervious areas<br>- Using BMPs/SuDS to infiltrate, capture, and/or treat stormwater runoff | Design storm event for water quality treatment is the 0.5-year or 6-month RI, 24-hour storm event | Yes |
| | | Target pollutant removal aimed at reducing the annual stormwater pollutant load discharged from the developed site by <u>on-site treatment measures</u> to achieve:<br>- A reduction of suspended solids (SS) by 80%<br>- A reduction of total Phosphorus (TP) by 45% | Yes |
| | | All developments must trap litter, oil, and grease at source | Yes |
| **Control quantity and rate of runoff**<br>Using on-site measures | Protect the stability of downstream channels | 24-hour extended detention of the 1-year RI, 24-hour storm event | Yes |
| | Protect downstream properties from frequent floods | Up to 10-year RI peak flow reduced to pre-development levels | Yes |
| | Protect floodplain developments and floodplains from extreme floods | Up to 50-year RI peak flow reduced to existing development levels | Yes |
| | | Evaluate the effects of the 100-year RI storm event on the stormwater system, adjacent property, and downstream facilities and property. | Yes |
| | | Manage the impacts through detention controls and/or floodplain management | Yes |
| | | Developments adjacent to floodplains must adhere to the requirements stipulated in the *Floodplain and River Corridor Management Policy* (CCT, 2009b) | Yes |
| **Encourage natural groundwater recharge** | | Where appropriate, site-specific requirements to be considered in consultation with Council. | Yes |

Table 24: Management of Urban Stormwater Impacts Policy Requirements (Compliance)

It is to be concluded that this report outlines the stormwater management objectives for the proposed development. Through strict adherence to the Concept Stormwater Management Plan, the potential adverse effects the stormwater runoff pose on the development and downstream infrastructure, can be successfully mitigated. Zutari trusts that the stormwater interventions as described in this Concept Stormwater Management Plan are acceptable to City of Cape Town's CSRM branch and sufficient to obtain the required support.

# 7 References

Armitage, N., Vice, M., Fisher-Jeffes, L., Winter, K., Spiegel, A., & Dunstan, J. (2013). The South African Guidelines for Sustainable Drainage Systems. Alternative Technology for Stormwater Management. WRC Project No. K 5/1826.

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CCT (2009b). Floodplain and River Corridor Management Policy, Balancing flood risk, ecological and socio-economic considerations in developments near watercourses and wetlands, Version 2.1. Catchment, Stormwater, and River Management Branch, Roads, and Stormwater Department.

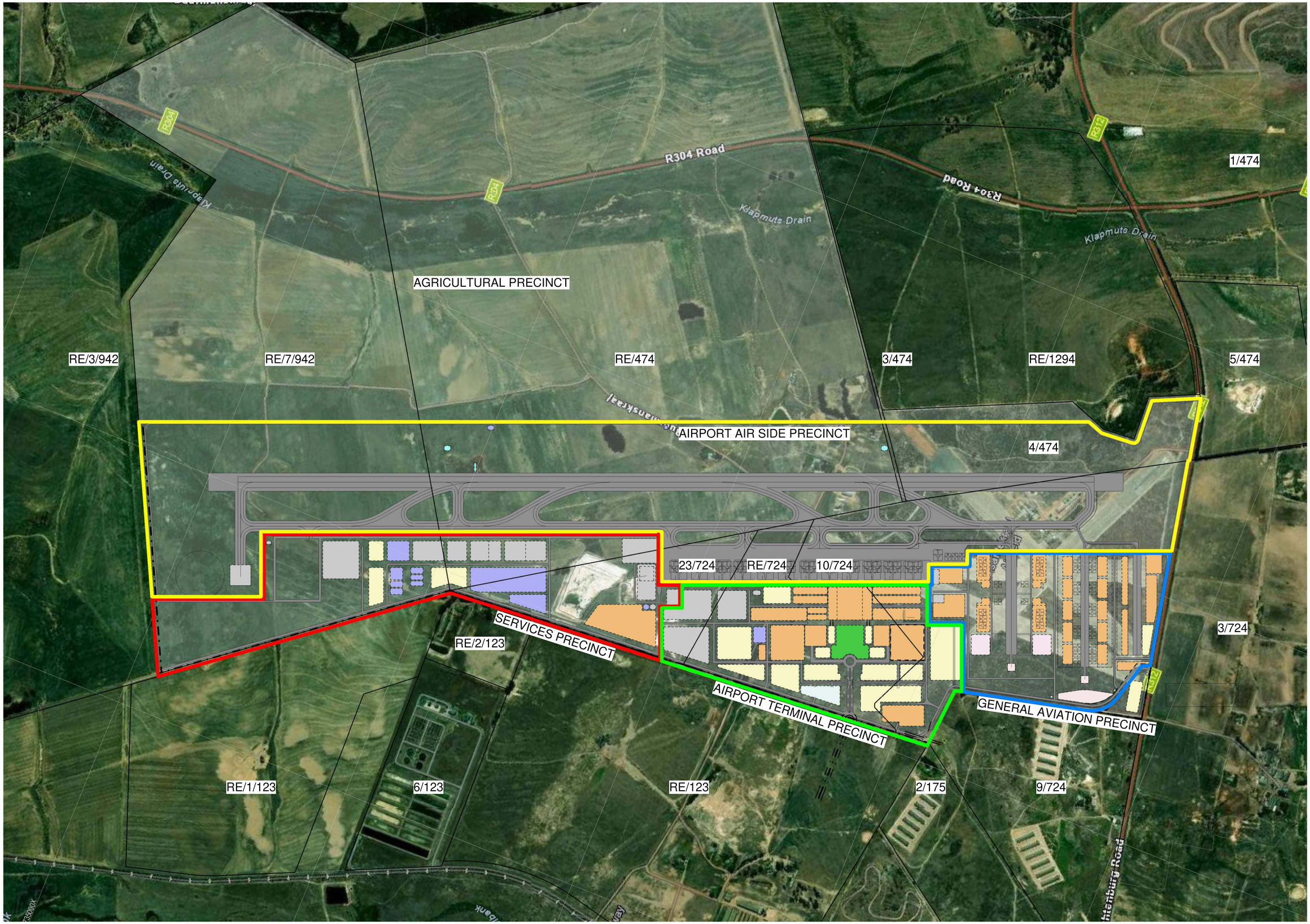
Personal Computer Stormwater Management Model (PCSWMM) (2023). PCSWMM 2023 Professional, Computational Hydraulics Institute (CHI).

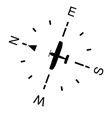
Woods Ballard, B., Wilson, S., Udale-Clark, H., Illman, S., Scott, T., Ashley, R., & Kellagher, R. (2015). The SuDS Manual. CIRIA: C753 (6). London, UK. ISBN 978-0-86017-760-9

# Appendix A

## Drawings

- **2311-VIVID-A-9002 - Site Development Plan (PAL4)**
- **A89083-0000-DRG-CC-001 Locality Map**
- **A89083-0000-DRG-CC-101 Concept Grading Plan**
- **A89083-0000-DRG-CC-302 Concept Stormwater Layout**
- **A89083-0000-DRG-CC-303 Concept Stormwater Ponds Layout**
- **A89083-0000-DRG-CC-310 Quarry as Stormwater Attenuation Pond**




**SITE PLAN - PHASE 2**

0 62.5 m 125.0 m 250.0 m

SCALE: 1:5000

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* ALL DRAINAGE RUNS TO BE ACCESSIBLE ALONG THEIR ENTIRE LENGTH.
* V.P.'s TO BE CARRIED UP TO 2m ABOVE ANY WINDOW OR DOOR OPENING IN THE BUILDING OR ANY OTHER BUILDING WITHIN A DISTANCE OF 6m.
* INSPECTION EYES (i.e.'s) TO BE PROVIDED AT ALL BENDS AND JUNCTIONS OF SOIL AND WASTE PIPES.
* RODDING EYES (r.e.'s) TO BE PROVIDED AT HEADS OF DRAINS AND AT A MAXIMUM OF 25m SPACINGS ALONG RUNS OF DRAINS.
* MARKED COVERS TO BE PROVIDED AT GROUND LEVEL FOR i.e's BELOW PAVING
* RESEAL TRAPS TO BE PROVIDED TO ALL WASTE FITTINGS.
* SOIL WATER DRAINS PASSING UNDER BUILDINGS TO BE ENCASED IN 150mm CONCRETE ALL ROUND AND BE PROVIDED WITH r.e.'s AS CLOSE TO THE BUILDING AS POSSIBLE AT BOTH ENDS.
* SOIL WATER PIPES HAVING A VERTICAL DROP EXCEEDING 1200mm TO THE MAIN DRAIN TO BE ANTI-SYPHONED.
* ALL BRANCH DRAINS EXCEEDING 6m IN LENGTH TO BE VENTED.
* uPVC PIPES ARE TO BE LAID IN ACCORDANCE WITH THE MANUFACTURERS TECHNICAL SPECIFICATIONS.

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* a) EXTINGUISHERS TO BE INSTALLED IN ACCORDANCE WITH SABS 0105.
  b) HOSE REELS TO BE INSTALLED IN ACCORDANCE WITH SABS 543.
  c) HYDRANTS TO BE INSTALLED IN ACCORDANCE WITH SABS 1128 PART 1
* PORTABLE FIRE EXTINGUISHERS TO BE HUNG ON PURPOSE MADE BOARDS AND LOCATED IN SECURE POSITIONS AS INDICATED ON PLAN.
* CLASS "B" FIRE DOORS TO COMPLY WITH SABS 1253 AND TO BE FITTED WITH APPROVED SELF CLOSING OR AUTOMATIC CLOSING DEVICES.
* STRUCTURAL ELEMENTS AND COMPONENTS TO COMPLY WITH TT7.
* FIRE EXIT DOORS ARE TO BE FITTED WITH EMERGENCY EXIT LOCKSETS.
* SYMBOLIC SAFETY SIGNS TO BE IN ACCORDANCE WITH S.A.B.S. CODE 1186 AND POSITIONED AS REQUIRED BY THE FIRE DEPARTMENT.

| Rev | Description | Revision Date |
|---|---|---|
| 11 | ISSUED TO PROFESSIONALS | 2024-07-24 |
| 10 | ISSUED | 2024-07-24 |
| 9 | ISSUED | 2024-07-24 |
| 8 | ISSUED | 2024-07-23 |
| 7 | Revised SDP/BA For Comment | 2024-07-23 |
| 6 | Revised SDP/BA For Comment | 2024-07-23 |
| 5 | Added ATCT and Helipad | 2024-05-24 |
| 4 | FOR REVIEW | 2024-04-10 |
| 3 | FOR REVIEW | 2024-04-03 |
| 2 | FOR REVIEW | 2024-04-03 |
| 1 | FOR REVIEW | 2024-03-28 |

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Client

Engineer

Registration NO: Designer

SACAP NO:

CLIENT: ENVIRONMENTAL CONSULTANT

TITLE: PHASE 2

DRAWING: CWA - PRECINCT PLANS

SIZE: A0 | DRG NO: 2024-3297 400 | REV: 11

SCALE: 1: 5000 | DATE: 2024-07-24 | DRAWN BY: CW DENNIS

# Appendix B

## Flood Line Risk Assessment Report

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Project report

# Cape Winelands Airport Development

Cape Winelands Airport Development Flood Risk Assessment

**Cape Winelands**

Submission date: 2024/06/05

Document number: A89083-0000-REP-CC-0002

Revision: 0

# Document control record

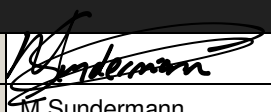
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| **Rev** | **Date** | **Revision details/status** | **Author** | **Reviewer** | **Verifier** (if required) | **Approver** |
| 0 | 2024/06/05 | Final | M Sundermann | M Kleynhans | | C Talip |
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| **Current revision** | | **0** | | | | |

| **Approval** | | | |
|---|---|---|---|
| Author signature |  | Approver signature |  |
| Name | M Sundermann | Name | C Talip |
| Title | Civil Engineer | Title | Technical Director |

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# 1 Introduction

## 1.1 Purpose of Report

This report presents a flood risk assessment conducted for the Cape Winelands Airport Development project located north of Durbanville. The aim of the assessment is to determine the impact of the development on flood risk in surrounding areas for the 1:100-Year recurrence interval (RI) flood. The evaluation considers the geographical location, hydrological characteristics, and the hydraulic structures within the site boundary and included hydraulic modelling to determine flood risk.

## 1.2 Study Area

The Cape Winelands Airport study area is bordered by three main roadways, R312, R302, and R304, forming a distinct boundary. It is located on the highest elevation within the study area. To the west of the site flows the Mosselbank River, which is a relatively significant river. To the east lies a tributary of the Klapmuts River. Furthermore, the site drains to sixteen tributaries that serve as conduits for runoff, which is directed to the Mosselbank River and Klapmuts tributary. These tributaries play an important role in drainage from the airport site. Figure 1-1 describes the study area.

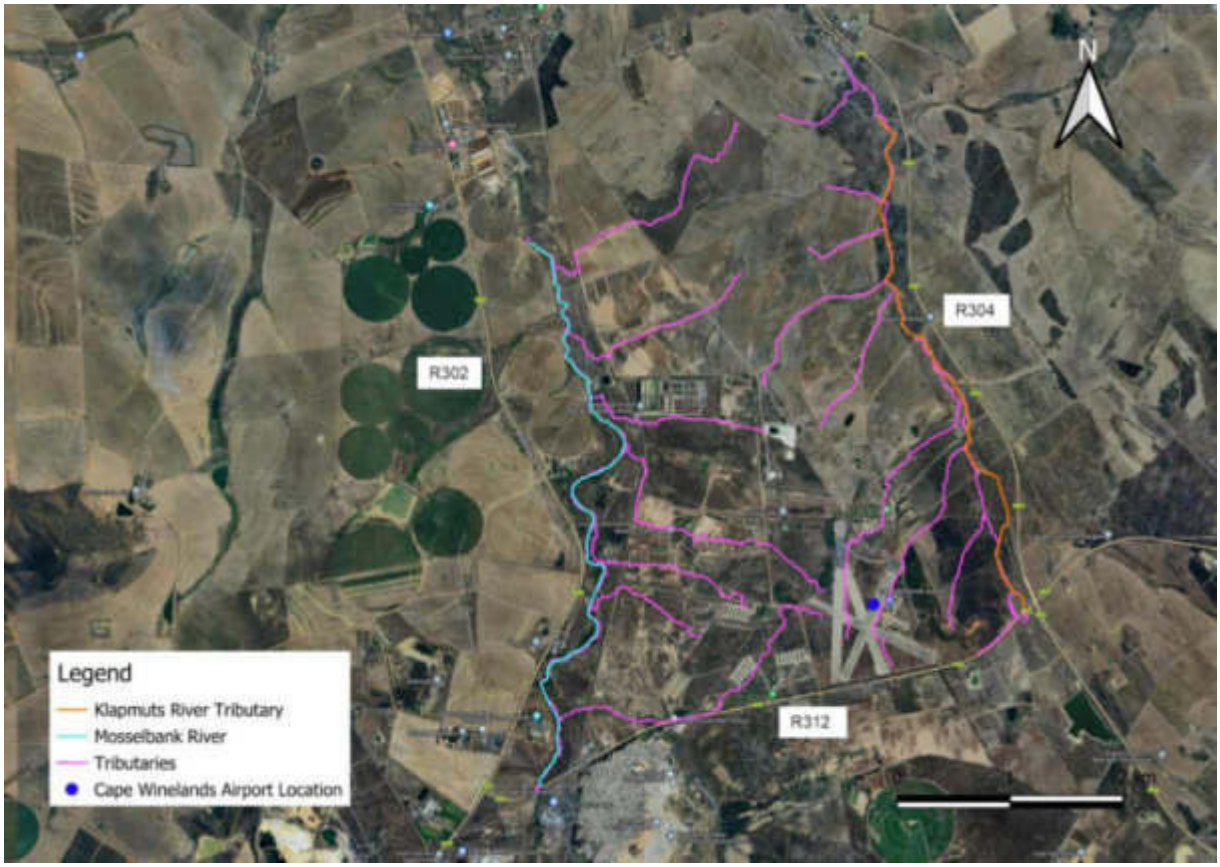



**Figure 1-1: Flood Risk Assessment study area for Cape Winelands Airport Development.**

Figure 1-2 shows the location and layout of the proposed airport along the watershed between the Mosselbank and Klapmuts Rivers.




**Figure 1-2: Proposed Cape Winelands Airport Development layout.**

## 1.3 Methodology

The determination of flood risk for the study area included the following components, which are explained in more detail in the following sections:

- Data collection
- Catchment delineation
- Flood risk assessment.
- Hydraulic model configuration and execution
- Floodplain mapping and analysis

# 2 Design Flood Determination

## 2.1 Introduction

Catchments were delineated to determine catchment characteristics using a 5 m Digital Elevation Model that was developed using Light Detection and Ranging (LiDAR) information, obtained from the City of Cape Town. The characteristics and rainfall were used as parameters for deterministic methods to calculate flow peaks and hydrographs.

The peak flows for the tributary catchments were determined using a Personal Computer Storm Water Management Model (PCSWMM) model, while deterministic methods were utilized to calculate the peak flows for the main river catchments.

## 2.2 Catchment Delineation

Catchments for each tributary within the study area were delineated. Additionally, the upstream catchments for the Mosselbank and Klapmuts Rivers were delineated to determine the inflows for the two main rivers. The basic catchment characteristics included catchment area, longest water course, water course slope, and average catchment slope. Catchment characteristics for the main rivers, are shown in Table 2-1.

**Table 2-1: Main rivers catchment characteristics.**

| Catchment | Area (sq. km) | Longest Water Course (km) | Water Course Slope (%) | Avg. Catchment Slope (%) |
|---|---|---|---|---|
| **Mosselbank** | 105 | 17 | 0.399 | 4.18 |
| **Klapmuts** | 7 | 4 | 1.131 | 4.96 |

The upstream catchments for both the Mosselbank River and Klapmuts River were delineated to calculate the inflow contributions that derive from the areas beyond the study area. The catchments delineated for the tributaries, and the water courses are shown in Figure 2-1 and Figure 2-2, respectively.




**Figure 2-1: Delineated catchments for tributaries within study area.**

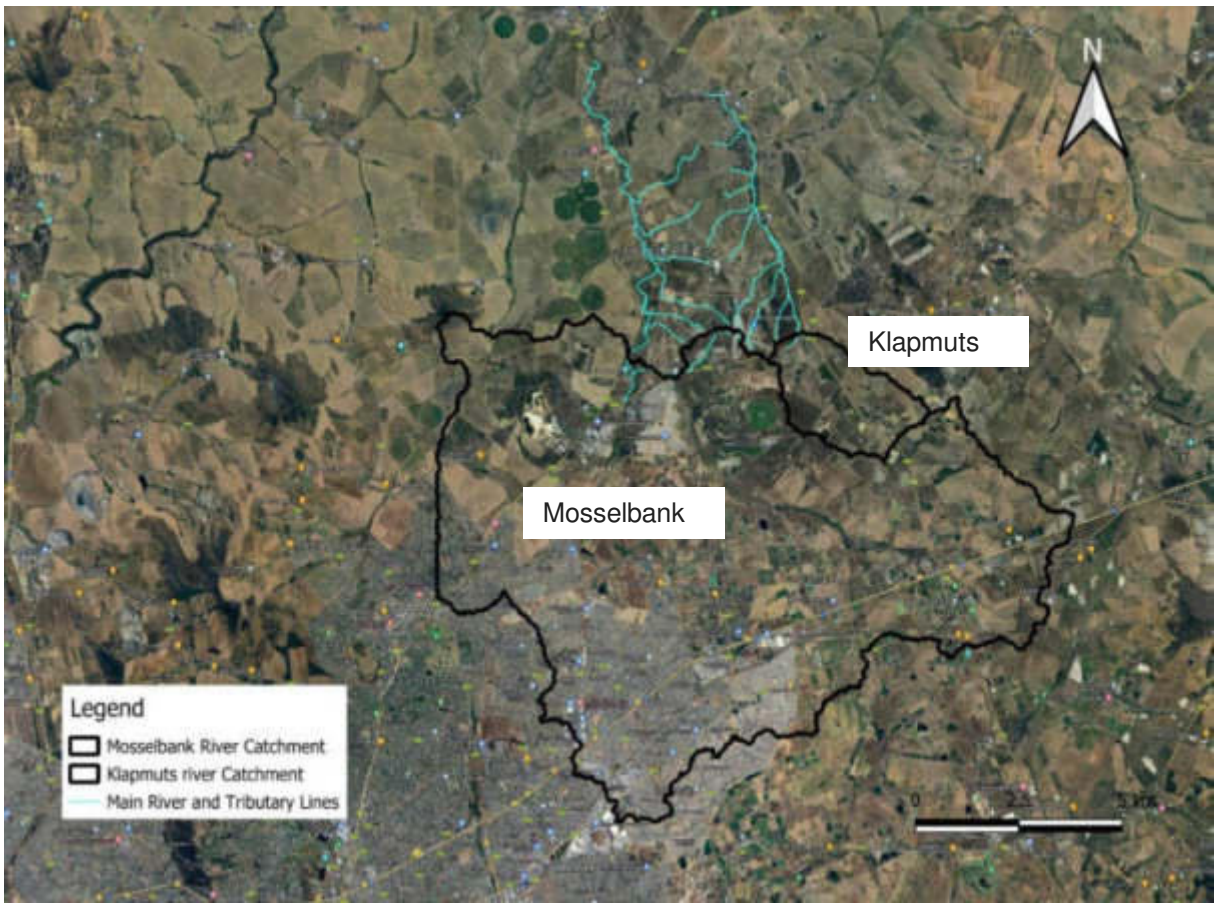



**Figure 2-2: Delineated catchments for main rivers.**

## 2.3 Design Rainfall

The design rainfall data was sourced from the City of Cape Town Rainfall Grid for the study area.

**Table 2-2: CCT Rainfall Grid 24-hour design rainfall.**

| Return Period (Years) | 24hr CCT Rainfall Grid (Includes 15% for climate change) |
|---|---|
| **2** | 44.9 |
| **5** | 60.3 |
| **10** | 71.4 |
| **20** | 83 |
| **50** | 99.4 |
| **100** | 112.7 |
| **200** | 127 |

## 2.4 Flood Peak Results

The catchment areas were determined for both the tributaries and main rivers. The 100-Year RI flood peaks for the tributaries were estimated using a PCSWMM model configured with the United States Soil Conservation Service (SCS) design flood determination method, while the flood peaks for the main river

catchments were estimated using the SCS method directly. Table 2-3 presents the flood peaks for the main river catchments, and Figure 2-3 illustrates the food peaks for each tributary catchment.

**Table 2-3: 1:100-Year RI flood peaks for the Mosselbank River and Klapmuts tributary.**

| Catchment | 100-year Flood Peak ($m^3/s$) |
|---|---|
| **Klapmuts River** | 37 |
| **Mosselbank River** | 325 |

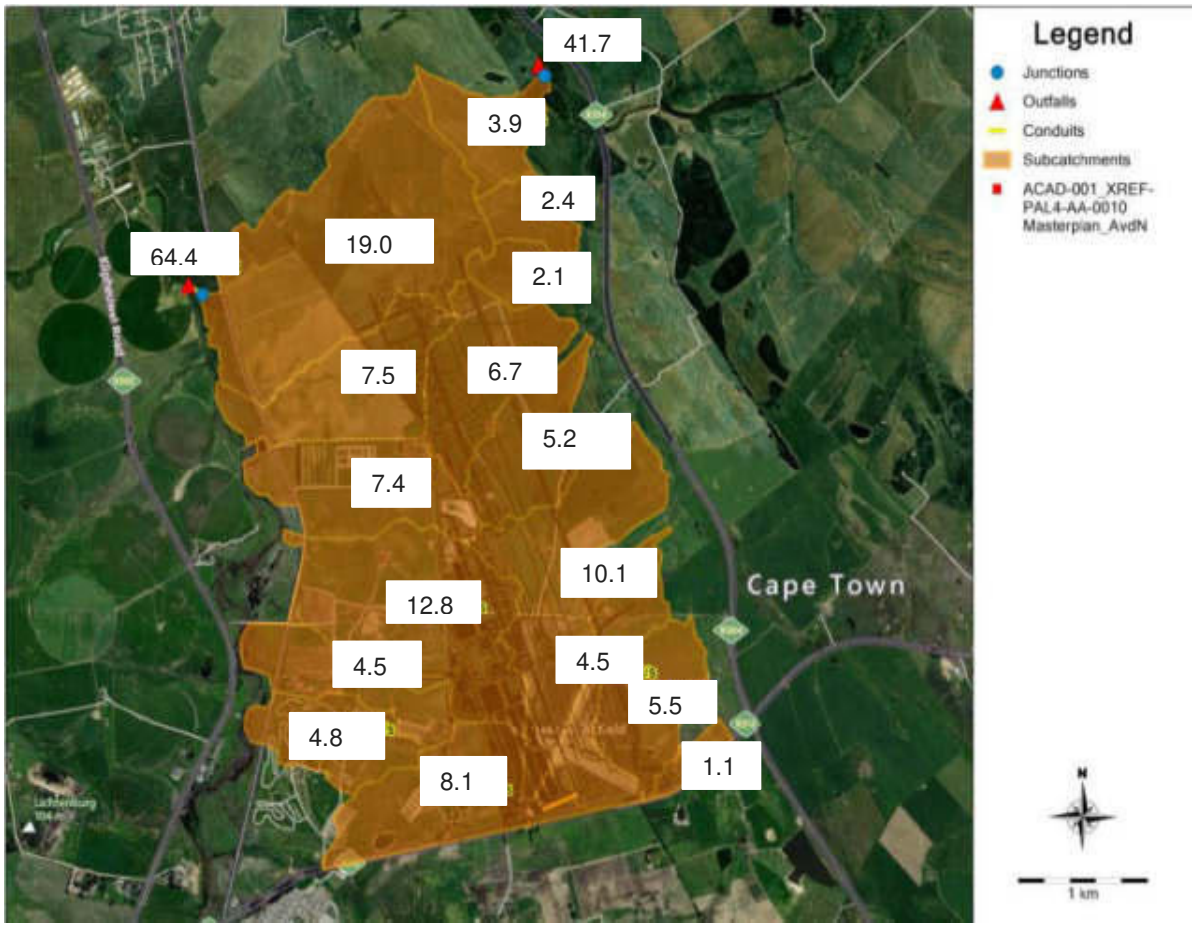



**Figure 2-3: The pre-development 1:100-Year RI flood peaks for each tributary catchment area determined using PCSWMM.**

Table 2-4 displays the 1:100-year RI design floods at the outfalls from the airport site. The post development floods have been attenuated in ponds on the airport property, upstream of the outfalls. None of the post development flood peaks at the airport outfalls exceed the pre-development values, and in some cases, they have been attenuated significantly by the ponds. In the case of Pond 6 the flood peak is reduced to 1% of its pre-development value.

**Table 2-4: 1:100-year airport design floods for the pre- and post-development stages.**

| Pond ID | 1:100yr Pre-Dev ($m^3/s$) | 1:100yr Post-Dev ($m^3/s$) |
|---|---|---|
| **Pond 1** | 1.01 | 1.33 |
| **Pond 2** | 3.05 | 2.59 |
| **Pond 3** | 0.65 | 1.09 |

| | | |
|---|---|---|
| **Pond 4** | 0.65 | 0.92 |
| **Pond 5** | 1.23 | 1.65 |
| **Pond 6** | 0.76 | 0.01 |
| **Pond 7** | 4.89 | 0.83 |
| **Pond 8** | 0.04 | 0.01 |

# 3 Hydraulic Analysis

## 3.1 Introduction

An extensive hydraulic model was required to assess the flood risk impact of the proposed airport on the surrounding study area. The United States Army Corps of Engineers' Hydrologic Engineering Centre's River Analysis System (HEC-RAS) software was utilized to simulate the hydraulics of the watercourses in the study area. The hydraulic model was configured as a two-dimensional (2D) HEC-RAS model with a 24-hour simulation run time. The model included the representation of tributaries as steady-state flow hydrographs from the proposed airport site and the incorporation of unsteady-state flow hydrographs for the inflows of the main rivers. Hydraulic structures in the watercourses have been incorporated in the model including two box culverts and a stormwater pipe.

## 3.2 Hydraulic Model Configuration

### 3.2.1 Digital Elevation Model

A Digital Elevation Model (DEM) of the Cape Winelands Airport study area was used to model the terrain in the hydraulic model. The DEM is a 3D map of the topography of the study area and was generated from Lidar data with a 5m resolution (Figure 3-1).

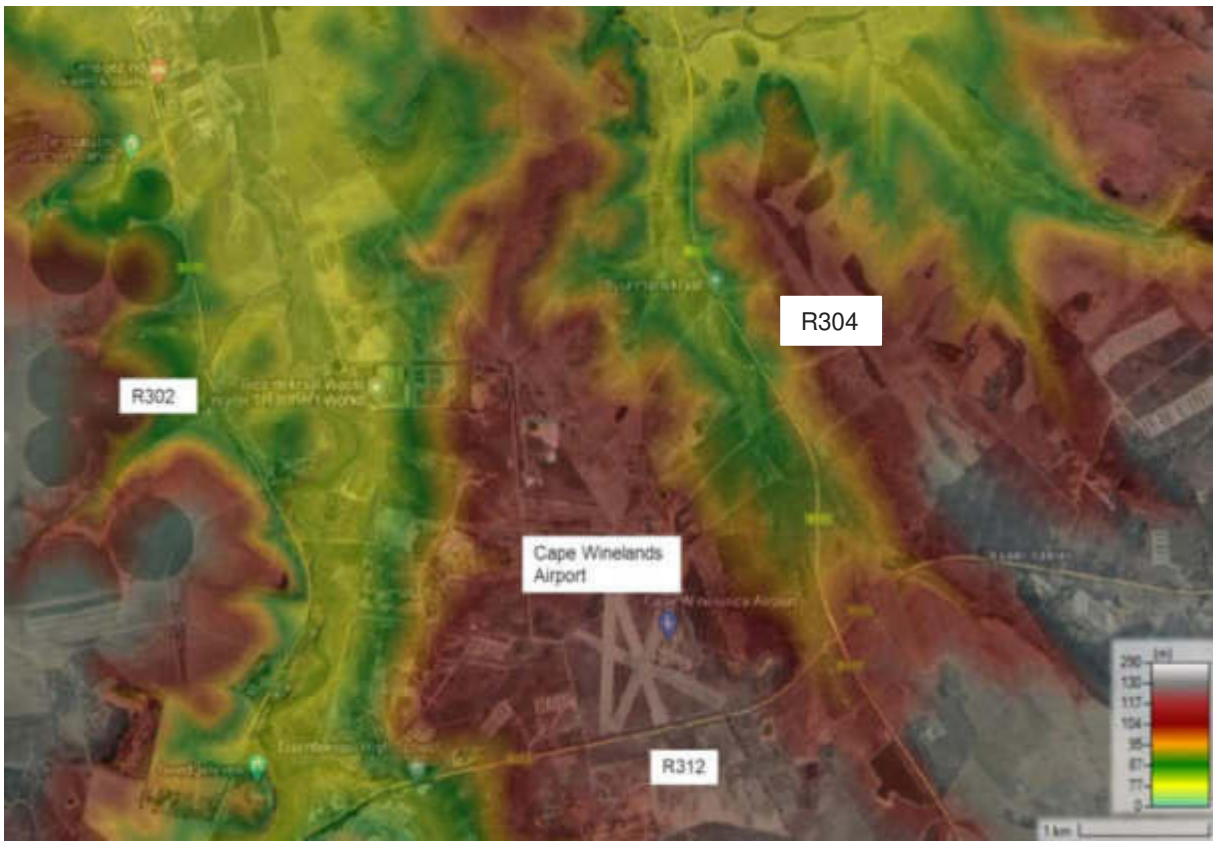



**Figure 3-1: Digital Elevation Model shown in HEC-RAS for study area.**

### 3.2.2 Computational Mesh

The 2D computational mesh in HEC-RAS for the Cape Winelands Airport study was configured with a 25m grid resolution. The centrelines of the main rivers and tributaries are represented as breaklines, indicated in red in Figure 3-2.

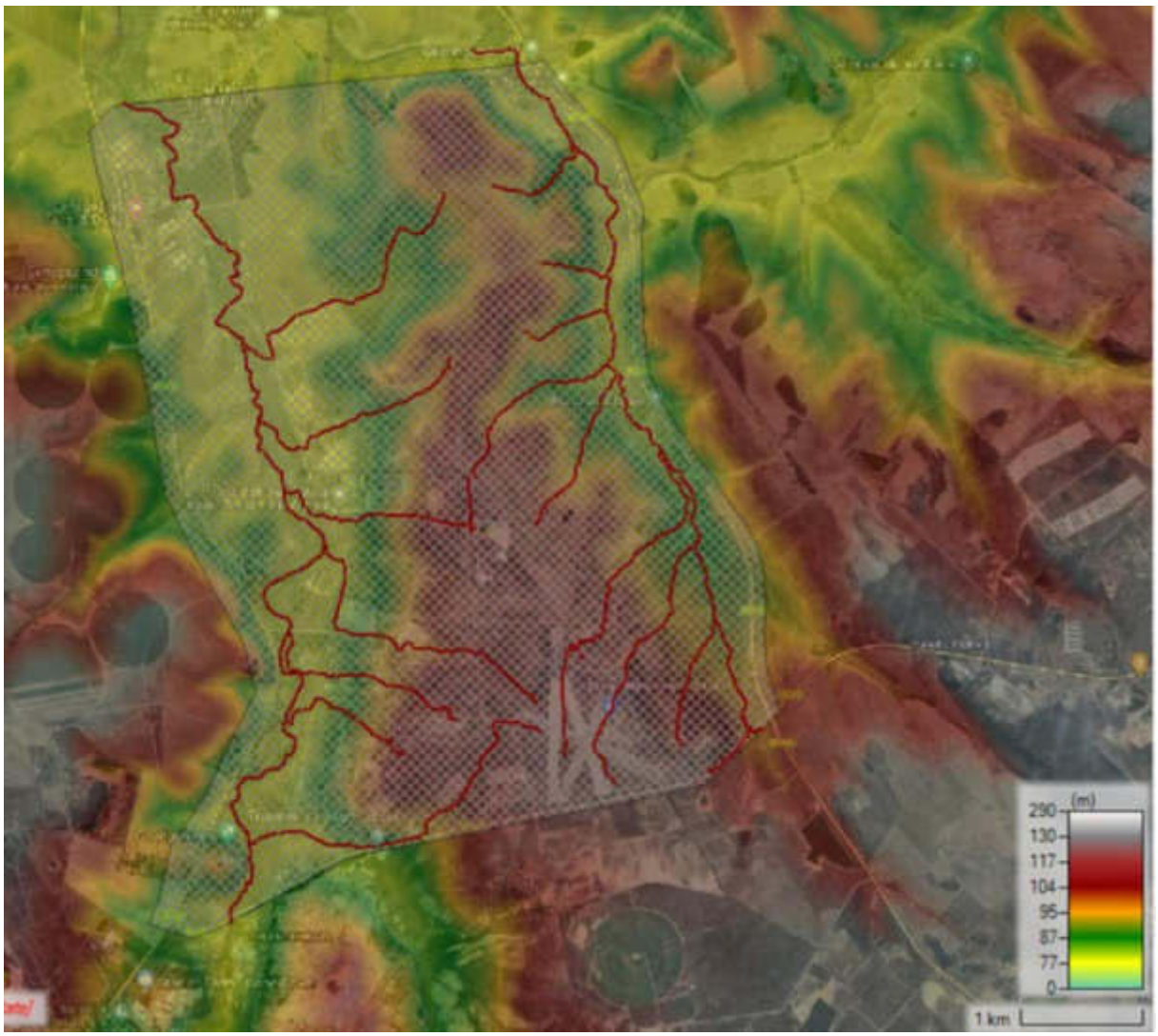



**Figure 3-2: Computational mesh, perimeter, and modelled breaklines in red.**

### 3.2.3 Hydraulic Structures

Hydraulic structures were included in the model and were configured considering typical dimensions for culvert and pipe structures. Structure data were configured based on dimensions measured from Lidar data, Google Earth, ArcGIS Earth, and Google Street View, considering typical dimensions for culvert and pipe structures. Typical dimensions required to configure the culverts included their span, rise, and length where pipes required internal diameter and length.

Four hydraulic structures were included, and these structures are presented in Figure 3-3. The structures were labelled according to their names and were included in the HEC-RAS model.

**Table 3-1: Hydraulic structure descriptions.**

| Structure Name | Structure Type |
|---|---|
| **Structure 1** | Box Culvert |
| **Structure 2** | Box Culvert |
| **Structure 3** | Stormwater Pipe |
| **Structure 4** | Box Culvert |

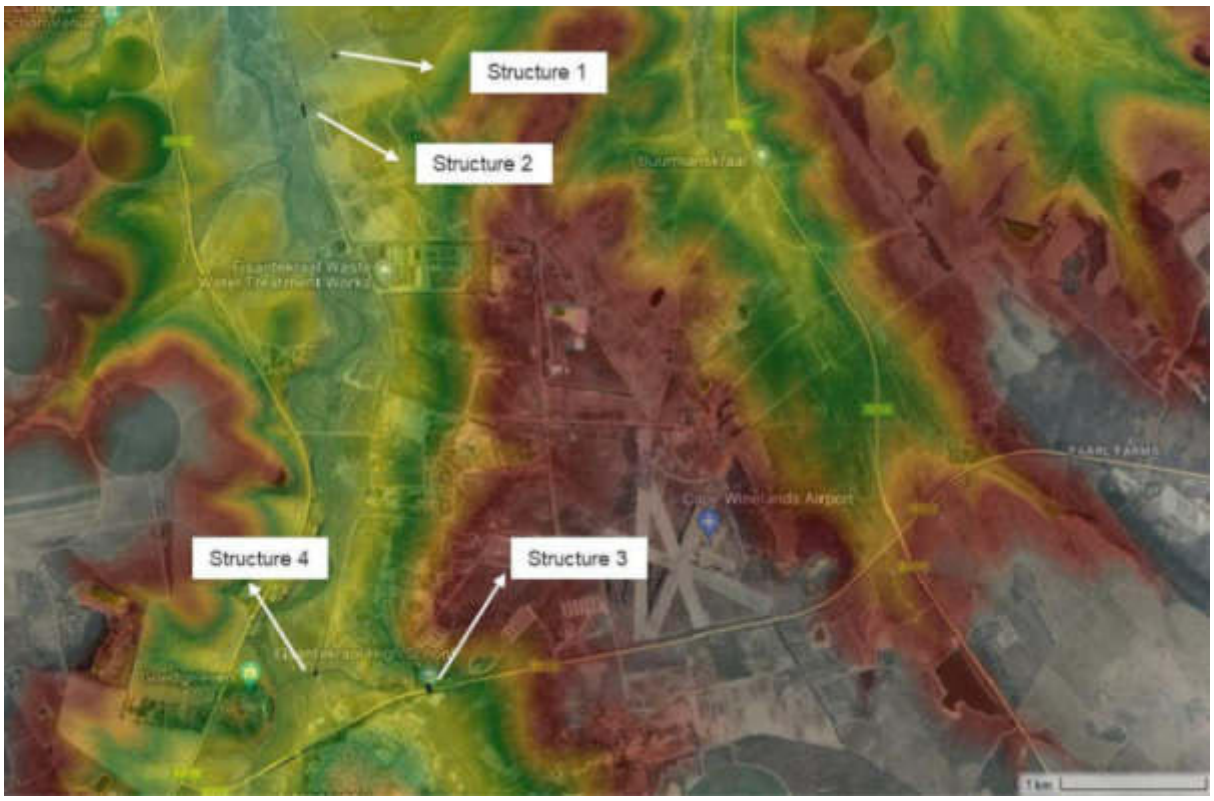



**Figure 3-3: Positions of hydraulic structures.**

### 3.2.4 Hydraulic Roughness

The hydraulic roughness was represented using the Manning's n values, which were assigned based on land cover characteristics. Manning's roughness values were assigned to specific land cover types. The South African National Land Cover (SANLC, 2018) was utilized in the model. Figure 3-4 represents the land cover layer for the study area.

**Table 3-2: Top three main land cover types used.**

| Rank | Land Cover Type | Manning's Roughness Value |
|---|---|---|
| **1** | Commercial Annuals Crops Rain-Fed / Dryland / Non-Irrigated | 0.05 |
| **2** | Low Shrubland (Fynbos) | 0.1 |
| **3** | Herbaceous Wetlands | 0.085 |

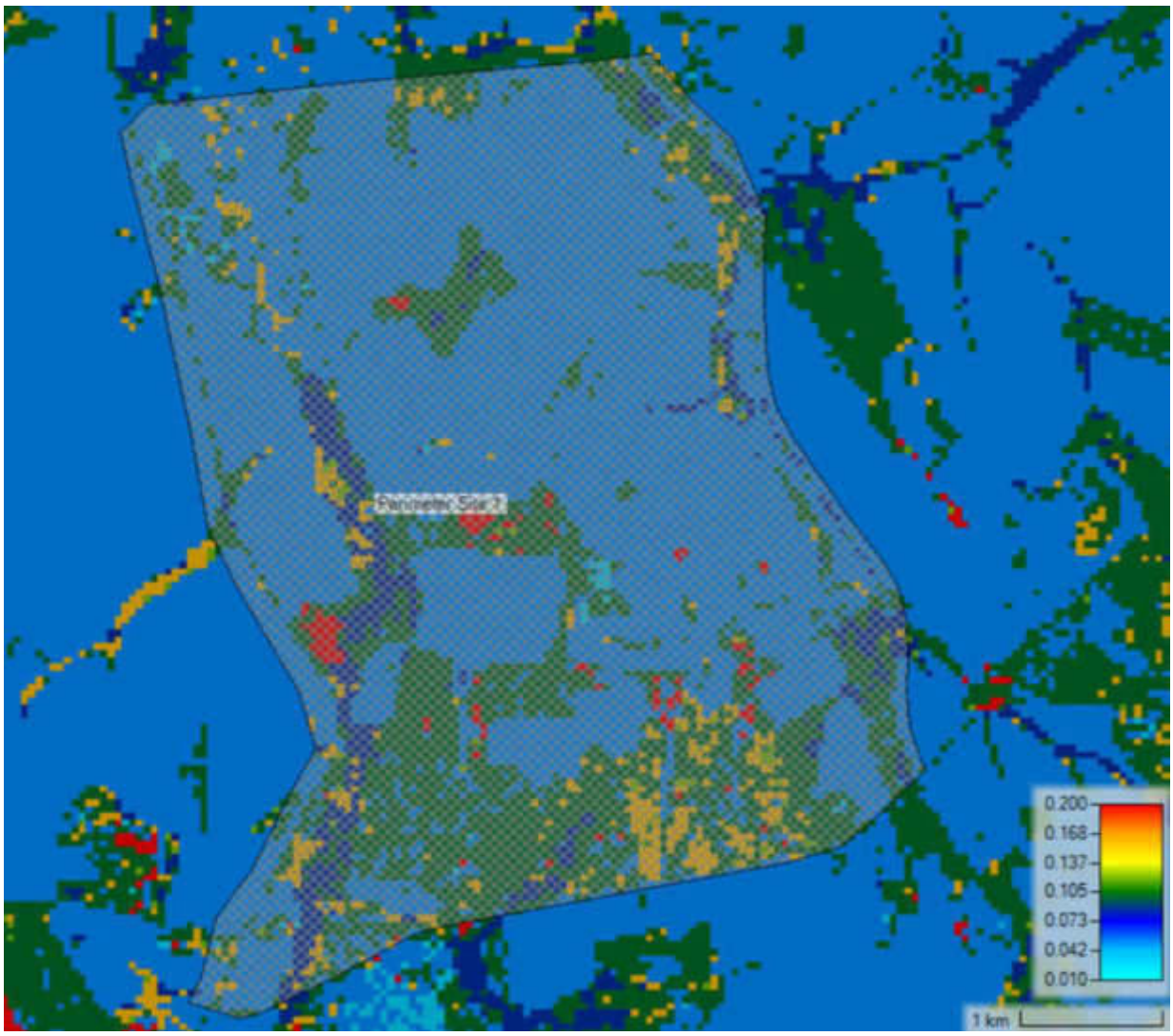



**Figure 3-4: Land cover layer in association with Manning's roughness values.**

### 3.2.5 Boundary Conditions

The model included four external boundaries: two upstream and two downstream boundaries. The two upstream boundaries were configured with the flood peak hydrographs from the catchments of the two main rivers, as mentioned in Section 2.4. The downstream boundaries were set as Normal Depth boundaries, necessitating frictional slope information. Internal boundaries were also configured, arranged with respect to the pre- and post-development of the Cape Winelands Airport. The tributary catchments will include a portion of the proposed airport in their upper parts, with the rest of the catchments remaining in their current condition. The model was configured to reflect this by including the outfall points from the airport site as internal boundaries, and the balance of the catchment contribution modelled pro-rata down the watercourse centreline to the downstream end. An example of this is illustrated in Figure 3-5.




**Figure 3-5: The portion of the catchment located inside the airport is bordered in white, and the rest of the catchment which will remain unchanged is bordered in red.**

The flood risk assessment utilized steady-state hydrographs for the design flood peaks in the tributaries which are all relatively small catchments, and unsteady-state hydrographs for the two main rivers. This is conservative because it is likely that the flood peaks of the small catchments surrounding the airport site will occur before the peaks arrive from the main river catchments, but it was modelled assuming that they would occur at the same time.

The locations of the various model boundaries are shown in Figure 3-6.

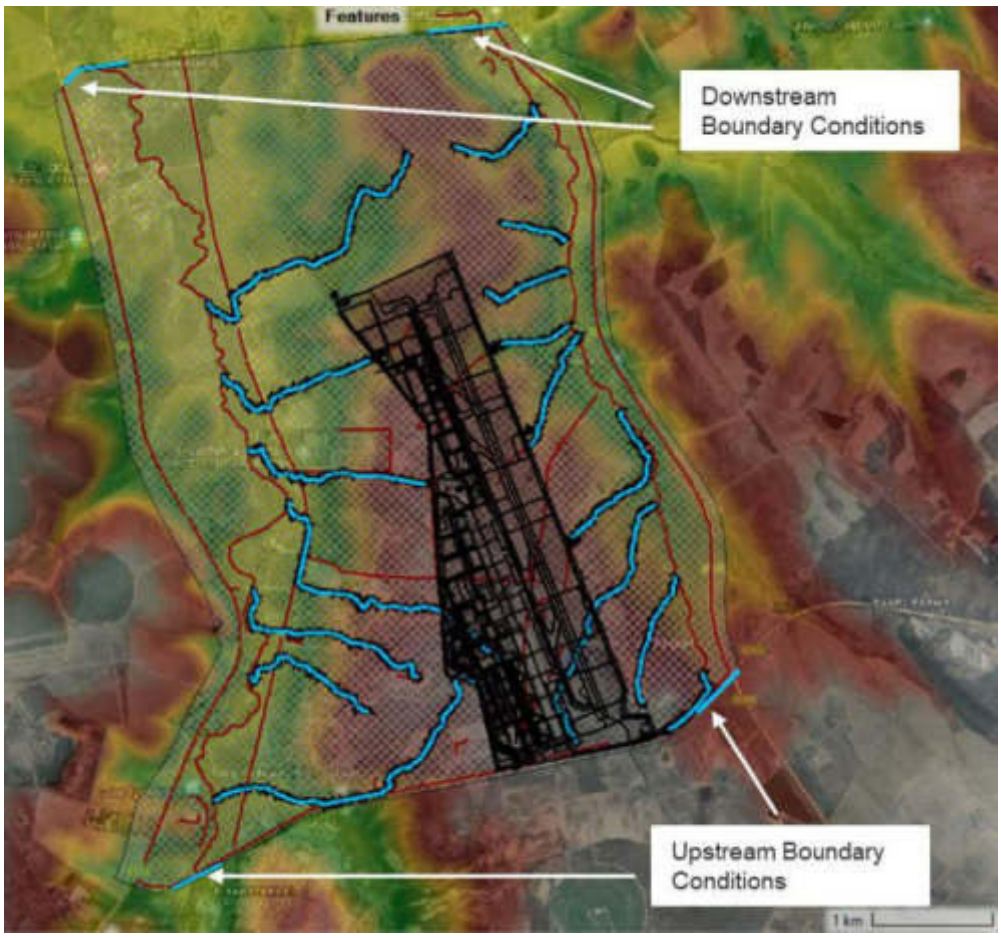



**Figure 3-6: External and internal boundary conditions with proposed airport layout.**

## 3.3 Hydraulic Model Results

### 3.3.1 1:100-Year RI Pre- and Post- Development Flood Extents

Figure 3-8 shows the 1:100-year RI flood inundations for the pre- and post-development scenarios. The effect of attenuation by the ponds decreased the post-development flood peaks at the outfalls from the airport site to values that were equal to or less than the pre-development flood peaks, resulting in the post-development flood inundation extents remaining similar to, or reducing in area from the pre-development flood peaks.

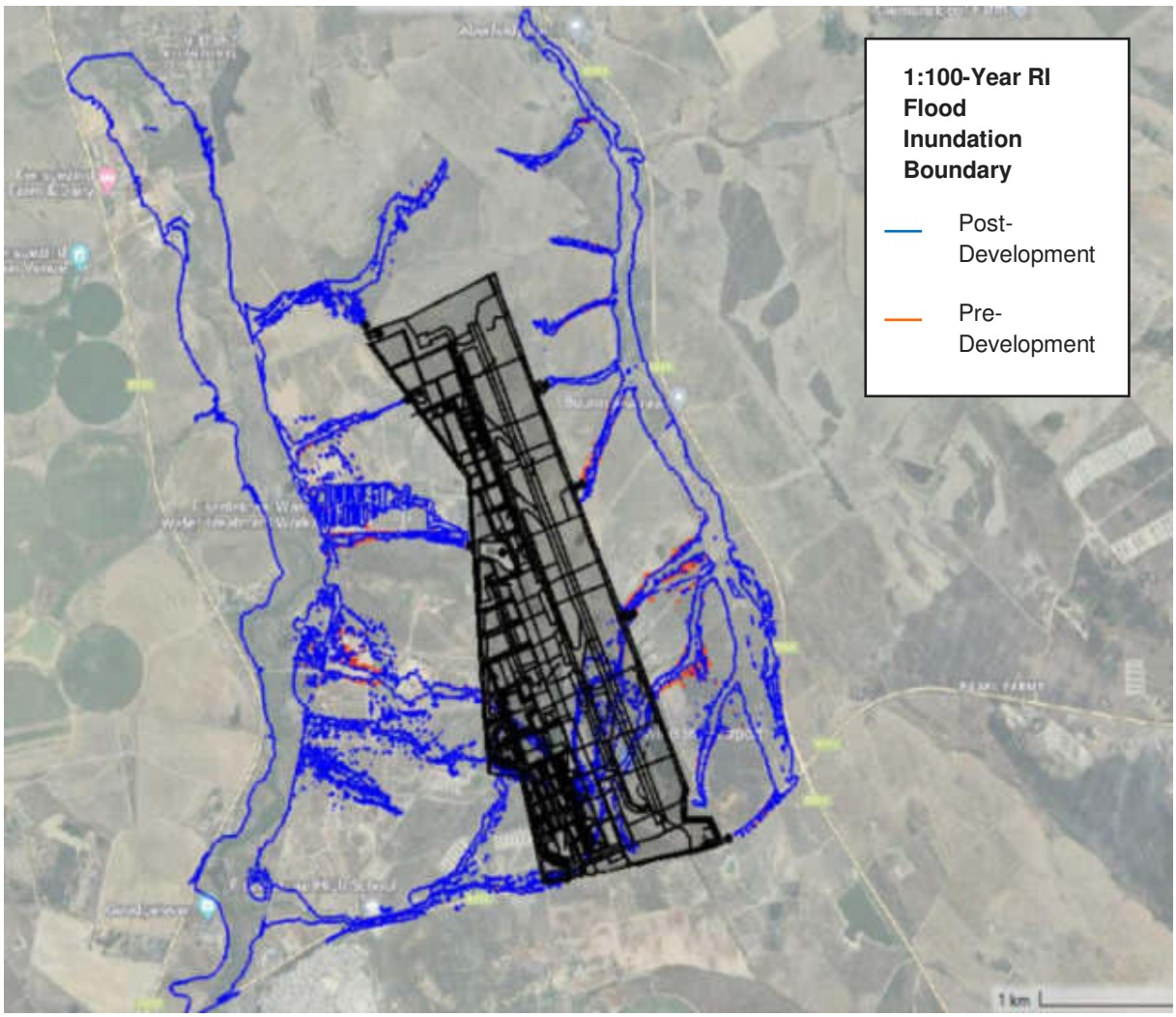



**Figure 3-7: 1:100-Year RI flood inundation boundaries for Pre- and Post-Development scenarios.**

# 4 Conclusion

This report details a study to determine the flood risk impact of the proposed Cape Winelands Airport on the downstream receiving catchments in the surrounding area. The proposed airport will be located on the watershed between the Mosselbank River and a tributary of the Klapmuts River. The airport site itself has zero risk of flooding from the surrounding rivers because of its elevated position, but runoff from the site will be altered by the airport development due to an increase in hardened surfaces (such as the runways, roads and roofs) and changes to the slopes and drainage patterns on the site due to the massive earthworks which are planned. The airport will therefore change flood risk in the catchments downstream, which has been mitigated by 8 detention ponds proposed on the airport site.

A 2D HEC-RAS hydraulic model was configured to determine the design flood inundations and depths for the 1:100-Year RI event for the pre- and post-development scenarios. It included the Mosselbank River and Klapmuts River tributary which lie to the west and east of the proposed airport site respectively, and several small tributaries that drain from the locations of the proposed detention ponds on the airport site. The model was configured incorporating flood peaks from a PCSWMM model for the tributary catchments and the proposed airport site, while employing the SCS Method to generate flood hydrographs for the Mosselbank and Klapmuts Rivers. The Zutari Land Infrastructure team developed the PCSWMM model to determine the pre- and post-development flood peaks for the outfalls from the airport site and these are detailed in a separate report.

The detention ponds have been sized to reduce the post-development flood peaks to magnitudes no greater than the pre-development flood peaks for recurrence intervals up to the 1:100-year recurrence interval. Many of the flood peaks have been reduced compared to the pre-development situation. The results of the pre- and post-development flood risk modelling indicate similar or slightly reduced flood inundations in the post-development situation compared to the pre-development situation.

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# Appendix C

## Geotechnical Investigation Report




# *Geotechnical Reconnaissance Investigation for Proposed Cape Winelands Airport, Fisantekraal, Western Cape.*

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*(Version 2.0)*

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GROUNDWATER AND EARTH SCIENCES
GEOSS
SOUTH AFRICA (Pty) Ltd

# EXECUTIVE SUMMARY

GEOSS South Africa (Pty) Ltd was requested by Mr Paul Slabbert of PHS Consulting, on behalf of Capex Projects, to complete a geotechnical investigation for the proposed Cape Winelands Airport (CWA).

The investigation involved undertaking a desk study, a site walk-over, an intrusive investigation (i.e. trial pit investigation), field and laboratory testing, and compilation and interpretation of the gathered data. This report covers aspects of preliminary road, drainage, foundation and pavement design and construction.

The most pertinent findings highlighted in this report are as follows:

- Five Geotechnical Zones have been delineated based on the investigation results:
    - A – Residual materials derived from granitoid sources.
    - B – Residual Materials derived from pelitic sources.
    - C – Area falling within Zones A and B with residual soils exhibiting characteristics of potentially expansive materials, and/or soils that are prone to settlement.
    - D - Areas of relatively deep/thick transported aeolian sand.
    - E – Areas of surficial ferricrete and/or silcrete.
- From a geotechnical standpoint, site development should proceed.
- Potential geotechnical challenges are associated with the intended development.
- All materials encountered in the trial pits classified as soft to intermediate excavation (SANS 1200D). The hardpan ferricrete horizons may require rock-breaking apparatus in areas of the site.
- A series of site-specific follow-up geotechnical investigations will be required prior to the construction of individual structures.
- In the case of structures with heavy structural loadings, where deeper foundations/piling are/is required, it would be prudent to consider a series of exploratory drilling as part of the site-specific investigations to determine whether core stones exist at depth, particularly in areas underlain by residual granitoids.
- A perched groundwater table was intersected on-site at between 0.85 and 1.4 mbgl. Excavations deeper than 1.0 mbgl will require battering to ensure safe working conditions. Final designs will have to cater for aggressive and corrosive groundwater and/or soil conditions. Drainage precaution will be required.
- The foundation solutions adopted for each structure on-site will depend on the cost of implementation, and the risk associated with the said solution.
- Due to the variation in topography within the northern extent of the property, considerable fill will be required
- During construction, potential geotechnical variations in the subsurface should be inspected and approved by a suitably qualified professional.

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# ABBREVIATIONS & SYMBOLS

| | |
|---|---|
| BH | Borehole |
| CBR | California bearing ratio |
| CGS | Council for Geoscience |
| c’ | Effective cohesion (kPa) |
| DCP | Dynamic Cone Penetrometer |
| DWS | Department of Water Affairs and Sanitation |
| EAM | Engineering and Asset Management |
| EC | electrical conductivity |
| EOH | End of hole |
| kPa | Kilopascals |
| LL | Liquid Limit |
| LS | Linear Shrinkage |
| L/s | Litres per second |
| m | metres |
| MCCSSO | Moisture content, colour, consistency, structure, soil type, and origin. |
| MDD | Maximum Dry Density |
| mm | millimetre |
| MOD | Modified AASHTO |
| mS/m | milli-Siemens per metre |
| NGA | National Groundwater Archive |
| NHBRC | National Home Builders Registration Council |
| OMC | Optimum moisture content |
| PI | Plasticity index |
| SABS | South African Bureau of Standards |
| SANS | South African National Standards |
| TLB | Tractor loader backhoe |
| Q3 | Third quartile |
| φ' | Effective angle of internal friction |

# GLOSSARY OF TERMS

Quartile: Equal groups into which a population can be divided according to the distribution of values of a particular variable. Here, the third quartile represents the value under which all data points (within the given group) fall.

Dynamic Cone Penetrometer: Device with a 20 mm 60° cone driven into the ground by an 8 kg weight dropped through 575 mm. The penetration resistance is recorded in mm/blow. This provides an indication of soil consistency (relative density).




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**Cover photo:**

Photo south-eastern corner of the site, near TP04.

**GEOSS project number:**

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# 1. INTRODUCTION

## *1.1 Terms of Reference*

GEOSS South Africa (Pty) Ltd was requested by Mr Paul Slabbert of PHS Consulting, on behalf of Capex Projects, to complete a geotechnical investigation for the proposed Cape Winelands Airport (CWA). The site that has been proposed to be upgraded and developed is located at the existing Fisantekraal airfield, some 2 km north-east of the township of Fisantekraal (**Map 1**).

## *1.2 Objectives and Methodology*

The primary aim of the geotechnical investigation was to establish the soil conditions and associated soil engineering properties across the site. The intention of this report is to enable preliminary design of the proposed development. The aim of this investigation was met by undertaking of a desk study, a site walk-over, and intrusive investigation (i.e. trial pit investigation), field and laboratory testing and compilation and interpretation of the gathered data. This report covers aspects of road, pavement and foundation construction, drainage, and excavatability of the substratum.

## *1.3 Proposed Development*

CWA is proposed to be built on the existing Fisantekraal Airfield which is an old South African Air Force airfield built circa 1943. It's existing foot print covers approximately 150 ha. Several of the neighbouring properties have been acquired therefore taking the proposed development area up to 660 ha. There are currently four concrete strips of 90m width each, in varying lengths between 700m and 1500m.

A site development plan has been provided which is included in **Appendix F** with the following information about the proposed facility:

- Runways (to be developed in phases).
- Taxiways.
- Roads.
- Stormwater lines and stormwater management system.
- Hangars.
- Aprons.
- Commercial/Industrial/Retail facilities.
- Hotel/Accommodation.
- Control Tower.
- Rescue & Firefighting facilities.
- Terminal buildings.
- Aviation Fuel Farm.
- Retail Service Station.
- Admin and office space.

- Electric Charging Stations.
- Renewable energy alternatives.
- Outdoor Media, e.g., signage and billboards.

In-depth descriptions of the above components of the project have been presented in GEOSS (2022).

Further, a possible extension has been proposed, and at this stage, for planning purposes, the additional area has been preliminarily investigated from a geotechnical standpoint. The possible extension is proposed to comprise the following elements:

- 3.0 km runway.
- Development of a full commercial terminal on the East of runway 01/19.
- Bulk still to be determined.
- Site plan still to be determined.
- Largest aircraft operable would be a Boeing 777 or Airbus A350.
- Commencement date would depend on demand.

### *1.4 Preliminary Loading*

At present, because the project is in the planning phase the proposed structures and their final loadings and ultimate locations are still being finalised, the loading conditions are unknown. For the sake of this report, loadings of between 100 and 250 kPa have been used for preliminary modelling. Specific details pertaining to the proposed structures are not available at present.

### *1.5 SANS 10160-5 Classification Category*

Based on the information available for the proposed structures and the conditions encountered on-site, the site can be classified as 'Category 2', i.e. the proposed development includes "conventional structures and foundations for which design methods are well established, where there are no exceptional risks in terms of overall stability or difficult ground conditions (e.g. conventional buildings on spread footings, rafts or piled foundations" (Day and Retief, 2009). This classification is defined by the following:

- The site presents no abnormal risks
- Routine field and laboratory tests have yielded estimated design parameters.
- No quantitative design has been presented by the Structural Engineer.
- Supervision/QC and follow up testing may be required prior to, or at the construction stage.
- Monitoring program - only if considered appropriate.

### *1.6 Scope and Limitations of Assessment*

The geotechnical investigation had one primary aim, to determine the geotechnical character of the site.

### *1.7 Information Available*

Ahead of the preparation of this report, the document titled "Cape Winelands Airport Development Project Description", dated 19 April 2022, was provided.

During the planning, desk study and compilation of the report, data was acquired from the following geological, geotechnical and hydrogeological sources:

- The 1: 50 000 geological series map – Sheet 3318DC Bellville.
- The 1: 50 000 geotechnical series map – Sheet 3318DC Bellville.
- The 1: 50 000 topocadastral map – Sheet 3318DC Bellville.
- The 1: 250 000 geological series map – Sheet 3318, Cape Town.
- The 1: 500 000 hydrogeological map – Sheet 3126, Cape Town.




***Map 1: Locality map showing the location of the proposed Cape Winelands Airport, Western Cape.***

# 2. SETTING

## *2.1 Site Location and Description*

The site that has been proposed for development is situated some 2 km north-east of the existing Fisantekraal township, and approximately 25 km northeast of Cape Town International Airport (**Map 1**). The site is mainly surrounded by cultivated land, livestock farms and poultry farms. Some areas are also used for recreational activity, and a waste water treatment facility is also located to the north-west of the boundary.

The Cape Winelands Airport (CWA) development is proposed to be constructed across several farm portions, including those presently occupied by the existing Fisantekraal airfield. The proposed CWA is to fall across several properties with a total cumulative extent of approximately 885 ha (Cape Farm Mapper, 2022). The proposed development extends across the following Farm portions (area of each farm shown in brackets):

- 23/724 (31.2 ha).
- RE/724 (42.3 ha).
- 10/724 (114.0 ha).
- 4/474 (36.5 ha).
- RE/474 (402.4 ha).
- 7/942 (257.8 ha).

## *2.2 Topography, Existing Infrastructure and Site History*

The topography of the site and surrounds is characterised by typical grass-covered low-relief rolling hills. The typical on-site elevation is between 90 - 130 m above mean sea level (mamsl). With natural slope surfaces rarely exceeding 12° (Stapelberg, 2009). In this region, there is a low drainage density (Stapelberg, 2009). Drainage channels and small tributaries usually occupy the lower-lying areas between the low-relief hills.

The area that is presently occupied by the airfield is characterised by generally flat terrain, with little undulation. The northern extent of the proposed development area (i.e. region earmarked for future development of extended runway) is characterised by undulous terrain with rolling hills.

## *2.3 Climate*

The Fisantekraal area experiences a Mediterranean Climate with mild wet winters and warm dry summers. **Figure 1** shows the monthly average air temperature and **Figure 2** shows the monthly median rainfall and evaporation distribution for the Fisantekraal area (Schulze, 2009). The long term (1950 – 2000) mean annual precipitation for the Fisantekraal area is 532 mm/a. The rainfall typically exceeds evaporation rates in the winter months between May and August.

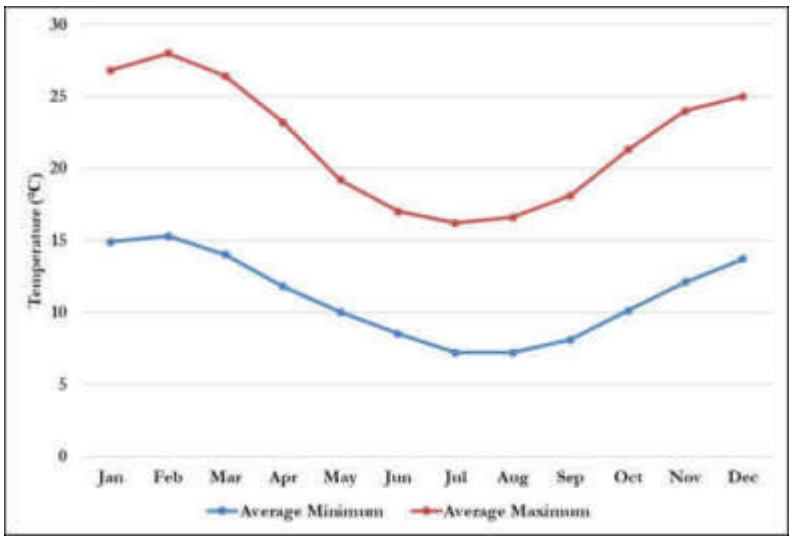



***Figure 1: Monthly average air temperature for the Fisantekraal area (Schulze, 2009).***

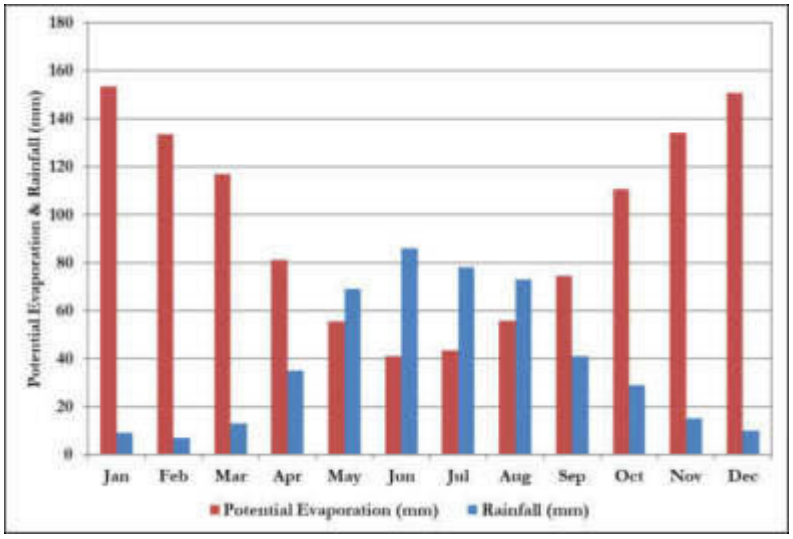



***Figure 2: Monthly average air temperature for the Fisantekraal area (Schulze, 2009).***

### *2.4* ***Behaviour of Existing Structures***

The structures on site were briefly examined for any typical tell-tale signs of geotechnical risks/problem soils, e.g. settlement/differential heave. The structures on the site are located predominantly in the south-eastern extent of the property, none of these showed clear evidence of typical foundation-related cracks. It is important to note that none of these structures appear to be heavily loaded. In the north-western extent of the site; however, the structures located on the Remainder of Erf 724 did show signs of foundation related cracks (**Appendix C**).

### *2.5* ***Weinert 'N' Value***

The present and past climate is a useful indicator of the typical soil conditions that may be encountered on a particular site (Weinert, 1975). Weinert (1975) developed a general model to categorise the climate of southern Africa based on what he termed the 'N'-value **Figure 3**.

The Weinert 'N'-value for the project area is shown to be less than 5 (Brink, 1983; Stapelberg, 2009). Weinert (1975) showed that where 'N'-values are less than 5, chemical decomposition is the

dominant mode of rock weathering and relatively thin transported soil cover can be expected with deep residual profiles. Where pedocretes are developed they are generally ferricrete (Brink, 1983).

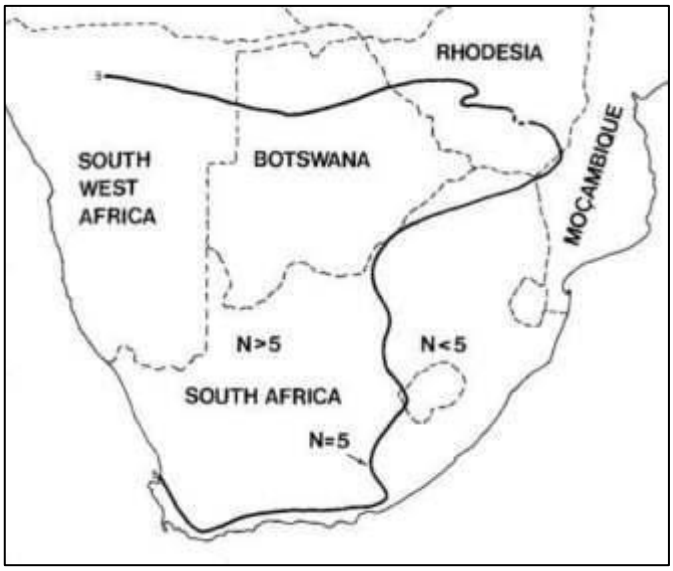



***Figure 3: Climatic 'N' value = 5 plotted for southern Africa (after Weinert, 1967).***

### *2.6* ***Geology & Engineering Geology***

The Council for Geoscience (CGS) has mapped the area at a scale of 1: 250 000 (3318, Cape Town). The geological setting is shown in **Map 3** and the main geology of the area is listed in **Table 1**. The geology underneath the proposed Cape Winelands Airport is shale of the Tygerberg Formation (Nt), which is part of the Malmesbury Group and it is the basement rock of the area. Regionally the Malmesbury Group is overlain by different (younger) quaternary formations (Qgg, Qg, Qf and Qs).

The bedrock in the region is shown to be predominantly Malmesbury Group (Nt) rocks; these are often associated with overlying ferricrete gravels/nodules. The Malmesbury Group rocks typically dip steeply to the northwest (Stapelberg, 2006). Rapid transitions occur within this unit between easy-weathering siltstone/phyllite to more competent greywacke/sandstone. This can lead to large differences in depth of weathering/depth and development of the soil profile over relatively short distances (Stapelberg, 2006).

Although intrusions of the Cape Granite Suite are not indicated (**Map 3**), indications of minor intrusive, or fault-bounded bodies of granite occur in this region (Stapelberg, 2006). These are considered extensions/satellite intrusions of the Kuilsriver–Helderberg pluton.

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

| Code | Formation/Pluton | Group/Suite | Description |
|---|---|---|---|
| ~ | Alluvium | Quaternary Group | Unconsolidated sand |
| Qgg | - | | Gravelly clay/loam soil |
| Qg | - | | Loam and sandy loam |
| Qf | - | | Limestone and calcrete |
| Qs | Springfontyn Formation | | Light-grey to pale red sandy soil |
| Cpo | Populierbos Formation | Klipheuwel Group | Shale, mudstone and sandy shale, mainly reddish |
| Cm | Magrug Formation | | Conglomerate, grit and sandstone, often reddish brown |
| Nf | Franschhoek Formation | Malmesbury Group | Grey, feldspathic conglomerate, grit and sandstone, with minor shale |
| Nt | Tygerberg Formation | | Nt - Greywacke, phyllite and quartzitic sandstone, interbedded lava and tuff |
| Nm | Moorreesburg Formation | | Greywacke and phyllite with beds and lenses of quartz schist, limestone and grit; quartz-sericite schist with occasional limestone lenses |

Note: N/A – Not Applicable.

### *2.7* ***Geotechnical Conditions***

The geotechnical conditions of the region were mapped at 1:50 000 scale by the CGS in 2006 (3318DC Bellville - Geotechnical Series), see **Map 4**. The geotechnical series provide an indication of the likely soil conditions and construction constraints at a particular location, for example, the soil beneath the site has been classified (according to the CGS) as 'M8', indicating that "*some precautionary measures needed to overcome engineering-geological problems*". Potential problems/conditions that may be experienced with subsoils of this classification are shown in **Table 2**. Note that the map codes in the legend correspond to the map codes shown in **Table 2.**

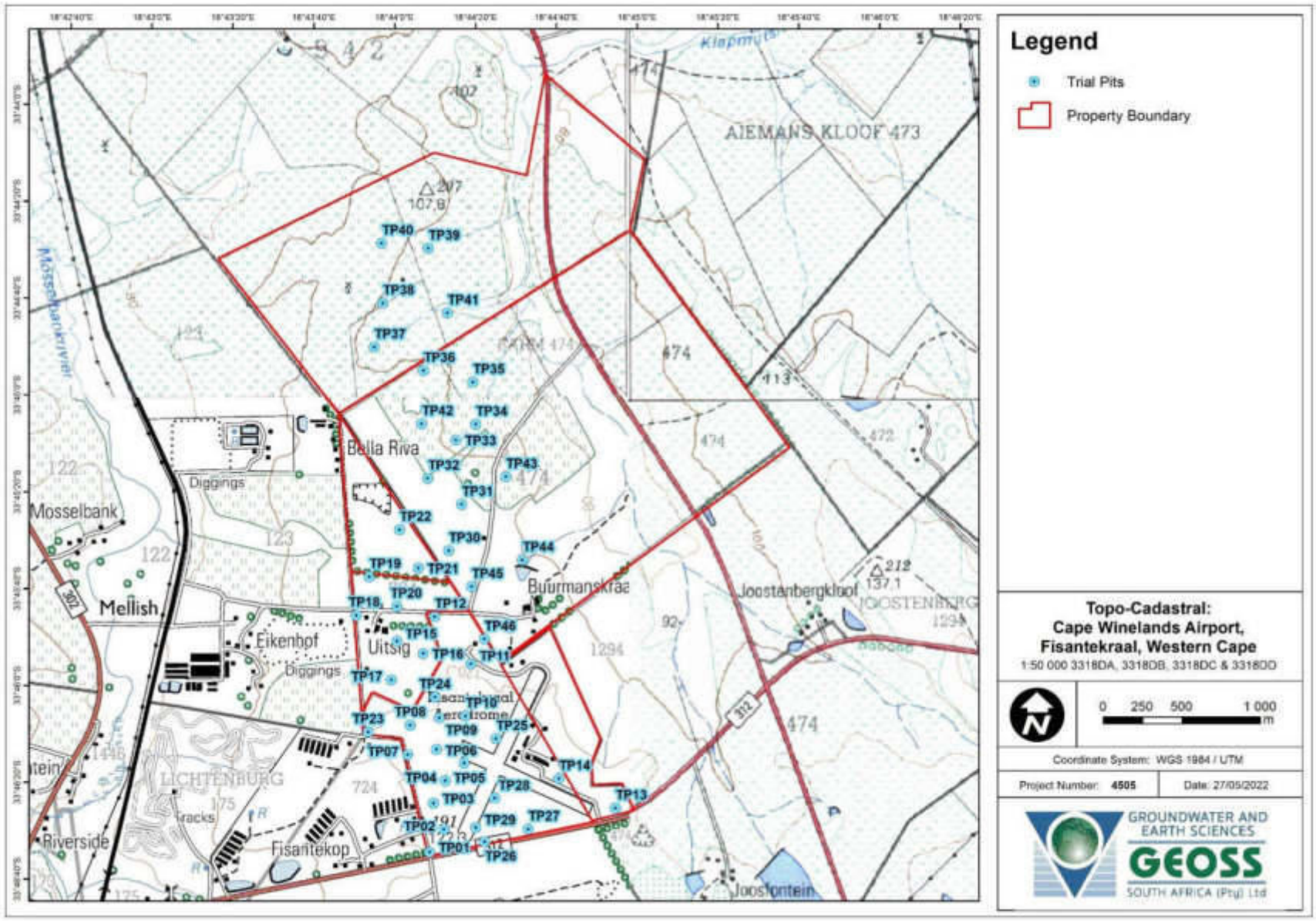
***Table 2: Potential geological constraints in the region of the site (after CGS, 2009).***

| **Geotechnical Condition/ Property** | **Description** | **Severity Class / Resulting Cost Implication** |
|---|---|---|
| Permeability (Map Code: Per) | Permeability measures the flow of water through saturated soil. This is determined by the grain size and shape and the degree of compaction of the soil. | Low permeability (< 3 x 10 cm/s) |
| Shallow water table (Map Code: Sha) | Water table occurring at shallow depth - often seasonal. | Moderate |
| Loose sand (consolidation) (Map Code: Con) | Material susceptible to excessive consolidation when used as foundation horizon. Non-cohesive sands. | Low |
| Active clay (Map Code: Act2-Act3) | The degree of expansion experienced when dry clayey soils are moistened to full saturation. In addition to the activity, the clay horizon depth and thickness contribute towards determining the amount of surface movement (expansion/contraction). | The residual soils of the Tygerberg Formation may exhibit low to medium expansiveness.<br><br>Medium cost implications may be incurred due to this type of material |

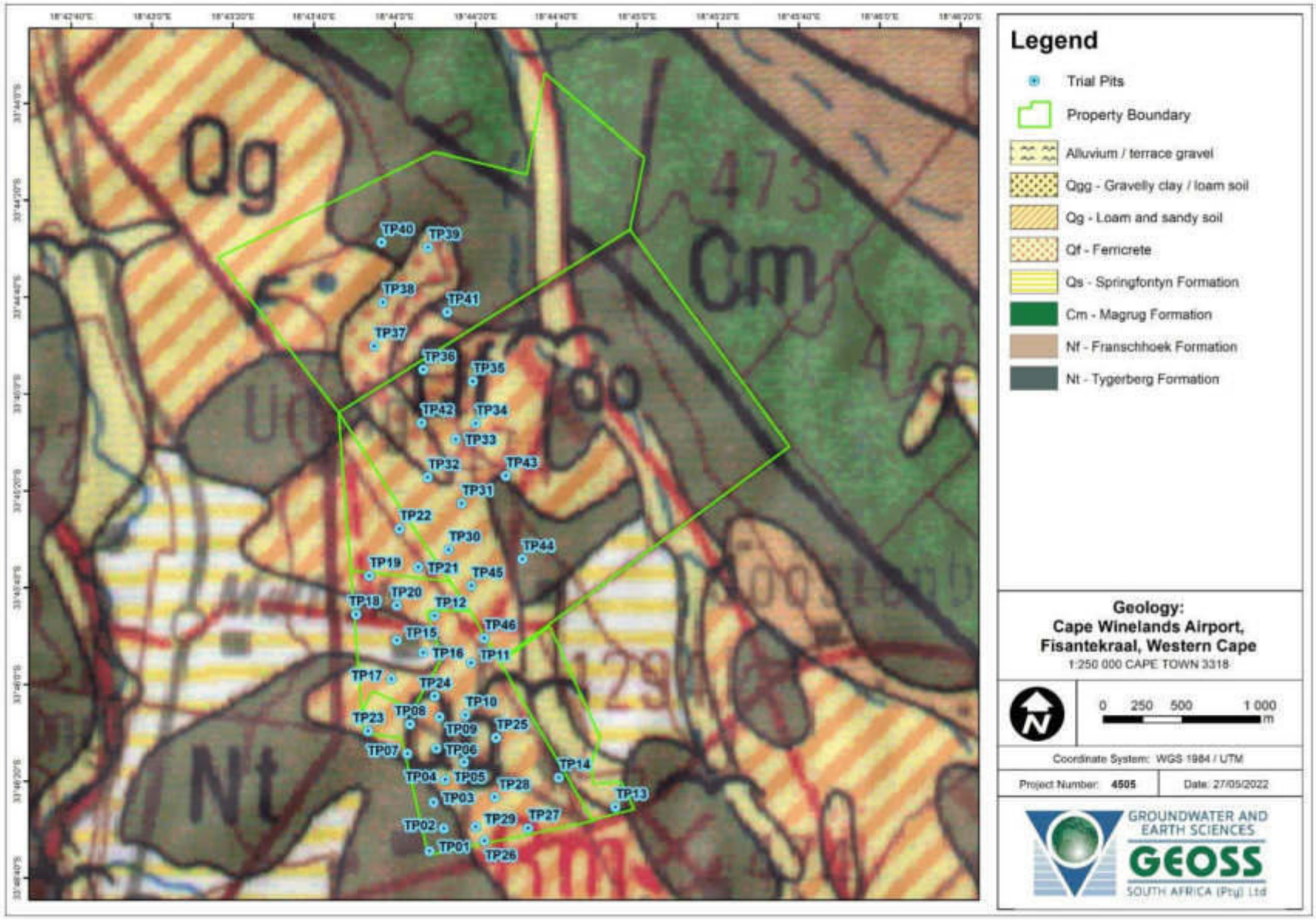
Selected results from Stapelberg (2009) have been presented in **Table 14** that were collected in the region (**Appendix G**). Relative to the existing CWA infrastructure Sample 5/3 is located to the north on Erf RE/474; Sample 5/8 within the development area on Erf 10/724, and; Sample 5/10 to the south on Erf 4. Of interest is the variation indicated between the lithologies, i.e., soils of granitic/intrusive (Cape Granite Suite) and pelitic/sedimentary (Malmesbury Group) origin. Similar conditions were encountered during the undertaking of the field investigation. The representative trial pit logs devised by F. Stapelberg were also consulted during compilation of this report.

### *2.8 Hydrogeology*

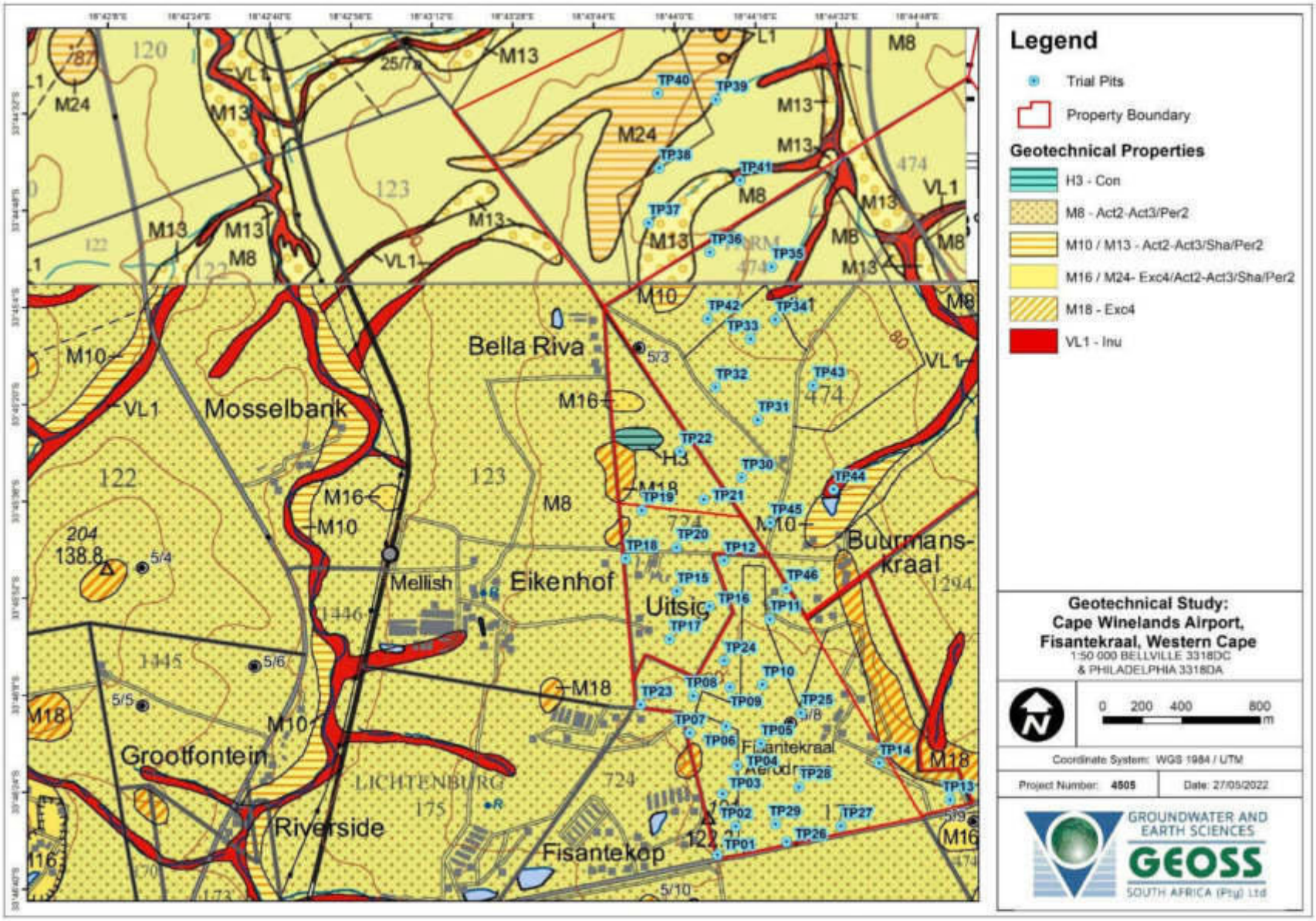
The regional aquifer directly underlying the site is classified by the Department of Water Affairs and Forestry (DWAF, 2002) as a fractured aquifer with an average yield potential that range from 0.5 – 0.5 L/s. A fractured aquifer describes an aquifer where groundwater only occurs in narrow fractures within the bedrock. The groundwater quality for study area ranges from "ideal" to "poor" with an associated electrical conductivity (EC) of between 70 – 1000 mS/m generally improving in quality (i.e. reducing EC) toward the south (DWAF, 2002). This information was derived from regional datasets. For more information on the groundwater status of the site, consult GEOSS (2022).




***Map 2: Topocadastral map showing the locations of trial pits in relation to the proposed Cape Winelands Airport and surrounds.***




***Map 3: Geological setting of the area (3318DC – Bellville, GCS 1984).***




***Map 4: Geotechnical conditions of the site and surrounds showing the positions of the trial pits (3318DC – Bellville, GCS 2008).***

# 3. INVESTIGATION METHODOLOGY

The geotechnical assessment has been undertaken primarily to characterise the engineering properties of soils underlying the site, confirm the local geology and the hydrogeological conditions. This investigation was also aimed to identify any potential geotechnical risks or 'problem soils' that may be present beneath the site.

The procedure adopted for this study involved a desktop study followed by site work. The initial desktop study involved gathering and reviewing all relevant data to the project. During this time, the GEOSS internal database was consulted, and geotechnical and hydrogeological investigation reports for work previously undertaken in the area were reviewed.

A site visit was then conducted to verify as much of this data as possible, collect additional data and make on-site observations (e.g. describe and document soil profiles), and collect representative soil samples from the trial pits to be submitted for laboratory analysis.

The following tasks were conducted on site, these are discussed and included in this report:

- A total of forty six (46) trial pits were excavated using a JCB 3DX Super Tractor Loader Backhoe. An image of the TLB is supplied in **Appendix C**.
    - Twenty nine (29) trial pits (TP01 to TP29) were excavated over a three (3) day period, from the 25 to the 27 January, during the summer of 2022.
    - Seventeen (17) trial pits (TP30 to TP46) were excavated over a two (2) day period, on 13 and 14 April, during the Autumn of 2022.
- The soil profiles exposed were described in terms of standard terminology as recommended by Jennings et al. (1973) and SAIEG (2001). A representative photograph of each trial pit has been supplied (**Appendix A**) and the trial logs have been captured using a commercially available hatching software dotPLOT (**Appendix B**). The spatial locations of the 29 trial pits is shown in relation to the topocadastral series map (**Map 2**).
- Dynamic Cone Penetrometer (DCP) tests were conducted adjacent to several trial pits to confirm and analyse representative soil consistencies / relative density across the site.
- Bulk samples of the dominant soil types were extracted from to best represent the soil profile(s) on-site. The following laboratory tests were undertaken on the collected bulk samples, and the results are presented in **Section 4**:
    - Foundation Indicators (Grading analysis, Hydrometer Analysis, Atterberg Limits);
    - Moisture/Density relationship (Mod. AASHTO)
    - California Bearing Ratio (CBR);
    - Basson Index test (on groundwater sample collected from TP25).
- A single undisturbed sample was collected, and the are presented in **Section 4**:

All of the collected data was analysed and interpreted to assess the potential geotechnical risks associated with the intended development, general recommendations have been made, and guidance on preliminary foundation solutions have been presented.

# 4. RESULTS

## *4.1 Field Investigation*

The geotechnical reconnaissance investigation involved a site walk over, the excavation of a total of forty-six (46) trial pits and the performance of thirty five (35) drop-weight cone penetrometer (DCP) tests across the site. Excavation and documenting of trial pits TP01 to TP29 took place between 25 and 27 January 2022; and trial pits TP30 to TP46 between 13 and 14 April 2022. The reconnaissance investigation sought to identify and confirm hydrological, hydrogeological and geotechnical features of interest. Relevant surface features were also documented, trial pits excavation was supervised and notes were made on the relative ease of excavation, exposed soil profiles were documented, and representative bulk soil samples were extracted from the exposed soil profiles (**Table 7**). Following excavation of the trial pits each exposed soil profile was logged and photographed (**Appendix A & Appendix B**).

The locations of the trial pits and DCP tests are listed in **Table 7**; spatial locations of the trial pits are shown in on the aerial imagery in **Map 5**. The DCP tests were labelled according to the trial pits next to which they were conducted. The DCP tests were conducted in selected horizons within the trial pits to confirm the soil consistencies recorded during profiling. The DCP results are elaborated upon in **Section 4.3.**

Once the trial pits were logged, DCP tests were conducted and representative soil samples were collected, the general soil conditions across the site were evaluated.

## *4.2 General Soil Profile & Geotechnical Zones*

Following the completion of trial pits, DCP testing and the site walkover, the site was divided into several zones which exhibit similar soil profile characteristics based on the descriptions of the material encountered in the trial pits. Five Geotechnical Zones were delineated, based on laboratory tests and observations made in the trial pits, the Zones have been named and are defined by the following:

- Zone A: Weathered relics fault-bounded blocks/satellite intrusions of the Kuilsriver-Helderberg granitoid of the Cape Granite Suite which is of igneous origin (**Table 3**).
- Zone B: Weathered Tygerberg Formation of the Malmesbury Group rocks of pelitic/sedimentary origin (**Table 4**).
- Zone C: Areas exhibiting characteristics of potentially expansive material, or material prone to settlement, derived from sediments of either the Kuilsriver-Helderberg intrusion or the Weathered sediments of the Tygerberg Formation (or a combination of both) (**Table 5**).
- Zone D: Areas of relatively deep transported aeolian sand (**Table 6**).
- Zone E: Areas with visible ferricrete and/or silcrete present on surface/in outcrop (**Figure 58**).

Note that the descriptions contained in the tables set out below are based on disturbed samples excavated from the trial pits. The Geotechnical Zones are shown spatially in **Map 6.**

***Table 3: Generalised soil profile for Geotechnical Zone A.***

| Depth (mbgl) | Generalised Soil Profile |
|---|---|
| 0.0 – 0.1/0.9 | Pale grey to grey-brown to black (humified) intact to slightly voided very loose to medium dense SAND to gravelly SAND. Transported/hillwash.<br><br>Note: (i) Roots generally present in upper 200 to 500 mm of horizon. (ii) Often includes ferricrete nodules and/or gravels. (i) Poorly developed in areas. |
| 0.0/0.1 – 0.3/1.4 | Red-, yellow- and/or orange-brown medium dense to very dense intact partially cemented NODULAR to HARDPAN FERRICRETE in a sandy matrix. Pedogenic.<br><br>Note: (i) Many times induced refusal. (ii) Nodular and Hardpan horizons often exhibiting honeycomb texture. |
| 0.3/1.4 – 0.6/1.4 | Yellow-/orange-/grey-brown very loose to medium dense intact to pinholed sandy fine GRAVEL. Transported.<br><br>Note: (i) Often partially cemented. (ii) Poorly developed or not present in places. (iii) Typically encountered beneath the ferricrete horizon, except for in TP24. |
| 0.6/1.4 – 0.8/2.2+ | Grey to white blotched/streaked/speckled/strained red-yellow-orange firm to very stiff intact to fissured/shattered gravelly sandy SILT/sandy SILT/sandy clayey SILT/silty CLAY to medium dense to very dense silty SAND or gravelly silty SAND. Residual.<br><br>Note: (i) Often contains ferricrete nodules which increases the gravel content. (ii) Believed to be derived from weathered granitic Kuilsriver-Helderberg Pluton rocks. (iii) Perched water table at between 0.85 and 1.4 mbgl. |

***Table 4: Generalised soil profile for Geotechnical Zone B.***

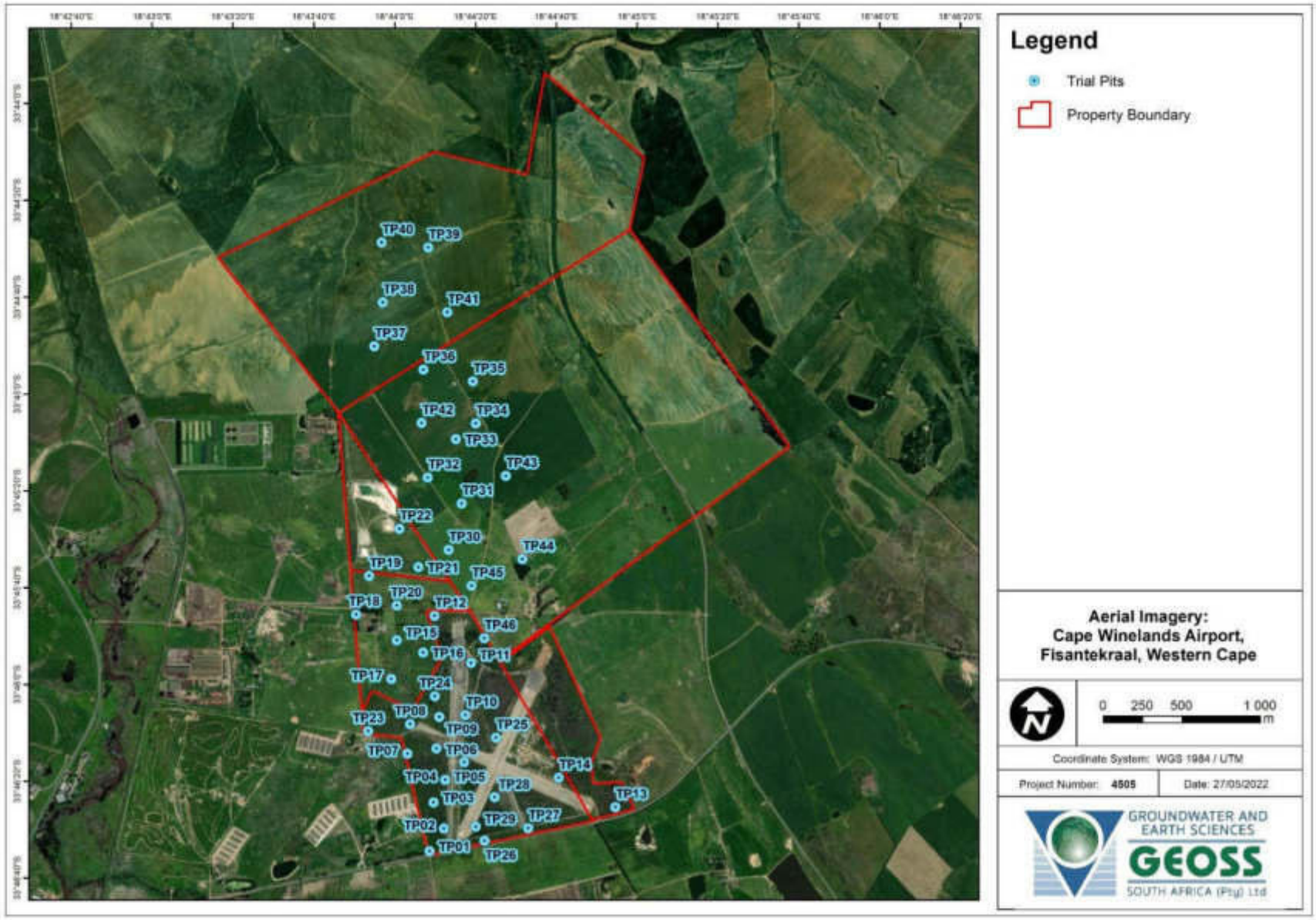
| Depth (mbgl) | Generalised Soil Profile |
|---|---|
| 0.0 – 0.15/0.6 | Light brown to black (humified) very loose to medium dense intact to slightly voided SAND with variable amounts and sizes of ferricrete nodules and/or gravels. Transported/hillwash. |
| 0.15/0.6 – 0.25/0.9 | Red-, yellow- and/or orange-brown medium dense to very dense intact partially cemented NODULAR to HARDPAN FERRICRETE in a sandy matrix. Pedogenic.<br><br>Note: (i) Many times induced refusal. (ii) Nodular and Hardpan horizons often exhibiting honeycomb texture. (iii) This could be considered an extension of the uppermost horizon as the ferricrete nodule concentration typically increases with depth. |
| 0.25/0.9 – 1.6+ | Grey-orange very dense intact gravelly clayey to silty SAND. Residual.<br>Note: (i) Usually encountered in the southern areas. (ii) Believed to underly hardpan ferricrete.<br><br>OR<br><br>Grey blotched/streaked/speckled brown-orange-red and yellow firm to very stiff slightly shattered/fissured silty CLAY. Residual.<br>Note: Believed to be derived from pelitic Malmsbury Group rocks. |

***Table 5: Generalised soil profile for Geotechnical Zone C.***

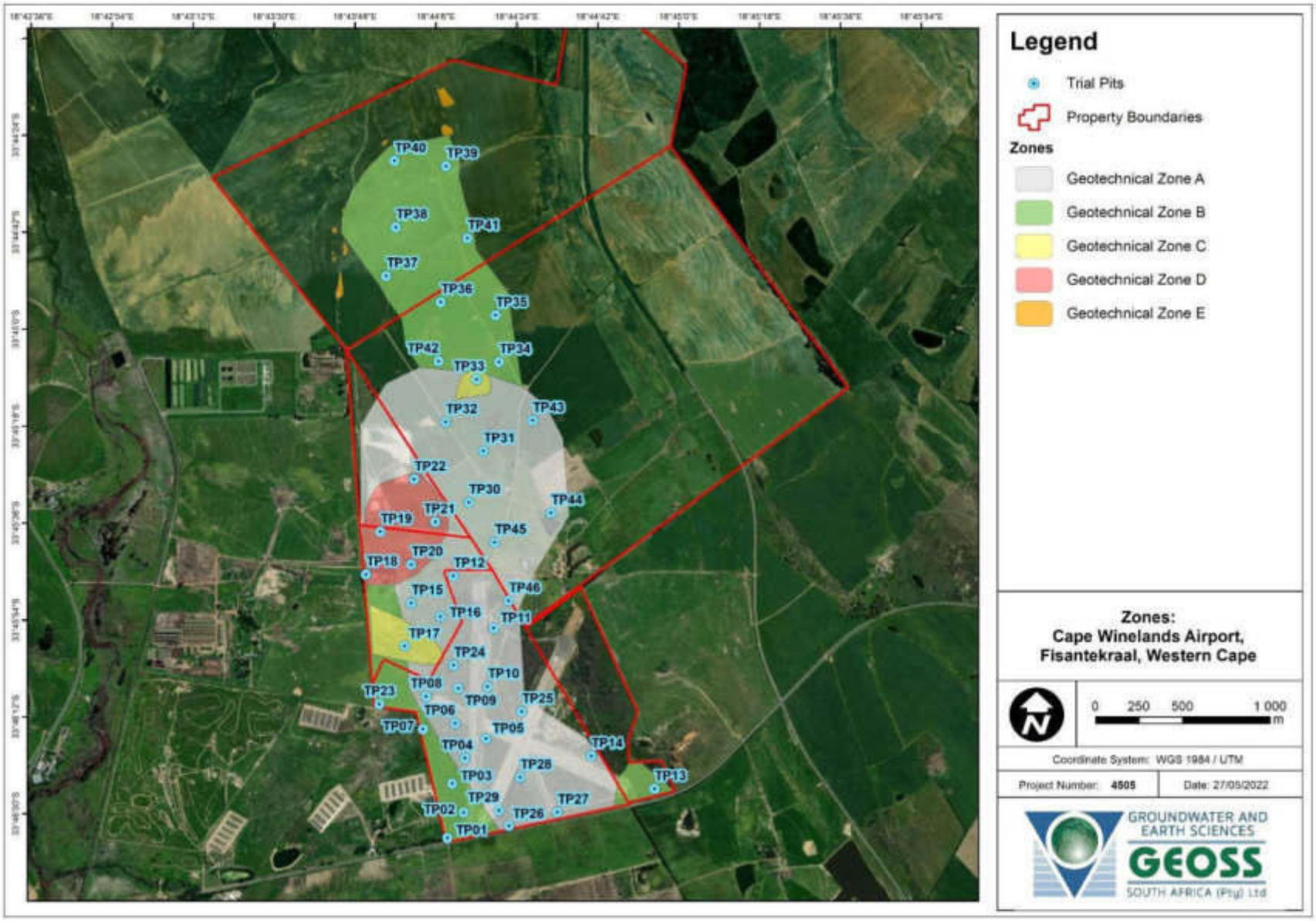
| Depth (mbgl) | Generalised Soil Profile |
|---|---|
| 0.0 – 0.1/0.9 | Light brown to black (humified) very loose to medium dense intact to slightly voided SAND with variable amounts and sizes of ferricrete nodules and/or gravels. Transported/hillwash.<br><br>OR<br><br>Pale grey to grey-brown to black (humified) intact to slightly voided very loose to medium dense SAND to gravelly SAND. Transported/hillwash.<br><br>Note: (i) Roots generally present in upper 200 to 500 mm of horizon. (ii) Often includes ferricrete nodules and/or gravels. (i) Poorly developed in areas. |
| 0.1/0.9 – 0.3/1.4 | Red-, yellow- and/or orange-brown medium dense to very dense intact partially cemented NODULAR to HARDPAN FERRICRETE in a sandy matrix. Pedogenic.<br><br>Note: (i) Many times induced refusal. (ii) Nodular and Hardpan horizons often exhibiting interlocked honeycomb texture. (iii) This could be considered an extension of the nodular horizon as the ferricrete nodule concentration typically increases with depth. |
| 0.3/1.4 – 0.6/1.4 | Yellow-/orange-/grey-brown very loose to medium dense intact to pinholed sandy fine GRAVEL. Transported.<br>Note: (i) Most often overlies sediments of weathered residual Malmesbury Group. |
| 0.6/1.4 – 0.8/2.2+ | Grey blotched/streaked/speckled brown-orange-red and yellow shattered/fissured firm to very stiff silty CLAY. Residual.<br>Note: (i) Typically derived from Malmesbury Group.<br><br>OR<br><br>Grey to white blotched/streaked/speckled/strained red-yellow-orange firm to very stiff intact to shattered/fissured sandy SILT/sandy clayey SILT/silty CLAY<br>Note: (i) Typically derived from Kuilsriver-Helderberg Pluton. |

***Table 6: Generalised soil profile for Geotechnical Zone D.***

| Depth (mbgl) | Generalised Soil Profile |
|---|---|
| 0.0 - >0.5 | Yellow-brown loose to medium dense slightly voided to intact medium SAND. Transported.<br>Note: (i) Area of substantial transported cover. (ii) Underlain by either Malmesbury Group or Cape Granite residual soils and/or bedrock. (iii) Fine grass roots in upper 0.5 m. |




***Map 5: Aerial imagery showing trial pit positions in relation to the property boundaries.***




***Map 6: Aerial imagery showing interpreted Geotechnical Zone boundaries.***

### *4.3 DCP Test Results*

Drop-weight cone penetrometer (DCP) tests were undertaken at selected locations across the site (**Table 7**). A summary of the DCP test data collected on site is shown in **Figure 4.** The DCP tests undertaken within the uppermost (<1 mbgl) transported/hillwash material revealed a high degree of variability. The consistency of the mostly cohesionless SAND with ferricrete and/or gravel showed variation between very loose and very dense (or very soft and very stiff; **Figure 4**). The variation is believed to be due to the considerable variation in depth at which the NODULAR to HARPAN FERRICRETE pedogenic was intersected (ranging from surface to about 1.1 mbgl. The NODULAR to HARPAN FERRICRETE pedogenic horizon exhibited variation in consistency between loose and very/extremely dense (or soft to very stiff; **Figure 4**). Generally, the greater the degree of cementation was greater the consistency was greater. The material underlying the ferricrete ranged from mostly granular to mostly cohesive materials with consistencies ranging between medium dense and dense or firm and very stiff (**Figure 4**).

To gain an appreciation of the general consistencies of the materials beneath the site, the third quartile (Q3) of the DCP data was plotted with depth increments of 0.3 mbgl (**Figure 4**). These data show that for the same units described above (that 75% of all data points/on average) range in consistency as indicated below (the bounds of consistencies shown in brackets are displayed on figure):

- Transported materials (assumed to be ~0.3 mbgl): loose (or firm).
- Mostly ferricrete horizons (assumed to be between 0.3 and 1.0 mbgl): medium dense (or very stiff).
- Mostly residual materials (assumed >1.5 mbgl): stiff to very stiff; increasing with depth (medium dense to very dense with depth).

The high degree of variability (and outliers) displayed by most (if not all) horizons is likely due to notes mentioned above as well as the disturbed nature of some of the soils when undertaking the DCP tests. Disturbance is due to excavation of the respective horizons, e.g. to expose the underlying material beneath the nodular to hardpan ferricrete horizon the TLB excavated the ferricrete out exposing and disturbing the uppermost surface of the underlying material.

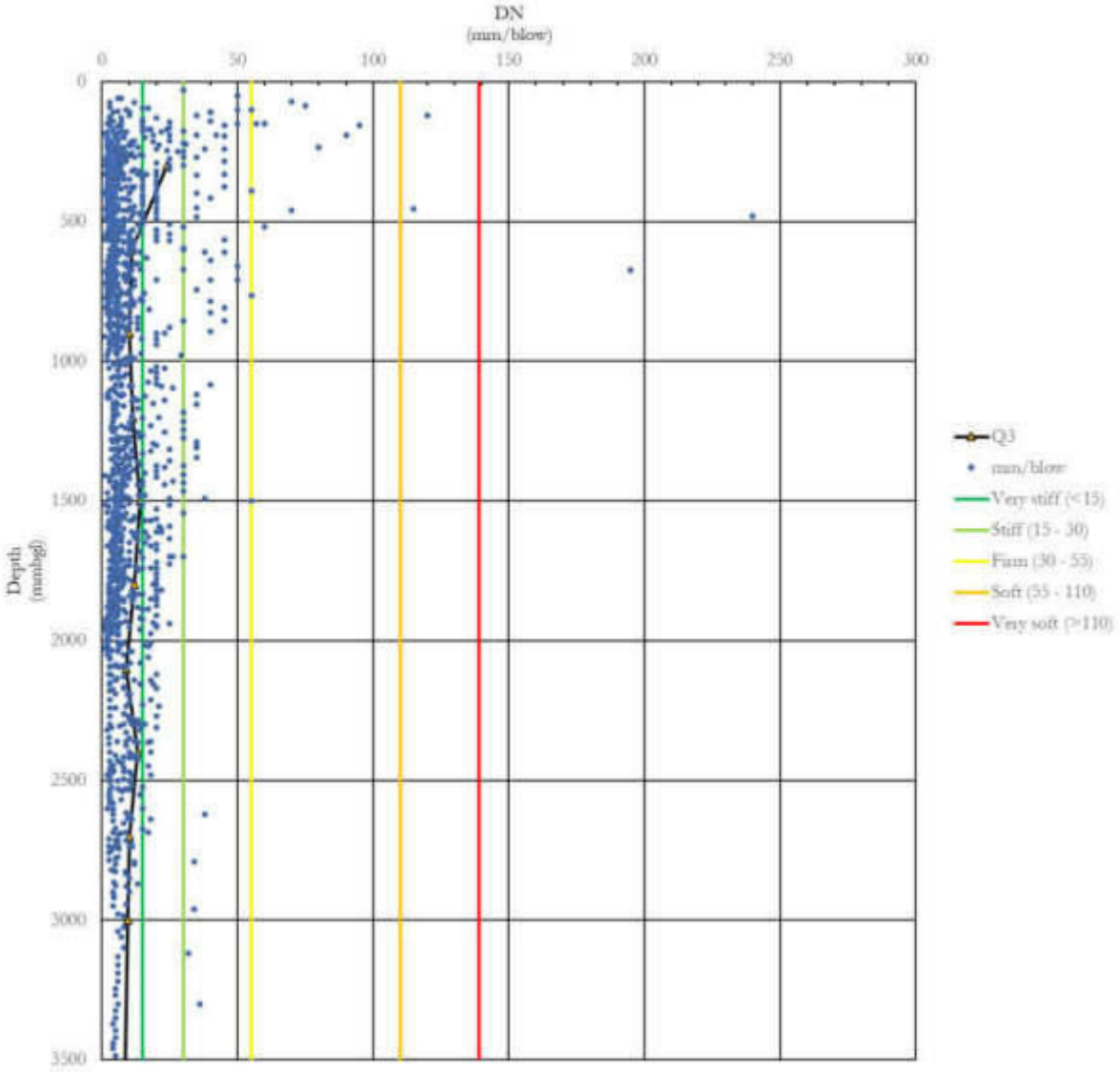



***Figure 4: DCP Test results plotted with the third quartile (Q3) of all tests undertaken; cohesive material interpretation boundaries shown.***

### *4.4 Laboratory Test Results*

A total of sixteen (16) bulk disturbed soil samples were collected from selected trial pits and submitted to a commercial laboratory for analysis. The laboratory classification tests served to determine the general mechanical/engineering properties of the soils encountered on-site. The samples were analysed for the following:

- Foundation Indicators (particle size/grading, hydrometer, and Atterberg Limits tests) (**Table 8**) and/or;
- Moisture density relationships, Specific Gravity (SG) and California Bearing Ratios (**Table 9**).
- Double oedometer analysis (**Appendix E**).

The single double oedometer test sought to determine the compressibility and heave properties of the residual material, as a typical example for the area. It should be noted; however, that conditions may vary locally.

Further, groundwater was intersected in two trial pits TP15 and TP25 in January 2022, and in a single trial pit TP33 in April 2022. A single groundwater sample was collected from TP25 and was submitted to a commercial laboratory for chemical analysis (**Appendix E**). A summary of the results is contained in **Table 10**. The pH of the groundwater sample is 6.7, which classes the water as moderately aggressive (Basson 1989). The Final Aggressiveness Index of 1777 classes the water as Very highly aggressive (Basson, 1989). Therefore, counter measures will be required, i.e. the concrete of the foundation bases in contact with groundwater will require protection, and any steel reinforcement within such bases should be covered by at least 30 mm of concrete. The advice of a specialist concrete and/or steel technologist/manufacturer should be sought in regard to final designs of cement coating and concrete protection of steel reinforcement. General guides for the assessment of the Final Aggressiveness Index have been presented in **Appendix E & G**.

***Table 7: Summary of trial pit data.***

| ID | Latitude (DD, WGS84) | Longitude (DD, WGS84) | Elevation (mamsl) | TP EOH (mbgl) | Samples | DCP No.: |
|---|---|---|---|---|---|---|
| TP01 | -33.7763 | 18.7356 | 125 | 0.7 | - | - |
| TP02 | -33.7750 | 18.7366 | 127 | 0.7 | - | - |
| TP03 | -33.7735 | 18.7359 | 126 | 0.6 | - | - |
| TP04 | -33.7722 | 18.7367 | 126 | 1.8 | 18589 | 4 |
| TP05 | -33.7712 | 18.7380 | 126 | 0.8 | - | - |
| TP06 | -33.7704 | 18.7361 | 126 | 2.0 | - | 6 |
| TP07 | -33.7707 | 18.7341 | 123 | 2.0 | - | 7 |
| TP08 | -33.7690 | 18.7343 | 124 | 1.9 | - | |
| TP09 | -33.7686 | 18.7363 | 125 | 0.8 | - | - |
| TP10 | -33.7685 | 18.7381 | 124 | 0.8 | - | 10 |
| TP11 | -33.7655 | 18.7385 | 123 | 2.1 | - | 11 |
| TP12 | -33.7628 | 18.7360 | 120 | 2.0 | 18590; 18591 | 12 |
| TP13 | -33.7738 | 18.7484 | 126 | 1.6 | - | - |
| TP14 | -33.7721 | 18.7445 | 128 | 2.0 | 18592; 18593 | 14 |
| TP15 | -33.7642 | 18.7334 | 117 | 1.7 | 18594 | 15 |
| TP16 | -33.7649 | 18.7352 | 119 | 1.6 | - | - |
| TP17 | -33.7664 | 18.7330 | 119 | 1.9 | 18595 | 17 |
| TP18 | -33.7627 | 18.7306 | 122 | 1.2 | 18596; 18597 | 18 |
| TP19 | -33.7605 | 18.7315 | 117 | 0.8 | - | - |
| TP20 | -33.7622 | 18.7334 | 120 | 0.8 | - | - |
| TP21 | -33.7600 | 18.7349 | 119 | 2.2 | - | 21 |
| TP22 | -33.7578 | 18.7336 | 119 | 1.8 | 18598 | 22 |
| TP23 | -33.7694 | 18.7314 | 121 | 1.9 | - | 23 |
| TP24 | -33.7674 | 18.7360 | 123 | 2.0 | - | 24 |
| TP25 | -33.7698 | 18.7402 | 125 | 1.4 | 18599; 18600 | 25 |
| TP26 | -33.7757 | 18.7394 | 128 | 1.7 | 18601 | 26 |
| TP27 | -33.7750 | 18.7424 | 127 | 1.9 | - | 27 |
| TP28 | -33.7732 | 18.7401 | 126 | 1.75 | - | 28 |
| TP29 | -33.7749 | 18.7388 | 126 | 0.8 | - | - |
| TP30 | -33.7590 | 18.7370 | 115 | 1.5 | - | 30 |
| TP31 | -33.7564 | 18.7379 | 113 | 3.0 | - | 31 |
| TP32 | -33.7549 | 18.7356 | 112 | 2.4 | - | 32 |
| TP33 | -33.7527 | 18.7375 | 103 | 2.5 | - | 33 |
| TP34 | -33.7518 | 18.7389 | 97 | 3.0 | 20003 | 34 |
| TP35 | -33.7493 | 18.7387 | 94 | 1.6 | - | 35 |
| TP36 | -33.7487 | 18.7353 | 105 | 1.5 | - | 36 |
| TP37 | -33.7473 | 18.7319 | 99 | 1.5 | - | 37 |
| TP38 | -33.7448 | 18.7325 | 100 | 1.4 | - | 38 |
| TP39 | -33.7417 | 18.7356 | 97 | 1.6 | - | 39 |
| TP40 | -33.7414 | 18.7324 | 107 | 2.1 | 20001 | 40 |
| TP41 | -33.7454 | 18.7369 | 89 | 1.7 | - | 41 |
| TP42 | -33.7517 | 18.7351 | 111 | 1.5 | 20002 | 42 |
| TP43 | -33.7548 | 18.7409 | 106 | 2.0 | - | 43 |
| TP44 | -33.7596 | 18.7420 | 104 | 1.6 | - | 44 |
| TP45 | -33.7611 | 18.7386 | 116 | 2.0 | - | 45 |
| TP46 | -33.7641 | 18.7394 | 120 | 1.6 | - | 46 |

Note: EOH – End of Hole.

***Table 8: Summary of grading analysis.***

| Sample No. (TP##) | Depth (m) | Soil Type | Grading Analysis | | | | LS % | LL % | PI % | Pot. Exp. | GM | USCS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Clay % | Silt % | Sand % | Gravel % | | | | | | |
| 18589 (TP4) | 1.7 | Red-white sandy clayey SILT | 17 | 19 | 47 | 17 | 8.1 | 33 | 15 | Low | 1.10 | SC |
| 18590 (TP12) | 0.0 – 0.6 | Brown gravelly SAND | 2 | 7 | 82 | 9 | 0.0 | NP | NP | Low | 1.42 | SP |
| 18591 (TP12) | 0.75 – 1.2 | Yellow-brown/orange gravelly SAND | 2 | 5 | 66 | 27 | 0.0 | NP | NP | Low | 1.82 | SP |
| 18592 (TP14) | 0.0 – 0.45 | Orange-brown sandy GRAVEL | 1 | 3 | 34 | 62 | 0.0 | NP | NP | Low | 2.35 | SP |
| 18593 (TP14) | 1.5 – 2.0 | Red-grey gravelly silty SAND | 12 | 11 | 58 | 19 | 7.9 | 32.2 | 15.7 | Low | 1.44 | SC |
| 18594 (TP15) | 0.9 – 1.7 | Orange-grey gravelly silty SAND | 16 | 11 | 61 | 12 | 6.0 | 27 | 9.8 | Low | 1.17 | SC |
| 18595 (TP17) | 0.0 – 1.9 | Brown SAND | 3 | 3 | 93 | 1 | 0.0 | NP | NP | Low | 1.13 | SW |
| 18596 (TP18) | 0.2 – 0.6 | Brown sandy GRAVEL | 6 | 1 | 32 | 61 | 0.0 | NP | NP | Low | 2.29 | GP |
| 18597 (TP18) | 0.6 – 1.0 | Red-brown silty CLAY | 55 | 30 | 11 | 4 | 18.9 | 79.9 | 41.8 | V.High | 0.25 | MH or OH |
| 18598 (TP22) | 0.5 – 2.0 | White-grey silty CLAY | 24 | 74 | 1 | 1 | 6.2 | 48 | 16.8 | Med. | 0.04 | ML or OL |
| 18599 (TP25) | 0.0 – 0.7 | Reddish-brown gravelly SAND | 3 | 5 | 47 | 45 | 0.0 | NP | NP | Low | 2.02 | SP - SC |
| 18600 (TP25) | 0.9 – 1.4 | Orange-grey sandy SILT | 15 | 18 | 60 | 7 | 4.5 | 24 | 8.6 | Low | 1.06 | SC |
| 18601 (TP26) | 1.0 – 1.7 | Orange-grey gravelly silty SAND | 12 | 10 | 66 | 12 | 7.3 | 36.9 | 13 | Low | 1.38 | SC |
| 20003 (TP34) | 1.2 | Brown sandy CLAY | 44 | 7 | 49 | - | 9.2 | 43.5 | 19.2 | Low | | |
| 20001 (TP40) | 0.5 – 1.1 | Orange clayey SILT | 19 | 62 | 18 | 1 | 7.8 | 28.8 | 14.6 | Med. | | |
| 20002 (TP42) | 0.8 | Grey-orange clayey SILT | 24 | 69 | 5 | 2 | 7.6 | 34.6 | 15.6 | Med. | | |

NOTES: LL - Liquid Limit LS - Linear Shrinkage USCS – Unified Soil Classification System
NP – Non-plastic GM – Grading Modulus Pot. Exp. – Potential Expansiveness
PI - Plasticity index

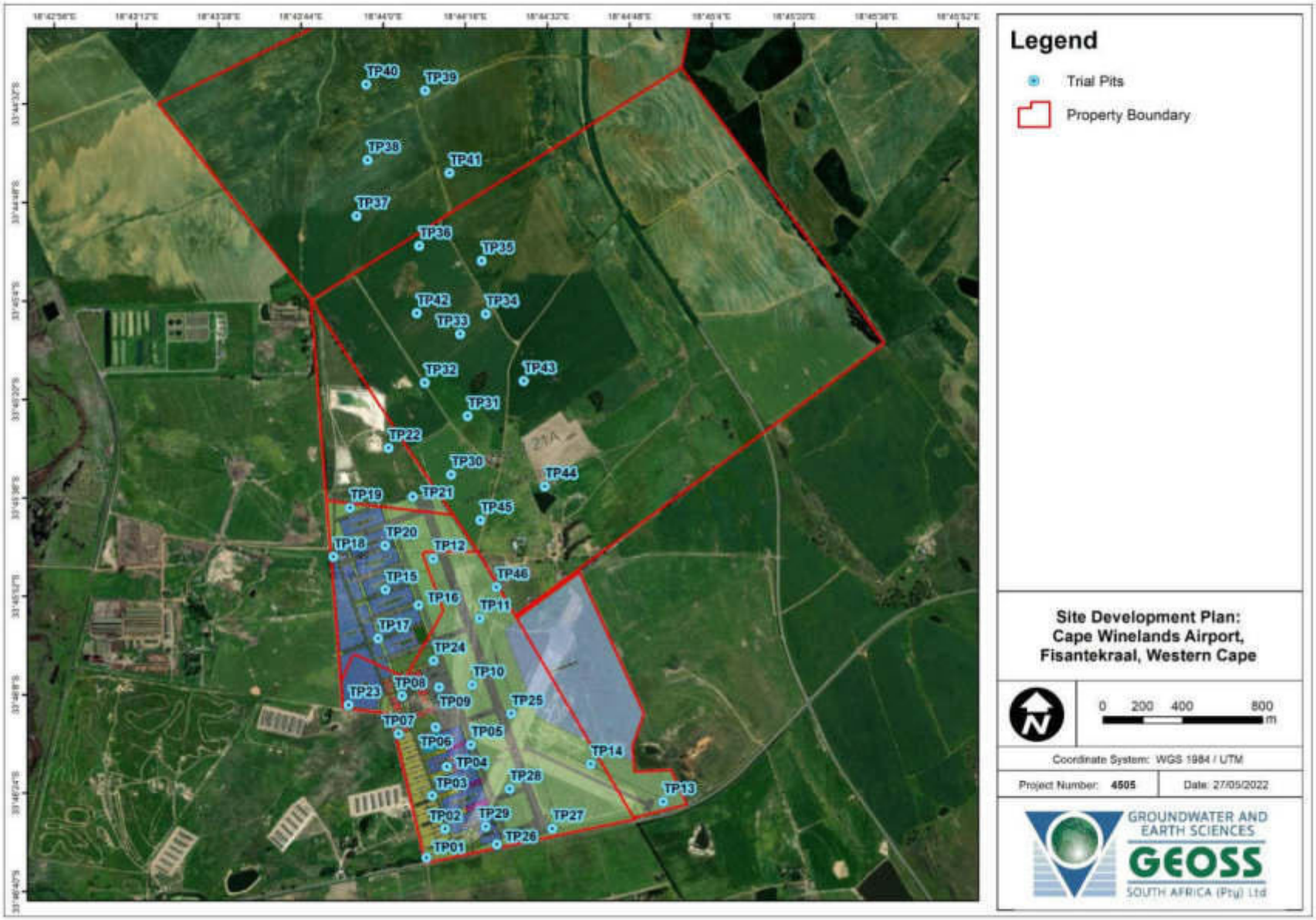
***Table 9: Summary of CBR and moisture density analyses.***

| Sample No. (TP##) | Sample depth (mbgl) | CBR @ (##%) | | | | | Gs | MDD kg/m³ | OMC % | NMC % |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 100 | 98 | 95 | 93 | 90 | | | | |
| 18589 (TP4) | 1.7 | 4 | 3 | 2 | 1 | 1 | 2.660 | 2102 | 10.2 | 1.5 |
| 18590 (TP12) | 0.0 – 0.6 | 17 | 14 | 10 | 8 | 5 | 2.604 | 1909 | 12.1 | 2.1 |
| 18591 (TP12) | 0.75 – 1.2 | 16 | 13 | 9 | 7 | 5 | 2.577 | 2030 | 9.2 | 1.2 |
| 18592 (TP14) | 0.0 – 0.45 | 75 | 50 | 40 | 30 | 21 | 2.604 | 2120 | 8.3 | 1.2 |
| 18593 (TP14) | 1.5 – 2.0 | 19 | 14 | 8 | 5 | 3 | 2.632 | 2025 | 12.2 | 4.2 |
| 18594 (TP15) | 0.9 – 1.7 | 17 | 11 | 5 | 3 | 2 | 2.660 | 2022 | 12.5 | 7.3 |
| 18595 (TP17) | 0.0 – 1.9 | 14 | 10 | 7 | 6 | 4 | 2.577 | 1808 | 12.3 | 4.5 |
| 18596 (TP18) | 0.2 – 0.6 | 50 | 39 | 26 | 20 | 13 | 2.632 | 2240 | 7.3 | 4.5 |
| 18597 (TP18) | 0.6 – 1.0 | 1 | 1 | 1 | 1 | 1 | 2.747 | 1788 | 14.3 | 15.8 |
| 18598 (TP22) | 0.5 – 2.0 | 1 | 1 | 1 | 1 | 1 | 2.747 | 1745 | 13.4 | 15.6 |
| 18599 (TP25) | 0.0 – 0.7 | 27 | 20 | 13 | 10 | 6 | 2.577 | 2047 | 9.2 | 4.4 |
| 18600 (TP25) | 0.9 – 1.4 | 14 | 12 | 9 | 7 | 5 | 2.632 | 2143 | 8.2 | 4.5 |
| 18601 (TP26) | 1.0 – 1.7 | 15 | 11 | 8 | 6 | 4 | 2.632 | 2008 | 12.4 | 5.9 |
| 20003 (TP34) | 1.2 | - | - | - | - | - | 2.747 | - | - | 13.5 |
| 20001 (TP40) | 0.5 – 1.1 | - | - | - | - | - | 2.660 | - | - | 15.7 |
| 20002 (TP42) | 0.8 | - | - | - | - | - | 2.688 | - | - | 11.4 |

NOTES: CBR - California bearing ratio Gs – Specific Gravity MDD - Maximum Dry Density
OMC - Optimum moisture content NP – Non-plastic NMC – Natural Moisture Content

***Table 10: Summary of Basson Index analyses results.***

| **Sample No. (Trial Pit No.)** | 4505_C_TP25 (TP25) |
|---|---|
| **Depth (mbgl)** | 0.85 |
| **pH** | 6.7 |
| **EC (mS/m)** | 31.8 |
| **Chloride as Cl** | 31 |
| **Sulphate as $SO_4$** | 34 |
| **Langelier Index** | -2.0 |
| **Leaching Index** | 1772 |
| **Ryznar Index** | 10.7 |
| **Corrosivity Ratio** | 2.5 |
| **Spalling Index** | 5 |
| **Final Aggressiveness Index** | 1777 |




***Map 7: Aerial map showing locations of trial pits superimposed on the Site Development Plan.***

# 5. GEOTECHNICAL INTERPRETATION & RECOMMENDATIONS

## *5.1 Site Geology and Soils Profile*

Based on the following:

- Published geological data,
- Geological, geotechnical and geophysical investigations undertaken by GEOSS in the region, and;
- Geotechnical reconnaissance investigations carried out by the Council for Geoscience in the area,

the site is known to be situated an area that typically shows surficial sandy and/or loamy quaternary/transported sediments of variable thickness and quantities of quartzitic sand and ferricrete gravel (which may also be present at the surface). These more recent deposits overly a basement rocks that are of variable origins, i.e. either of igneous (granitic) or sedimentary (pelitic).

## *5.2 Groundwater and drainage*

Groundwater was intersected in trial pits TP14 and TP25 in February 2022; and in TP33 in April 2022. General seepages were encountered at 1.5, 0.9, and 1.4 mbgl, respectively in TP14, TP25, and TP33. These seepages were observed to emanate from the lower transported sandy angular fine GRAVEL unit, which typically occurred beneath the pedogenic horizon. The perched water table rose to 1.0 and 0.85, respectively for TP14 and TP25 after approximately 1 hour of the trial pits remaining open.

Although groundwater/seepage was not encountered in the other trial pits excavated across the site, the development of a perched water table should not be discounted; particularly after periods of heavy rainfall, or following a winter season of above average annual rainfall. Due to occurrence of perched water table and low permeability of substratum across the site - storm water that cannot be directed to natural topographic run-offs will need to be directed to appropriately designed & engineered soakaways.

Open excavations in sand-dominated materials exceeding 1 m in depth should be shored to 30°, and excavations in cohesive soils can be battered to 45°.

Stormwater should be directed to municipal stormwater infrastructure, or an appropriately designed stormwater soakaway.

## *5.3 Slope stability and bracing*

It is important to mention that beneath a depth as shallow as 0.85 mbgl groundwater seepage is encountered. This induces slumping/collapse of the granular mostly cohesionless material horizons. Excavations should be suitably battered for foundation placement, additional support in the form of sand bags (placed at toe of excavations) or other suitable temporary support measures may be required.

Hazardous conditions must be expected when the trenches are exposed to wet weather conditions. Collapse of the sidewalls normally occurs without any warning. Safe working conditions must therefore be ensured in all trenches deeper than 1.0 mbgl, or beneath the nodular to hardpan ferricrete horizons. This can be achieved by either shoring the sidewalls or battering them back at a safe angle, e.g. 30° for mostly cohesionless materials and 45° for materials which are largely cohesive.

## *5.4 Excavation Conditions*

### 5.4.1 Transported materials

The granular surficial gravelly sands are classified as soft excavation in terms of SANS 1200D.

### 5.4.2 Pedogenic materials

The pedogenic material encountered in the trial pits is variably cemented across the site. In general, the pedogenic material classifies as soft to intermediate excavation (SANS 1200D). Indurated hardpan ferricrete horizons may require pneumatic/hydraulic rock-breaking apparatus (e.g. a Montabert) during excavation.

### 5.4.3 Residual materials

Residual horizons showed excavation of soft to intermediate with depth (SANS 1200D).

## *5.5 Preliminary Foundation Modelling*

### 5.5.1 Pad foundations

Based on the observations made in the trial pits, the results of the dynamic cone penetrometer tests, and preliminary modelling, the maximum bearing capacities have been calculated based on Meyerhoff method (**Table 11**). The following parameters were used during the preliminary modelling:

- Friction angle (φ'): 33°
- Cohesion (c'): 0 kPa
- Bulk unit weight: 19.5 kN/m$^3$
- Saturated unit weight: 21 kN/m$^3$
- Water table depth: 0.5 mbgl (worst case).
- Founding depth: 1.0 mbgl.

***Table 11: Allowable bearing capacities***

| Pad Dimension ($m^2$) | Allowable Bearing Capacity (kPa) |
|---|---|
| 0.75 | 278 |
| 1.00 | 282 |
| 1.25 | 291 |
| 1.50 | 301 |
| 2.00 | 325 |

The final depth and design of the founding(s) should be subject to the discretion of the engineer and based on site specific geotechnical investigations for each of the structures as per the SAICE code of practice.

### 5.5.2 Strip footings

The nodular to hardpan ferricrete horizons will very likely provide more than adequate bearing capacity for typical supporting infrastructure, e.g. single story masonry structures. However, due to the laterally discontinuous nature of the ferricrete horizon, site specific investigations should be conducted for such structures.

### 5.5.3 Anticipated settlements

Estimated immediate settlements range between 17 and 29 mm, depending on the loads imposed on the founding stratum (**Table 12**).

***Table 12: Estimated immediate settlement results***

| | Settlement (mm) for a given pressure (*kPa)* : | | |
|---|---|---|---|
| **Pad dimensions ($m^2$)** | ***150*** | ***200*** | ***250*** |
| **2.0** | 16.6 | 22.7 | 28.9 |

### 5.5.4 Anticipated heave

The area delineated as 'Geotechnical Zone D', has been interpreted to be potentially expansive, based on observations made in the trial pits and the characterisation test results obtained from the laboratory. Anticipated heave was calculated based on the Weston (1980) method of heave determination. Weston's method of heave determination is based on the weighted liquid limit, moisture content and overburden pressure the material is subjected to, the following percentage swell can be expected at the surface (**Table 13**). The predicted heave varied between 0.05% and 50% of the layer thickness. It is important to point out that heave has been predicted by Weston (1980) outside the region delineated as potentially expansive due to elevated liquid limits of the residual material encountered in TP4 (sample 18598).

***Table 13: Anticipated heave at given pressures and layer thicknesses for pad footings.***

| Pressure (kPa) | | 1 | 1 | 1 | 50 | 50 | 50 | 200 | 200 | 200 |
|---|---|---|---|---|---|---|---|---|---|---|
| *Layer thickness beneath footing (mm)* | | *500* | *1000* | *2000* | *500* | *1000* | *2000* | *500* | *1000* | *2000* |
| TP04 (1.7m) | Heave at surface (mm) | 249 | 499 | 998 | 55 | 110 | 220 | 32 | 65 | 129 |
| TP14 (1.5 – 2.0) | | 5 | 9 | 18 | 1 | 2 | 4 | 1 | 1 | 2 |
| TP15 (0.9 – 1.7) | | 3 | 5 | 10 | 1 | 1 | 2 | 0 | 1 | 1 |
| TP18 (0.6 – 1.0) | | 180 | 360 | 721 | 40 | 80 | 159 | 23 | 47 | 93 |
| TP22 (0.5 – 2.0) | | 33 | 67 | 134 | 7 | 15 | 30 | 4 | 9 | 17 |
| TP25 (0.9 – 1.4) | | 5 | 9 | 19 | 1 | 2 | 4 | 1 | 1 | 2 |
| TP26 (1.0 – 1.7) | | 4 | 7 | 15 | 1 | 2 | 3 | 0 | 1 | 2 |

Potentially expansive materials were also encountered within the region that has been proposed for future development, i.e. within trial pits TP30 to TP46. The materials tested showed low to medium potential expansiveness, which are similar to the results presented in the table above. Structures should be preliminarily designed accordingly.

### 5.5.5 Compressibility Index

A sample of undisturbed residual material was extracted at a depth of 0.8 mbgl from trial pit TP42. This sample was submitted to an accredited laboratory for the determination of compressibility and expansive properties. The coefficient of volume compressibility ($M_v$) of this sample was computed based on the results of the saturated double oedometer test:

$M_v = 0.0004431\ m^2/kN$

A stress increment of 100 $kN/m^2$ was used to determine the above result (Knappett and Craig, 2012).

## *5.6 Sub-Grade Modulus*

### 5.6.1 Transported Materials

The modulus variation ($n_h$) of the sand-dominated materials is anticipated to be as low as 2.5 $MN/m^3$, or less, to about 20.0 $MN/m^3$ with depth. Based on the modulus of variation the expected modulus of subgrade reaction ($k_h$) can be calculated for piles using the following formula:

$$k_h = {}^{n_h x\, Z}/_{B}$$

Where, Z is the depth in metres and B is the pile breadth (m) (after, Franki 2019).

### 5.6.2 Transported Materials

The modulus subgrade reaction of the firm mostly cohesive residual materials is anticipated to be greater than 18 $MN/m^3$, increasing proportionally with increased consistency (after, Franki 2019).

## *5.7 **Reuse of in-situ soil***

### 5.7.1 Material classifications according to TRH14

The transported materials encountered in Geotechnical Zone D do not meet the classification criteria of G9 materials, due to insufficient CBR values at 93% Mod AASHTO density.

The transported sediments mixed with considerable proportions of ferricrete nodules and gravels classify as at least G8. With increasing proportions of ferricrete nodules this CBR value is anticipated to increase.

The residual materials encountered in all of the trial pits classify as G9 or worse due to the often low CBR values.

### 5.7.2 Runway & Layer Works

Regarding the preparation of the runway, all surficial materials (0 – 0.2 mbgl) containing vegetation or other organics must be removed and either spoiled off site, or stockpiled for later incorporation in future landscaping operations. The resultant surface (that is free of organics) should be 'ripped and mixed' to a depth of about 0.5 m below the prepared surface of the transported horizon, which is devoid of organics. This serves to blend the remaining transported sediments and nodular ferricrete horizon (refer to samples 18599, 18596, 18590, 18592). The ripped and mixed material should be placed in 150 mm thick layers and compacted to at least 95% MOD AASHTO density. The resultant surface must yield a minimum CBR value of 15 (once compacted). The resultant prepared surface is anticipated to serve as an appropriate lower and upper subbase. The project engineer is to advise on the final design for the subbase, base and seal for runway and taxiing areas according to expected design air traffic loadings.

The resultant densities achieved for the respective layer works horizons should checked in 10 m intervals using a Troxler density device, for the length of the runway.

It is important to mention that material encountered in the northern extent of the property, i.e. north of trial pits TP12 and TP15, residual materials possess considerably greater cohesive components, which dramatically reduce the CBR values (TP18 to TP22, refer samples 18591, 18597, 18598). For reference see **Table 7**. Such cohesive materials should be removed and spoiled off site.

The ripped and compacted material from the southern extent of the site should be sufficient to infill the resultant 'void' created by the removal of the spoiled mostly cohesive material in the northern extent of the present site. Further, any additional material required to supplement the construction of the runway and taxiing area, could be sourced from south- and north-western portions of the site, particularly from excavations required for the construction of the commercial and aviation development areas in the southwestern portion of the site.

Reuse of excavated material for general pavement construction should be at the site engineers' discretion, and is expected to only be suitable for LSSG course. The following generalised layer works are recommended:

| | | | |
|---|---|---|---|
| • Seal | Cape Seal | 13/19 mm | to be specified by engineer |
| • Base | Imported G2/G3 | 150 mm | 100% MMD |
| • Subbase | Imported G5 | 150 mm | 95% MDD |
| • USSG | Imported G7 | 150 mm | 93% MDD |
| • LSSG | Imported / in-situ G7 | 150 mm | 100 % MMD |

# 6. CONCLUSIONS

This report summarises the results from a Phase I Geotechnical Investigation that aimed to determine and classify the engineering properties on the site proposed for development, and to provide preliminary recommendations for the geotechnical design and further investigations required for the proposed structures. The most pertinent findings from this Phase I investigation are as follows:

- The site is covered by a surficial horizon of mostly cohesive transported soil, which is underlain by a laterally discontinuous and variably cemented nodular to hardpan ferricrete pedogenic horizon. These strata are underlain by residual materials derived from either the Cape Granite Suite or the Malmesbury Group.
- From a geotechnical standpoint, site development should proceed; however, there are potential geotechnical challenges with development of this site. There is a great degree of variability within the composition of the residual materials, and consequently, there are areas across the site that present a risk of highly expansive soils, and may be subject to high consolidation.
- Due to the variation in topography within the northern extent of the property, considerable fill will be required, should the development be extended from the present level at which the Fisantekraal Airport is situated. In this case a suitable granular fill will need to be imported; materials could be sourced locally, but would need to be sieved and mixed in appropriate proportions.
- The tractor loader backhoe was unable to penetrate materials with consistencies of very dense and/or very stiff, and beyond. However, it is anticipated that in unrestricted excavations, and/or with prior ripping, conventional light earth-moving equipment could carry out the bulk of the earthworks. All materials encountered in the trial pits classified as soft to intermediate excavation (SANS 1200D). The hardpan ferricrete horizons may require rock-breaking apparatus in areas of the site.
- A series of site-specific follow-up geotechnical investigations will be required prior to the construction of individual structures, which should include field and laboratory tests to more accurately reflect/characterise the mechanical properties (e.g. consolidation settlement) of the variable residual soils.
- In the case of larger structures, where deeper foundations/piling is required, it would be prudent to consider a series of exploratory drilling to determine whether core stones exist within the areas underlain by residual granite as these may present challenges for construction. Consolidation settlement is anticipated to guide the foundation design of larger structures.
- The site is characterised by a laterally discontinuous perched water table, which may be seasonally exacerbated. The perched groundwater table was intersected on-site at between 0.85 and 1.0 mbgl in trial pits TP14 and TP25, respectively; and at 1.4 mbgl in TP33. Excavations deeper than 1.0 mbgl will require battering to ensure safe working conditions. Excavation required should be undertaken during the summer, when rainfall is at a minimum, which provides for more favourable safe working conditions.
- Final designs should appropriately cater for aggressive and corrosive groundwater and/or soil conditions.

- Drainage precaution will be required on-site, this would entail diverting rainwater away from the perimeter walls of structures and paved areas (i.e. taxi areas and runway) to limit the ingress of moisture into the founding stratum and basecourse horizons.
- Preliminary modelling has been carried out to determine potential bearing capacities, using assumed loads and several foundation dimensions. Structure specific investigations and additional testing would be required to verify these results. The foundation solution that is to be adopted each structure on-site will depend on the cost and of implementation, and the risk associated with the said solution.
- Every effort has been made to ensure the accuracy of the information presented in this report. It must be stressed that naturally occurring materials are never uniform, and results of a field investigation only provide a limited view of the subsurface conditions. Considerable lateral and vertical variation can occur over short distances, and deviations from the presented results may be encountered on-site. Therefore, as a precautionary measure, potential geotechnical variations in the subsurface (i.e. inspection of excavation slopes, pile and founding conditions) should be inspected and approved by a suitably qualified professional.

# 7. ASSUMPTIONS AND LIMITATIONS

It should be noted that the results of the laboratory analyses presented in this report were undertaken on representative bulk disturbed samples, and therefore, some degree of variability may be encountered on-site. We have assumed that the laboratory results accurately reflect the in-situ conditions.

The results presented are based on trial pits excavated to depths of between 0.6 and 2.2 mbgl, this only provides information at discrete locations across the site, and interpolation was conducted across considerable distances. Geotechnical zones have been delineated using such interpolation, using trial pit, dynamic cone penetrometer and laboratory data; therefore, variation across/within the zone boundaries may be encountered on-site. Geotechnical Zone D was delineated based on two trial pits (TP17 and TP33), which have been interpreted to be transported sediments that had infilled a low-lying areas.

Due to the variability in soil conditions encountered on-site, the results contained in this report cannot be applied to all structures across the site. The settlement results presented reflect settlements expected during the construction period, more investigation should be undertaken prior to modelling of consolidation settlements. Little information is available for the design of the proposed structures, and therefore, the results presented in this report are of a preliminary nature. The results presented are subject to confirmation during site specific investigation and more detailed testing.

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# 9. APPENDIX A: TRIAL PIT PHOTOS

| *TP01* | *TP02* |
| --- | --- |
|  |  |
| *TP03* | *TP04* |
|  |  |

***Figure 5: TP01 to TP04.***

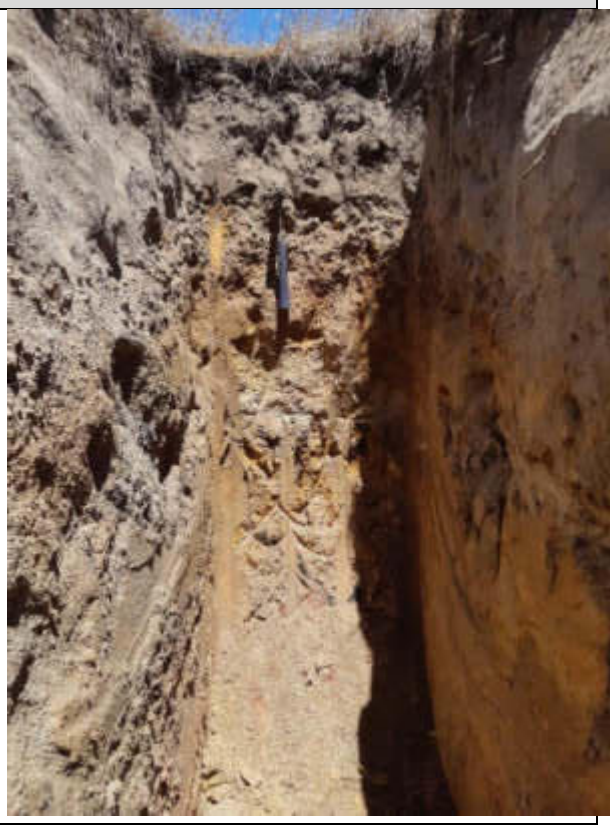
| *TP05* | *TP06* |
| --- | --- |
|  |  |
| *TP07* | *TP08* |
|  |  |

***Figure 6: TP05 to TP08.***

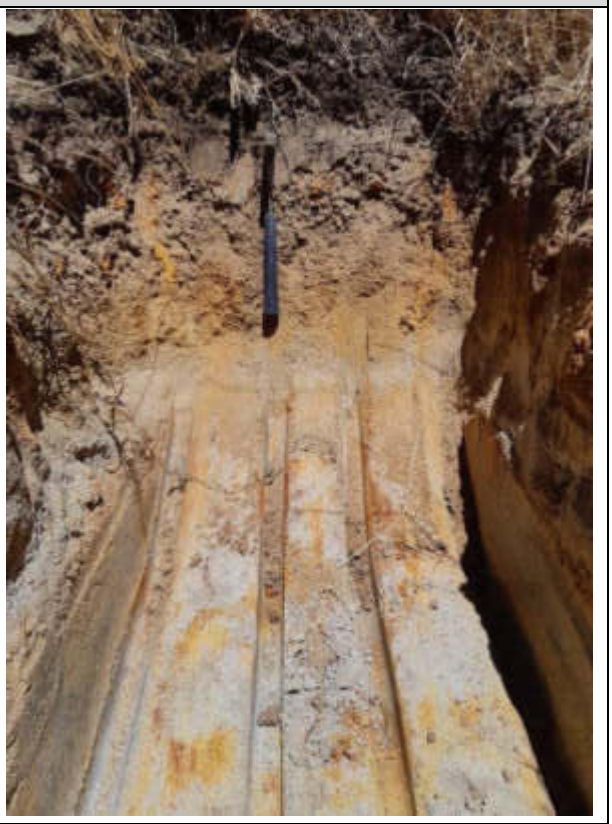
| *TP09* | *TP10* |
| --- | --- |
|  |  |
| *TP11* | *TP12* |
|  |  |

***Figure 7: TP09 to TP12.***

| *TP13* | *TP14* |
| --- | --- |
|  |  |
| *TP15* | *TP16* |
|  |  |

***Figure 8: TP13 to TP16.***

| *TP17* | *TP18* |
| --- | --- |
|  |  |
| *TP19* | *TP20* |
|  |  |

***Figure 9: TP17 to TP20.***




***Figure 10: TP21 to TP24.***

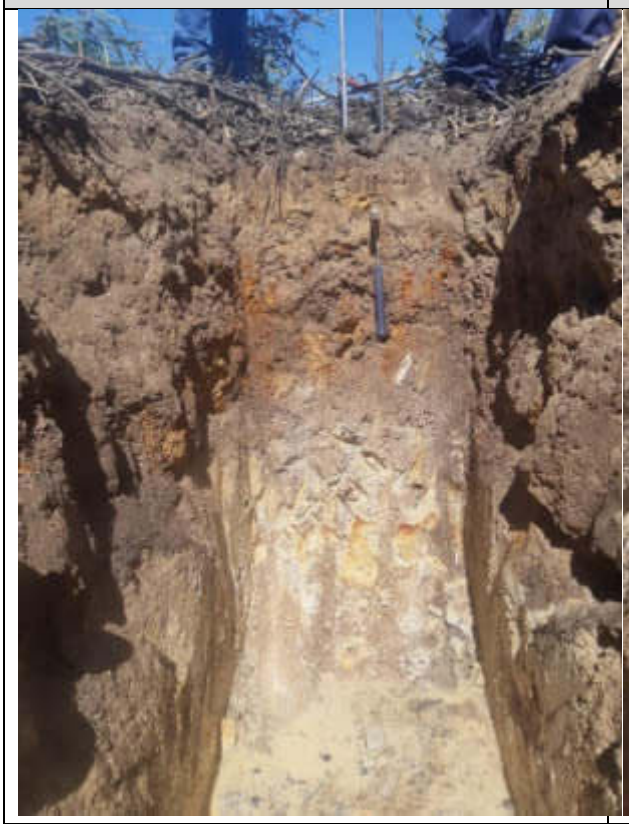
| *TP25* | *TP26* |
| --- | --- |
|  |  |
| *TP27* | *TP28* |
|  |  |

***Figure 11: TP25 to TP28.***

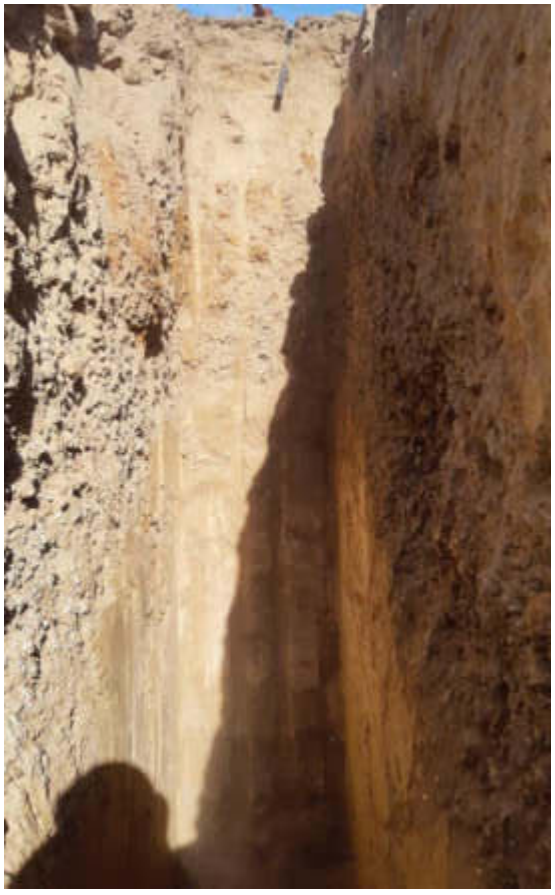
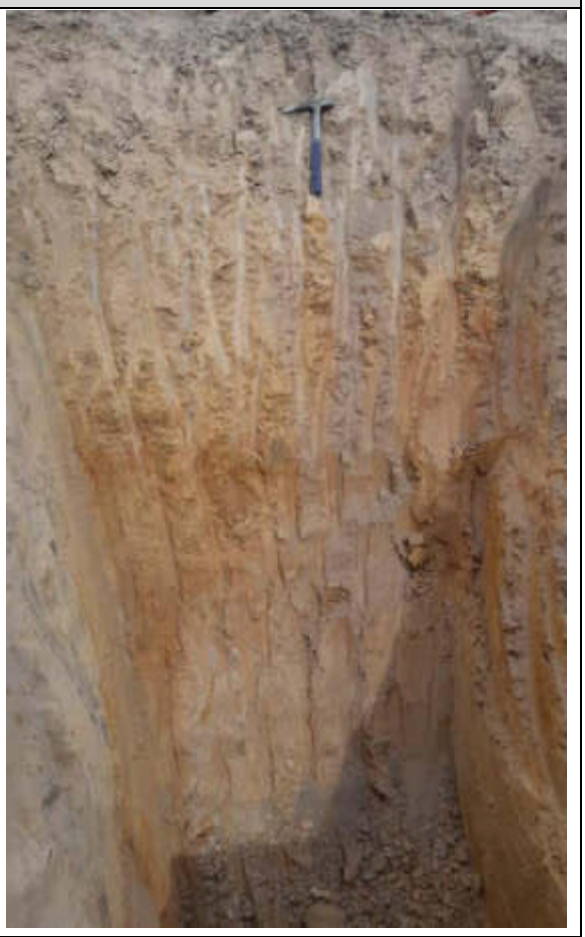
| *TP29* | *TP30* |
| --- | --- |
|  |  |
| *TP31* | *TP32* |
|  |  |

***Figure 12: TP29 to TP32.***

| *TP33* | *TP34* |
| --- | --- |
|  |  |
| *TP35* | *TP36* |
|  |  |

***Figure 13: TP33 to TP36.***

| *TP37* | *TP38* |
| --- | --- |
|  |  |
| *TP39* | *TP40* |
|  |  |

***Figure 14: TP37 to TP40.***

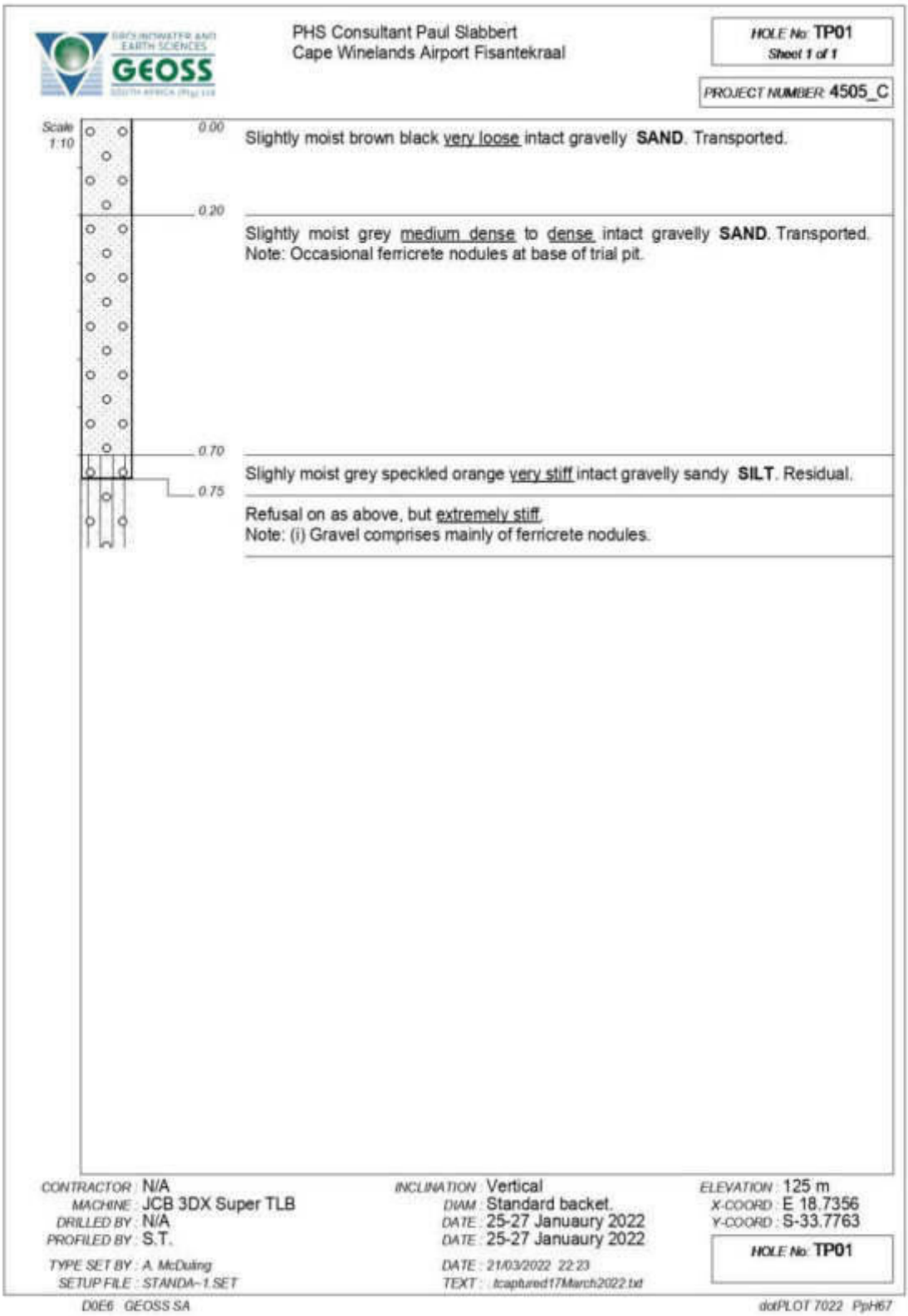
| *TP41* | *TP42* |
| --- | --- |
|  |  |
| *TP43* | *TP44* |
|  |  |

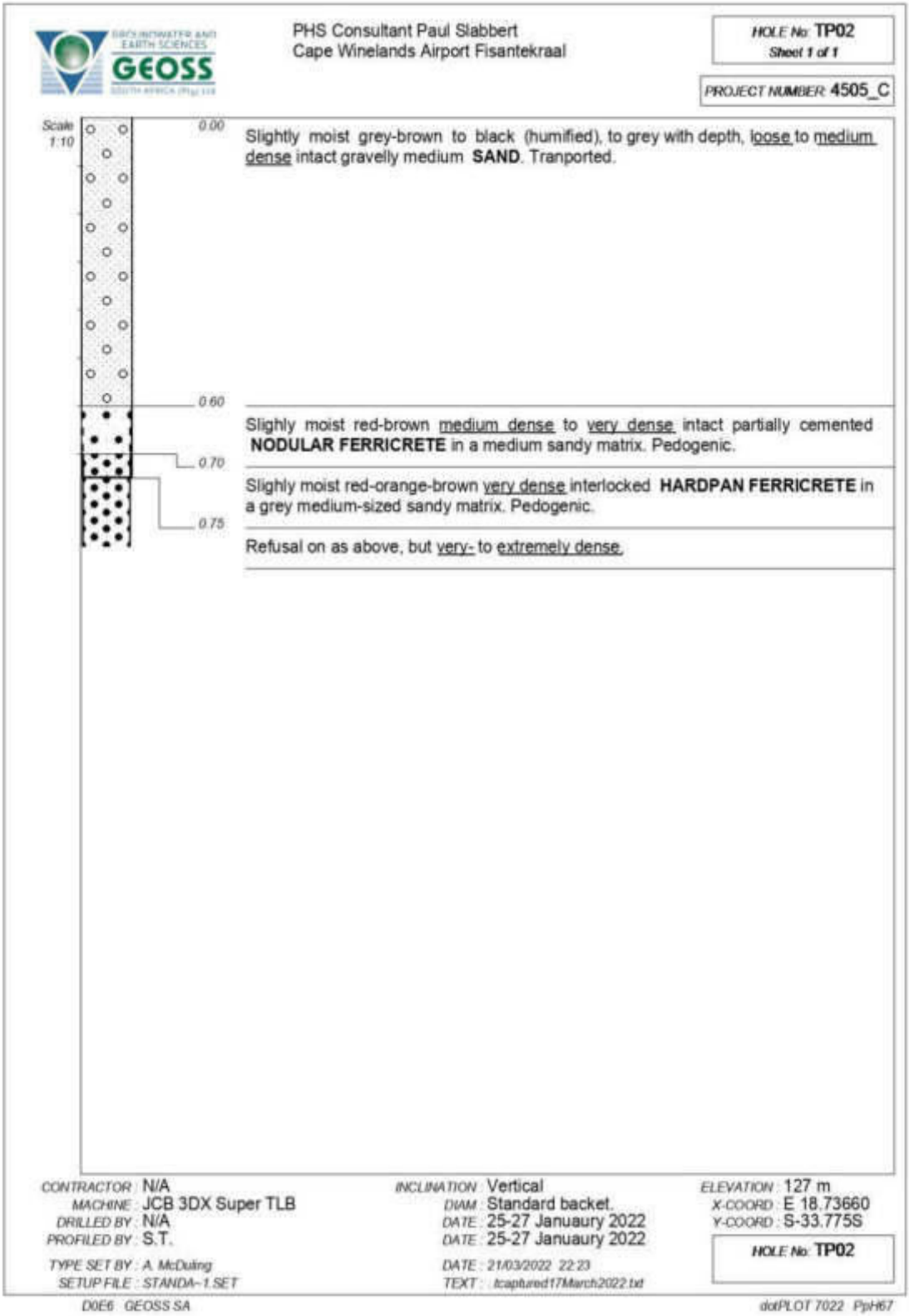
***Figure 15: TP41 to TP44.***

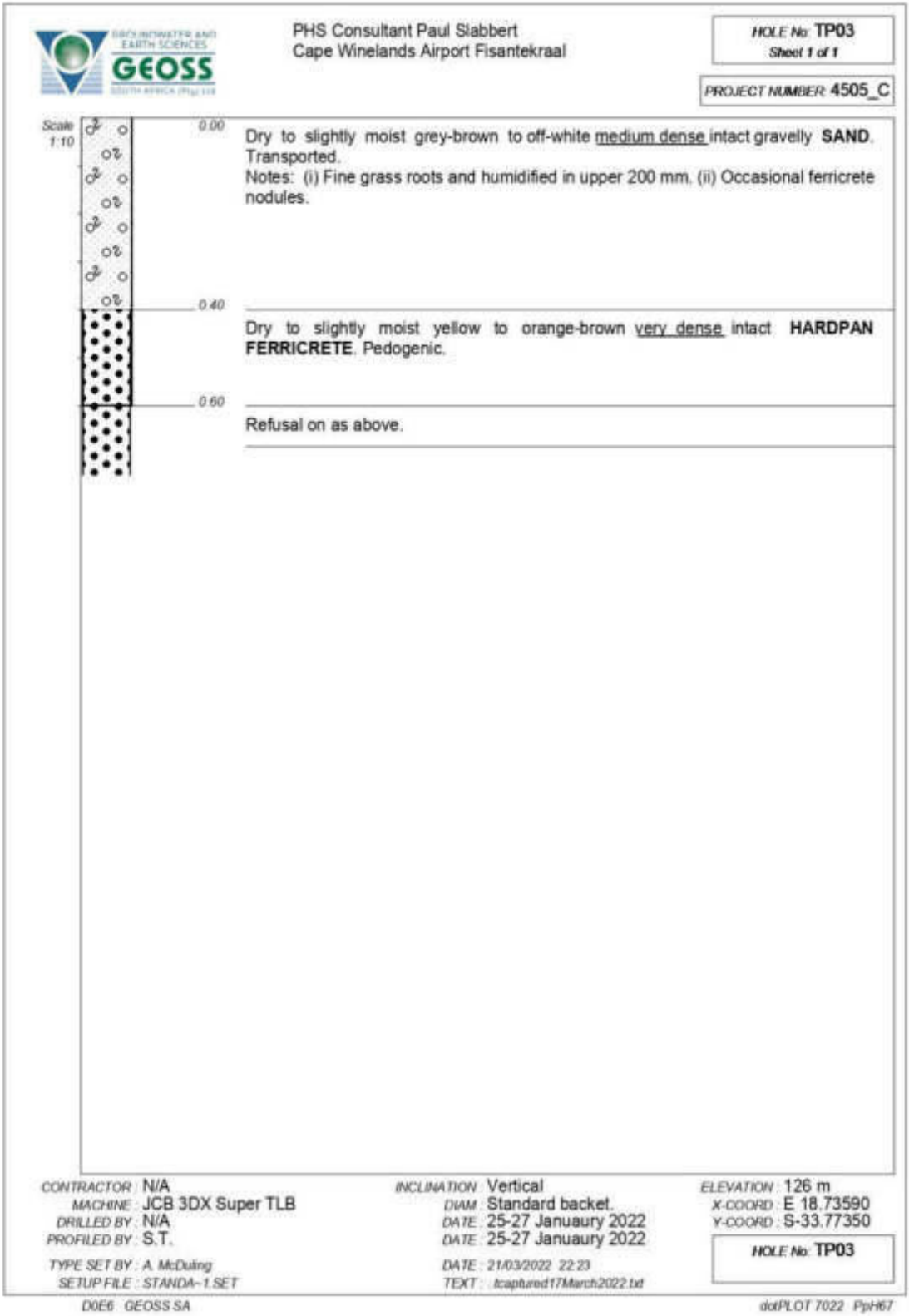
| *TP45* | *TP46* |
| --- | --- |
| ***No Photo Available*** |  |

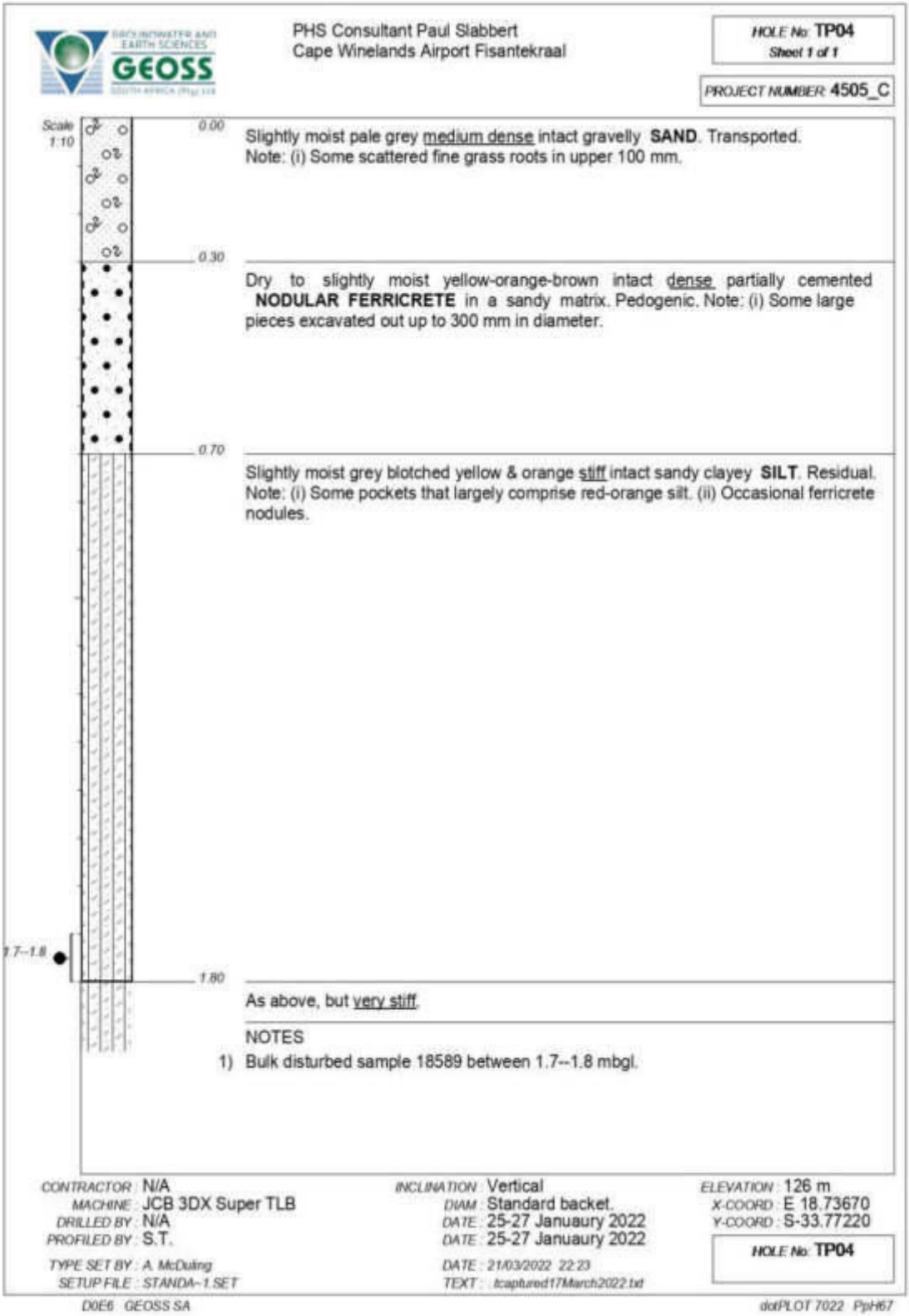
***Figure 16: TP45 to TP46.***

# 10. APPENDIX B: TRIAL PIT LOGS


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP01
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown black very loose intact gravelly SAND. Transported.
0.20
Slightly moist grey medium dense to dense intact gravelly SAND. Transported.
Note: Occasional ferricrete nodules at base of trial pit.
0.70
Slighly moist grey speckled orange very stiff intact gravelly sandy SILT. Residual.
0.75
Refusal on as above, but extremely stiff.
Note: (i) Gravel comprises mainly of ferricrete nodules.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt
ELEVATION : 125 m
X-COORD : E 18.7356
Y-COORD : S-33.7763
HOLE No: TP01
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP02
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown to black (humified), to grey with depth, loose to medium dense intact gravelly medium SAND. Tranported.
0.60
Slighly moist red-brown medium dense to very dense intact partially cemented NODULAR FERRICRETE in a medium sandy matrix. Pedogenic.
0.70
Slighly moist red-orange-brown very dense interlocked HARDPAN FERRICRETE in a grey medium-sized sandy matrix. Pedogenic.
0.75
Refusal on as above, but very- to extremely dense.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt
ELEVATION : 127 m
X-COORD : E 18.73660
Y-COORD : S-33.775S
HOLE No: TP02
D0E6 GEOSS SA
dotPLOT 7022 PpH67

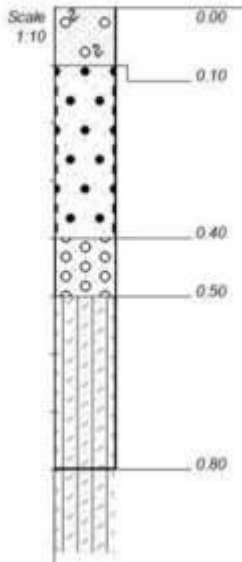

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP03
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Dry to slightly moist grey-brown to off-white medium dense intact gravelly SAND. Transported.
Notes: (i) Fine grass roots and humidified in upper 200 mm. (ii) Occasional ferricrete nodules.
0.40
Dry to slightly moist yellow to orange-brown very dense intact HARDPAN FERRICRETE. Pedogenic.
0.60
Refusal on as above.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 126 m
X-COORD: E 18.73590
Y-COORD: S-33.77350
HOLE No: TP03
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP04
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist pale grey medium dense intact gravelly SAND. Transported.
Note: (i) Some scattered fine grass roots in upper 100 mm.
0.30
Dry to slightly moist yellow-orange-brown intact dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic. Note: (i) Some large pieces excavated out up to 300 mm in diameter.
0.70
Slightly moist grey blotched yellow & orange stiff intact sandy clayey SILT. Residual.
Note: (i) Some pockets that largely comprise red-orange silt. (ii) Occasional ferricrete nodules.
1.7--1.8
1.80
As above, but very stiff.
NOTES
1) Bulk disturbed sample 18589 between 1.7--1.8 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt
ELEVATION : 126 m
X-COORD : E 18.73670
Y-COORD : S-33.77220
HOLE No: TP04
D0E6 GEOSS SA
dotPLOT 7022 PpH67

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal

HOLE No: TP05
Sheet 1 of 1

PROJECT NUMBER: 4505_C




0.00 – 0.10: Slightly moist grey-brown loose to medium dense intact gravelly **SAND**. Transported. Note: (i) Fine grass roots & humified in upper 100 mm.

0.10 – 0.40: Slightly moist grey loose to medium dense intact partially cemented **NODULAR FERRICRETE** in a sandy matrix. Pedogenic. Notes: (i) Undlose contact. (ii) Laterally discontinuous. (iii) Ant nest encountered at base of layer.

0.40 – 0.50: Slightly moist grey loose pinholed sandy fine **GRAVEL**. Transported.

0.50 – 0.80: Slighlty moist grey intact stiff sandy clayey **SILT**. Residual.

0.80 – : As above, but very- to extremely stiff.

CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET

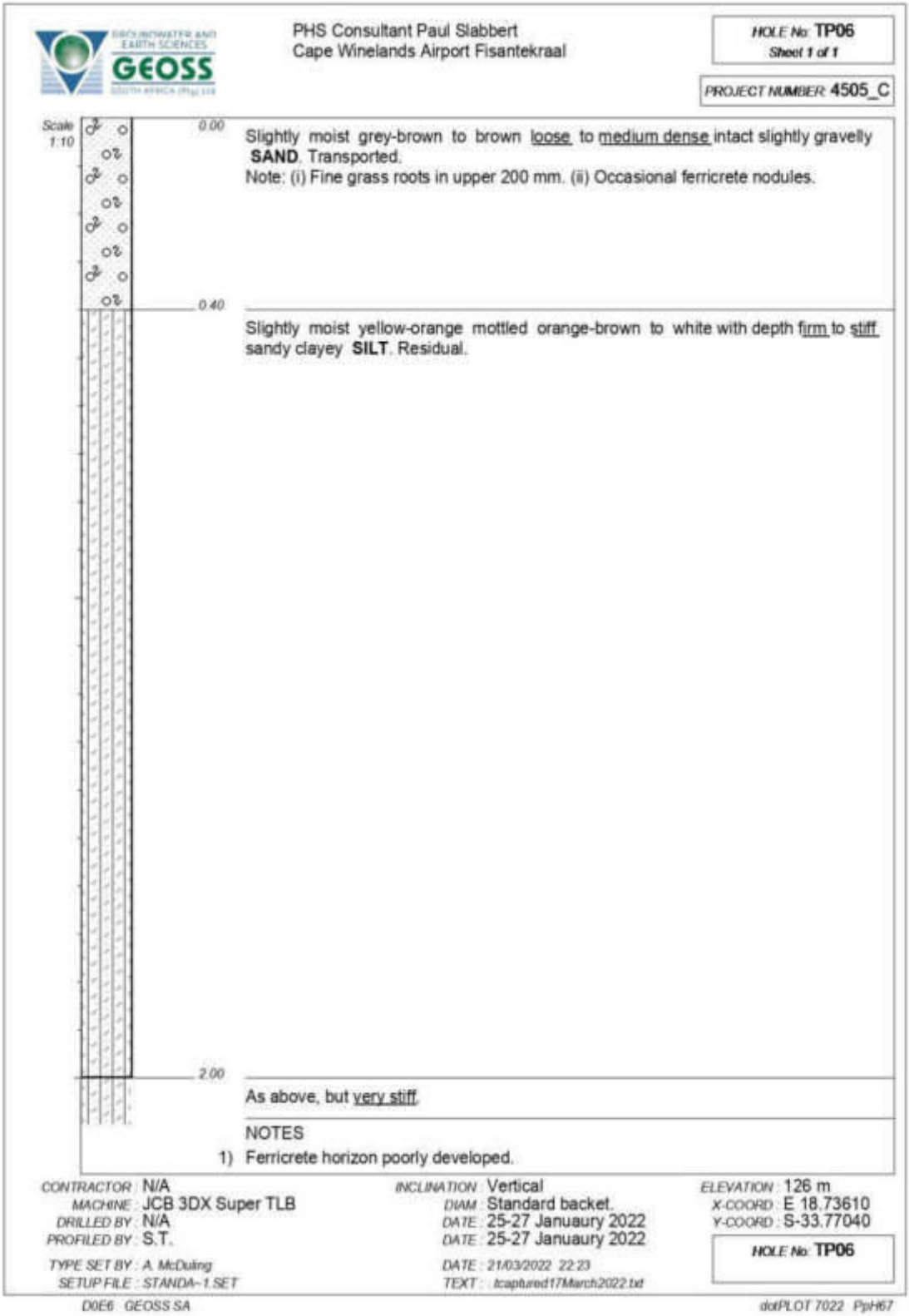
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt

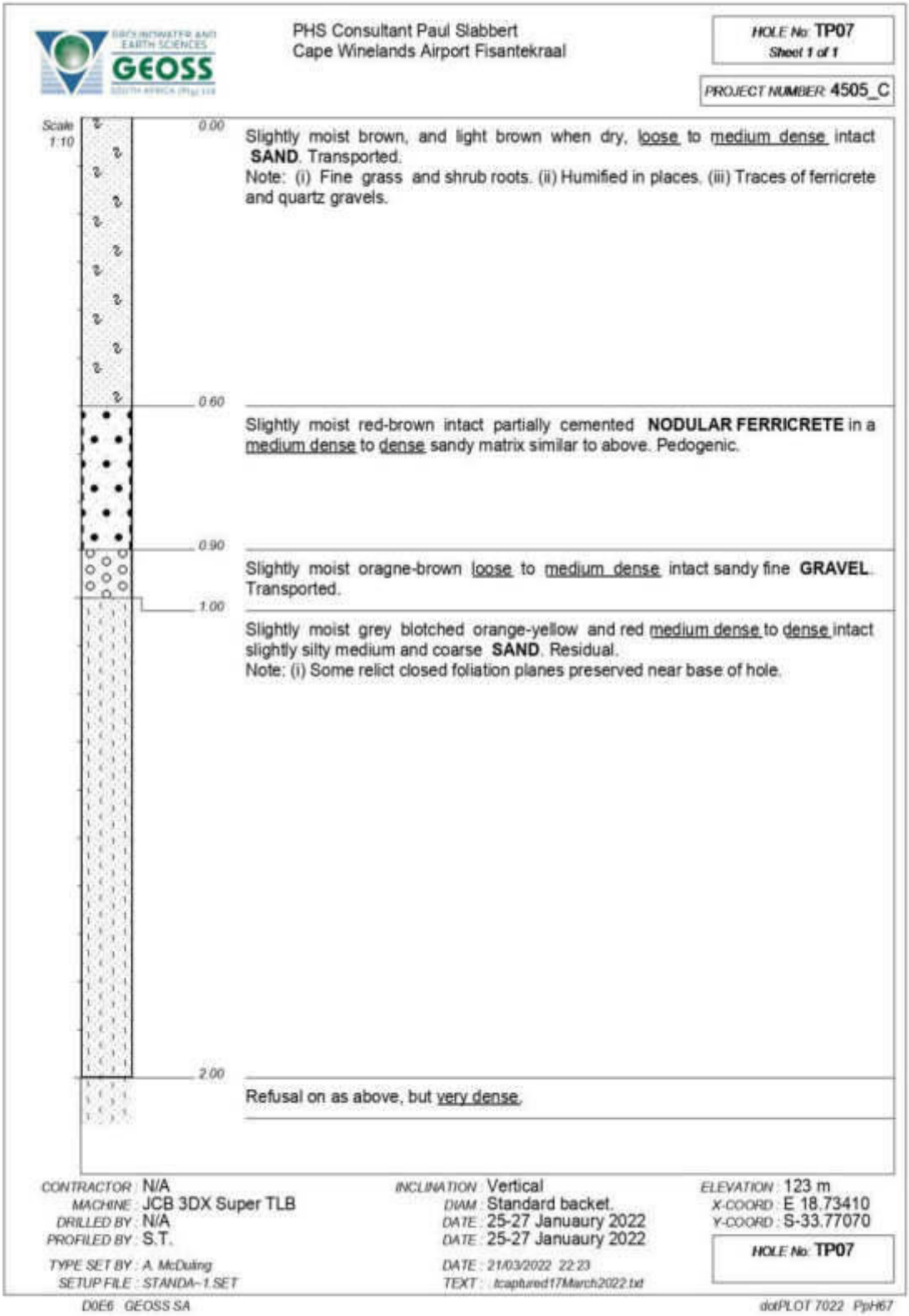
ELEVATION : 126 m
X-COORD : E 18.73800
Y-COORD : S-33.77120

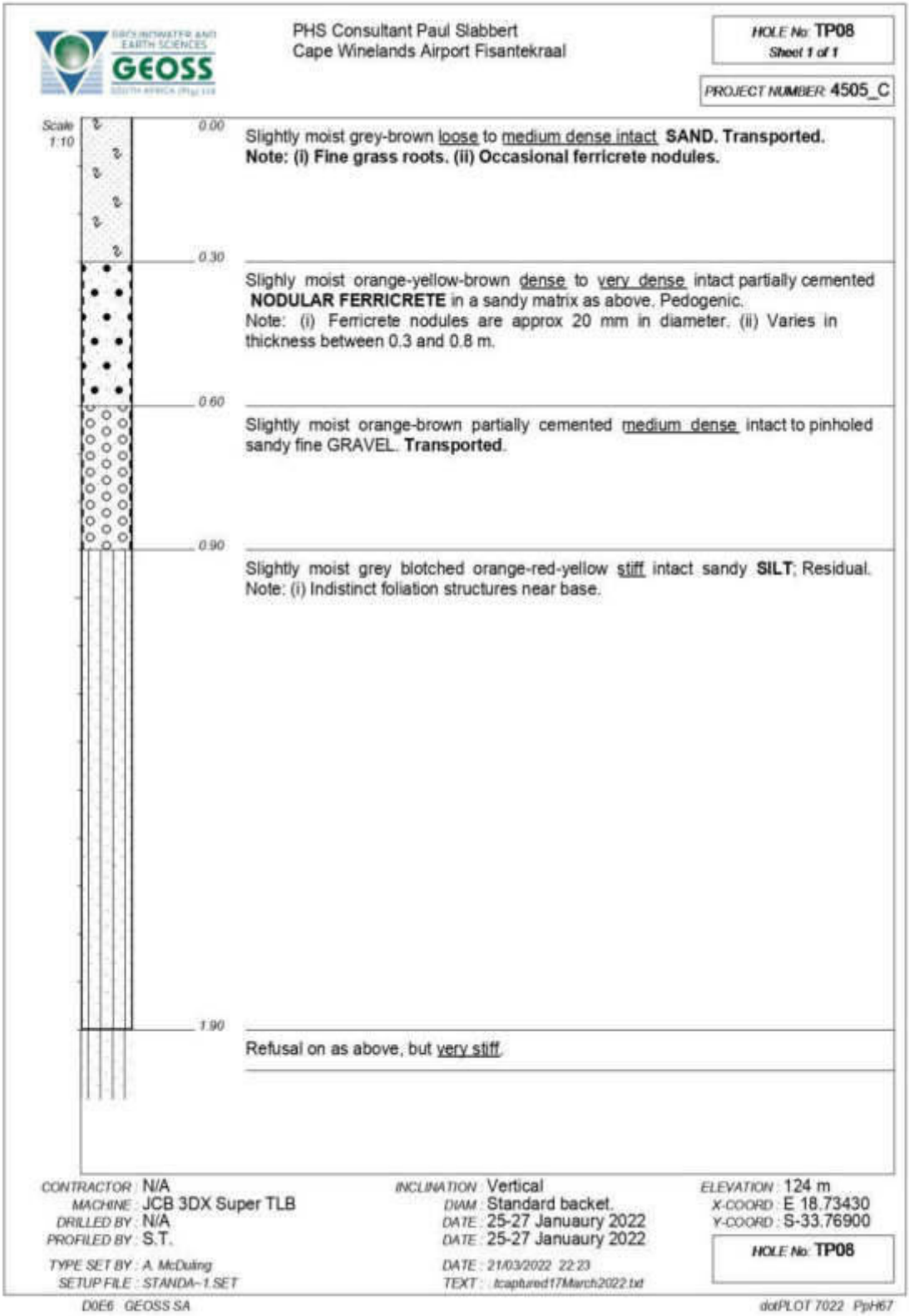
HOLE No: TP05

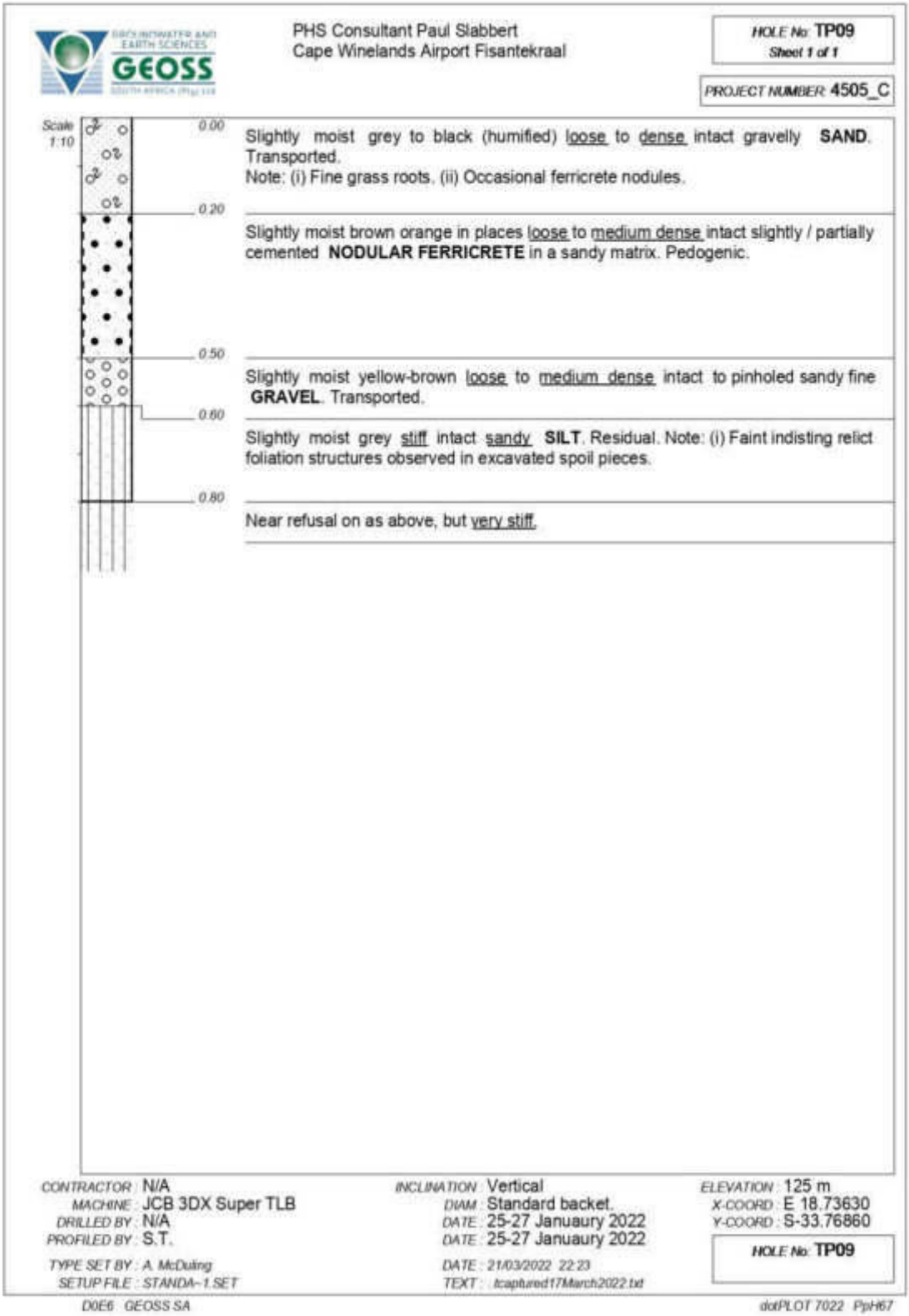
D0E6 GEOSS SA

dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP06
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown to brown loose to medium dense intact slightly gravelly SAND. Transported.
Note: (i) Fine grass roots in upper 200 mm. (ii) Occasional ferricrete nodules.
0.40
Slightly moist yellow-orange mottled orange-brown to white with depth firm to stiff sandy clayey SILT. Residual.
2.00
As above, but very stiff.
NOTES
1) Ferricrete horizon poorly developed.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 126 m
X-COORD: E 18.73610
Y-COORD: S-33.77040
HOLE No: TP06
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP07
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown, and light brown when dry, loose to medium dense intact SAND. Transported.
Note: (i) Fine grass and shrub roots. (ii) Humified in places. (iii) Traces of ferricrete and quartz gravels.
0.60
Slightly moist red-brown intact partially cemented NODULAR FERRICRETE in a medium dense to dense sandy matrix similar to above. Pedogenic.
0.90
Slightly moist oragne-brown loose to medium dense intact sandy fine GRAVEL. Transported.
1.00
Slightly moist grey blotched orange-yellow and red medium dense to dense intact slightly silty medium and coarse SAND. Residual.
Note: (i) Some relict closed foliation planes preserved near base of hole.
2.00
Refusal on as above, but very dense.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 123 m
X-COORD: E 18.73410
Y-COORD: S-33.77070
HOLE No: TP07
D0E6 GEOSS SA
dotPLOT 7022 PpH67

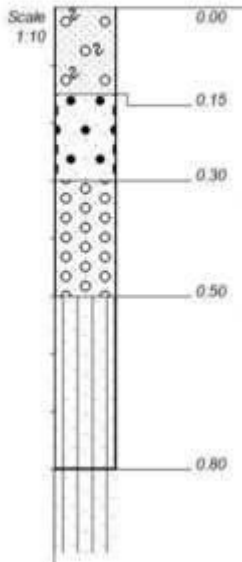

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP08
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown loose to medium dense intact SAND. Transported.
Note: (i) Fine grass roots. (ii) Occasional ferricrete nodules.
0.30
Slighly moist orange-yellow-brown dense to very dense intact partially cemented NODULAR FERRICRETE in a sandy matrix as above. Pedogenic.
Note: (i) Ferricrete nodules are approx 20 mm in diameter. (ii) Varies in thickness between 0.3 and 0.8 m.
0.60
Slightly moist orange-brown partially cemented medium dense intact to pinholed sandy fine GRAVEL. Transported.
0.90
Slightly moist grey blotched orange-red-yellow stiff intact sandy SILT; Residual.
Note: (i) Indistinct foliation structures near base.
1.90
Refusal on as above, but very stiff.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 124 m
X-COORD: E 18.73430
Y-COORD: S-33.76900
HOLE No: TP08
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP09
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey to black (humified) loose to dense intact gravelly SAND. Transported.
Note: (i) Fine grass roots. (ii) Occasional ferricrete nodules.
0.20
Slightly moist brown orange in places loose to medium dense intact slightly / partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic.
0.50
Slightly moist yellow-brown loose to medium dense intact to pinholed sandy fine GRAVEL. Transported.
0.60
Slightly moist grey stiff intact sandy SILT. Residual. Note: (i) Faint indisting relict foliation structures observed in excavated spoil pieces.
0.80
Near refusal on as above, but very stiff.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 125 m
X-COORD: E 18.73630
Y-COORD: S-33.76860
HOLE No: TP09
D0E6 GEOSS SA
dotPLOT 7022 PpH67

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal

HOLE No: TP10
Sheet 1 of 1

PROJECT NUMBER: 4505_C




0.00 – 0.15: Dry to slightly moist grey blotched black (humified) loose intact gravelly **SAND**. Transported.
Note: (i) Fine grass roots throughout. (ii) Occasional ferricrete nodules.

0.15 – 0.30: Slightly moist orange-brown and red partially cemented dense **NODULAR FERRICRETE** in a medium sandy matrix. Pedogenic.

0.30 – 0.50: Slightly moist grey-orange-brown intact to slightly pinholed medium dense sandy fine **GRAVEL**. Transported.

0.50 – 0.80: Slighly moist grey stiff intact sandy **SILT**. Residual.

0.80 +: As above, but very stiff.

CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET

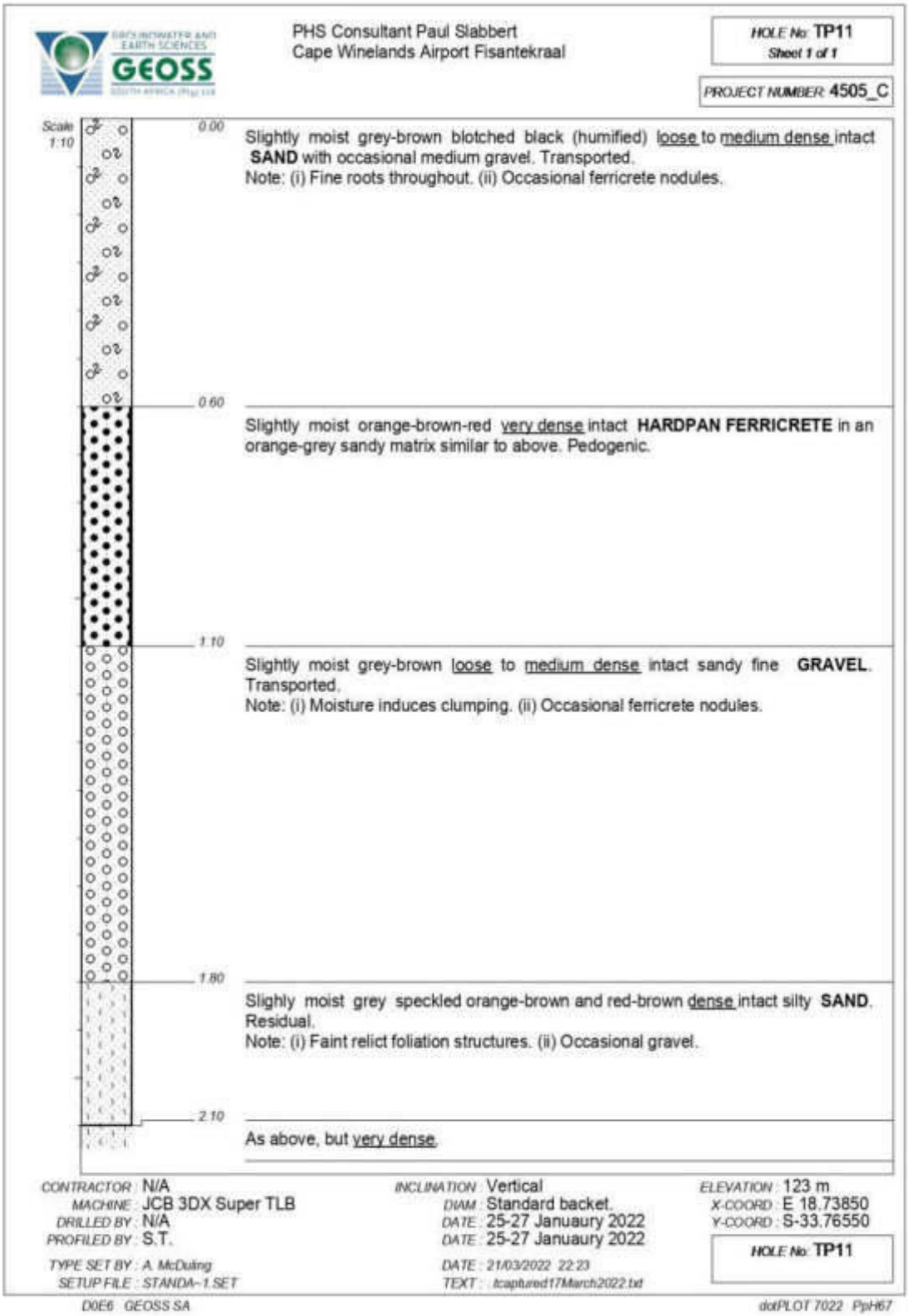
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DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt

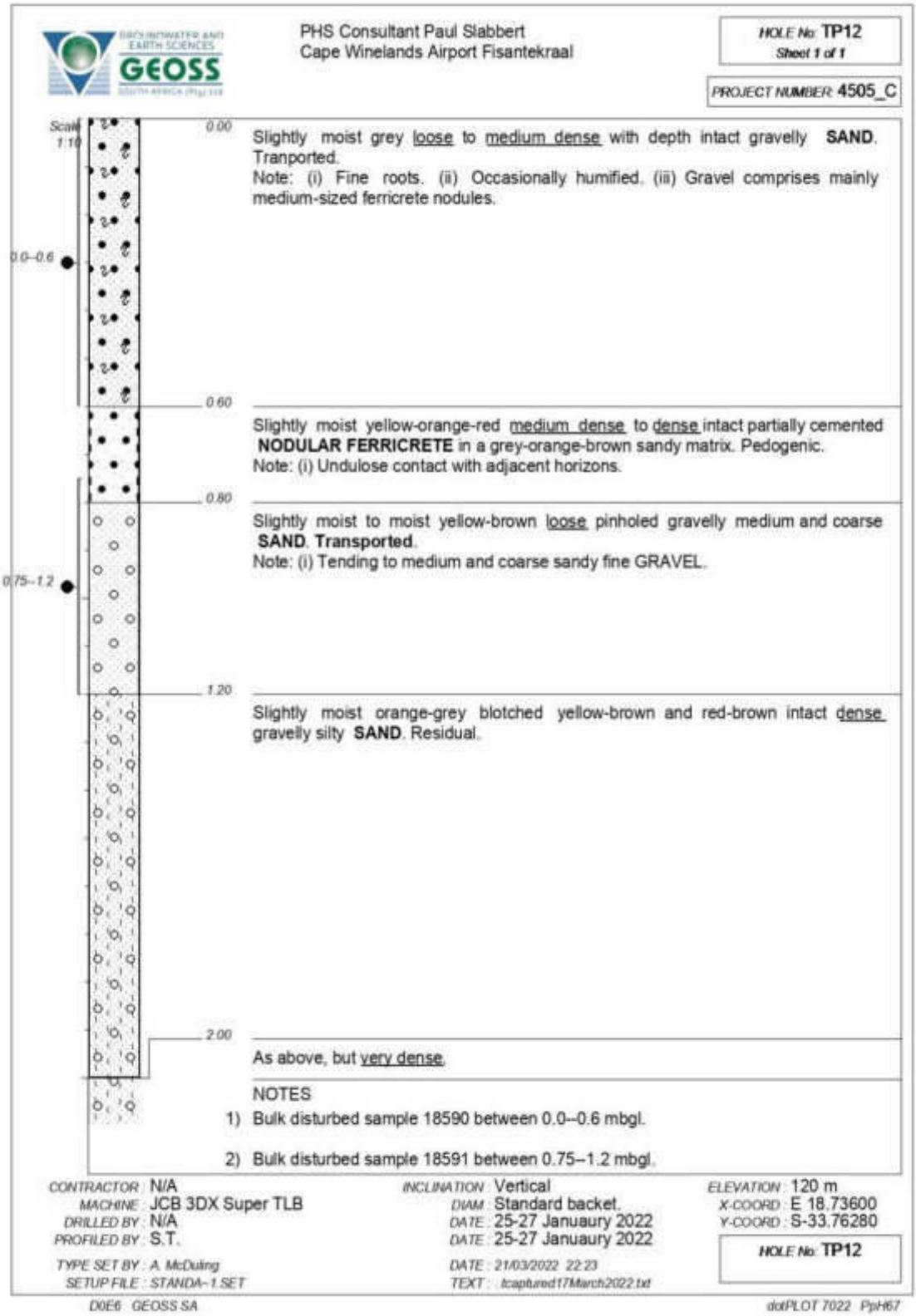
ELEVATION : 124 m
X-COORD : E 18.73810
Y-COORD : S-33.76850

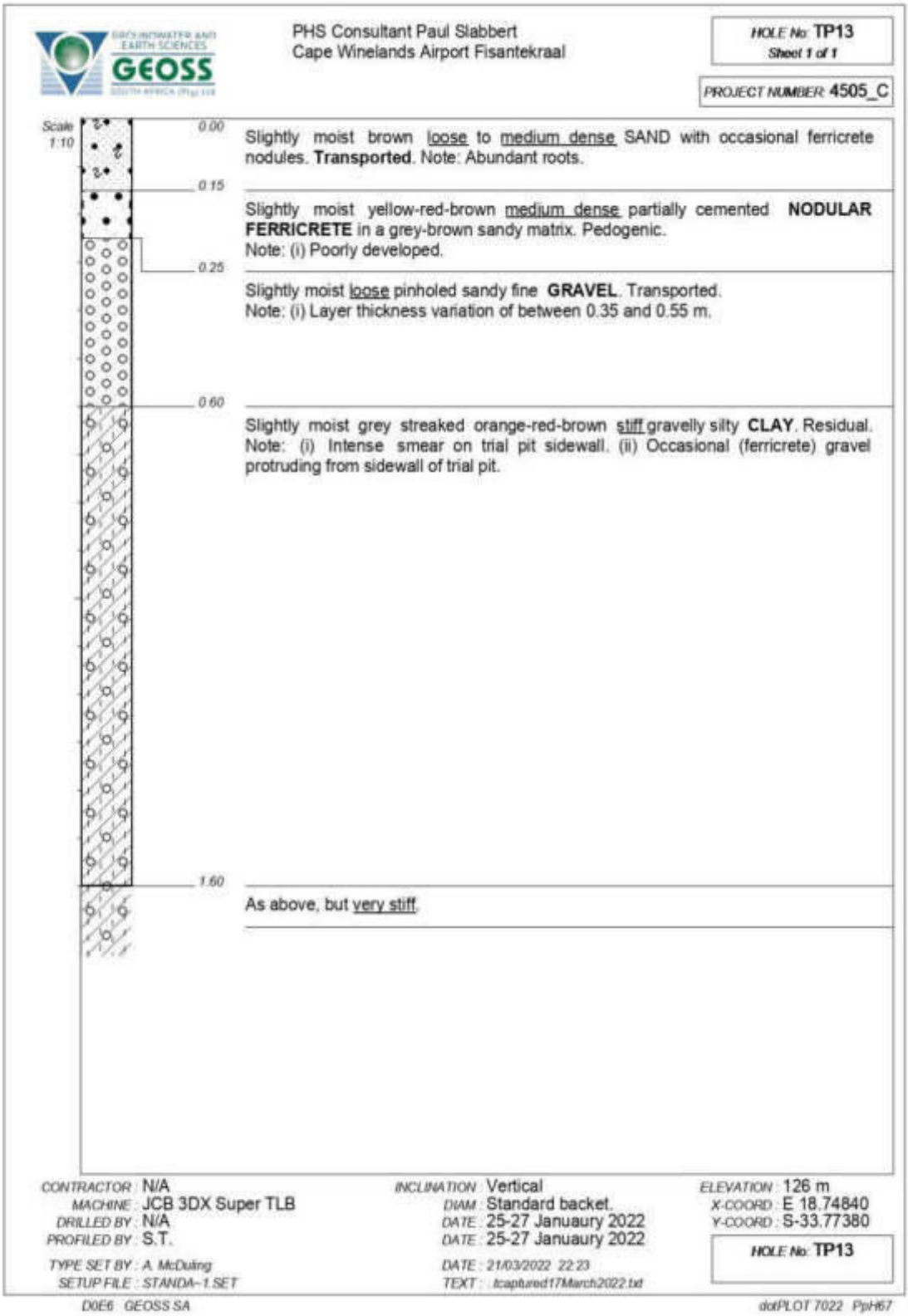
HOLE No: TP10

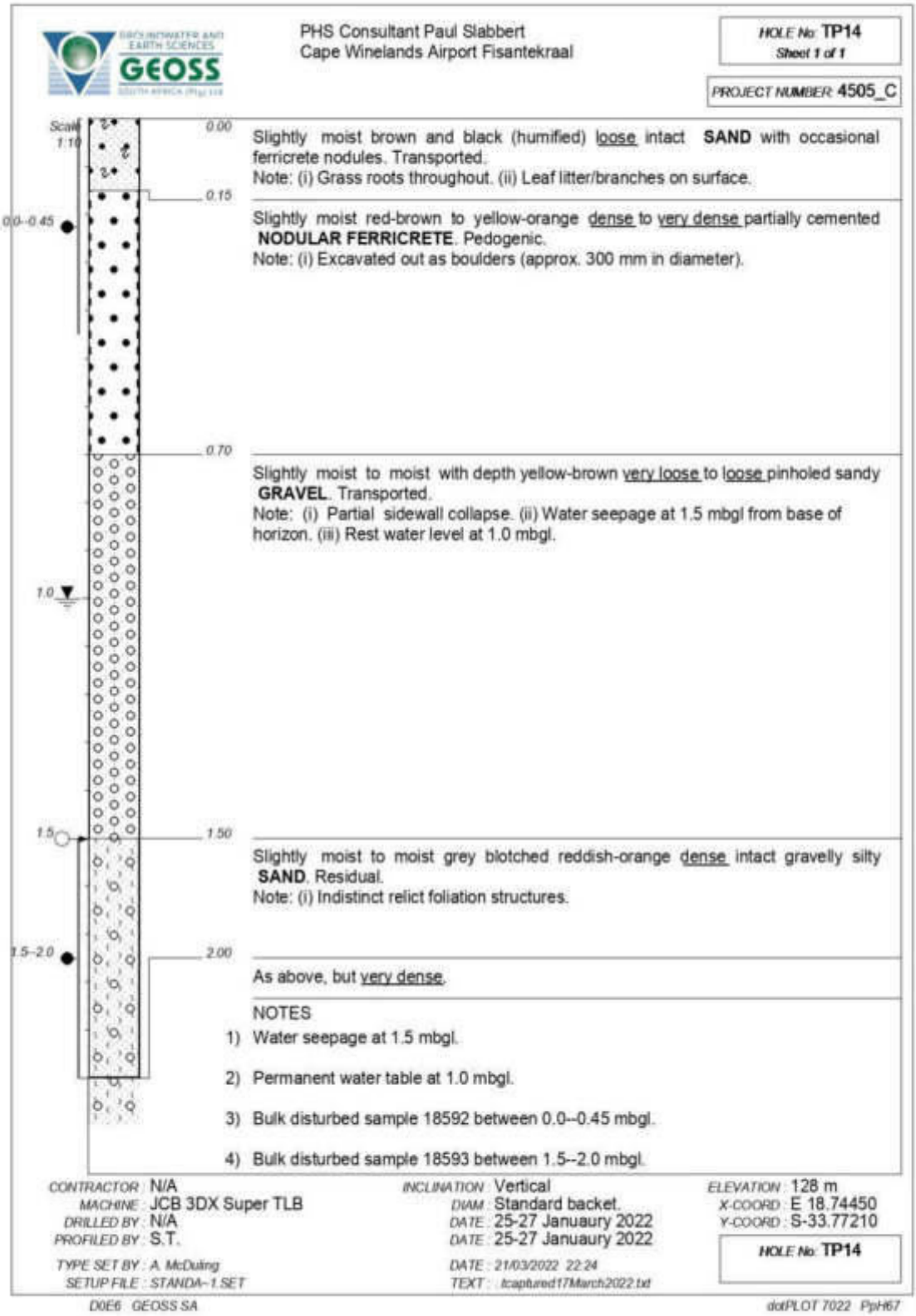
D0E6 GEOSS SA

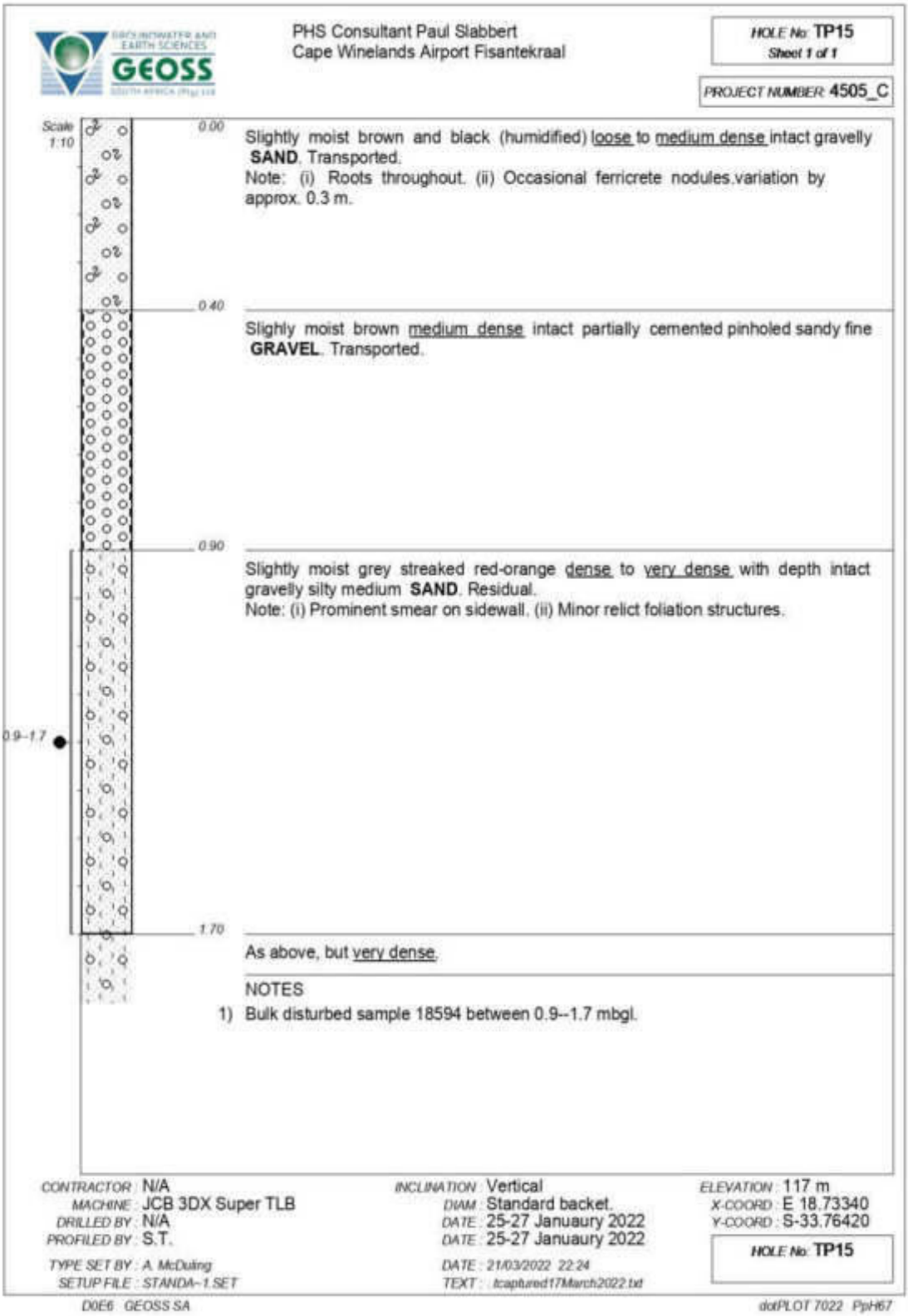
dotPLOT 7022 PpH67

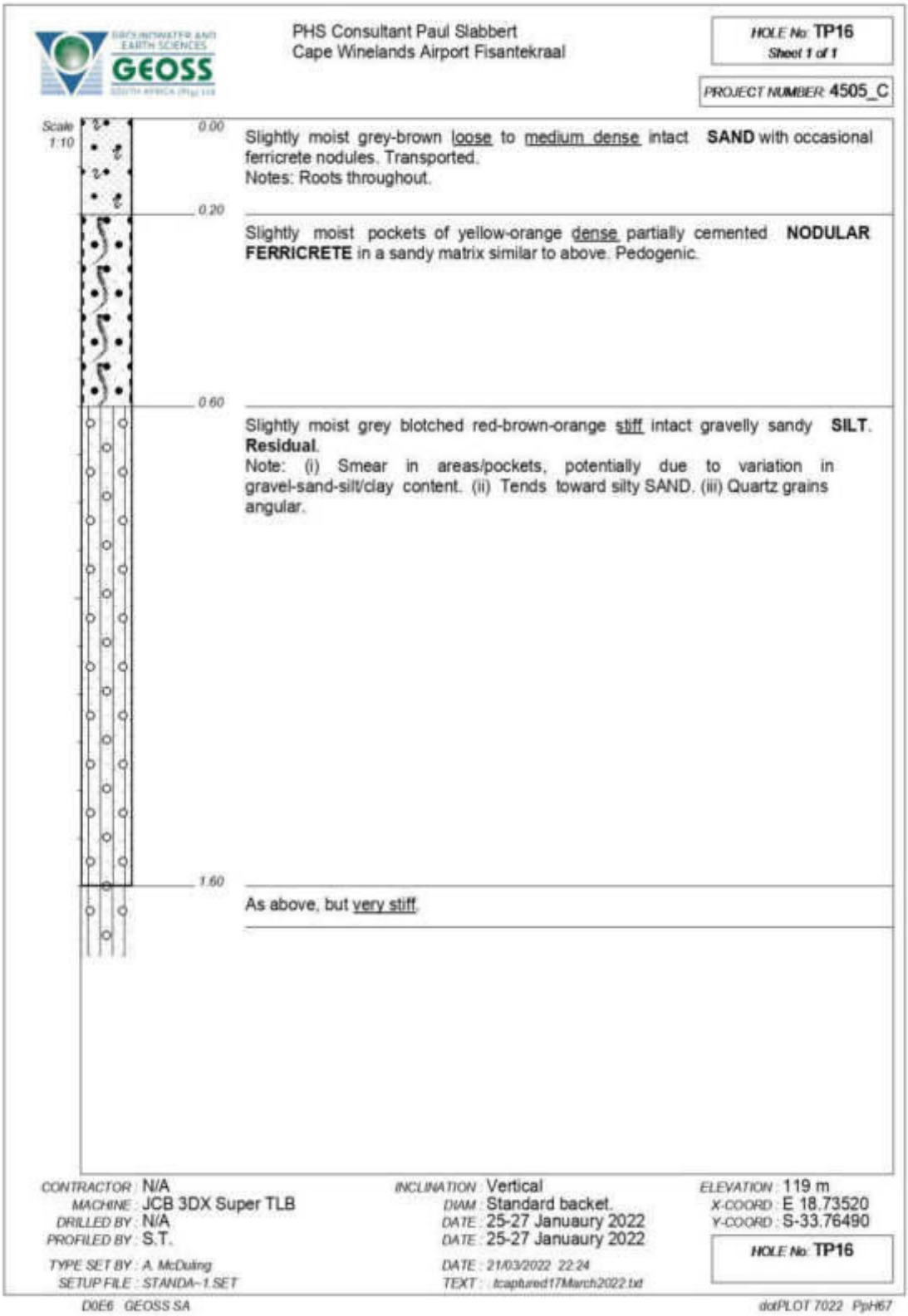

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP11
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown blotched black (humified) loose to medium dense intact SAND with occasional medium gravel. Transported.
Note: (i) Fine roots throughout. (ii) Occasional ferricrete nodules.
0.60
Slightly moist orange-brown-red very dense intact HARDPAN FERRICRETE in an orange-grey sandy matrix similar to above. Pedogenic.
1.10
Slightly moist grey-brown loose to medium dense intact sandy fine GRAVEL. Transported.
Note: (i) Moisture induces clumping. (ii) Occasional ferricrete nodules.
1.80
Slighly moist grey speckled orange-brown and red-brown dense intact silty SAND. Residual.
Note: (i) Faint relict foliation structures. (ii) Occasional gravel.
2.10
As above, but very dense.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 123 m
X-COORD: E 18.73850
Y-COORD: S-33.76550
HOLE No: TP11
D0E6 GEOSS SA
dotPLOT 7022 PpH67

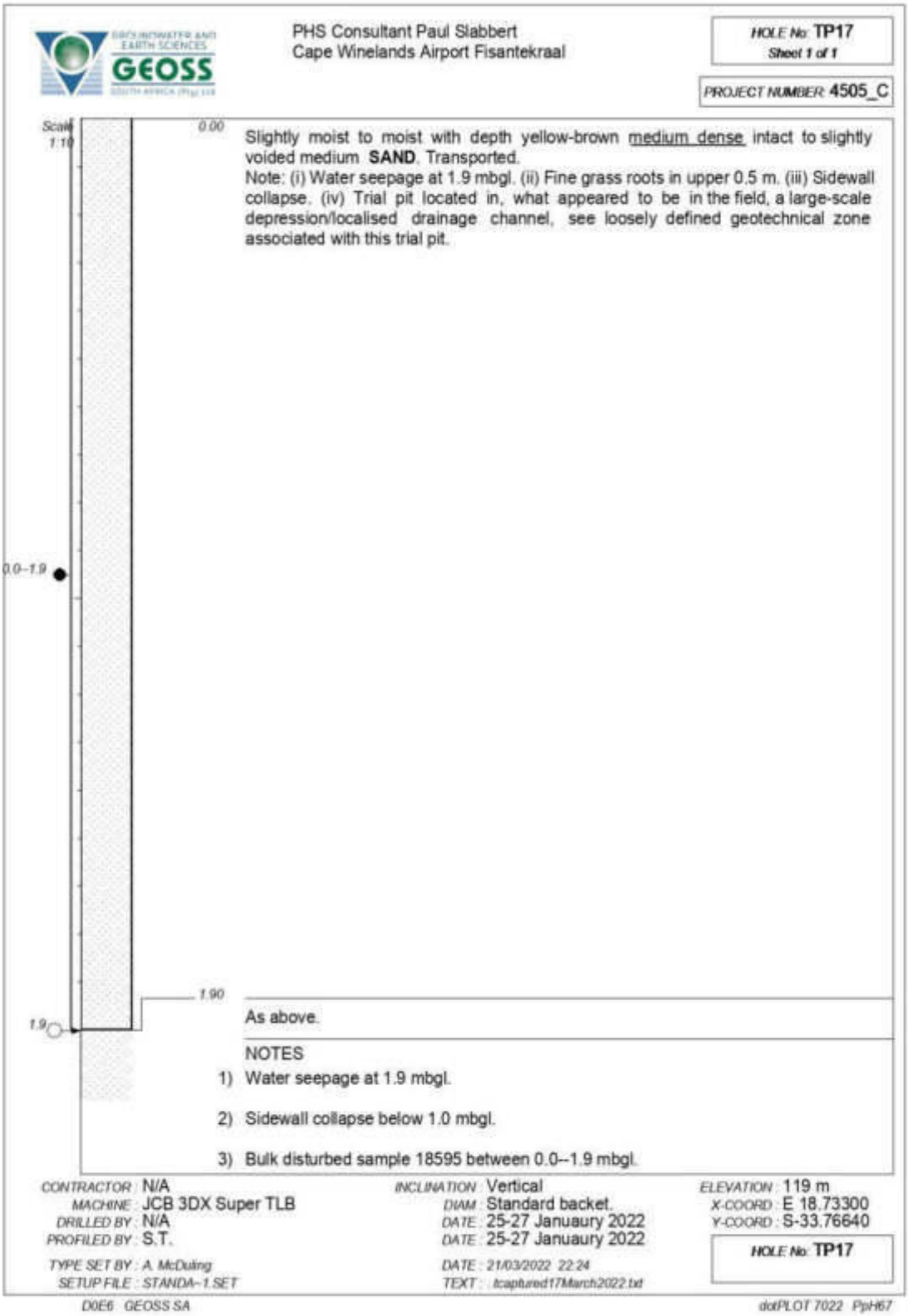

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP12
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey loose to medium dense with depth intact gravelly SAND. Tranported.
Note: (i) Fine roots. (ii) Occasionally humified. (iii) Gravel comprises mainly medium-sized ferricrete nodules.
0.0--0.6
0.60
Slightly moist yellow-orange-red medium dense to dense intact partially cemented NODULAR FERRICRETE in a grey-orange-brown sandy matrix. Pedogenic.
Note: (i) Undulose contact with adjacent horizons.
0.80
Slightly moist to moist yellow-brown loose pinholed gravelly medium and coarse SAND. Transported.
Note: (i) Tending to medium and coarse sandy fine GRAVEL.
0.75--1.2
1.20
Slightly moist orange-grey blotched yellow-brown and red-brown intact dense gravelly silty SAND. Residual.
2.00
As above, but very dense.
NOTES
1) Bulk disturbed sample 18590 between 0.0--0.6 mbgl.
2) Bulk disturbed sample 18591 between 0.75--1.2 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt
ELEVATION : 120 m
X-COORD : E 18.73600
Y-COORD : S-33.76280
HOLE No: TP12
D0E6 GEOSS SA
dotPLOT 7022 PpH67

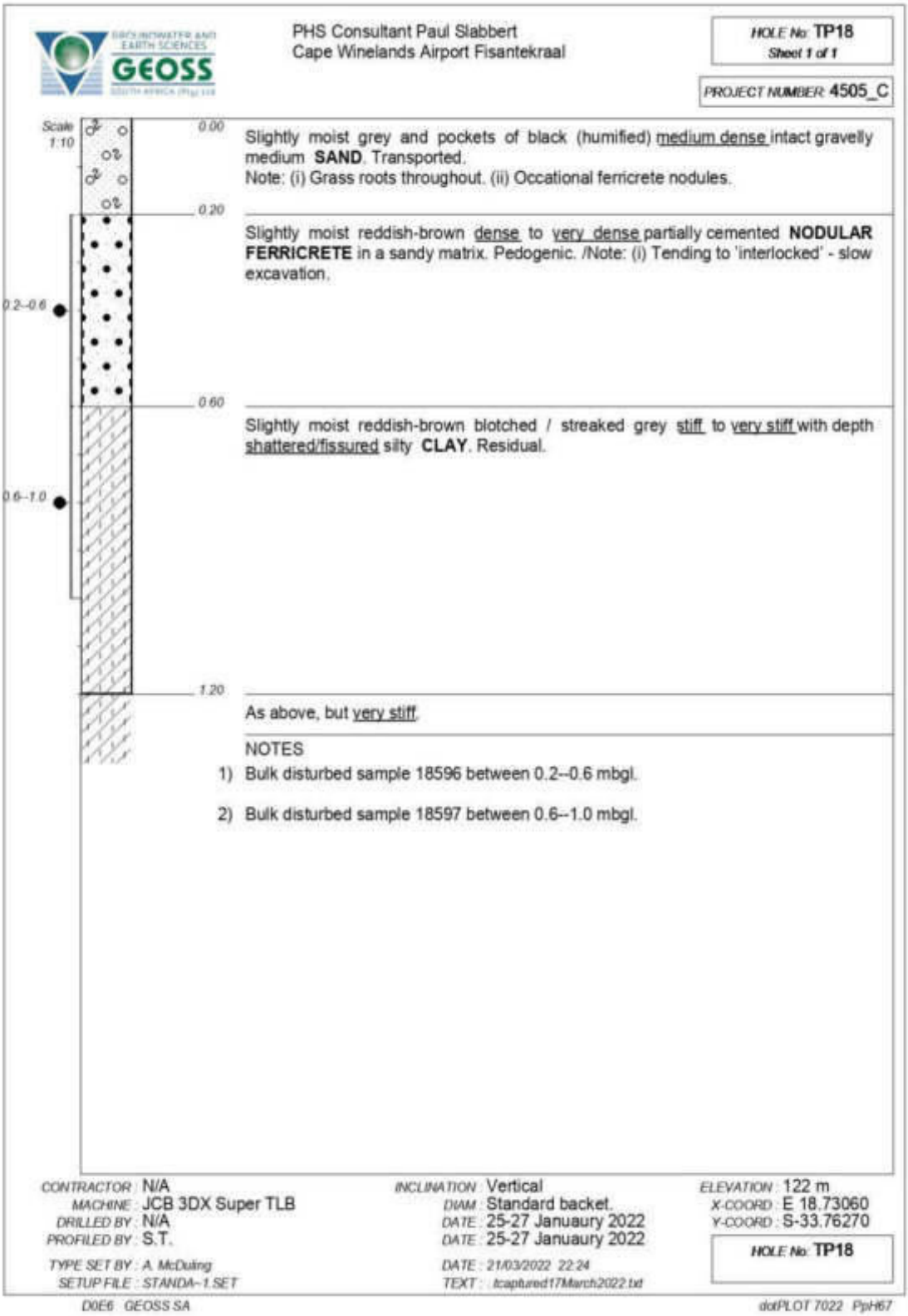

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP13
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown loose to medium dense SAND with occasional ferricrete nodules. Transported. Note: Abundant roots.
0.15
Slightly moist yellow-red-brown medium dense partially cemented NODULAR FERRICRETE in a grey-brown sandy matrix. Pedogenic.
Note: (i) Poorly developed.
0.25
Slightly moist loose pinholed sandy fine GRAVEL. Transported.
Note: (i) Layer thickness variation of between 0.35 and 0.55 m.
0.60
Slightly moist grey streaked orange-red-brown stiff gravelly silty CLAY. Residual.
Note: (i) Intense smear on trial pit sidewall. (ii) Occasional (ferricrete) gravel protruding from sidewall of trial pit.
1.60
As above, but very stiff.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 126 m
X-COORD: E 18.74840
Y-COORD: S-33.77380
HOLE No: TP13
D0E6 GEOSS SA
dotPLOT 7022 PpH67

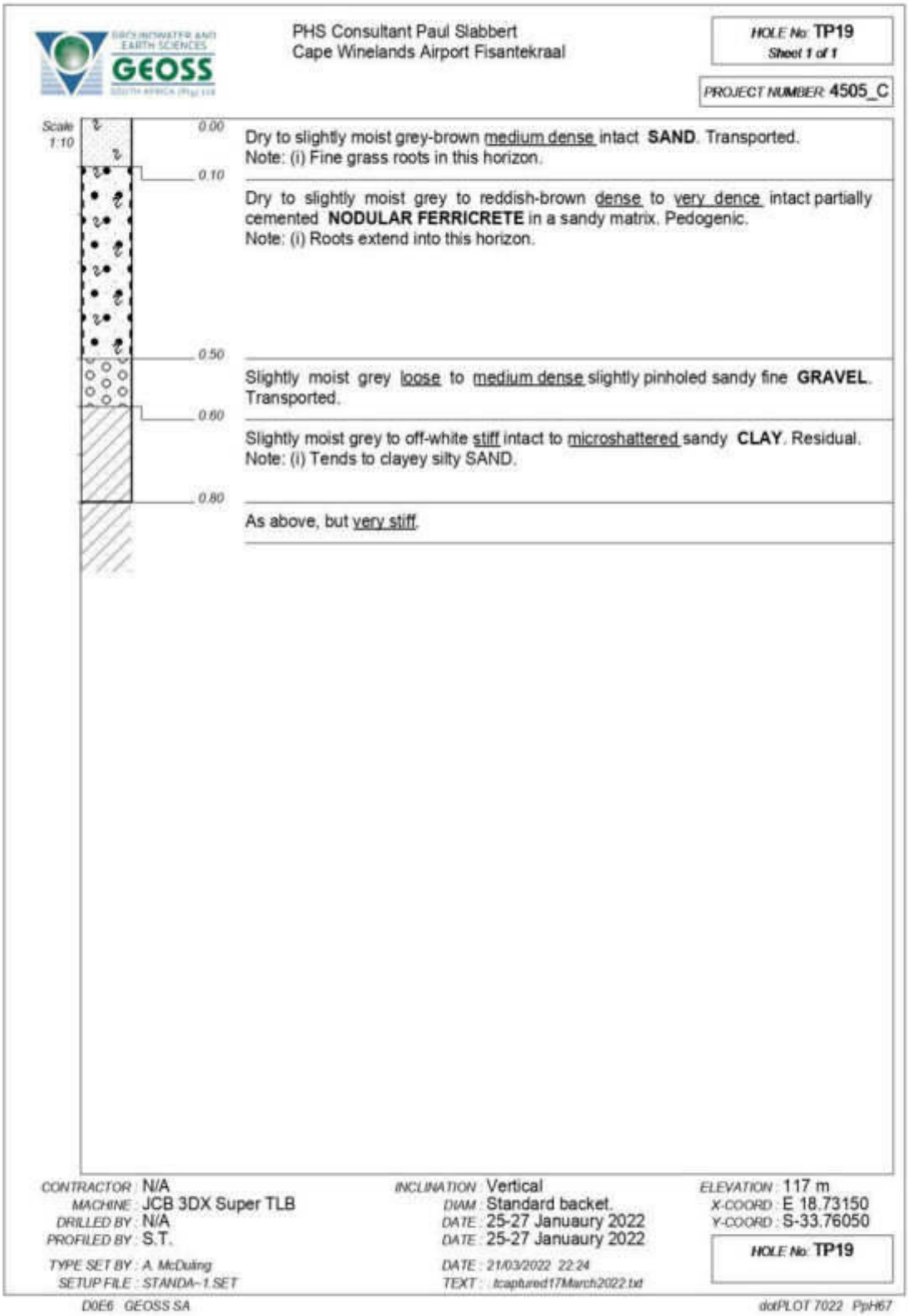

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP14
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown and black (humified) loose intact SAND with occasional ferricrete nodules. Transported.
Note: (i) Grass roots throughout. (ii) Leaf litter/branches on surface.
0.15
0.0--0.45
Slightly moist red-brown to yellow-orange dense to very dense partially cemented NODULAR FERRICRETE. Pedogenic.
Note: (i) Excavated out as boulders (approx. 300 mm in diameter).
0.70
Slightly moist to moist with depth yellow-brown very loose to loose pinholed sandy GRAVEL. Transported.
Note: (i) Partial sidewall collapse. (ii) Water seepage at 1.5 mbgl from base of horizon. (iii) Rest water level at 1.0 mbgl.
1.0
1.5
1.50
Slightly moist to moist grey blotched reddish-orange dense intact gravelly silty SAND. Residual.
Note: (i) Indistinct relict foliation structures.
1.5--2.0
2.00
As above, but very dense.
NOTES
1) Water seepage at 1.5 mbgl.
2) Permanent water table at 1.0 mbgl.
3) Bulk disturbed sample 18592 between 0.0--0.45 mbgl.
4) Bulk disturbed sample 18593 between 1.5--2.0 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 128 m
X-COORD : E 18.74450
Y-COORD : S-33.77210
HOLE No: TP14
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP15
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown and black (humidified) loose to medium dense intact gravelly SAND. Transported.
Note: (i) Roots throughout. (ii) Occasional ferricrete nodules.variation by approx. 0.3 m.
0.40
Slighly moist brown medium dense intact partially cemented pinholed sandy fine GRAVEL. Transported.
0.90
Slightly moist grey streaked red-orange dense to very dense with depth intact gravelly silty medium SAND. Residual.
Note: (i) Prominent smear on sidewall. (ii) Minor relict foliation structures.
0.9--1.7
1.70
As above, but very dense.
NOTES
1) Bulk disturbed sample 18594 between 0.9--1.7 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 117 m
X-COORD : E 18.73340
Y-COORD : S-33.76420
HOLE No: TP15
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP16
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown loose to medium dense intact SAND with occasional ferricrete nodules. Transported.
Notes: Roots throughout.
0.20
Slightly moist pockets of yellow-orange dense partially cemented NODULAR FERRICRETE in a sandy matrix similar to above. Pedogenic.
0.60
Slightly moist grey blotched red-brown-orange stiff intact gravelly sandy SILT. Residual.
Note: (i) Smear in areas/pockets, potentially due to variation in gravel-sand-silt/clay content. (ii) Tends toward silty SAND. (iii) Quartz grains angular.
1.60
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 119 m
X-COORD : E 18.73520
Y-COORD : S-33.76490
HOLE No: TP16
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP17
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist to moist with depth yellow-brown medium dense intact to slightly voided medium SAND. Transported.
Note: (i) Water seepage at 1.9 mbgl. (ii) Fine grass roots in upper 0.5 m. (iii) Sidewall collapse. (iv) Trial pit located in, what appeared to be in the field, a large-scale depression/localised drainage channel, see loosely defined geotechnical zone associated with this trial pit.
0.0--1.9
1.90
1.9
As above.
NOTES
1) Water seepage at 1.9 mbgl.
2) Sidewall collapse below 1.0 mbgl.
3) Bulk disturbed sample 18595 between 0.0--1.9 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 119 m
X-COORD : E 18.73300
Y-COORD : S-33.76640
HOLE No: TP17
D0E6 GEOSS SA
dotPLOT 7022 PpH67

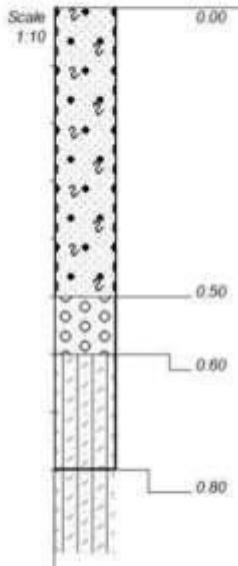

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP18
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey and pockets of black (humified) medium dense intact gravelly medium SAND. Transported.
Note: (i) Grass roots throughout. (ii) Occational ferricrete nodules.
0.20
Slightly moist reddish-brown dense to very dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic. /Note: (i) Tending to 'interlocked' - slow excavation.
0.2--0.6
0.60
Slightly moist reddish-brown blotched / streaked grey stiff to very stiff with depth shattered/fissured silty CLAY. Residual.
0.6--1.0
1.20
As above, but very stiff.
NOTES
1) Bulk disturbed sample 18596 between 0.2--0.6 mbgl.
2) Bulk disturbed sample 18597 between 0.6--1.0 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 122 m
X-COORD : E 18.73060
Y-COORD : S-33.76270
HOLE No: TP18
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP19
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Dry to slightly moist grey-brown medium dense intact SAND. Transported.
Note: (i) Fine grass roots in this horizon.
0.10
Dry to slightly moist grey to reddish-brown dense to very dence intact partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic.
Note: (i) Roots extend into this horizon.
0.50
Slightly moist grey loose to medium dense slightly pinholed sandy fine GRAVEL. Transported.
0.60
Slightly moist grey to off-white stiff intact to microshattered sandy CLAY. Residual.
Note: (i) Tends to clayey silty SAND.
0.80
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 117 m
X-COORD : E 18.73150
Y-COORD : S-33.76050
HOLE No: TP19
D0E6 GEOSS SA
dotPLOT 7022 PpH67

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal

HOLE No: TP20
Sheet 1 of 1

PROJECT NUMBER: 4505_C




0.00 – Slightly moist dark brown to greyish-brown with depth medium dense intact partially cemented **SAND** with occasional ferricrete nodules. **Transported**.
Note: (i) Fine grass roots. (ii) Humified in upper 200 mm.

0.50 – Slightly moist grey loose to medium dense slightly pinholed sandy fine **GRAVEL**. Transported.

0.60 – Slightly moist grey blotched red-orange firm to stiff intact clayey sandy **SILT**. Residual.
Note: (i) Occasional gravel / ferricrete nodules. (ii) Intense sidewall 'smear'. (iii) Tends to sandy CLAY.

0.80 – As above, but very stiff.

NOTES
1) Profile recorded from trial pit sidewall where deepest depth was attained.

CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.

TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET

INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022

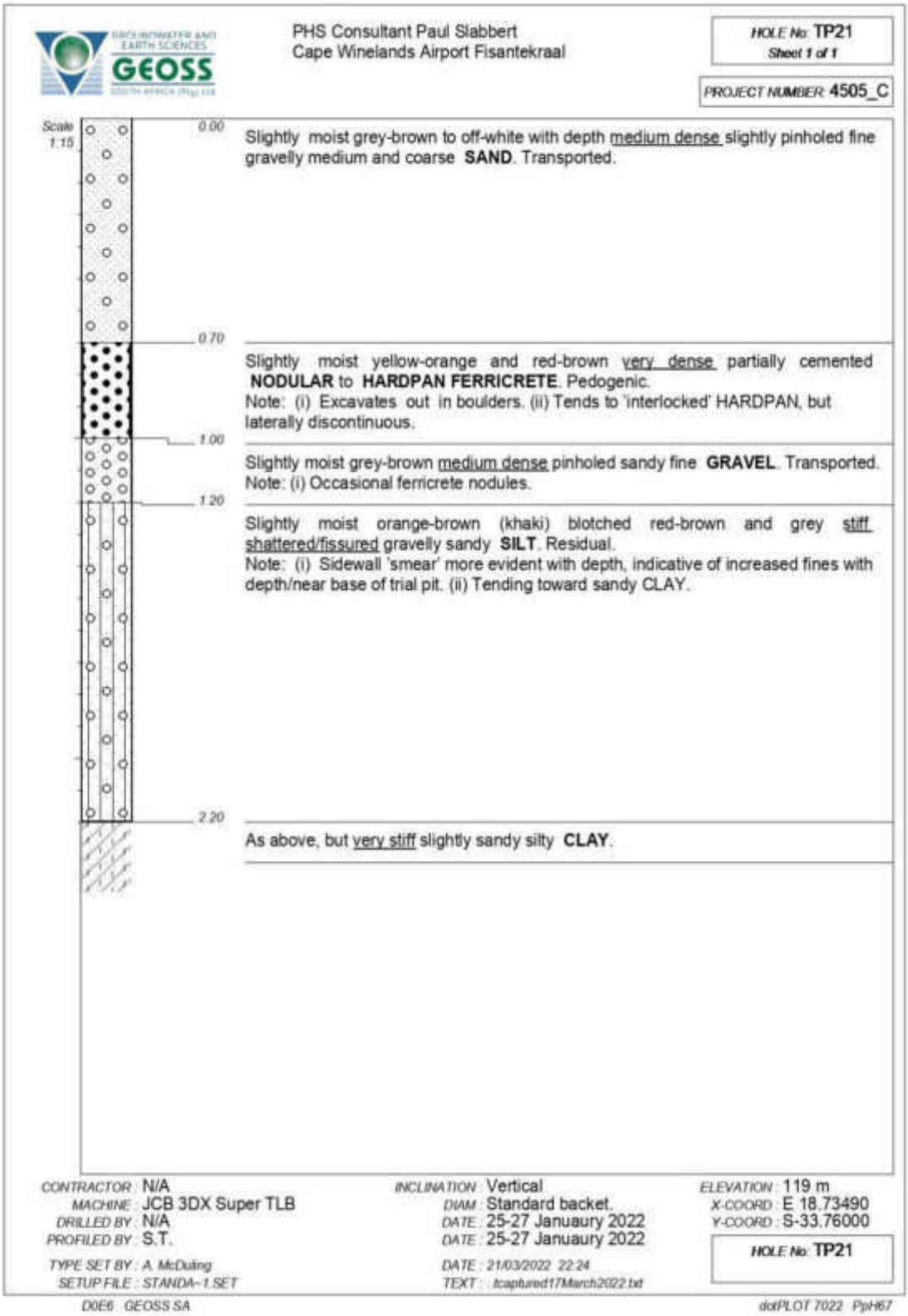
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt

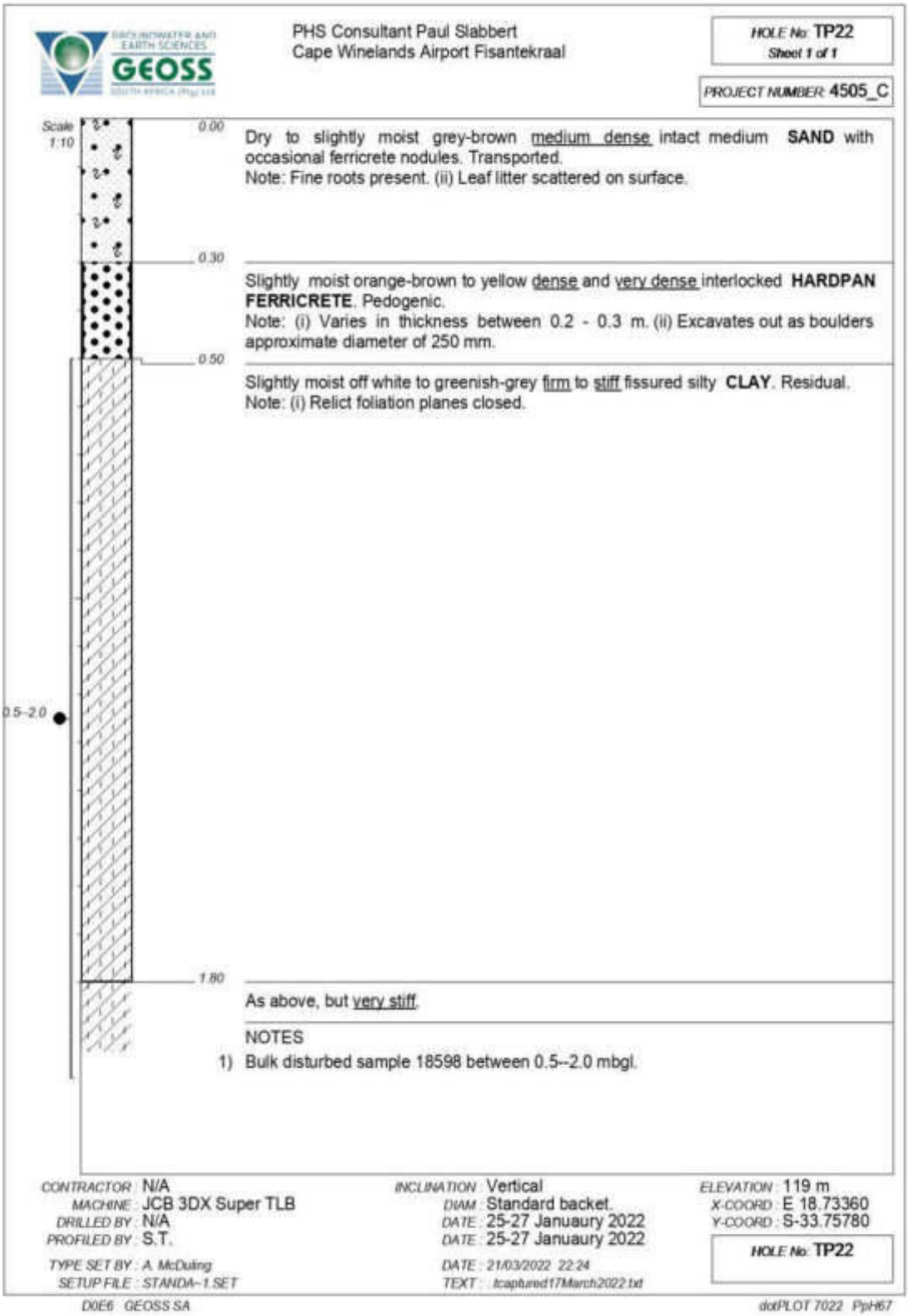
ELEVATION : 120 m
X-COORD : E 18.73340E
Y-COORD : S-33.76220S

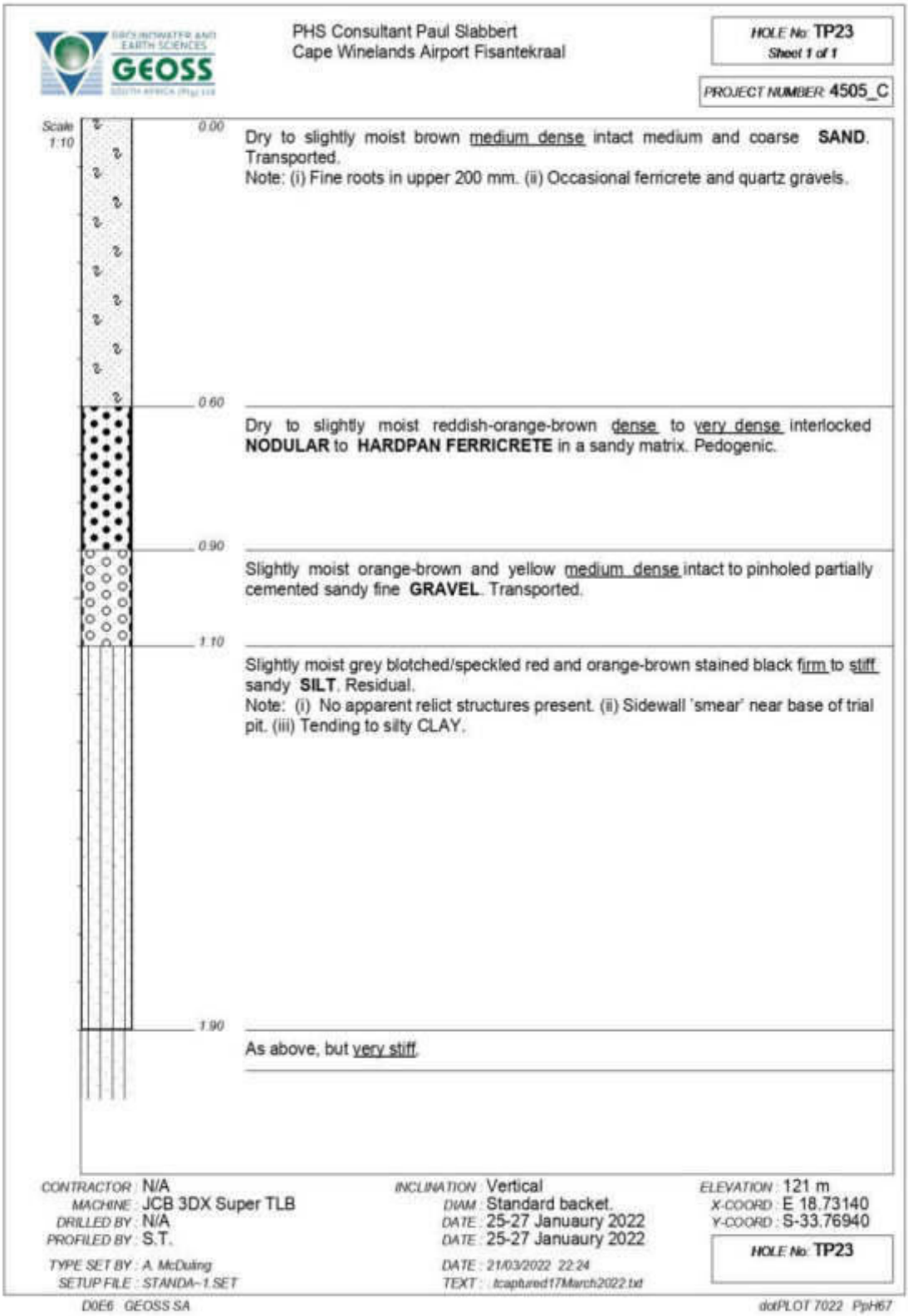
HOLE No: TP20

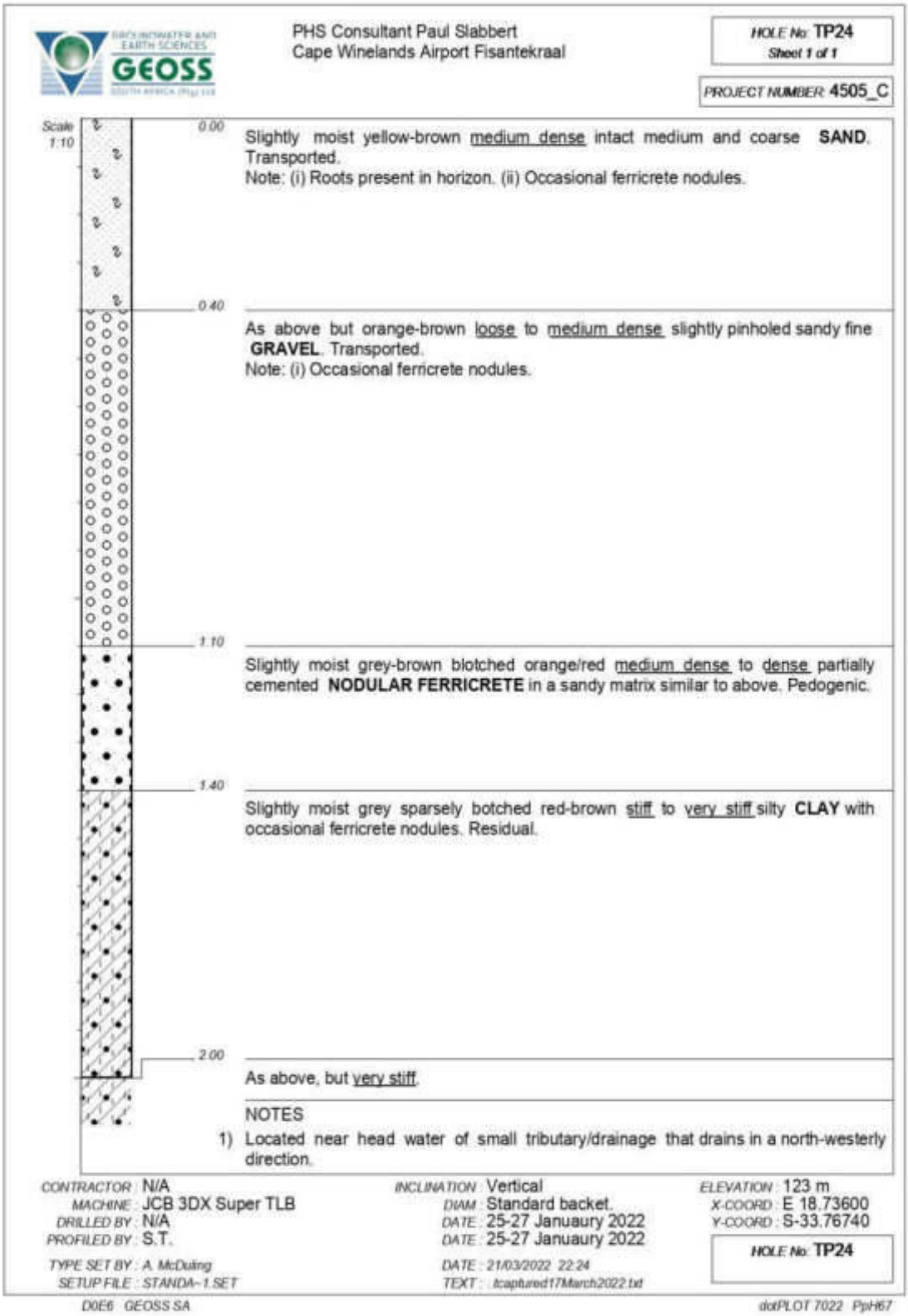
D0E6 GEOSS SA

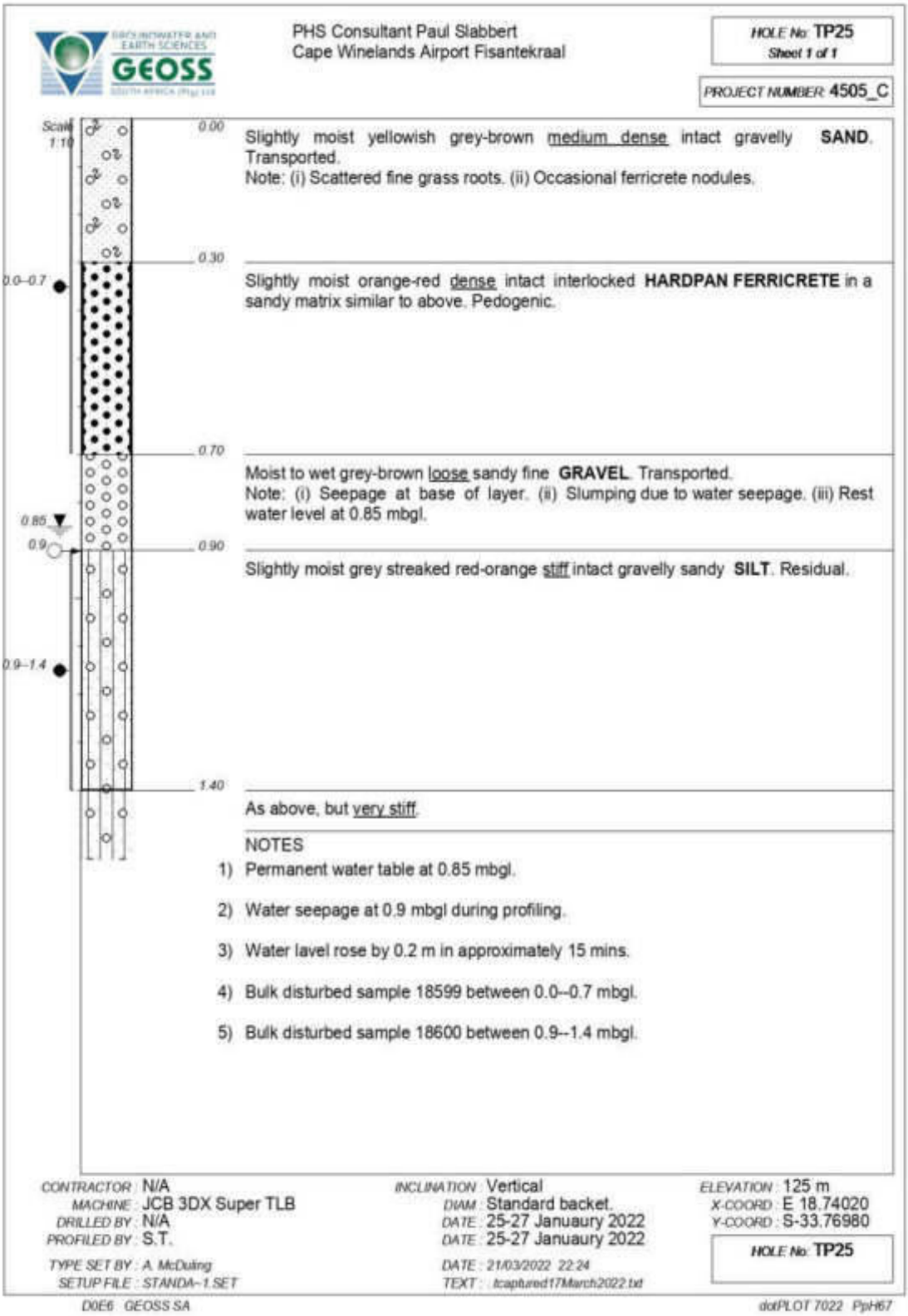
dotPLOT 7022 PpH67

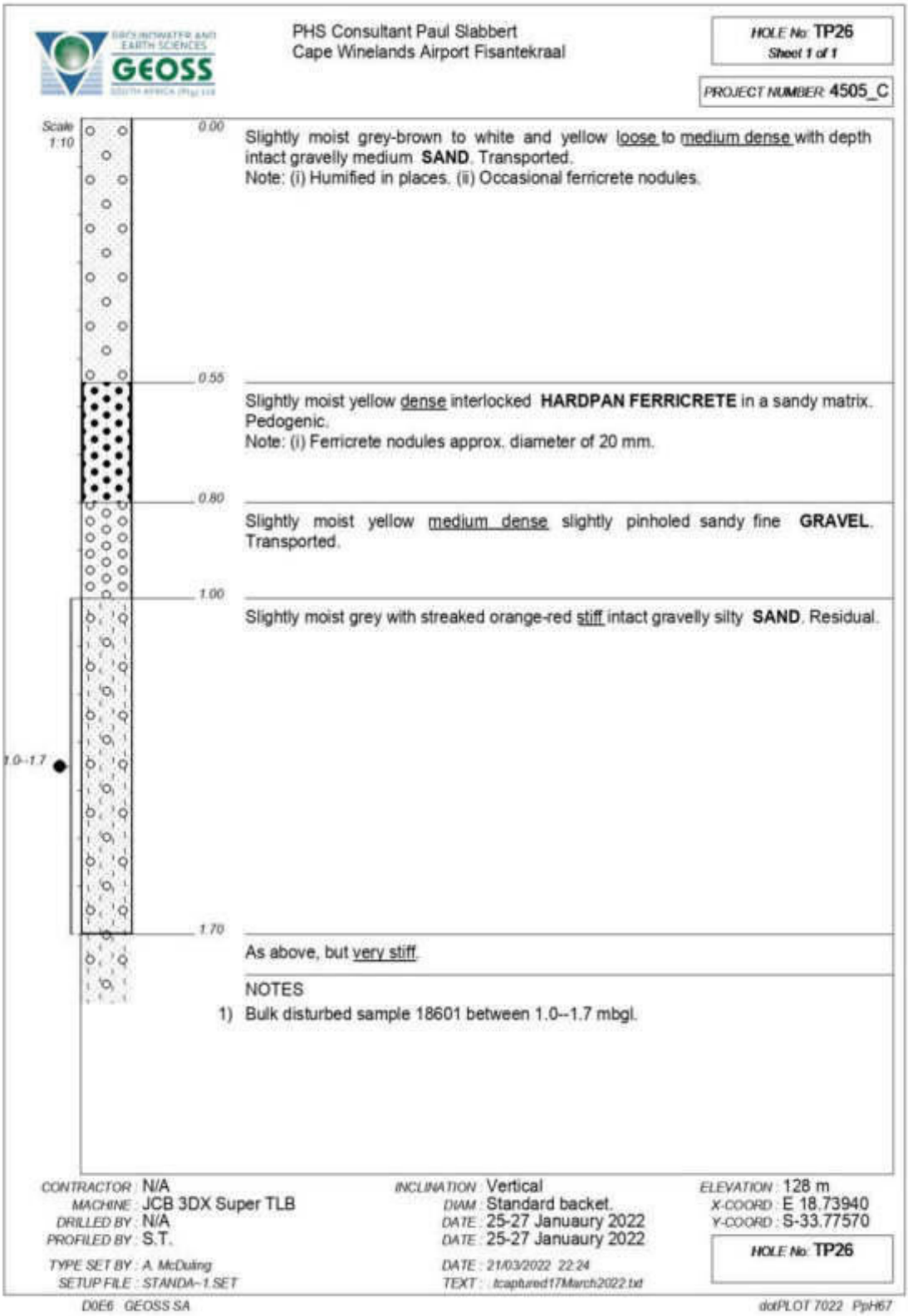

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP21
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:15
0.00
Slightly moist grey-brown to off-white with depth medium dense slightly pinholed fine gravelly medium and coarse SAND. Transported.
0.70
Slightly moist yellow-orange and red-brown very dense partially cemented NODULAR to HARDPAN FERRICRETE. Pedogenic.
Note: (i) Excavates out in boulders. (ii) Tends to 'interlocked' HARDPAN, but laterally discontinuous.
1.00
Slightly moist grey-brown medium dense pinholed sandy fine GRAVEL. Transported.
Note: (i) Occasional ferricrete nodules.
1.20
Slightly moist orange-brown (khaki) blotched red-brown and grey stiff shattered/fissured gravelly sandy SILT. Residual.
Note: (i) Sidewall 'smear' more evident with depth, indicative of increased fines with depth/near base of trial pit. (ii) Tending toward sandy CLAY.
2.20
As above, but very stiff slightly sandy silty CLAY.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 119 m
X-COORD : E 18.73490
Y-COORD : S-33.76000
HOLE No: TP21
D0E6 GEOSS SA
dotPLOT 7022 PpH67

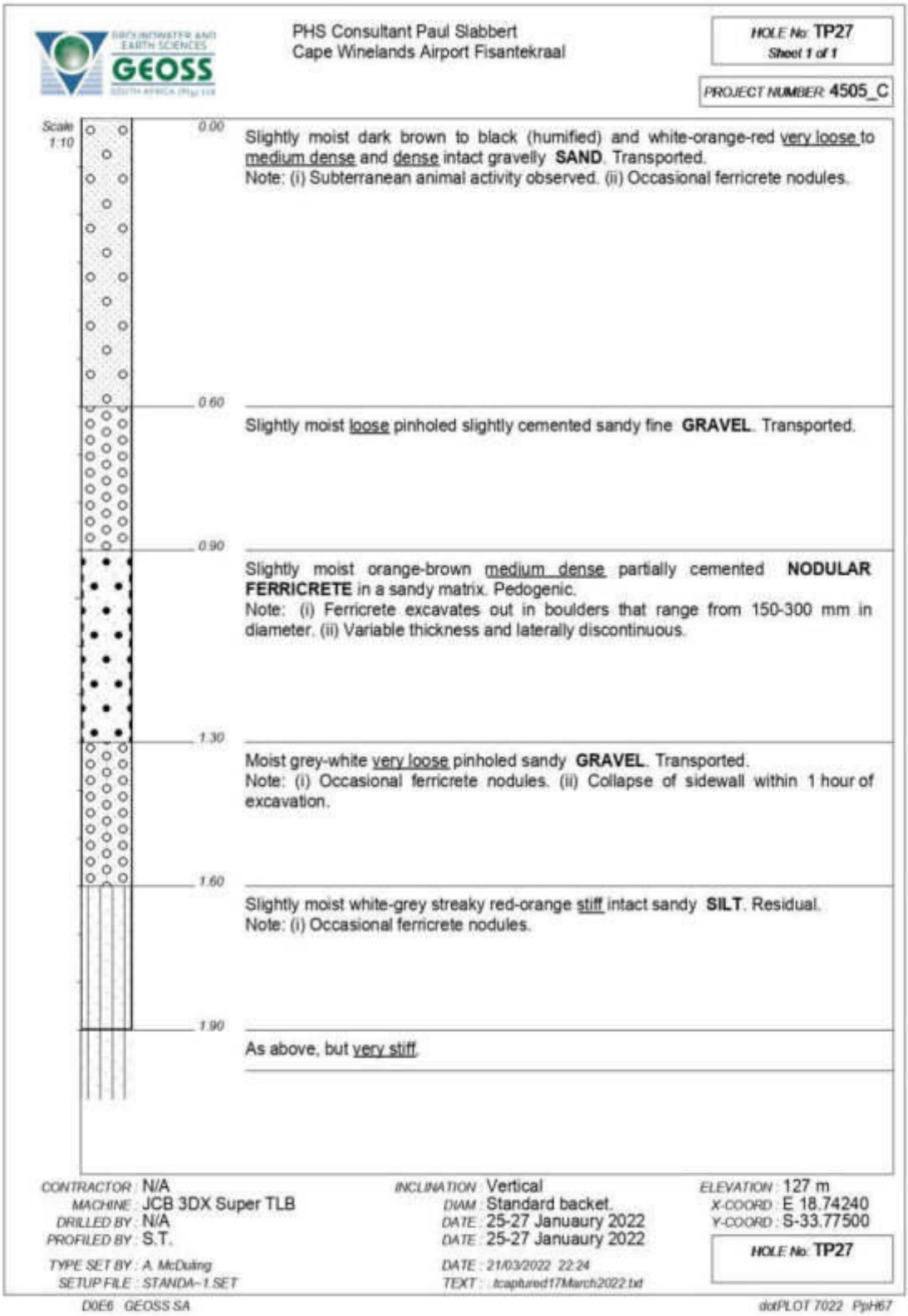

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP22
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Dry to slightly moist grey-brown medium dense intact medium SAND with occasional ferricrete nodules. Transported.
Note: Fine roots present. (ii) Leaf litter scattered on surface.
0.30
Slightly moist orange-brown to yellow dense and very dense interlocked HARDPAN FERRICRETE. Pedogenic.
Note: (i) Varies in thickness between 0.2 - 0.3 m. (ii) Excavates out as boulders approximate diameter of 250 mm.
0.50
Slightly moist off white to greenish-grey firm to stiff fissured silty CLAY. Residual.
Note: (i) Relict foliation planes closed.
0.5-2.0
1.80
As above, but very stiff.
NOTES
1) Bulk disturbed sample 18598 between 0.5--2.0 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 119 m
X-COORD : E 18.73360
Y-COORD : S-33.75780
HOLE No: TP22
D0E6 GEOSS SA
dotPLOT 7022 PpH67

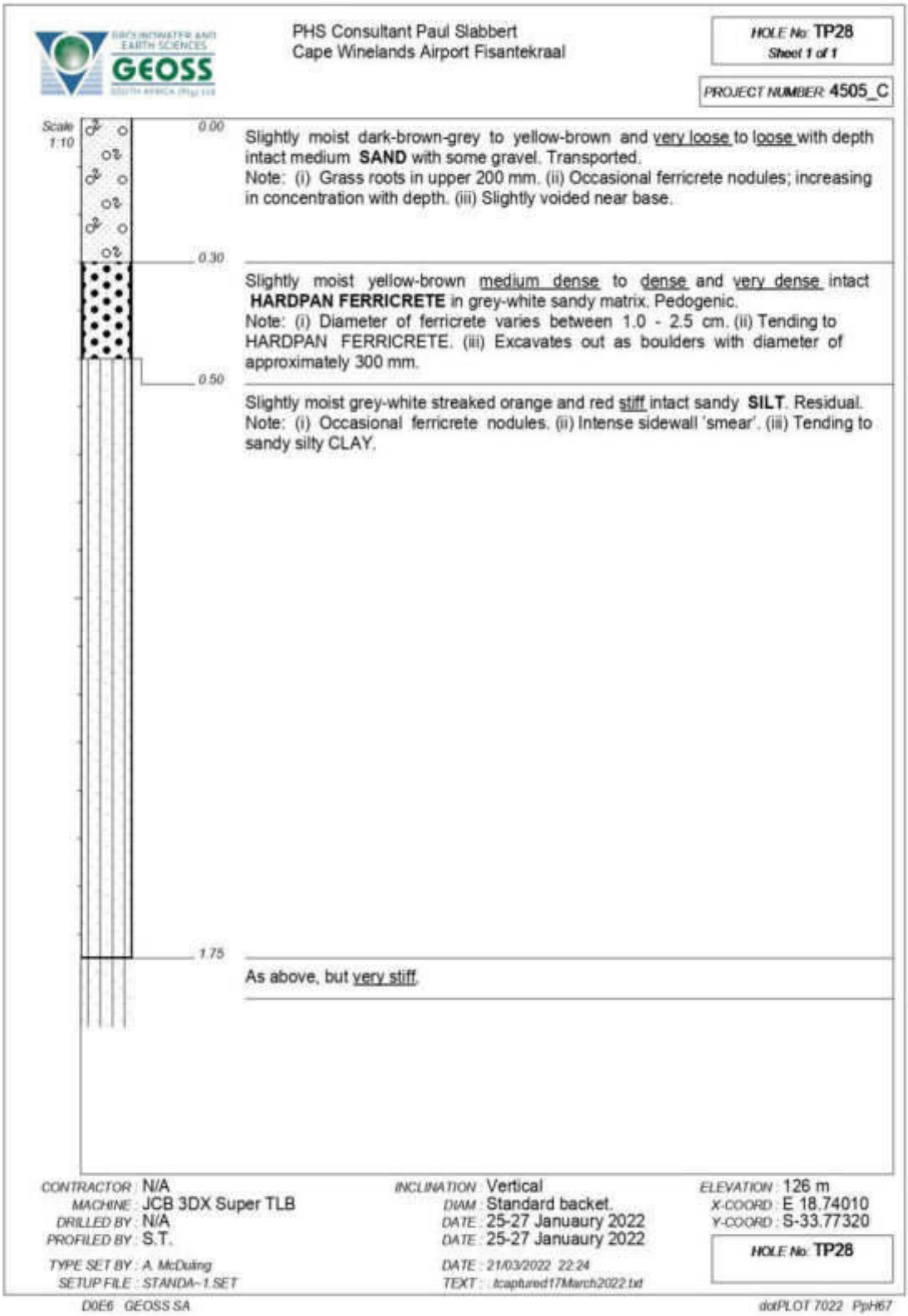

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP23
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Dry to slightly moist brown medium dense intact medium and coarse SAND. Transported.
Note: (i) Fine roots in upper 200 mm. (ii) Occasional ferricrete and quartz gravels.
0.60
Dry to slightly moist reddish-orange-brown dense to very dense interlocked NODULAR to HARDPAN FERRICRETE in a sandy matrix. Pedogenic.
0.90
Slightly moist orange-brown and yellow medium dense intact to pinholed partially cemented sandy fine GRAVEL. Transported.
1.10
Slightly moist grey blotched/speckled red and orange-brown stained black firm to stiff sandy SILT. Residual.
Note: (i) No apparent relict structures present. (ii) Sidewall 'smear' near base of trial pit. (iii) Tending to silty CLAY.
1.90
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 121 m
X-COORD : E 18.73140
Y-COORD : S-33.76940
HOLE No: TP23
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP24
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist yellow-brown medium dense intact medium and coarse SAND. Transported.
Note: (i) Roots present in horizon. (ii) Occasional ferricrete nodules.
0.40
As above but orange-brown loose to medium dense slightly pinholed sandy fine GRAVEL. Transported.
Note: (i) Occasional ferricrete nodules.
1.10
Slightly moist grey-brown blotched orange/red medium dense to dense partially cemented NODULAR FERRICRETE in a sandy matrix similar to above. Pedogenic.
1.40
Slightly moist grey sparsely botched red-brown stiff to very stiff silty CLAY with occasional ferricrete nodules. Residual.
2.00
As above, but very stiff.
NOTES
1) Located near head water of small tributary/drainage that drains in a north-westerly direction.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 123 m
X-COORD : E 18.73600
Y-COORD : S-33.76740
HOLE No: TP24
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP25
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist yellowish grey-brown medium dense intact gravelly SAND. Transported.
Note: (i) Scattered fine grass roots. (ii) Occasional ferricrete nodules.
0.30
0.0–0.7
Slightly moist orange-red dense intact interlocked HARDPAN FERRICRETE in a sandy matrix similar to above. Pedogenic.
0.70
Moist to wet grey-brown loose sandy fine GRAVEL. Transported.
Note: (i) Seepage at base of layer. (ii) Slumping due to water seepage. (iii) Rest water level at 0.85 mbgl.
0.85
0.9
0.90
Slightly moist grey streaked red-orange stiff intact gravelly sandy SILT. Residual.
0.9–1.4
1.40
As above, but very stiff.
NOTES
1) Permanent water table at 0.85 mbgl.
2) Water seepage at 0.9 mbgl during profiling.
3) Water lavel rose by 0.2 m in approximately 15 mins.
4) Bulk disturbed sample 18599 between 0.0--0.7 mbgl.
5) Bulk disturbed sample 18600 between 0.9--1.4 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 125 m
X-COORD : E 18.74020
Y-COORD : S-33.76980
HOLE No: TP25
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP26
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown to white and yellow loose to medium dense with depth intact gravelly medium SAND. Transported.
Note: (i) Humified in places. (ii) Occasional ferricrete nodules.
0.55
Slightly moist yellow dense interlocked HARDPAN FERRICRETE in a sandy matrix. Pedogenic.
Note: (i) Ferricrete nodules approx. diameter of 20 mm.
0.80
Slightly moist yellow medium dense slightly pinholed sandy fine GRAVEL. Transported.
1.00
Slightly moist grey with streaked orange-red stiff intact gravelly silty SAND. Residual.
1.0-1.7
1.70
As above, but very stiff.
NOTES
1) Bulk disturbed sample 18601 between 1.0--1.7 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 128 m
X-COORD : E 18.73940
Y-COORD : S-33.77570
HOLE No: TP26
D0E6 GEOSS SA
dotPLOT 7022 PpH67

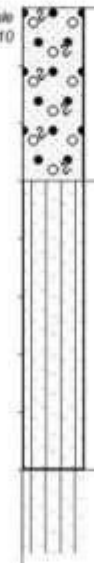

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP27
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist dark brown to black (humified) and white-orange-red very loose to medium dense and dense intact gravelly SAND. Transported.
Note: (i) Subterranean animal activity observed. (ii) Occasional ferricrete nodules.
0.60
Slightly moist loose pinholed slightly cemented sandy fine GRAVEL. Transported.
0.90
Slightly moist orange-brown medium dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic.
Note: (i) Ferricrete excavates out in boulders that range from 150-300 mm in diameter. (ii) Variable thickness and laterally discontinuous.
1.30
Moist grey-white very loose pinholed sandy GRAVEL. Transported.
Note: (i) Occasional ferricrete nodules. (ii) Collapse of sidewall within 1 hour of excavation.
1.60
Slightly moist white-grey streaky red-orange stiff intact sandy SILT. Residual.
Note: (i) Occasional ferricrete nodules.
1.90
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 127 m
X-COORD : E 18.74240
Y-COORD : S-33.77500
HOLE No: TP27
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP28
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist dark-brown-grey to yellow-brown and very loose to loose with depth intact medium SAND with some gravel. Transported.
Note: (i) Grass roots in upper 200 mm. (ii) Occasional ferricrete nodules; increasing in concentration with depth. (iii) Slightly voided near base.
0.30
Slightly moist yellow-brown medium dense to dense and very dense intact HARDPAN FERRICRETE in grey-white sandy matrix. Pedogenic.
Note: (i) Diameter of ferricrete varies between 1.0 - 2.5 cm. (ii) Tending to HARDPAN FERRICRETE. (iii) Excavates out as boulders with diameter of approximately 300 mm.
0.50
Slightly moist grey-white streaked orange and red stiff intact sandy SILT. Residual.
Note: (i) Occasional ferricrete nodules. (ii) Intense sidewall 'smear'. (iii) Tending to sandy silty CLAY.
1.75
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 126 m
X-COORD : E 18.74010
Y-COORD : S-33.77320
HOLE No: TP28
D0E6 GEOSS SA
dotPLOT 7022 PpH67

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal

HOLE No: TP29
Sheet 1 of 1

PROJECT NUMBER: 4505_C




0.00 Slightly moist dark-brown / black (humic) to grey with depth very loose intact gravelly medium and coarse **SAND**. Transported.
Note: (i) Grass roots provide stabilisation. (ii) Humified in places. (iii) Occasional ferricrete nodules; diameter of ferricrete varies from 10 to 15 mm, and up to 25 cm, where more interlocked/indurated/cemented.

0.30 Slightly moist grey with streaks of yellow and red very stiff intact sandy **SILT**. Residual.
Note: (i) Tending to silty CLAY.

0.80 As above, but extremely stiff.

NOTES
1) Excavation with TLB particularly time consuming; difficult excavation.

CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.

TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET

INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022

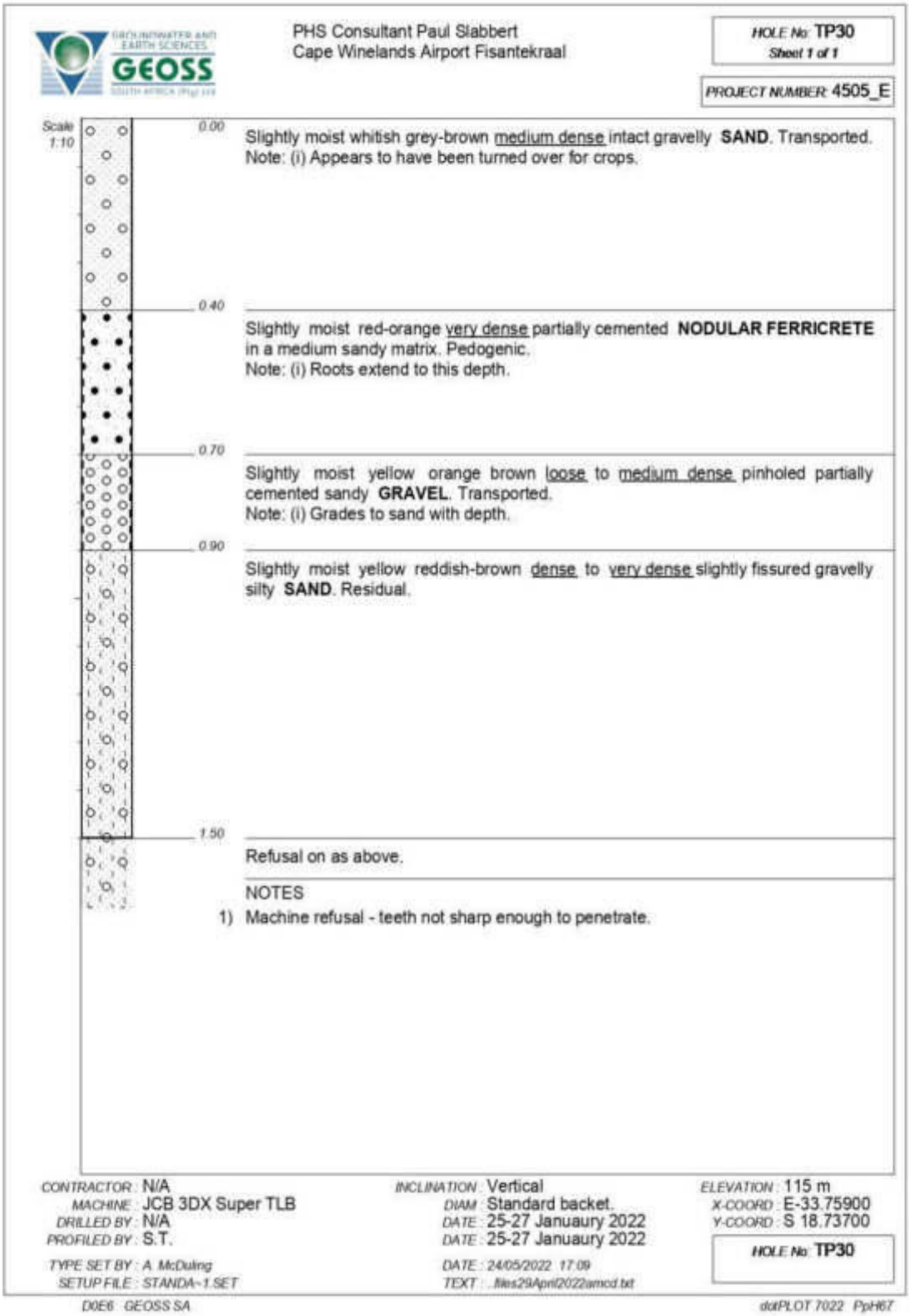
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt

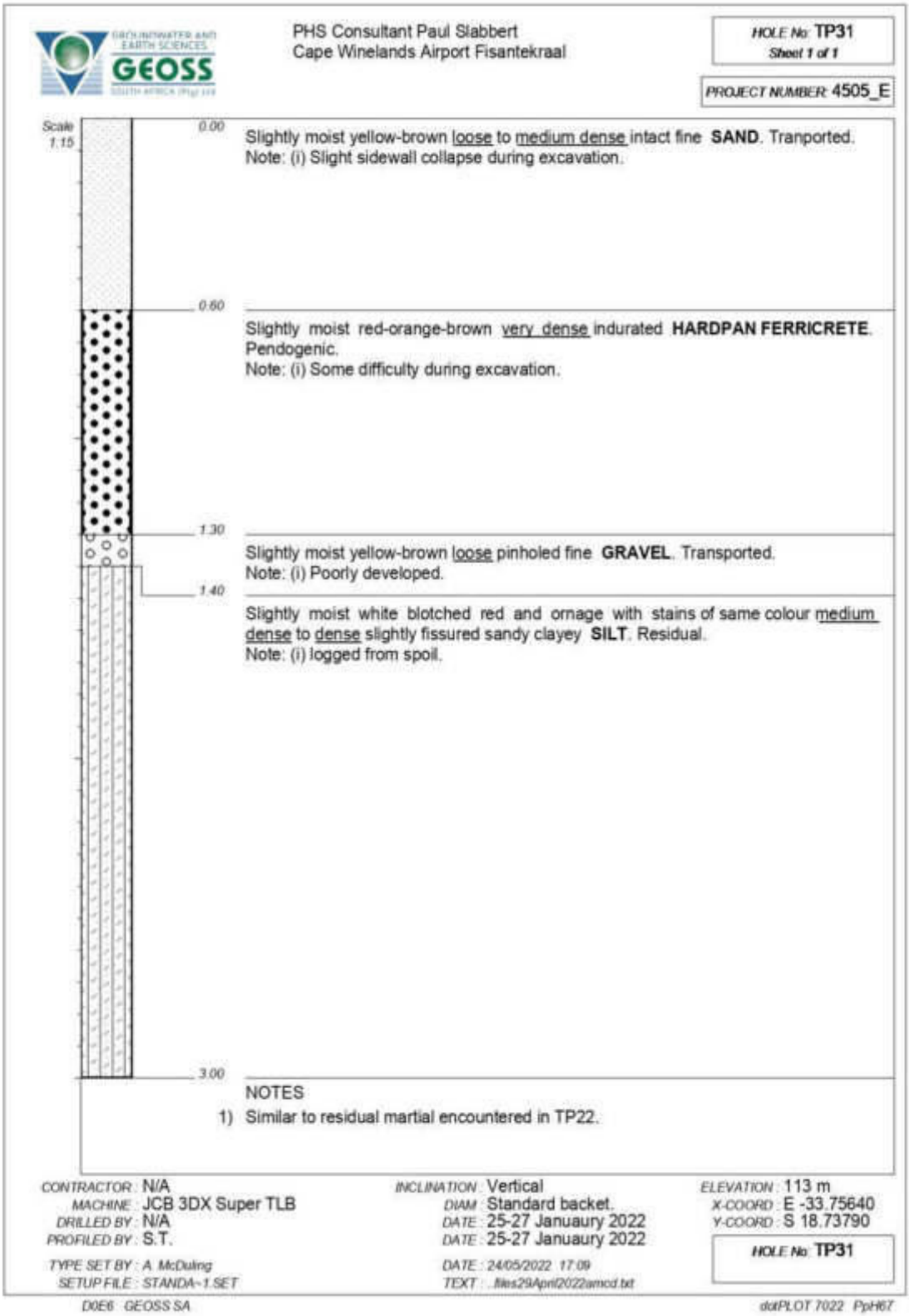
ELEVATION : 126 m
X-COORD : E 18.73880
Y-COORD : S-33.77490

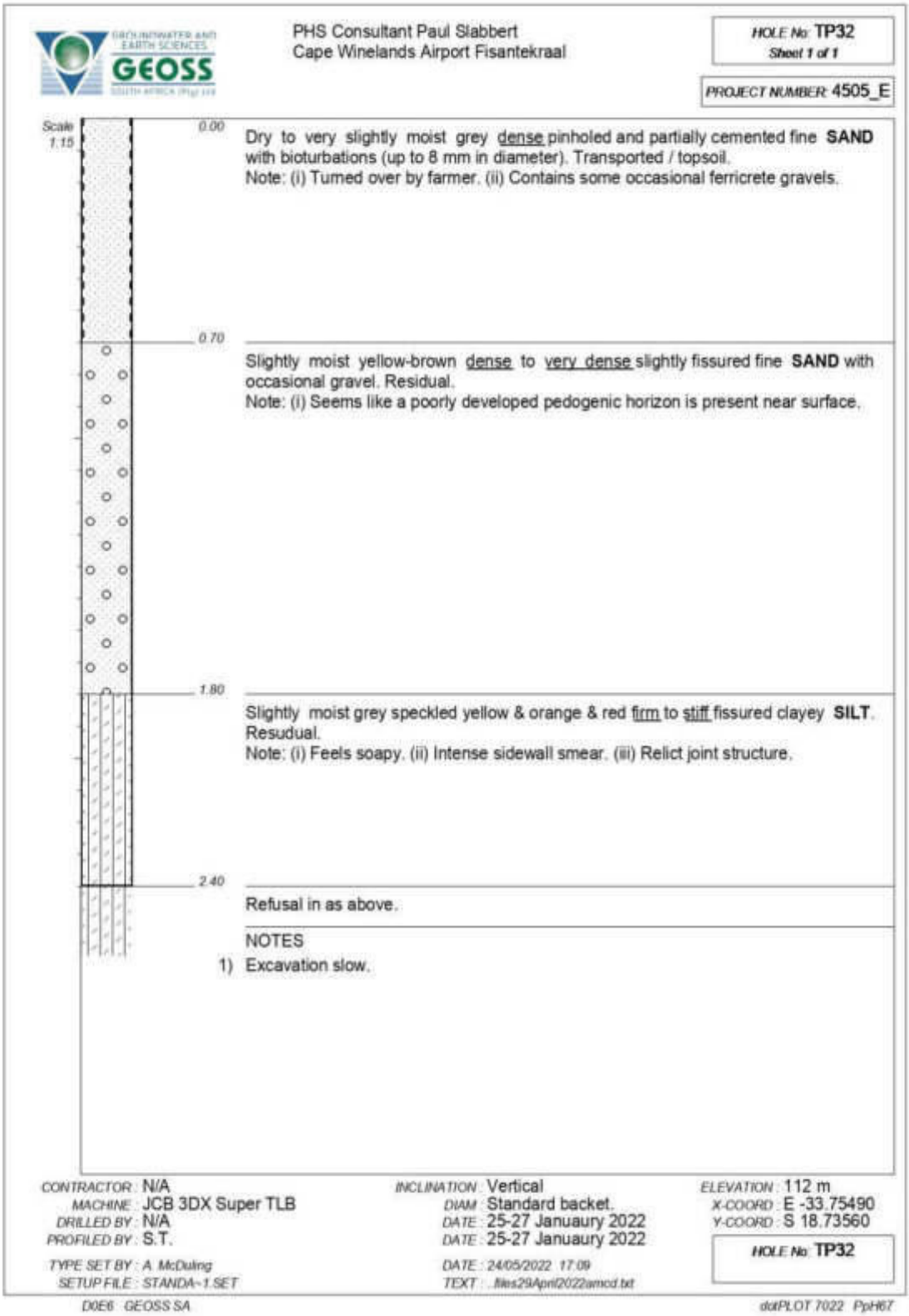
HOLE No: TP29

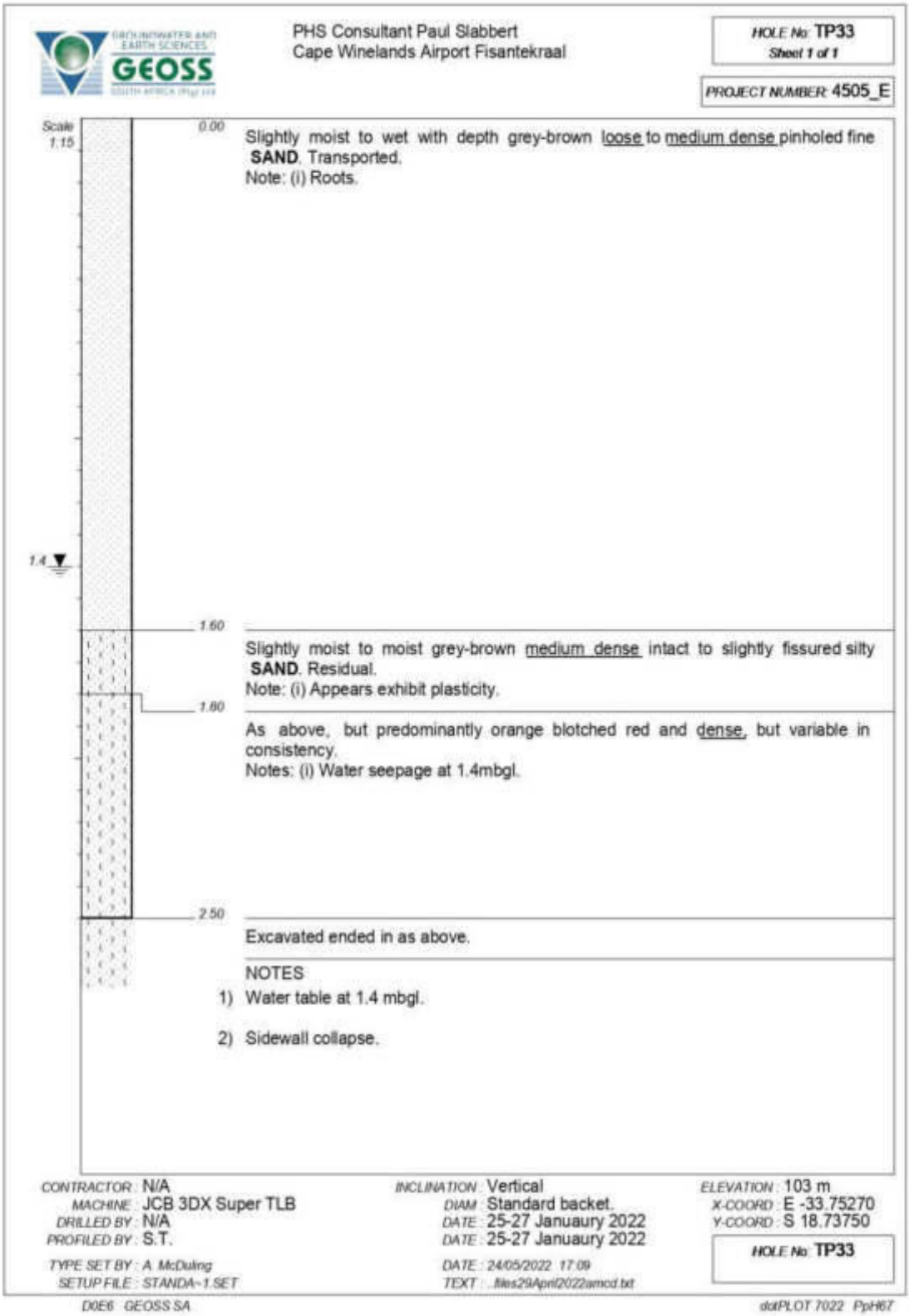
D0E6 GEOSS SA

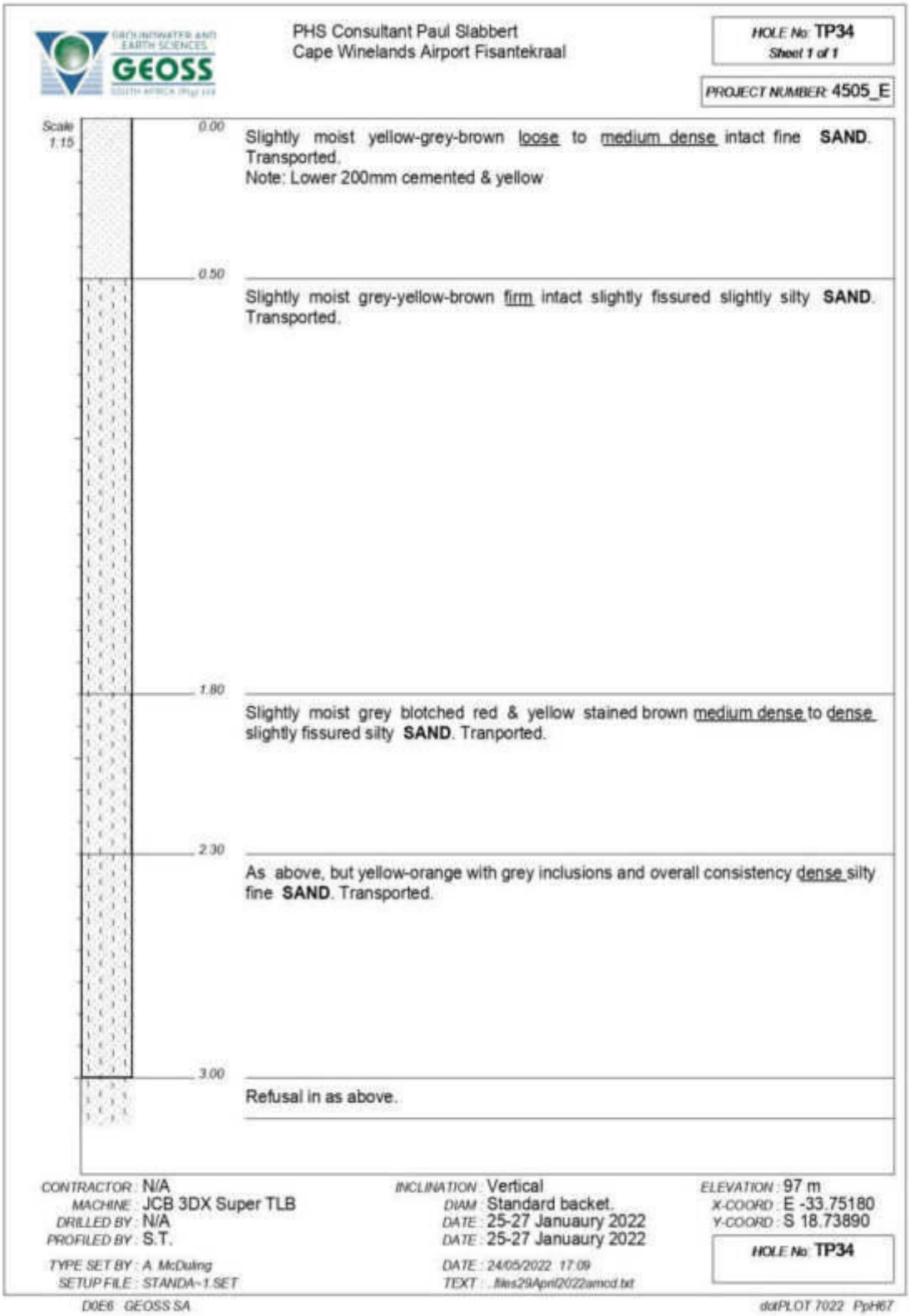
dotPLOT 7022 PpH67

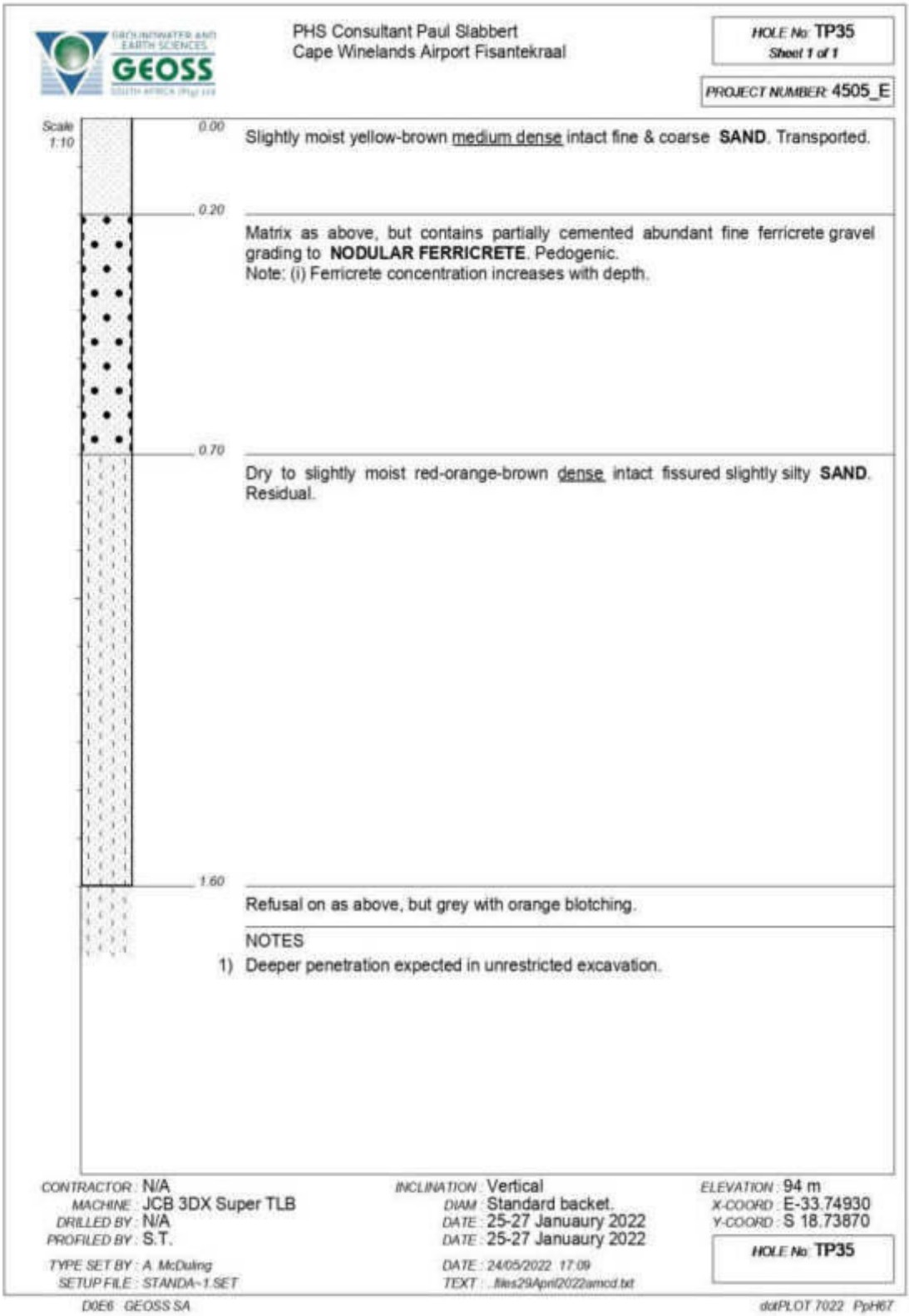

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP30
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist whitish grey-brown medium dense intact gravelly SAND. Transported.
Note: (i) Appears to have been turned over for crops.
0.40
Slightly moist red-orange very dense partially cemented NODULAR FERRICRETE in a medium sandy matrix. Pedogenic.
Note: (i) Roots extend to this depth.
0.70
Slightly moist yellow orange brown loose to medium dense pinholed partially cemented sandy GRAVEL. Transported.
Note: (i) Grades to sand with depth.
0.90
Slightly moist yellow reddish-brown dense to very dense slightly fissured gravelly silty SAND. Residual.
1.50
Refusal on as above.
NOTES
1) Machine refusal - teeth not sharp enough to penetrate.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 115 m
X-COORD : E-33.75900
Y-COORD : S 18.73700
HOLE No: TP30
D0E6 GEOSS SA
dotPLOT 7022 PpH67

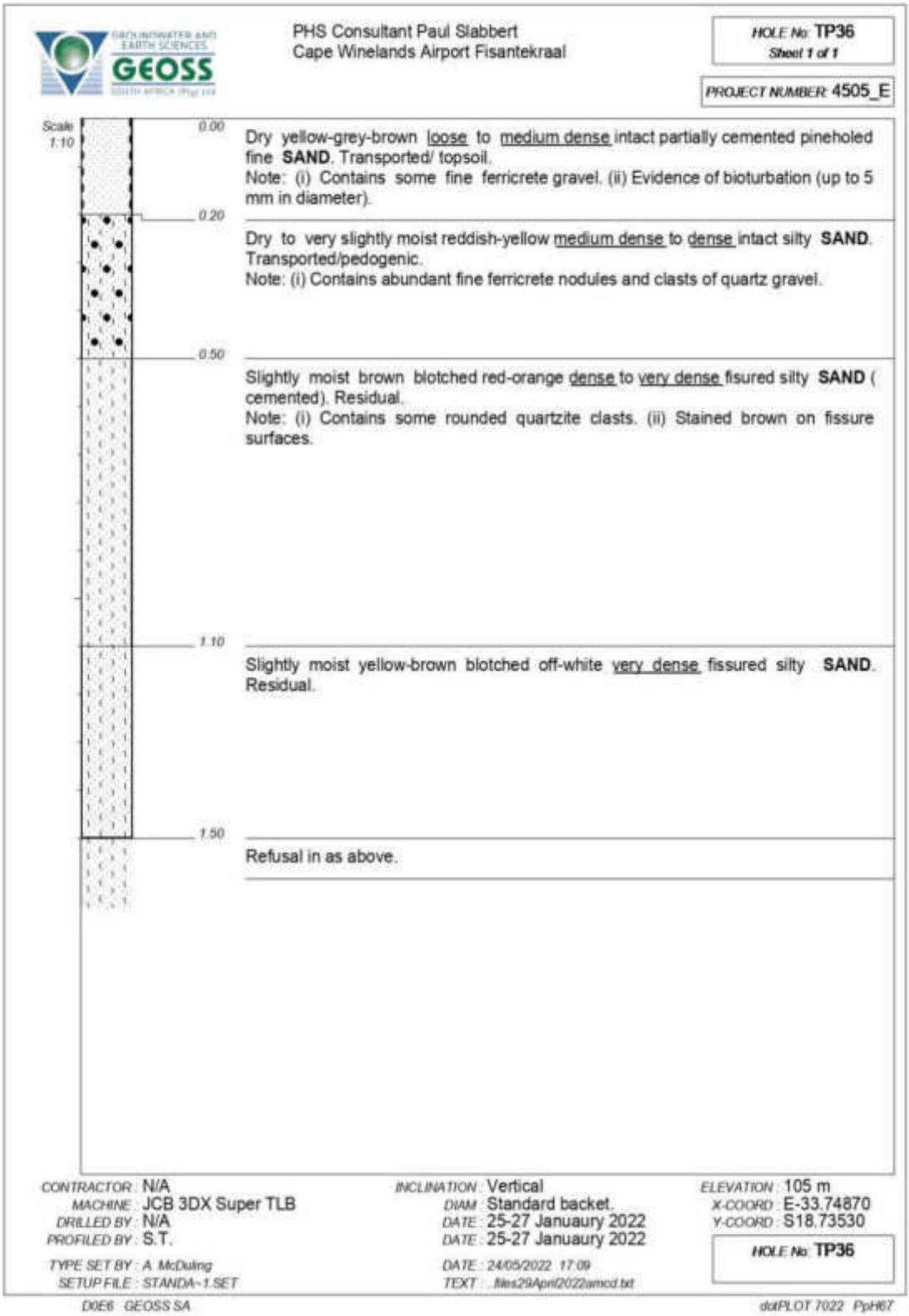

GEOSS
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Cape Winelands Airport Fisantekraal
HOLE No: TP31
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:15
0.00
Slightly moist yellow-brown loose to medium dense intact fine SAND. Tranported.
Note: (i) Slight sidewall collapse during excavation.
0.60
Slightly moist red-orange-brown very dense indurated HARDPAN FERRICRETE. Pendogenic.
Note: (i) Some difficulty during excavation.
1.30
Slightly moist yellow-brown loose pinholed fine GRAVEL. Transported.
Note: (i) Poorly developed.
1.40
Slightly moist white blotched red and ornage with stains of same colour medium dense to dense slightly fissured sandy clayey SILT. Residual.
Note: (i) logged from spoil.
3.00
NOTES
1) Similar to residual martial encountered in TP22.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 113 m
X-COORD : E -33.75640
Y-COORD : S 18.73790
HOLE No: TP31
D0E6 GEOSS SA
dotPLOT 7022 PpH67

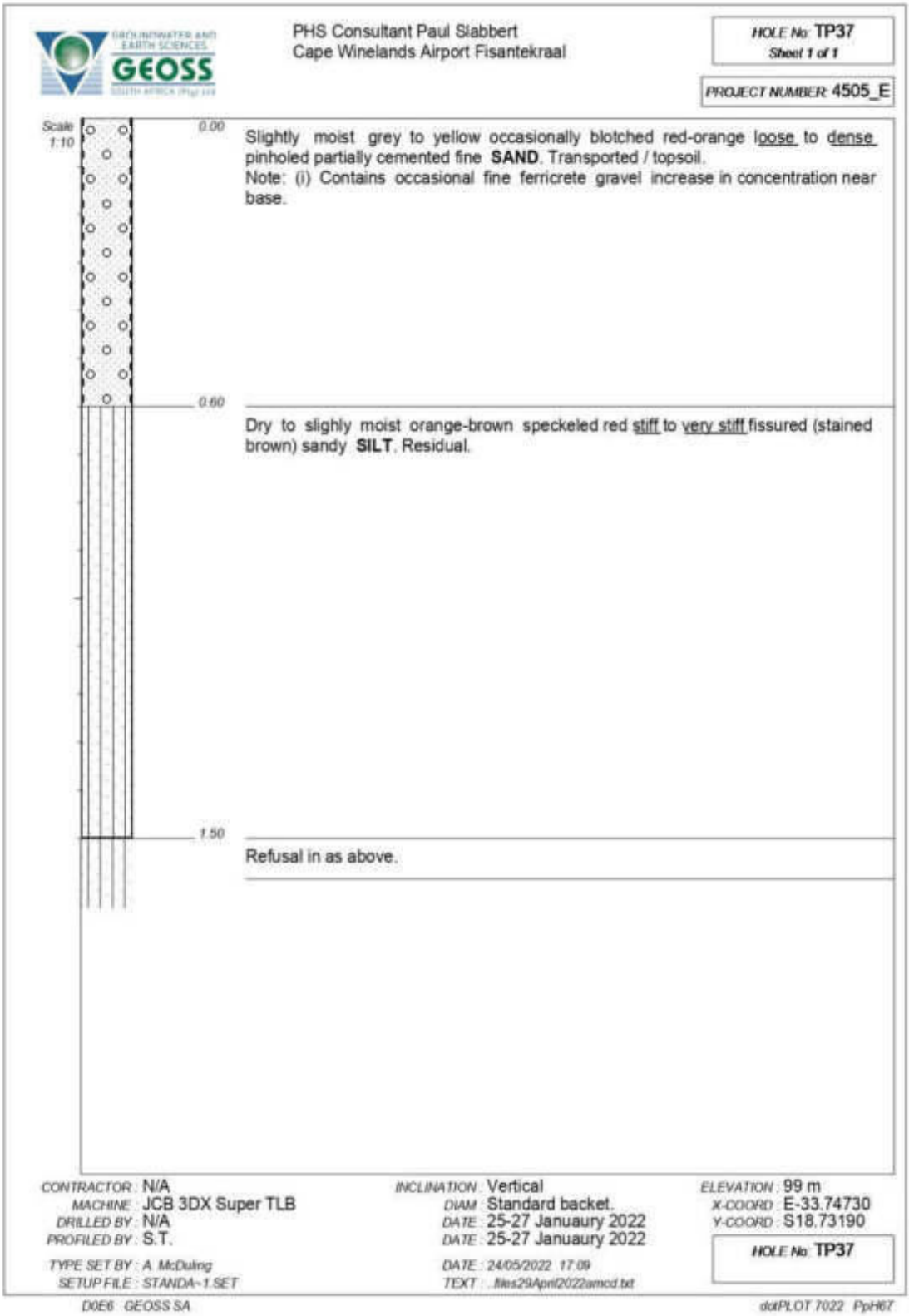

GEOSS
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Cape Winelands Airport Fisantekraal
HOLE No: TP32
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:15
0.00
Dry to very slightly moist grey dense pinholed and partially cemented fine SAND with bioturbations (up to 8 mm in diameter). Transported / topsoil.
Note: (i) Turned over by farmer. (ii) Contains some occasional ferricrete gravels.
0.70
Slightly moist yellow-brown dense to very dense slightly fissured fine SAND with occasional gravel. Residual.
Note: (i) Seems like a poorly developed pedogenic horizon is present near surface.
1.80
Slightly moist grey speckled yellow & orange & red firm to stiff fissured clayey SILT. Resudual.
Note: (i) Feels soapy. (ii) Intense sidewall smear. (iii) Relict joint structure.
2.40
Refusal in as above.
NOTES
1) Excavation slow.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 112 m
X-COORD : E -33.75490
Y-COORD : S 18.73560
HOLE No: TP32
D0E6 GEOSS SA
dotPLOT 7022 PpH67

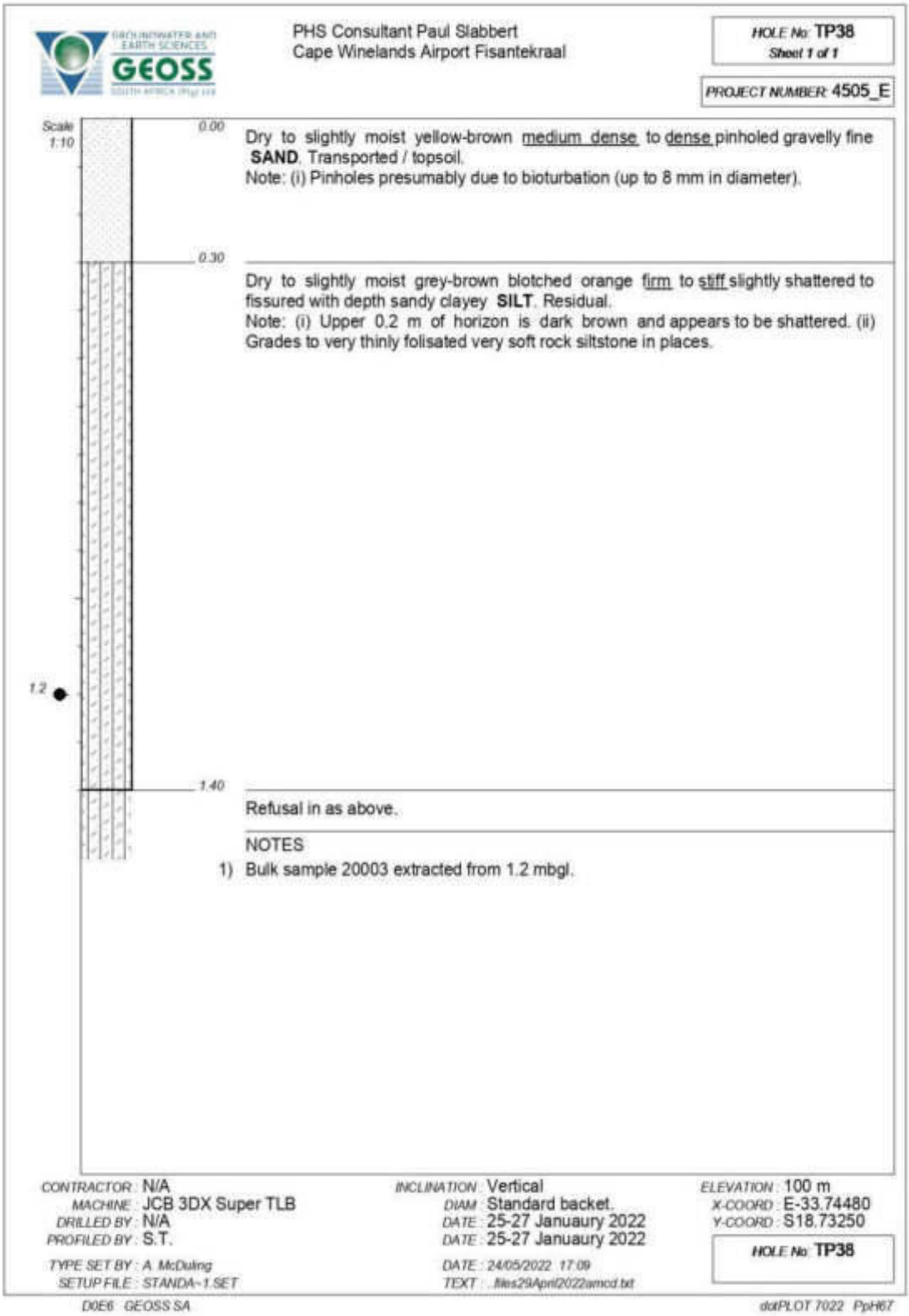

GEOSS
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Cape Winelands Airport Fisantekraal
HOLE No: TP33
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:15
0.00
Slightly moist to wet with depth grey-brown loose to medium dense pinholed fine SAND. Transported.
Note: (i) Roots.
1.4
1.60
Slightly moist to moist grey-brown medium dense intact to slightly fissured silty SAND. Residual.
Note: (i) Appears exhibit plasticity.
1.80
As above, but predominantly orange blotched red and dense, but variable in consistency.
Notes: (i) Water seepage at 1.4mbgl.
2.50
Excavated ended in as above.
NOTES
1) Water table at 1.4 mbgl.
2) Sidewall collapse.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 103 m
X-COORD : E -33.75270
Y-COORD : S 18.73750
HOLE No: TP33
D0E6 GEOSS SA
dotPLOT 7022 PpH67

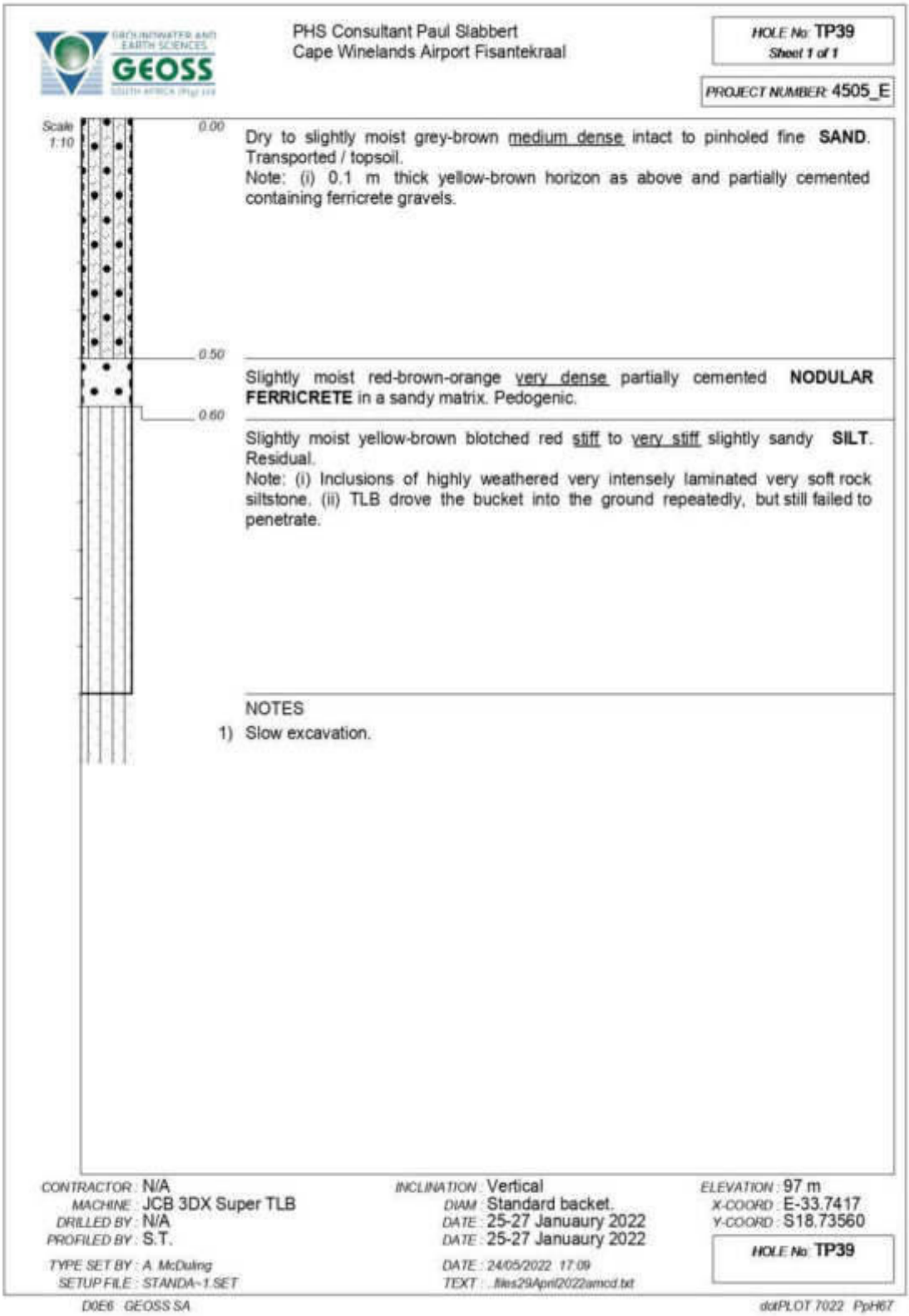

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP34
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:15
0.00
Slightly moist yellow-grey-brown loose to medium dense intact fine SAND. Transported.
Note: Lower 200mm cemented & yellow
0.50
Slightly moist grey-yellow-brown firm intact slightly fissured slightly silty SAND. Transported.
1.80
Slightly moist grey blotched red & yellow stained brown medium dense to dense slightly fissured silty SAND. Tranported.
2.30
As above, but yellow-orange with grey inclusions and overall consistency dense silty fine SAND. Transported.
3.00
Refusal in as above.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 97 m
X-COORD : E -33.75180
Y-COORD : S 18.73890
HOLE No: TP34
D0E6 GEOSS SA
dotPLOT 7022 PpH67

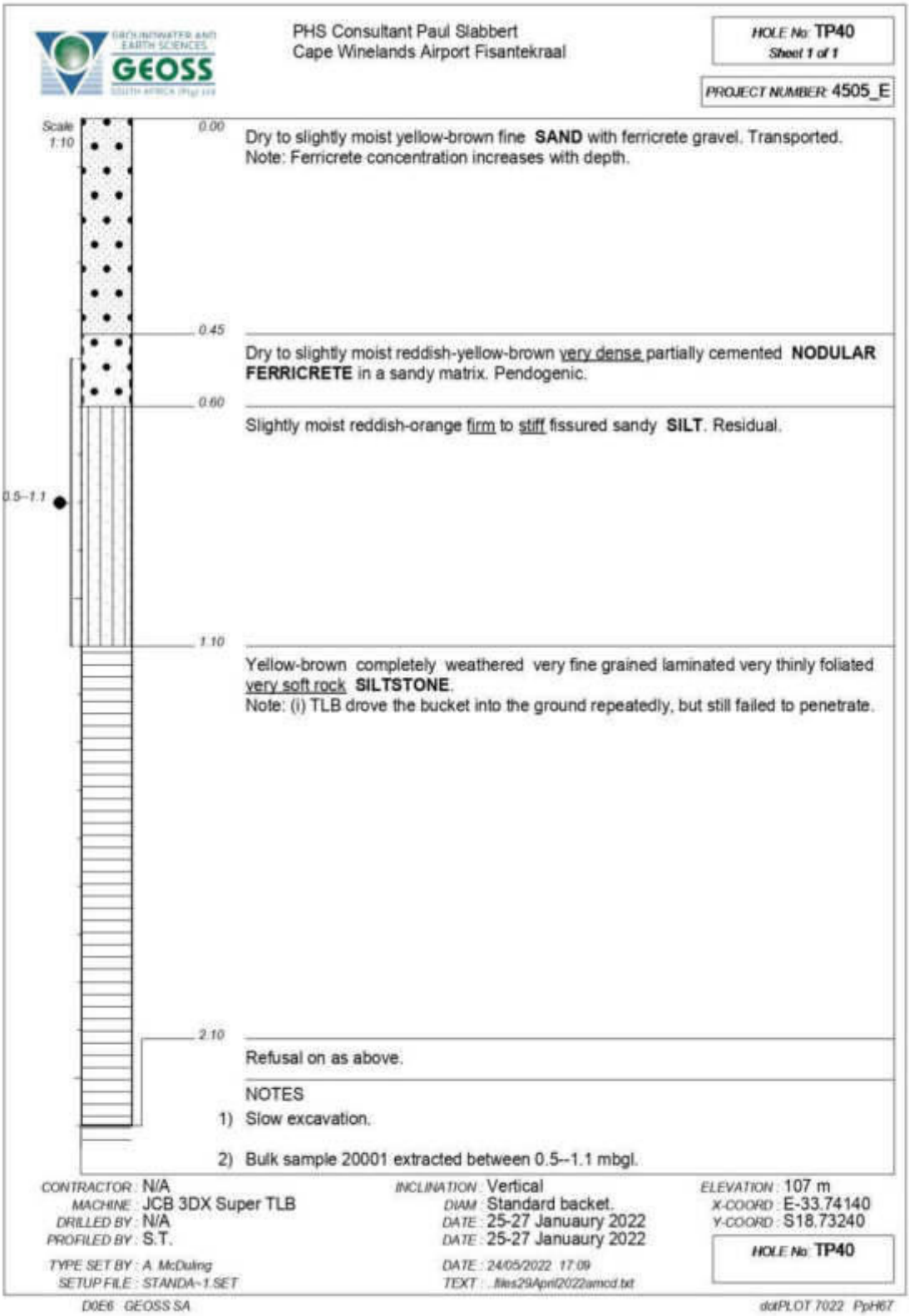

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP35
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist yellow-brown medium dense intact fine & coarse SAND. Transported.
0.20
Matrix as above, but contains partially cemented abundant fine ferricrete gravel grading to NODULAR FERRICRETE. Pedogenic.
Note: (i) Ferricrete concentration increases with depth.
0.70
Dry to slightly moist red-orange-brown dense intact fissured slightly silty SAND. Residual.
1.60
Refusal on as above, but grey with orange blotching.
NOTES
1) Deeper penetration expected in unrestricted excavation.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 94 m
X-COORD : E-33.74930
Y-COORD : S 18.73870
HOLE No: TP35
D0E6 GEOSS SA
dotPLOT 7022 PpH67

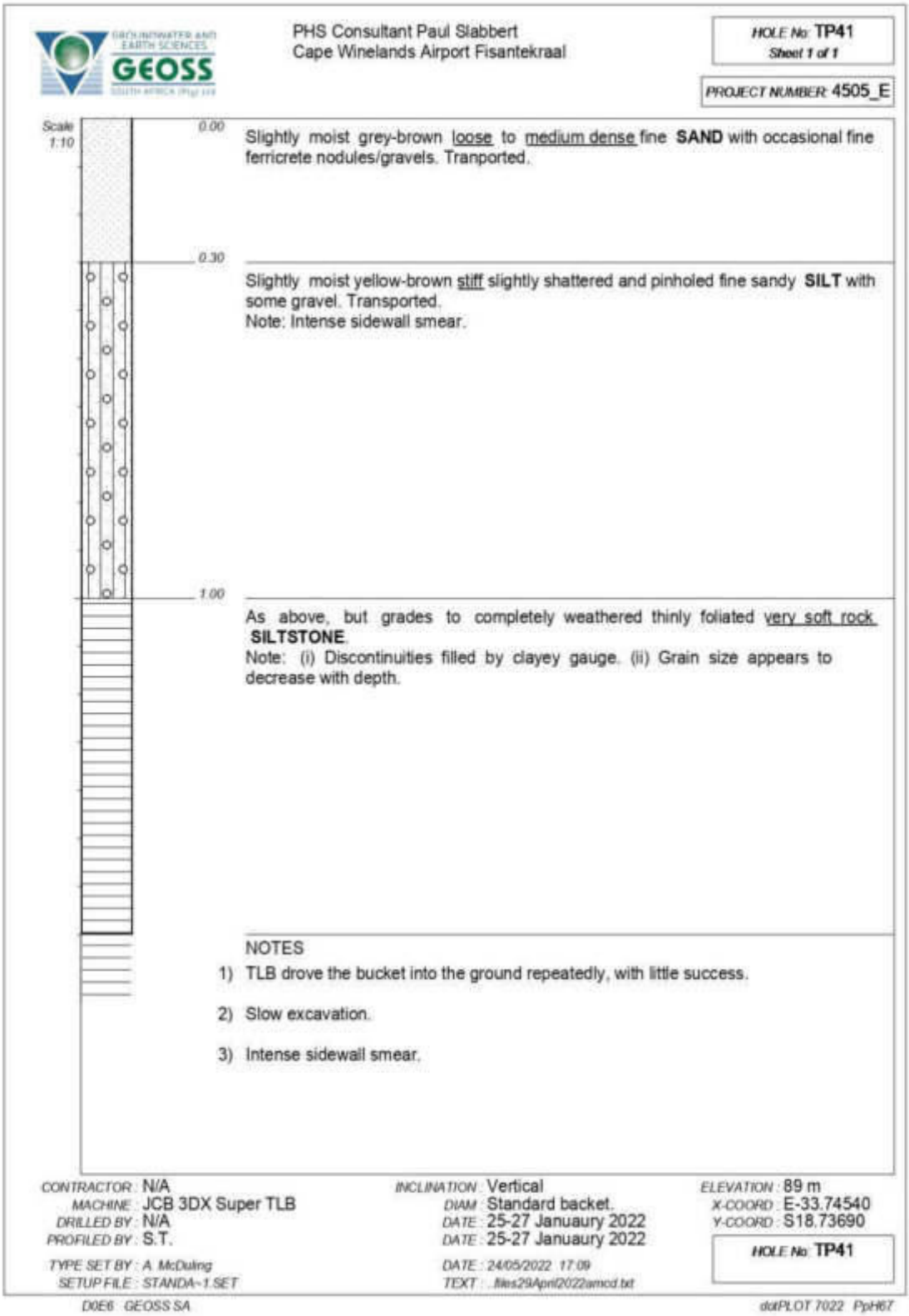

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP36
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry yellow-grey-brown loose to medium dense intact partially cemented pineholed fine SAND. Transported/ topsoil.
Note: (i) Contains some fine ferricrete gravel. (ii) Evidence of bioturbation (up to 5 mm in diameter).
0.20
Dry to very slightly moist reddish-yellow medium dense to dense intact silty SAND. Transported/pedogenic.
Note: (i) Contains abundant fine ferricrete nodules and clasts of quartz gravel.
0.50
Slightly moist brown blotched red-orange dense to very dense fisured silty SAND ( cemented). Residual.
Note: (i) Contains some rounded quartzite clasts. (ii) Stained brown on fissure surfaces.
1.10
Slightly moist yellow-brown blotched off-white very dense fissured silty SAND. Residual.
1.50
Refusal in as above.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 105 m
X-COORD : E-33.74870
Y-COORD : S18.73530
HOLE No: TP36
D0E6 GEOSS SA
dotPLOT 7022 PpH67

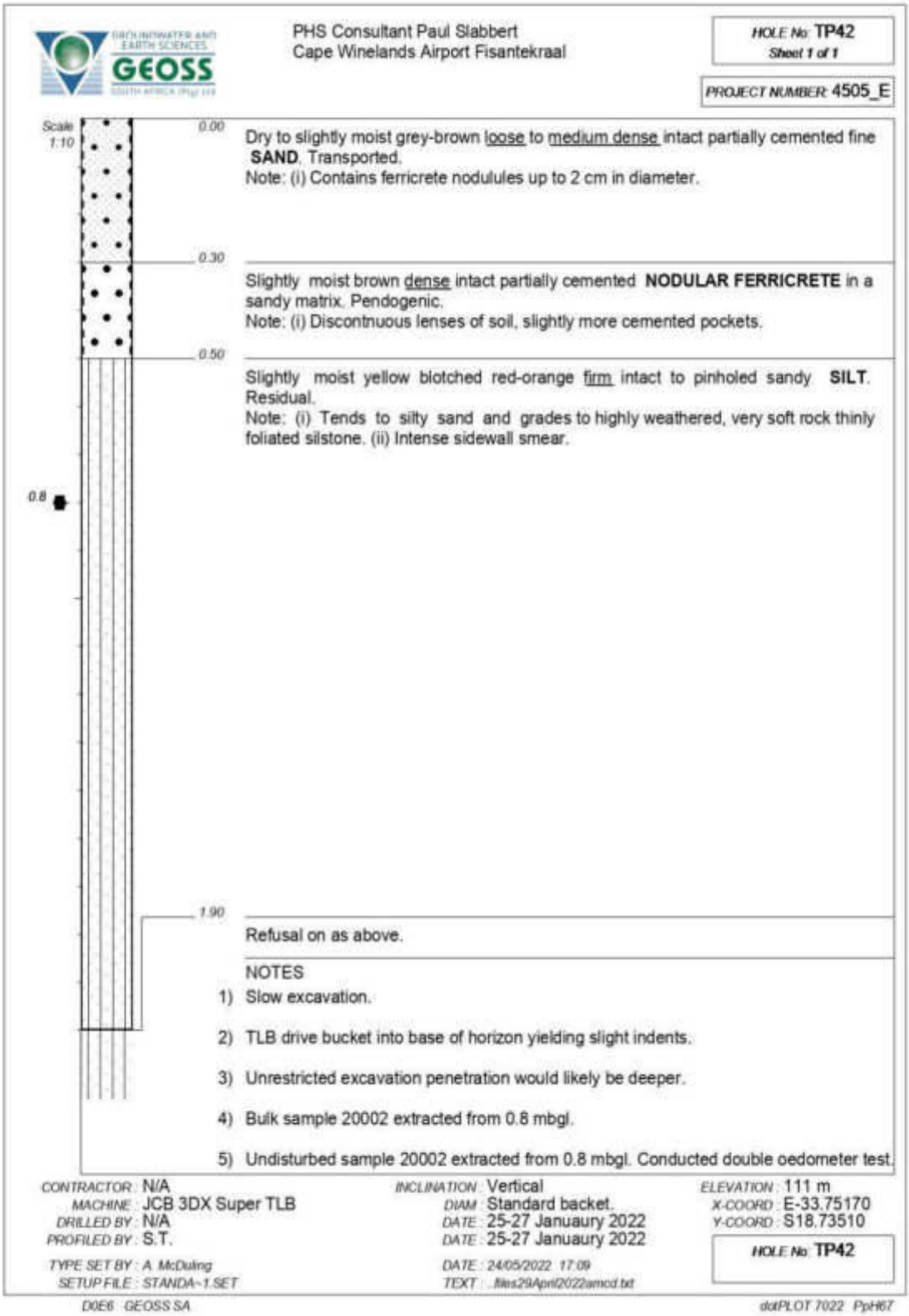

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP37
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey to yellow occasionally blotched red-orange loose to dense pinholed partially cemented fine SAND. Transported / topsoil.
Note: (i) Contains occasional fine ferricrete gravel increase in concentration near base.
0.60
Dry to slighly moist orange-brown speckeled red stiff to very stiff fissured (stained brown) sandy SILT. Residual.
1.50
Refusal in as above.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 99 m
X-COORD : E-33.74730
Y-COORD : S18.73190
HOLE No: TP37
D0E6 GEOSS SA
dotPLOT 7022 PpH67

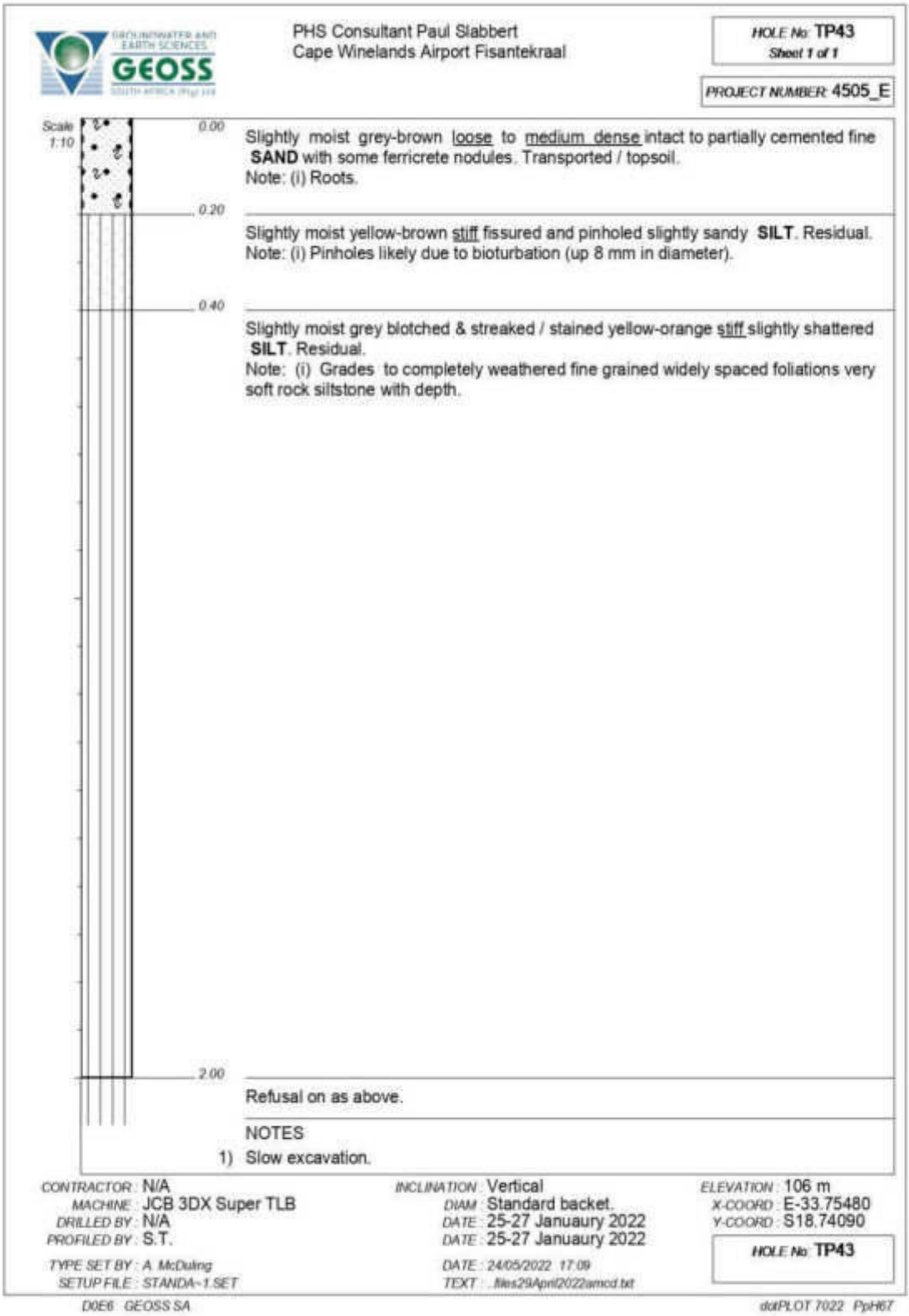

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP38
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist yellow-brown medium dense to dense pinholed gravelly fine SAND. Transported / topsoil.
Note: (i) Pinholes presumably due to bioturbation (up to 8 mm in diameter).
0.30
Dry to slightly moist grey-brown blotched orange firm to stiff slightly shattered to fissured with depth sandy clayey SILT. Residual.
Note: (i) Upper 0.2 m of horizon is dark brown and appears to be shattered. (ii) Grades to very thinly folisated very soft rock siltstone in places.
1.2
1.40
Refusal in as above.
NOTES
1) Bulk sample 20003 extracted from 1.2 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 100 m
X-COORD : E-33.74480
Y-COORD : S18.73250
HOLE No: TP38
D0E6 GEOSS SA
dotPLOT 7022 PpH67

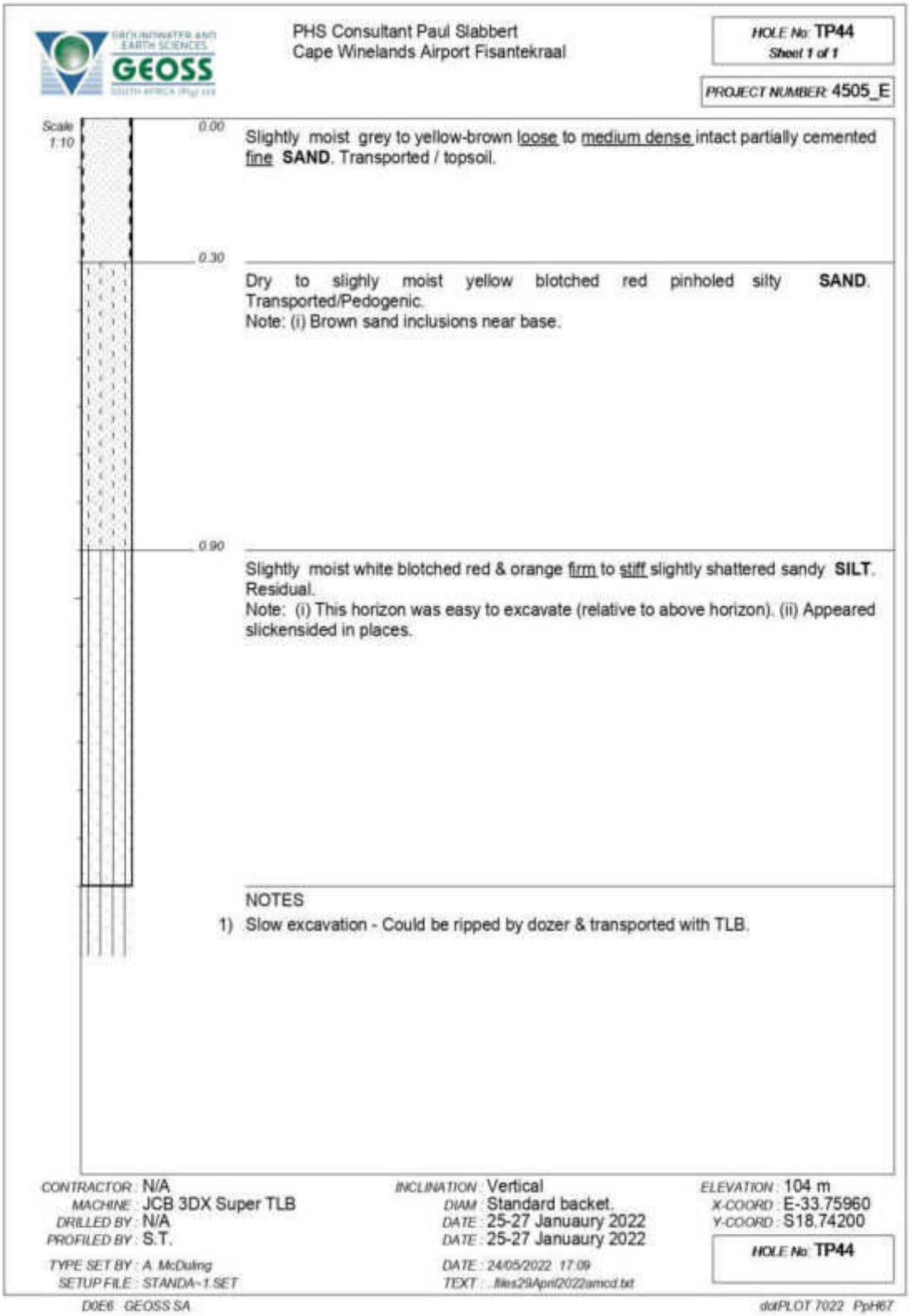

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP39
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist grey-brown medium dense intact to pinholed fine SAND. Transported / topsoil.
Note: (i) 0.1 m thick yellow-brown horizon as above and partially cemented containing ferricrete gravels.
0.50
Slightly moist red-brown-orange very dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic.
0.60
Slightly moist yellow-brown blotched red stiff to very stiff slightly sandy SILT. Residual.
Note: (i) Inclusions of highly weathered very intensely laminated very soft rock siltstone. (ii) TLB drove the bucket into the ground repeatedly, but still failed to penetrate.
NOTES
1) Slow excavation.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 97 m
X-COORD : E-33.7417
Y-COORD : S18.73560
HOLE No: TP39
D0E6 GEOSS SA
dotPLOT 7022 PpH67

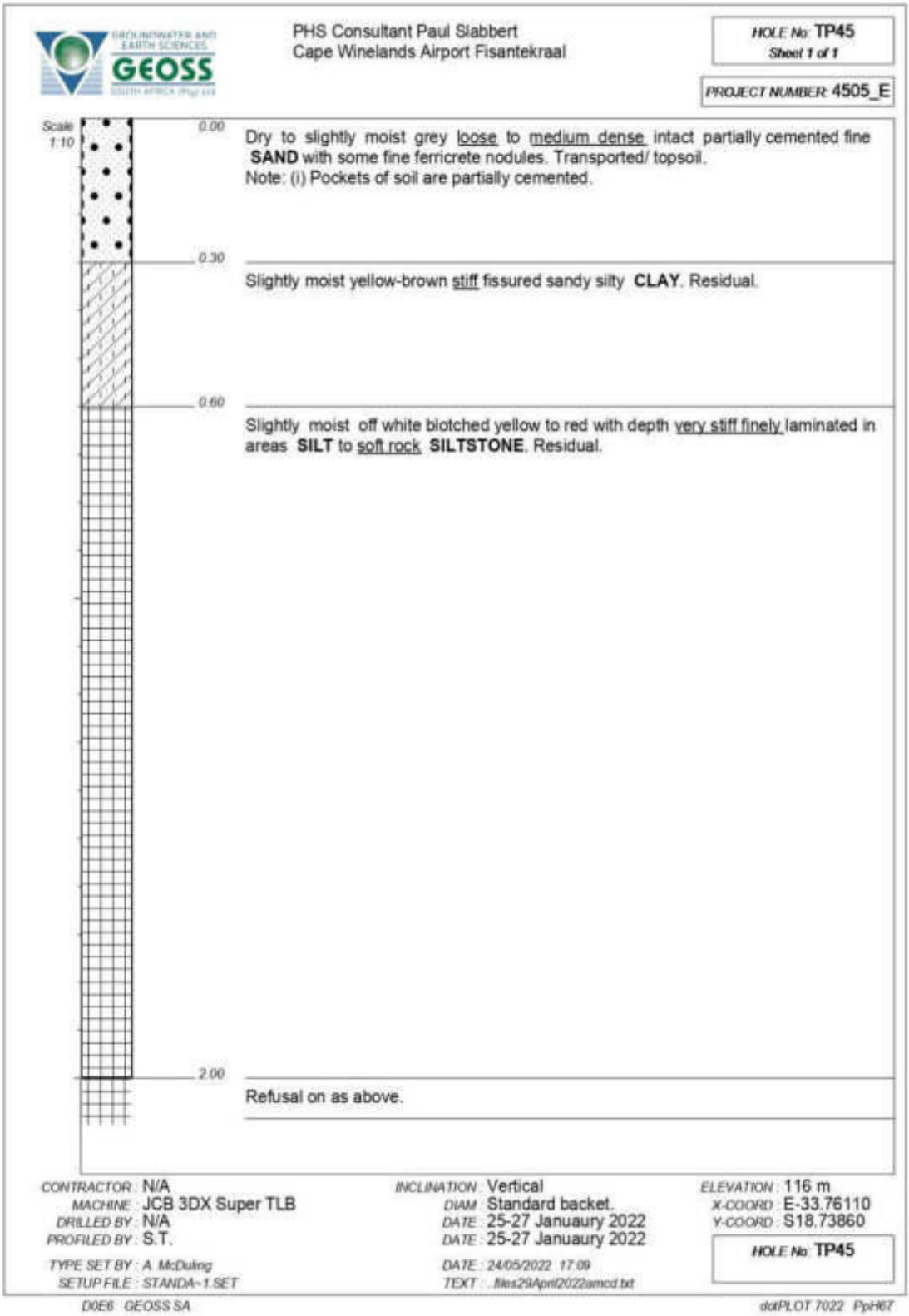

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP40
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist yellow-brown fine SAND with ferricrete gravel. Transported.
Note: Ferricrete concentration increases with depth.
0.45
Dry to slightly moist reddish-yellow-brown very dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pendogenic.
0.60
Slightly moist reddish-orange firm to stiff fissured sandy SILT. Residual.
0.5--1.1
1.10
Yellow-brown completely weathered very fine grained laminated very thinly foliated very soft rock SILTSTONE.
Note: (i) TLB drove the bucket into the ground repeatedly, but still failed to penetrate.
2.10
Refusal on as above.
NOTES
1) Slow excavation.
2) Bulk sample 20001 extracted between 0.5--1.1 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 107 m
X-COORD : E-33.74140
Y-COORD : S18.73240
HOLE No: TP40
D0E6 GEOSS SA
dotPLOT 7022 PpH67

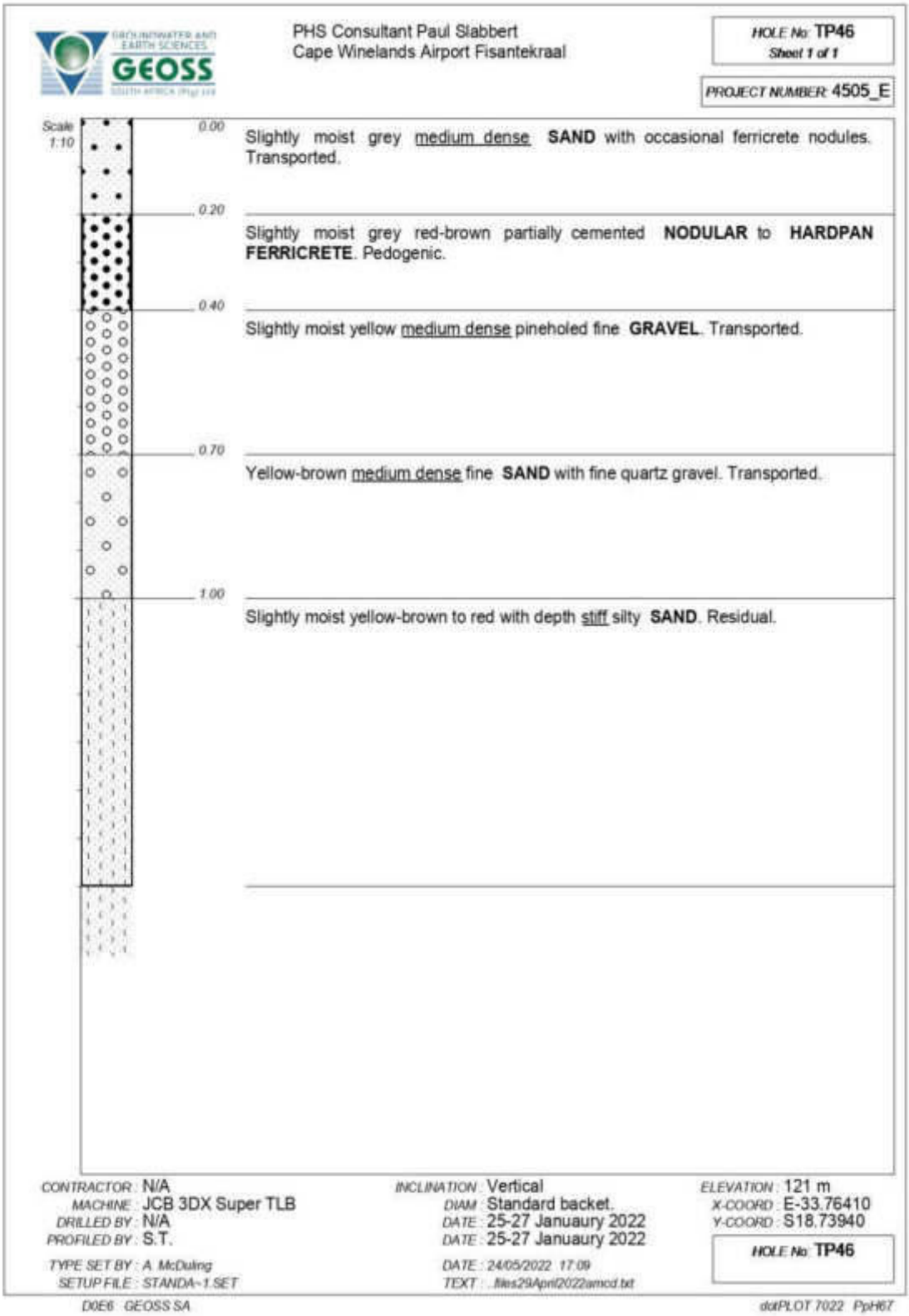

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP41
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey-brown loose to medium dense fine SAND with occasional fine ferricrete nodules/gravels. Tranported.
0.30
Slightly moist yellow-brown stiff slightly shattered and pinholed fine sandy SILT with some gravel. Transported.
Note: Intense sidewall smear.
1.00
As above, but grades to completely weathered thinly foliated very soft rock SILTSTONE.
Note: (i) Discontinuities filled by clayey gauge. (ii) Grain size appears to decrease with depth.
NOTES
1) TLB drove the bucket into the ground repeatedly, with little success.
2) Slow excavation.
3) Intense sidewall smear.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 89 m
X-COORD : E-33.74540
Y-COORD : S18.73690
HOLE No: TP41
D0E6 GEOSS SA
dotPLOT 7022 PpH67

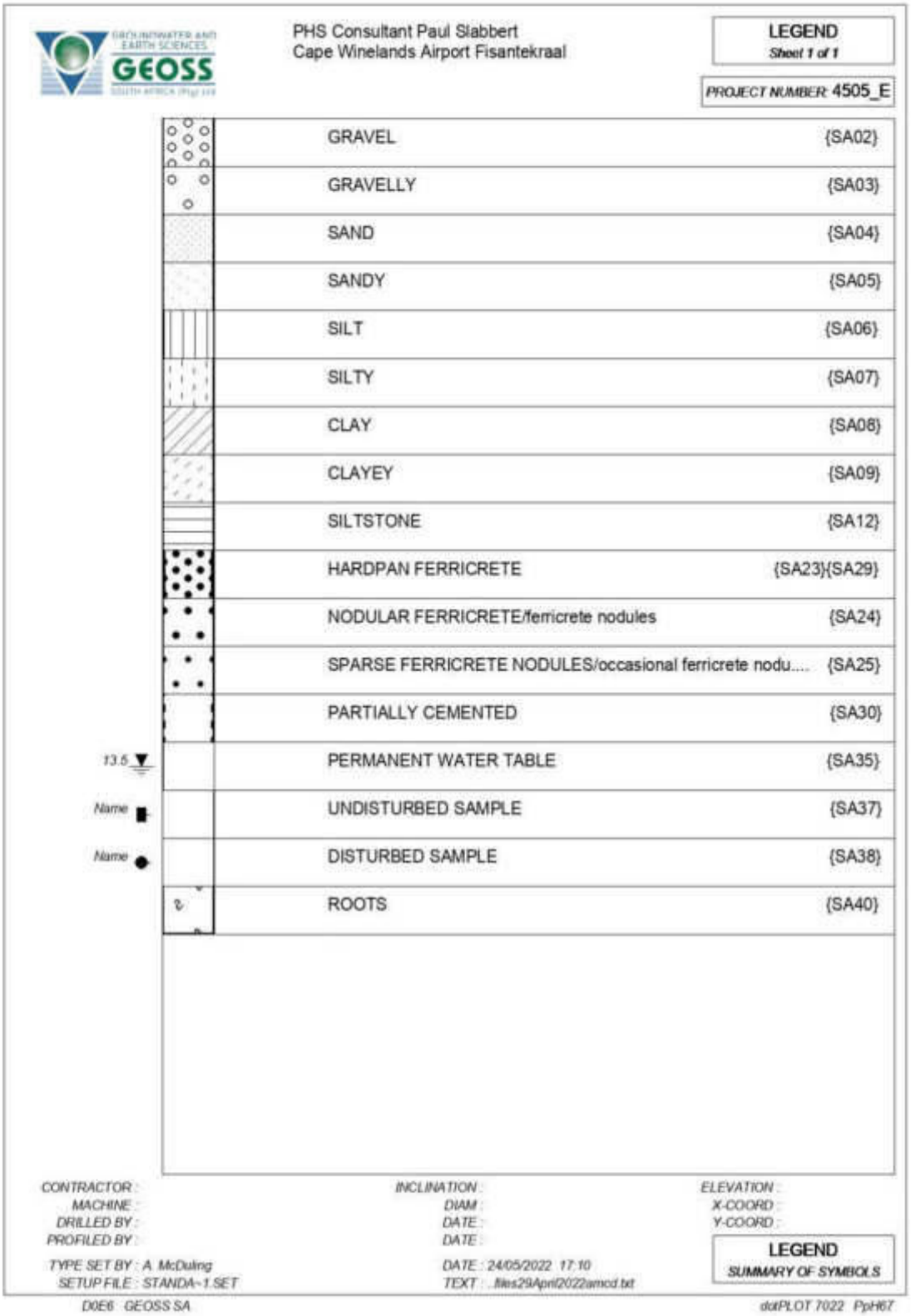

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP42
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist grey-brown loose to medium dense intact partially cemented fine SAND. Transported.
Note: (i) Contains ferricrete nodulules up to 2 cm in diameter.
0.30
Slightly moist brown dense intact partially cemented NODULAR FERRICRETE in a sandy matrix. Pendogenic.
Note: (i) Discontnuous lenses of soil, slightly more cemented pockets.
0.50
Slightly moist yellow blotched red-orange firm intact to pinholed sandy SILT. Residual.
Note: (i) Tends to silty sand and grades to highly weathered, very soft rock thinly foliated silstone. (ii) Intense sidewall smear.
0.8
1.90
Refusal on as above.
NOTES
1) Slow excavation.
2) TLB drive bucket into base of horizon yielding slight indents.
3) Unrestricted excavation penetration would likely be deeper.
4) Bulk sample 20002 extracted from 0.8 mbgl.
5) Undisturbed sample 20002 extracted from 0.8 mbgl. Conducted double oedometer test.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 111 m
X-COORD : E-33.75170
Y-COORD : S18.73510
HOLE No: TP42
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP43
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey-brown loose to medium dense intact to partially cemented fine SAND with some ferricrete nodules. Transported / topsoil.
Note: (i) Roots.
0.20
Slightly moist yellow-brown stiff fissured and pinholed slightly sandy SILT. Residual.
Note: (i) Pinholes likely due to bioturbation (up 8 mm in diameter).
0.40
Slightly moist grey blotched & streaked / stained yellow-orange stiff slightly shattered SILT. Residual.
Note: (i) Grades to completely weathered fine grained widely spaced foliations very soft rock siltstone with depth.
2.00
Refusal on as above.
NOTES
1) Slow excavation.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 106 m
X-COORD : E-33.75480
Y-COORD : S18.74090
HOLE No: TP43
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP44
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey to yellow-brown loose to medium dense intact partially cemented fine SAND. Transported / topsoil.
0.30
Dry to slighly moist yellow blotched red pinholed silty SAND. Transported/Pedogenic.
Note: (i) Brown sand inclusions near base.
0.90
Slightly moist white blotched red & orange firm to stiff slightly shattered sandy SILT. Residual.
Note: (i) This horizon was easy to excavate (relative to above horizon). (ii) Appeared slickensided in places.
NOTES
1) Slow excavation - Could be ripped by dozer & transported with TLB.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 104 m
X-COORD : E-33.75960
Y-COORD : S18.74200
HOLE No: TP44
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP45
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist grey loose to medium dense intact partially cemented fine SAND with some fine ferricrete nodules. Transported/ topsoil.
Note: (i) Pockets of soil are partially cemented.
0.30
Slightly moist yellow-brown stiff fissured sandy silty CLAY. Residual.
0.60
Slightly moist off white blotched yellow to red with depth very stiff finely laminated in areas SILT to soft rock SILTSTONE. Residual.
2.00
Refusal on as above.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 116 m
X-COORD : E-33.76110
Y-COORD : S18.73860
HOLE No: TP45
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP46
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey medium dense SAND with occasional ferricrete nodules. Transported.
0.20
Slightly moist grey red-brown partially cemented NODULAR to HARDPAN FERRICRETE. Pedogenic.
0.40
Slightly moist yellow medium dense pineholed fine GRAVEL. Transported.
0.70
Yellow-brown medium dense fine SAND with fine quartz gravel. Transported.
1.00
Slightly moist yellow-brown to red with depth stiff silty SAND. Residual.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 121 m
X-COORD : E-33.76410
Y-COORD : S18.73940
HOLE No: TP46
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
LEGEND
Sheet 1 of 1
PROJECT NUMBER 4505_E
GRAVEL {SA02}
GRAVELLY {SA03}
SAND {SA04}
SANDY {SA05}
SILT {SA06}
SILTY {SA07}
CLAY {SA08}
CLAYEY {SA09}
SILTSTONE {SA12}
HARDPAN FERRICRETE {SA23}{SA29}
NODULAR FERRICRETE/ferricrete nodules {SA24}
SPARSE FERRICRETE NODULES/occasional ferricrete nodu.... {SA25}
PARTIALLY CEMENTED {SA30}
13.5
PERMANENT WATER TABLE {SA35}
Name
UNDISTURBED SAMPLE {SA37}
Name
DISTURBED SAMPLE {SA38}
ROOTS {SA40}
CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :
INCLINATION :
DIAM :
DATE :
DATE :
ELEVATION :
X-COORD :
Y-COORD :
LEGEND
SUMMARY OF SYMBOLS
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
DATE : 24/05/2022 17:10
TEXT : ..files29April2022amod.txt
D0E6 GEOSS SA
dotPLOT 7022 PpH67

# 11. APPENDIX C: SUPPORTING PHOTOS



***Figure 17: Close-up of TP01. Note cohesive nature of the material in the foreground, and the fine gravelly nature of material above refusal surface, i.e. next to hammer.***



***Figure 18: TP02 - Close-up of sidewall showing hardpan ferricrete refusal surface, note thin humified horizon on surface.***



***Figure 19: TP02 - Close-up of ferricrete nodules encountered near base of trial pit.***



***Figure 20: TP03 - Close up of sidewall; note nodular ferricrete grading to very dense hardpan ferricrete refusal surface.***



***Figure 21: TP04 – Nodular to hardpan ferricrete.***



***Figure 22: TP04: Close-up of trial pit sidewall. Note cemented nature of nodular ferricrete above hammer, and texture of sidewall 'smear' beneath hammer; sand- to clay- dominated with depth.***



***Figure 23: TP04 - Close-up of lower sandy clayey silt near base of trial pit.***



***Figure 24: TP04 – Close-up of sandy clayey silt spoil.***




***Figure 25: TP05 – Close-up of trial pit sidewall. Note pinch out of nodular ferricrete horizon, and pinholed nature of gravel horizon near base of hammer. Sidewall smear near base indicating high fines content.***



***Figure 26: TP05 – ferricrete nodules scattered on surface.***



***Figure 27: TP06 – Close-up of spoil excavated from lower-most sandy clayey silt horizon.***



*Figure 28: TP07 – Close-up of spoil excavated from residual horizon.*

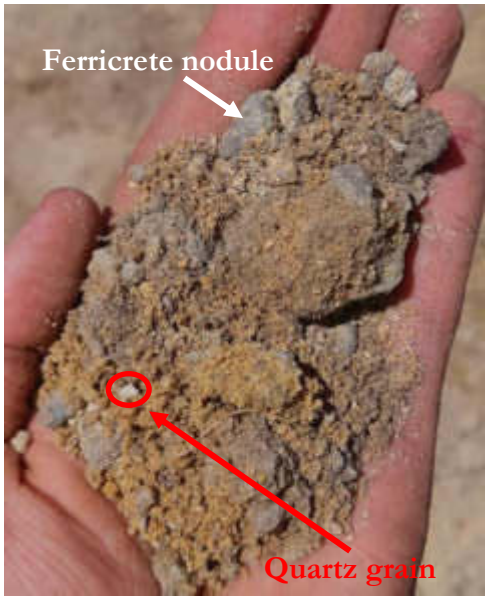



*Figure 29: TP07 – Close-up of spoil from residual horizon; note angular nature of grains. Rounded grains are ferricrete.*



*Figure 30: TP08 – Close-up of upper transported sand horizon.*

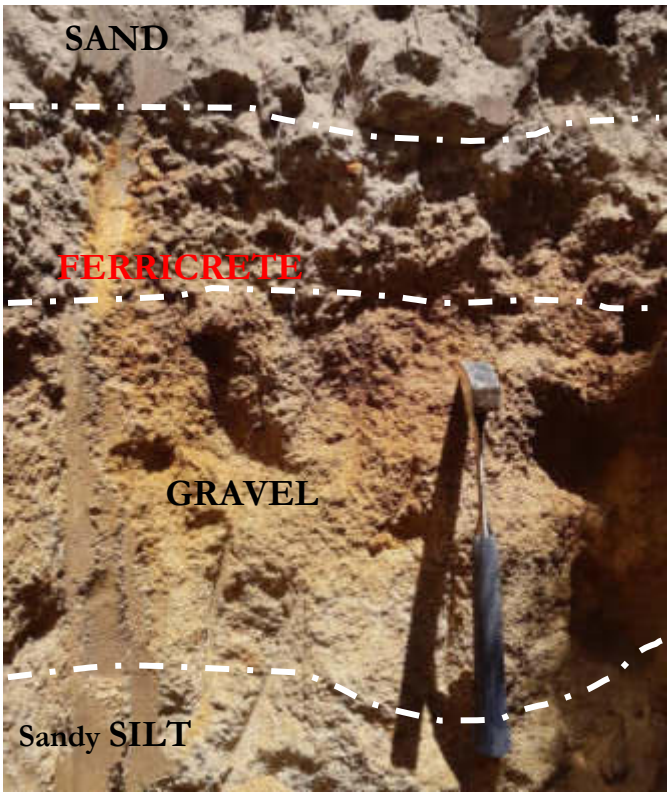



*Figure 31: TP08 – Close-up of partially cemented pinholed sandy fine gravel horizon beneath nodular ferricrete. Note there is large variation in thickness of the ferricrete horizon (between 0.3 and 0.8 m thick).*



***Figure 32: TP10 – Close up of bottom of trial pit; note sidewall smear near base of trial pit.***



***Figure 33: TP10 – Close up of bottom of ferricrete nodules strewn across surface surrounding trial pit; exposed soil profile pictured on LHS of photograph.***



***Figure 34: TP11 – Close-up of spoil pile of ferricrete nodules excavated from trial pit.***



***Figure 35: TP11 – Close-up of ferricrete nodule; note angular nature of grains stuck to nodule.***

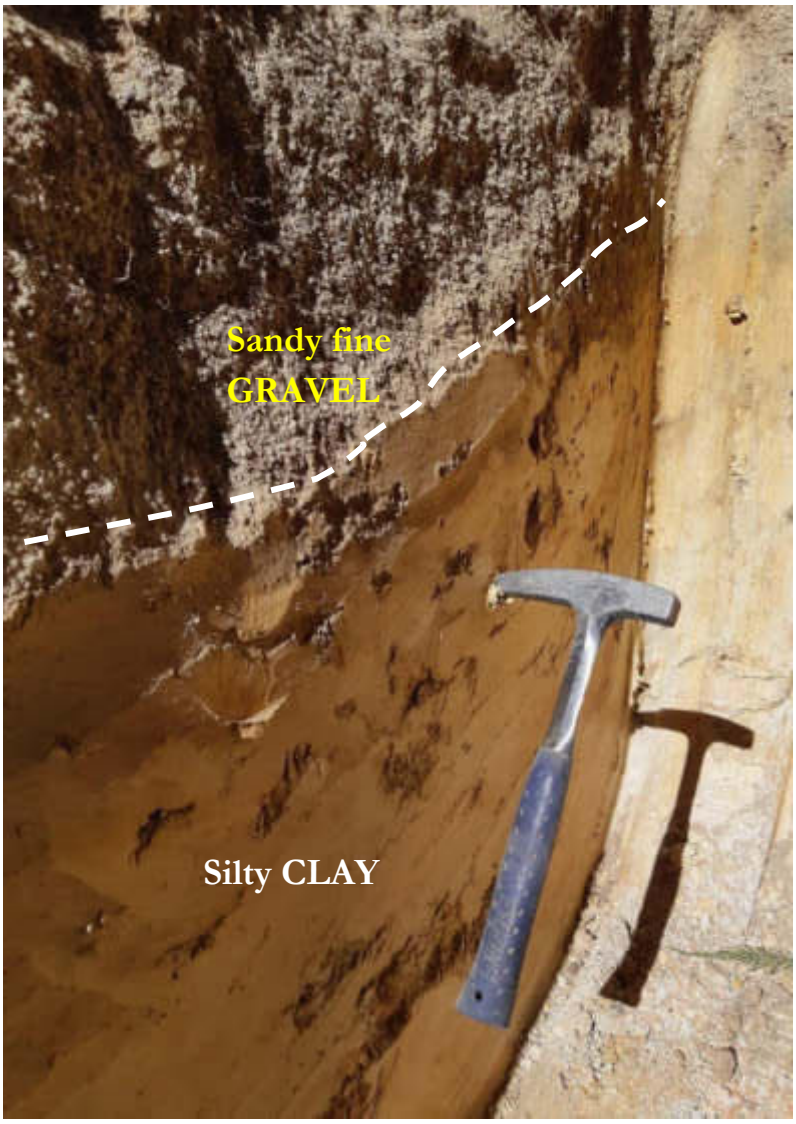



***Figure 36: TP13 – Close-up of sidewall smear in silty clay residual horizon.***



***Figure 37: TP14 – Close-up of ferricrete boulders excavated from nodular ferricrete horizon.***

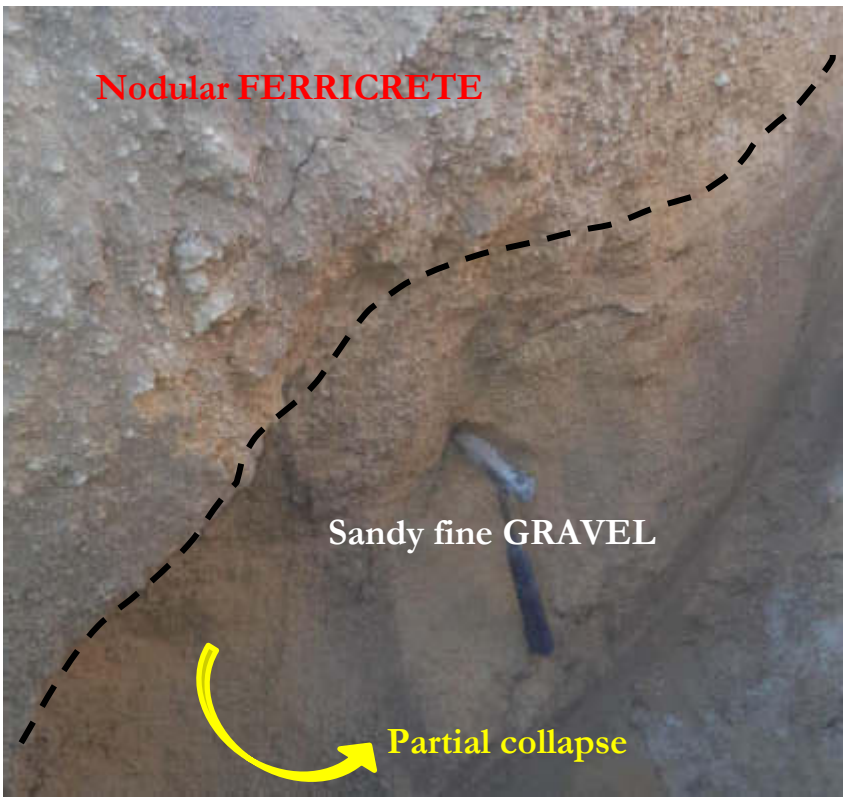



***Figure 38: TP14 – Partial collapse of trial pit sidewall within the pinholed sandy fine gravel horizon; prior to water level rise.***

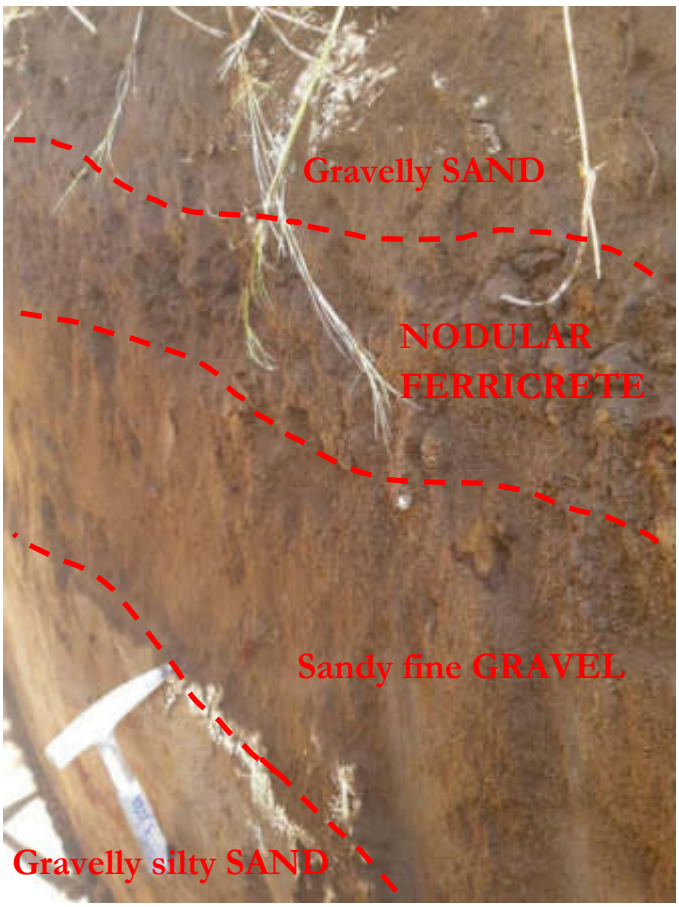



***Figure 39: TP15 – Close-up of trial pit sidewall showing various horizons encountered.***

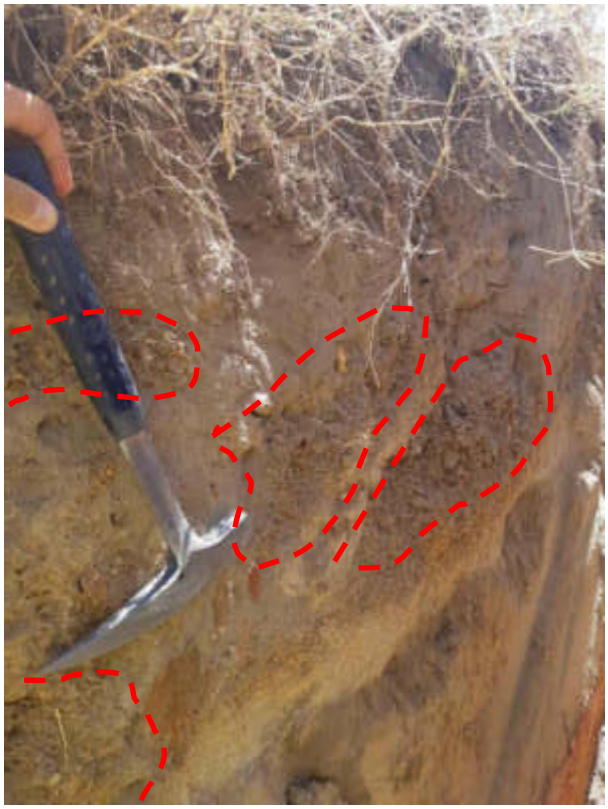


***Figure 40: TP16 – Close-up of trial pit sidewall showing pockets of ferricrete nodules (annotated in red).***



***Figure 41: TP16 – Close-up of trial pit sidewall showing variation in 'smear' texture; material becomes less sandy toward base. Upon close inspection sandy grains are angular suggesting in-situ weathering.***



***Figure 42: TP18 – Close-up of trial pit upper surface of red-orange-brown nodular ferricrete horizon prior to excavation through to silty clay residual horizon.***



***Figure 43: TP19 – Close-up of trial pit floor; note metallic coating on base of trial pit.***




***Figure 44: TP21 – GEOSS team conducting DCP test beneath nodular ferricrete horizon. White clay-silt Corrobrick material pictured in the background.***



***Figure 45: TP22 – Close-up of transported gravelly sand horizon.***



***Figure 46: TP22 – Close-up of nodular ferricrete spoil pile; note this material excavated out in boulder-form occasionally. Excavation slow and time consuming.***



***Figure 47: TP22 – Close-up of spoil of silty clay material of the residual horizon; note blocky form of material in foreground - evidence of relict foliations.***




***Figure 48: TP27 – Close-up of soil profile; note the highly pinholed nature of fine gravel horizon near base of trial pit.***



***Figure 49: TP28 – Ferricrete boulders (approx. 300 mm in diameter) excavated from pedogenic hardpan ferricrete horizon.***



***Figure 50: TP29 – Close-up of trial pit sidewall; note occasional indurated ferricrete boulders in upper-most horizon. Intense sidewall 'smear' in residual clayey sandy silt horizon.***



***Figure 51: TP29 – Close-up of spoil of residual sandy silt horizon.***



***Figure 52: TP32 – Close-up of pin holed nature of transported material; likely due to bioturbation.***



***Figure 53: TP32 – Close-up of orange blotched red residual horizon.***



***Figure 54: TP43 – Close-up of voided/bioturbated residual material.***



***Figure 55: TP44 – Close-up of slightly smoothed/slickensided surface of residual material encountered in trial pit.***



***Figure 56: Corner down type crack possibly related to potentially expansive nature of subsoils; stable structure located between TP18 and TP15.***



***Figure 57: Vertical crack possibly related to potentially expansive nature of subsoils; storage structure located between TP18 and TP15.***



***Figure 58: Ferricrete outcrop exposed in northern portion of the site near TP36.***



***Figure 59: Fill dumped in drainage in northern portion of the site intended for future development.***




***Figure 60: View of JCB 3DX Super Tractor Loader Backhoe excavating a trial pit near the central portion of the site.***



***Figure 61: Close-up of TLB bucket tines used for conducting reconnaissance investigation.***

# 12. APPENDIX D: DCP TESTING LOGS

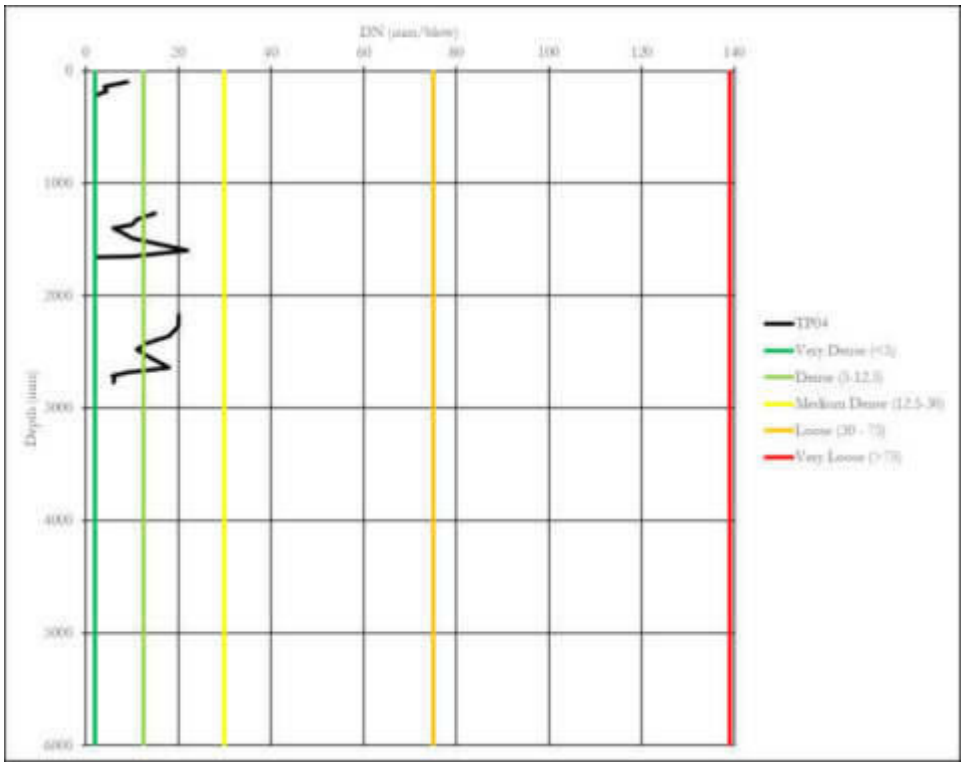



***Figure 62: DCP04 Log.***

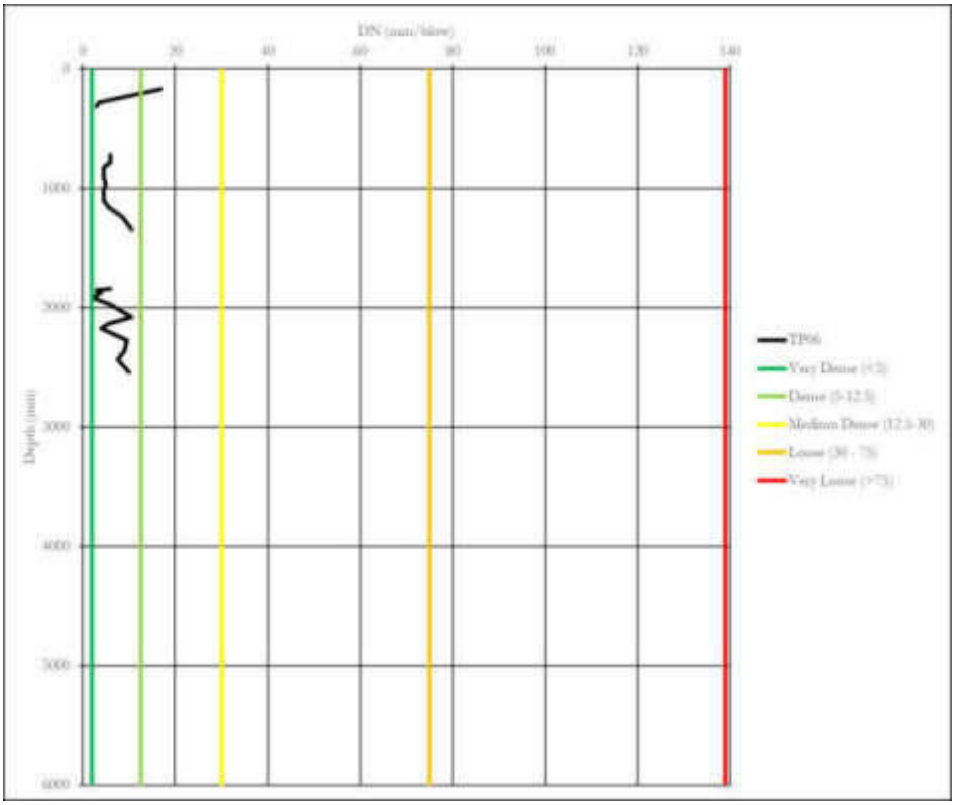



***Figure 63: DCP06 Log.***

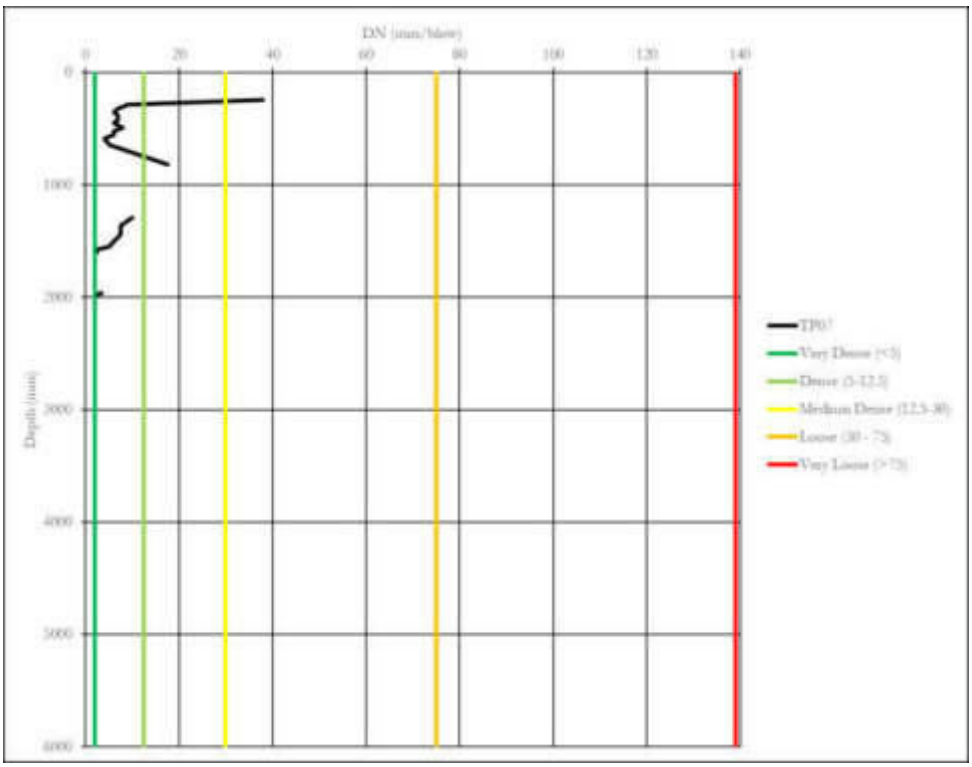



***Figure 64: DCP07 Log.***

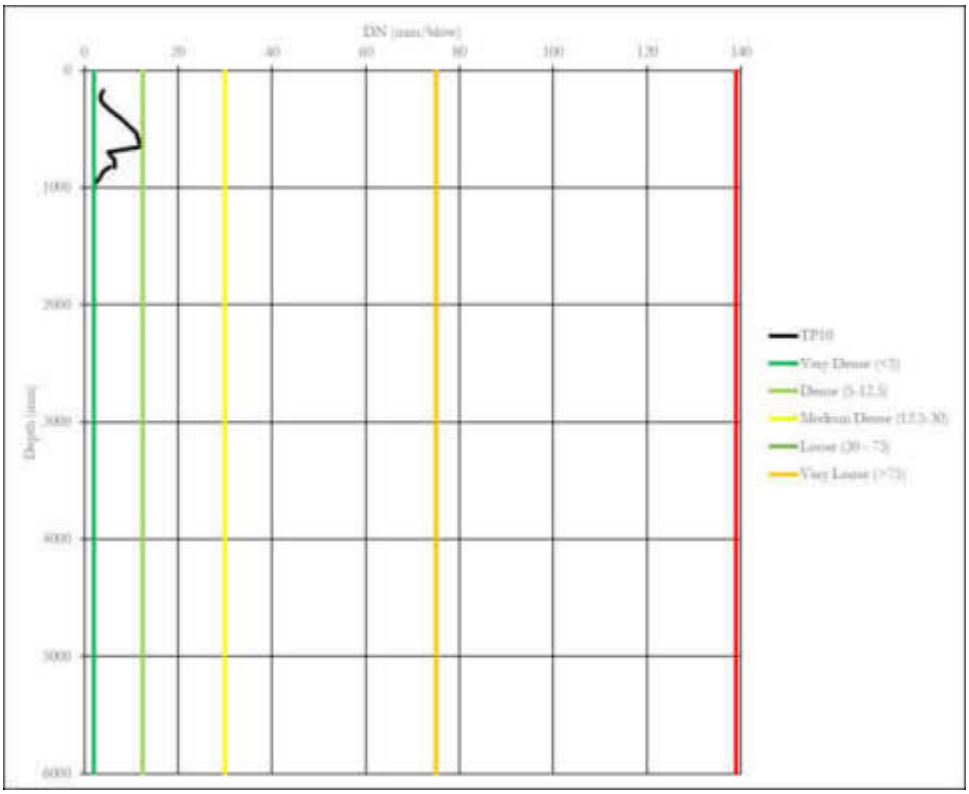



***Figure 65: DCP10 Log.***

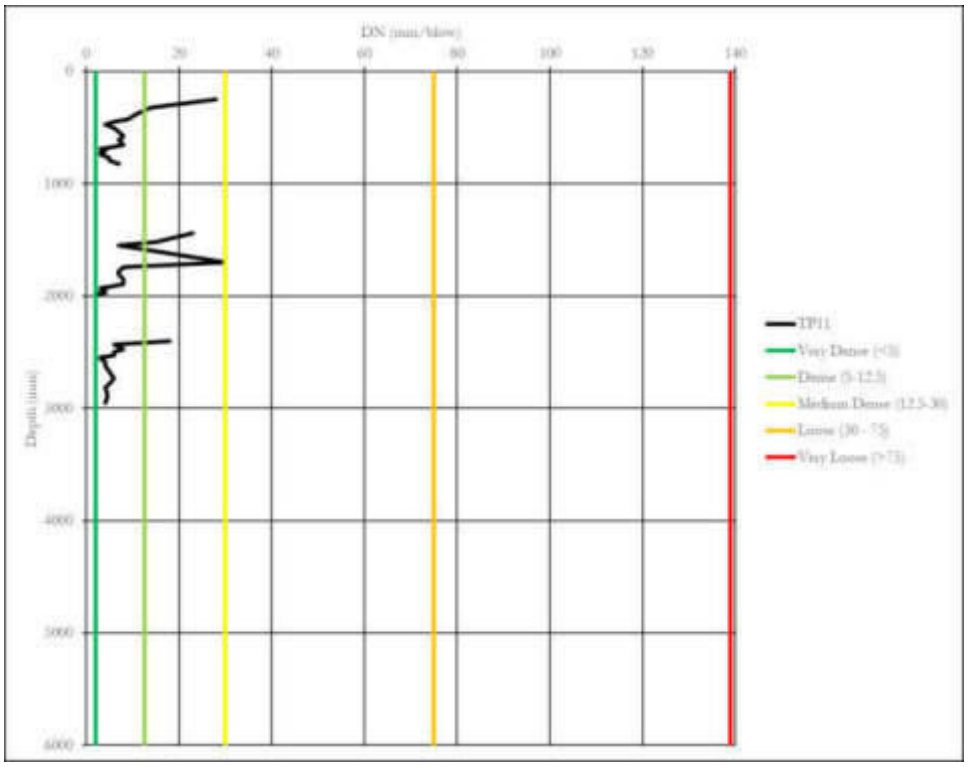



***Figure 66: DCP11 Log.***

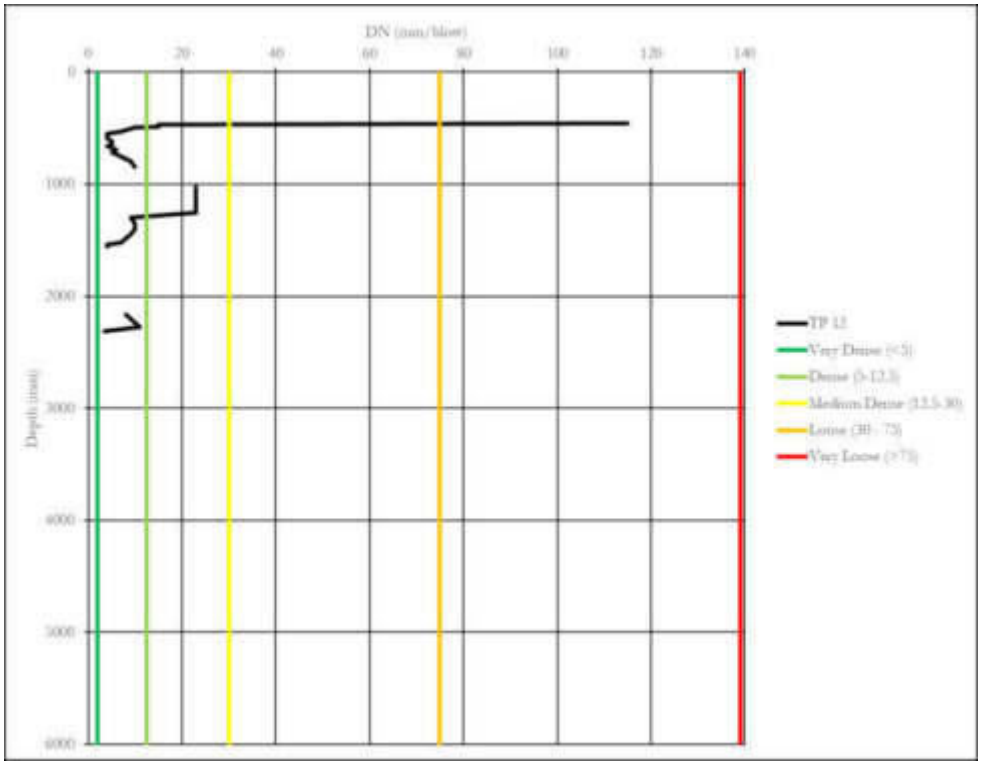



***Figure 67: DCP12 Log.***

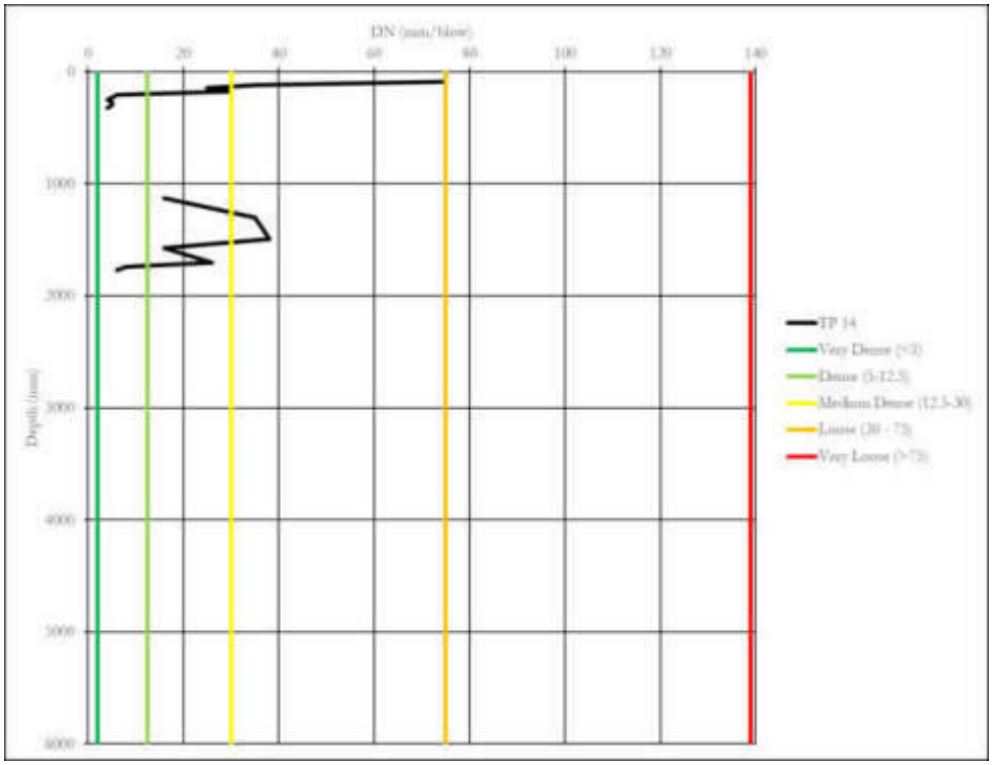



***Figure 68: DCP14 Log.***




***Figure 69: DCP15 Log.***

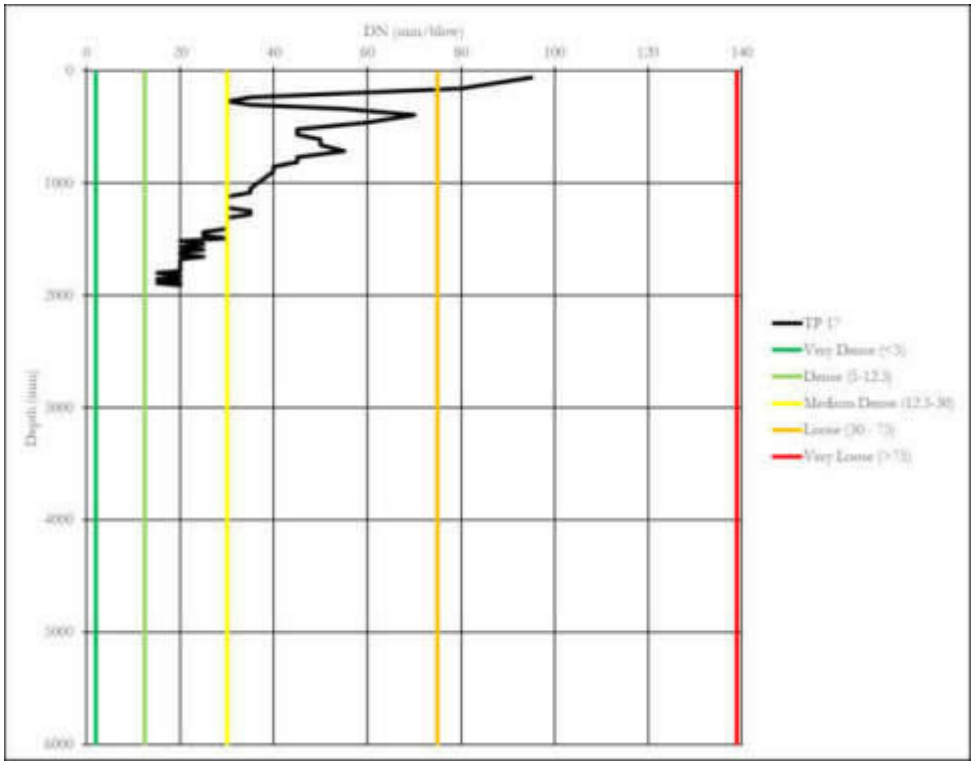



***Figure 70: DCP17 Log.***

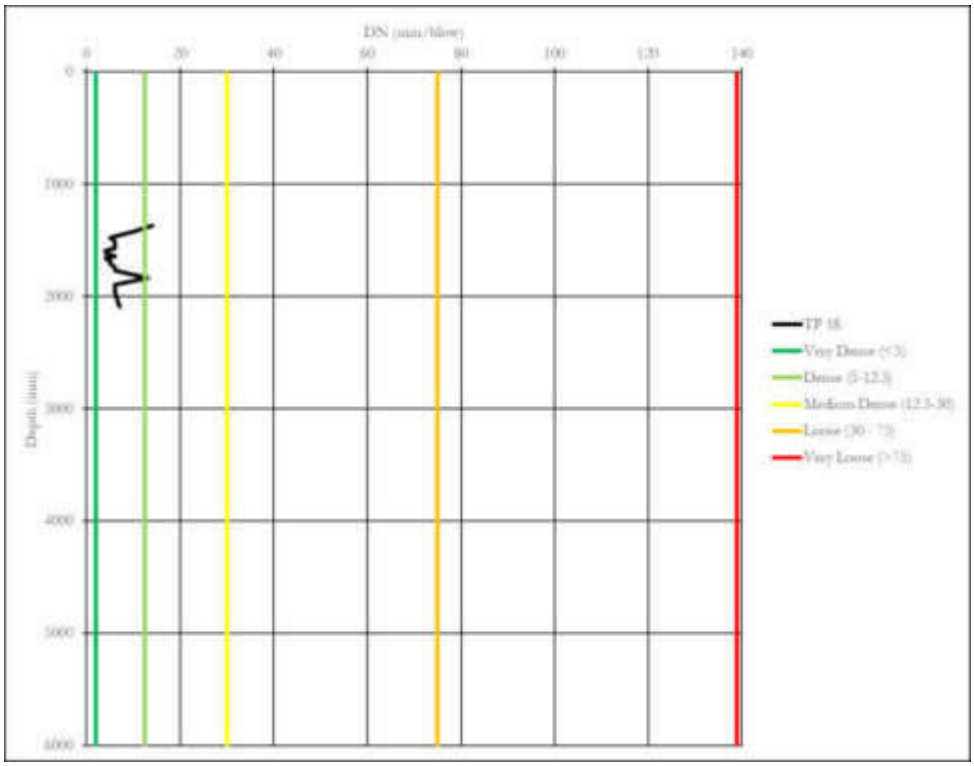



***Figure 71: DCP18 Log.***

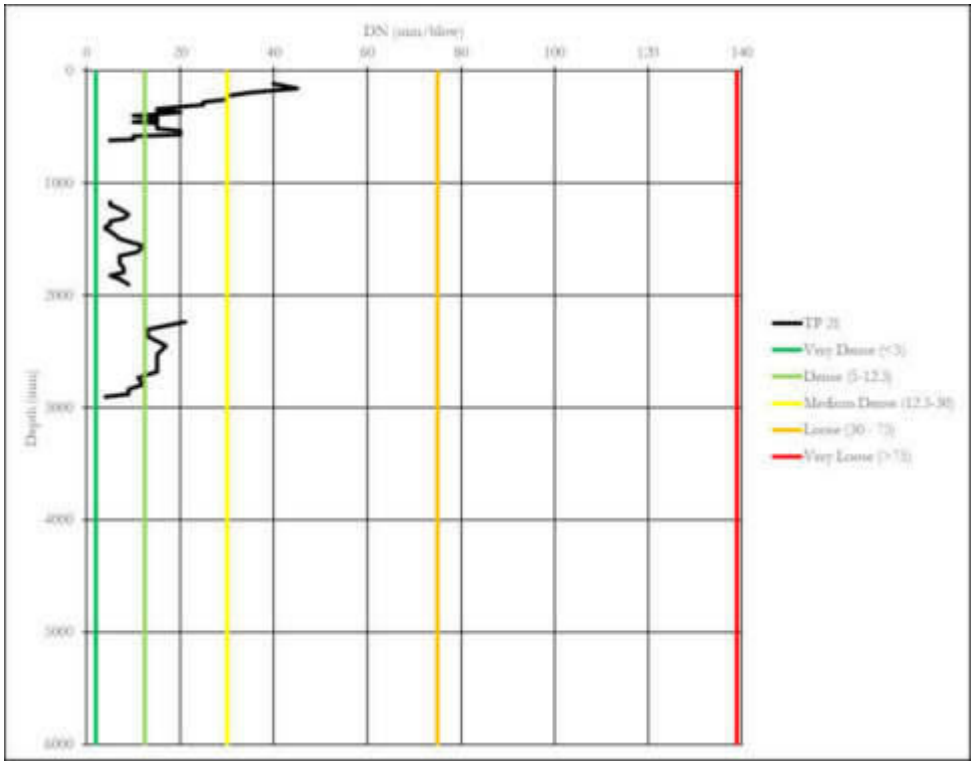



***Figure 72: DCP21 Log.***

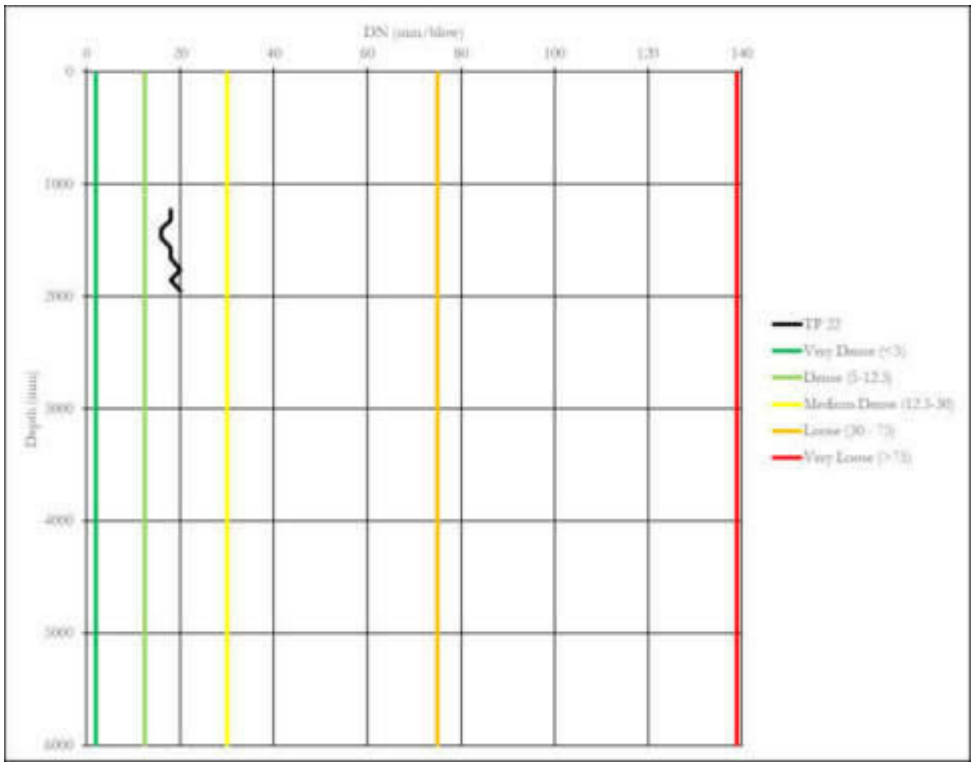



***Figure 73: DCP22 Log.***

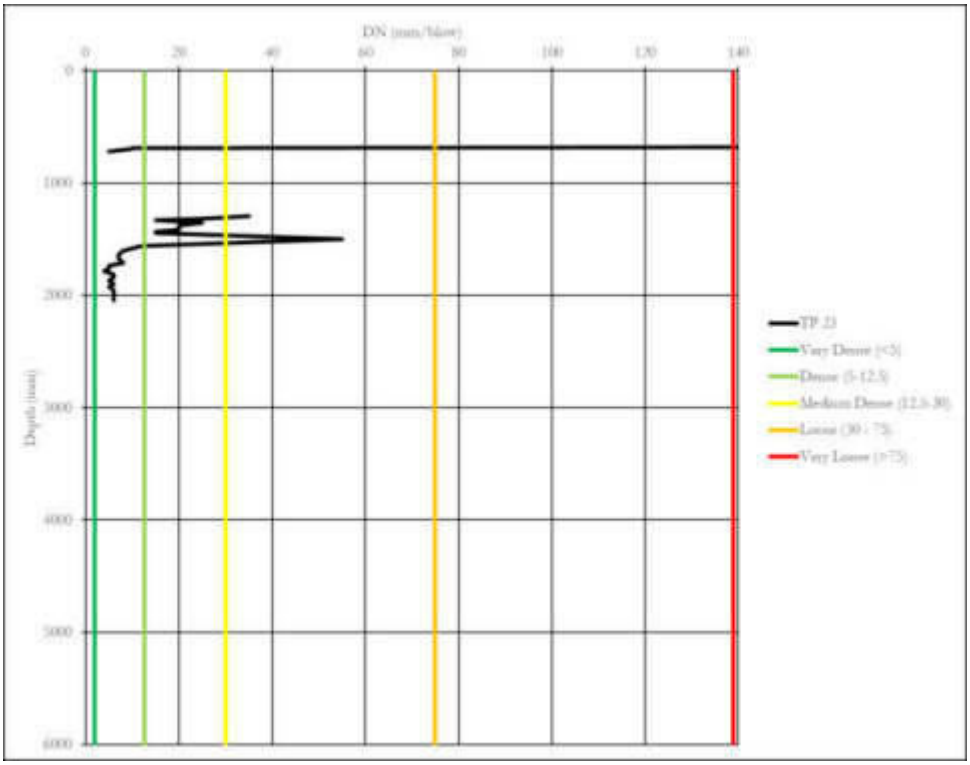



***Figure 74: DCP23 Log.***

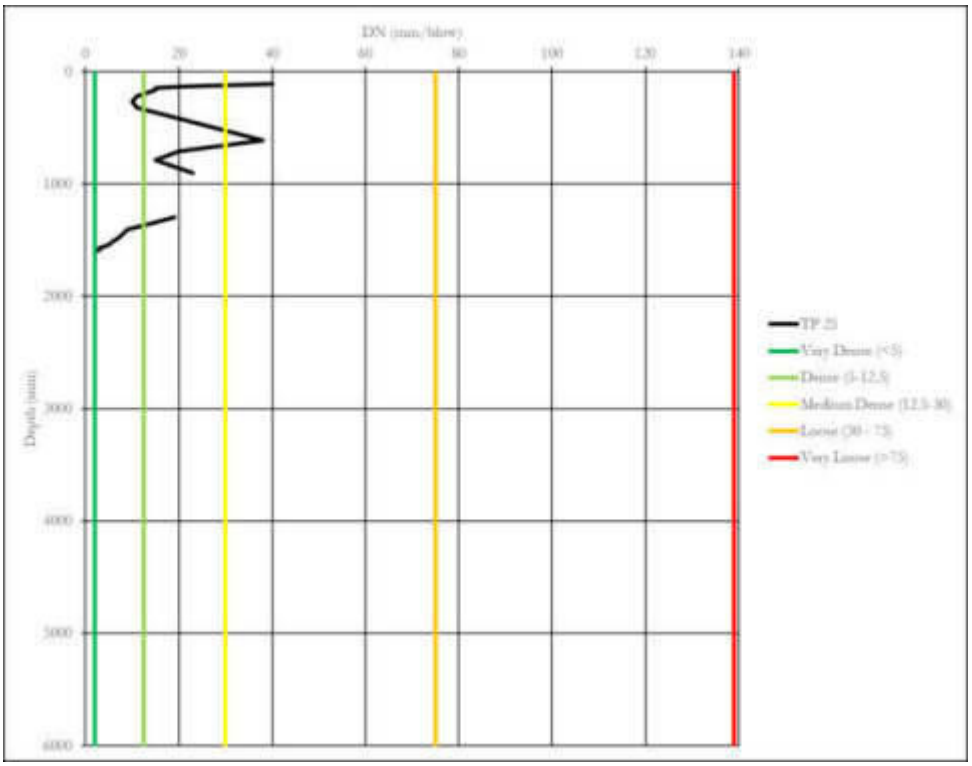



***Figure 75: DCP25 Log.***

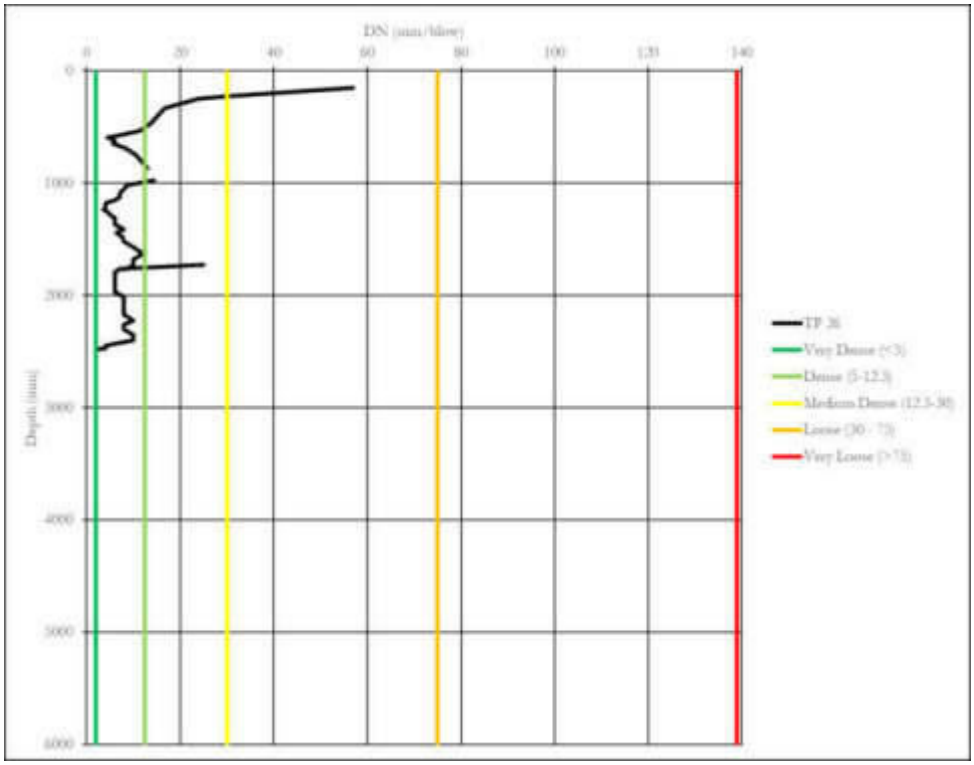



***Figure 76: DCP26 Log.***

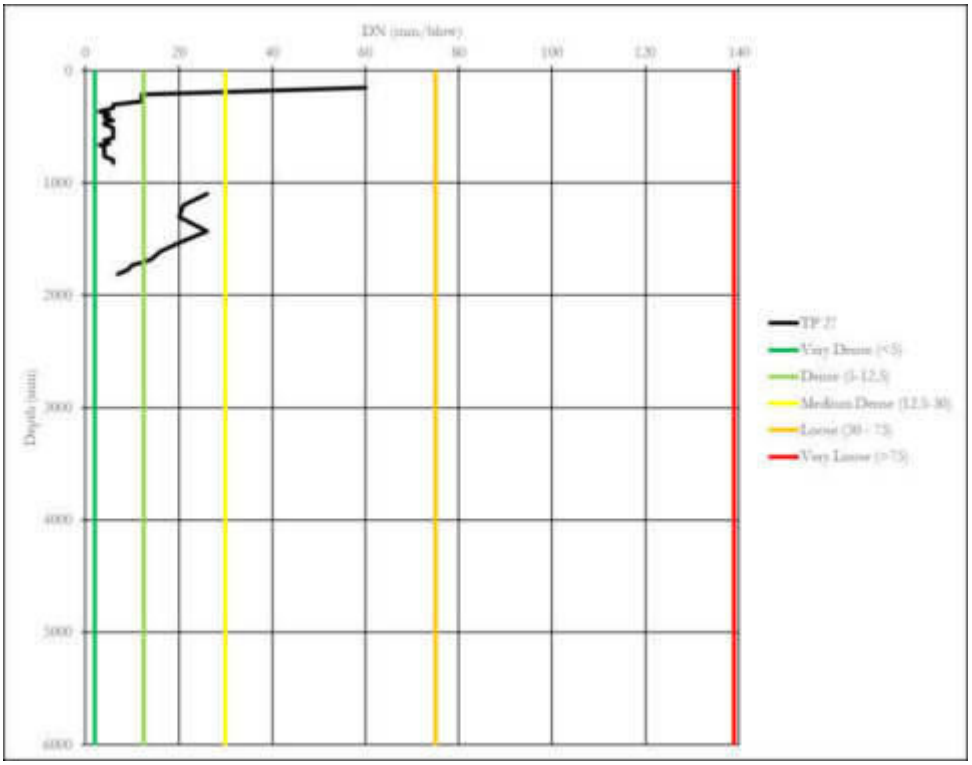



***Figure 77: DCP27 Log.***

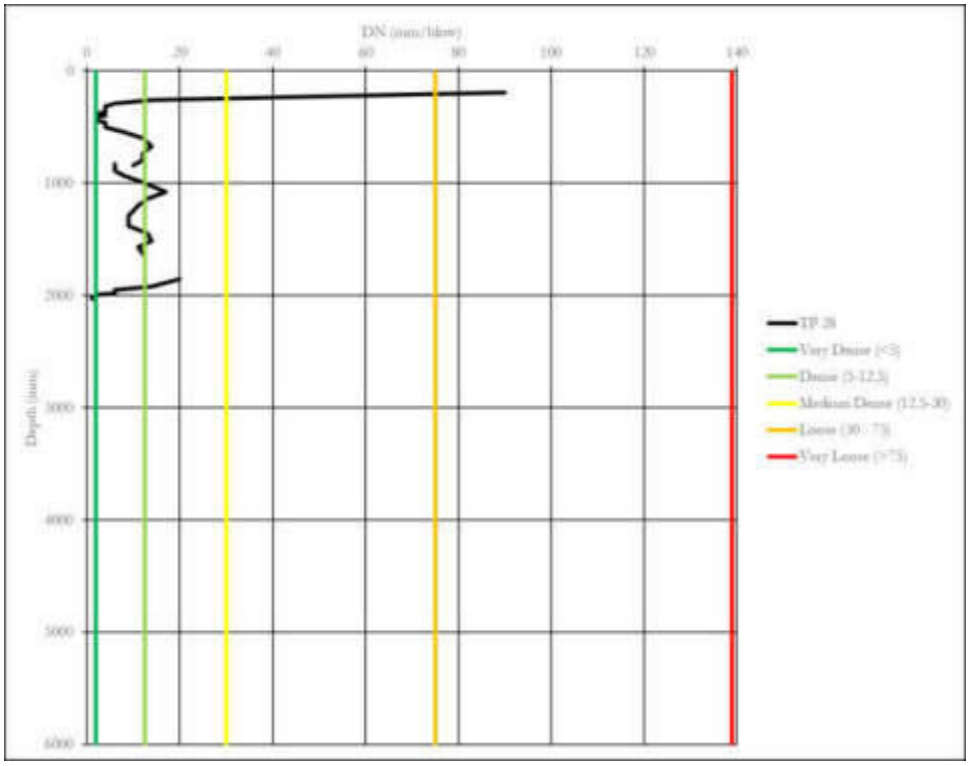



***Figure 78: DCP28 Log.***

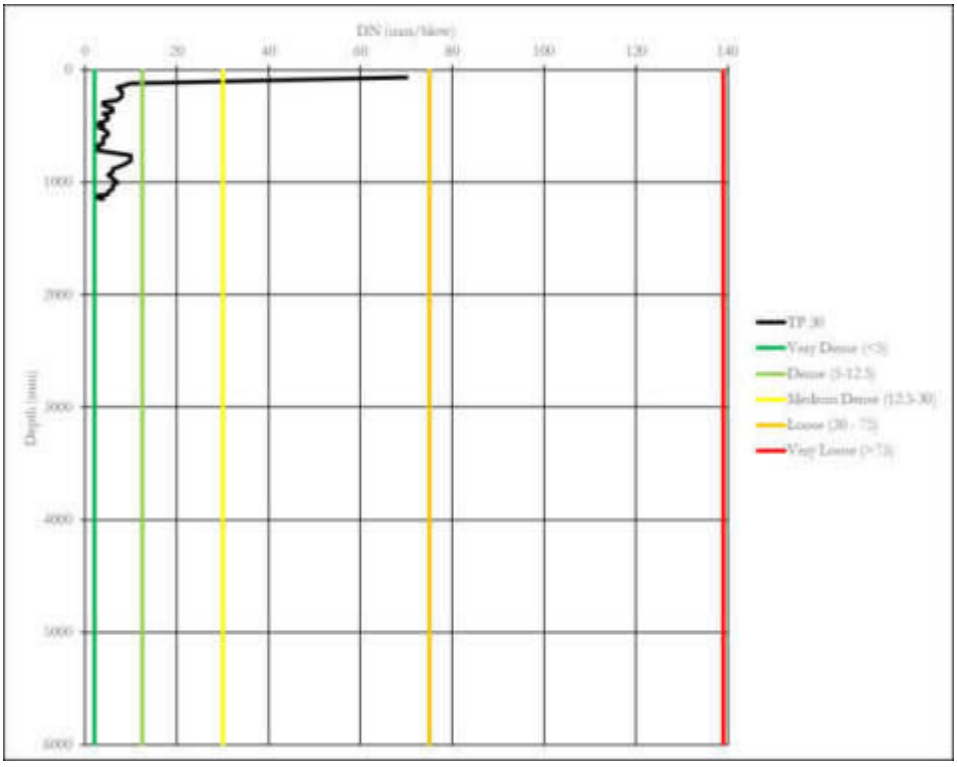



***Figure 79: DCP30 Log.***

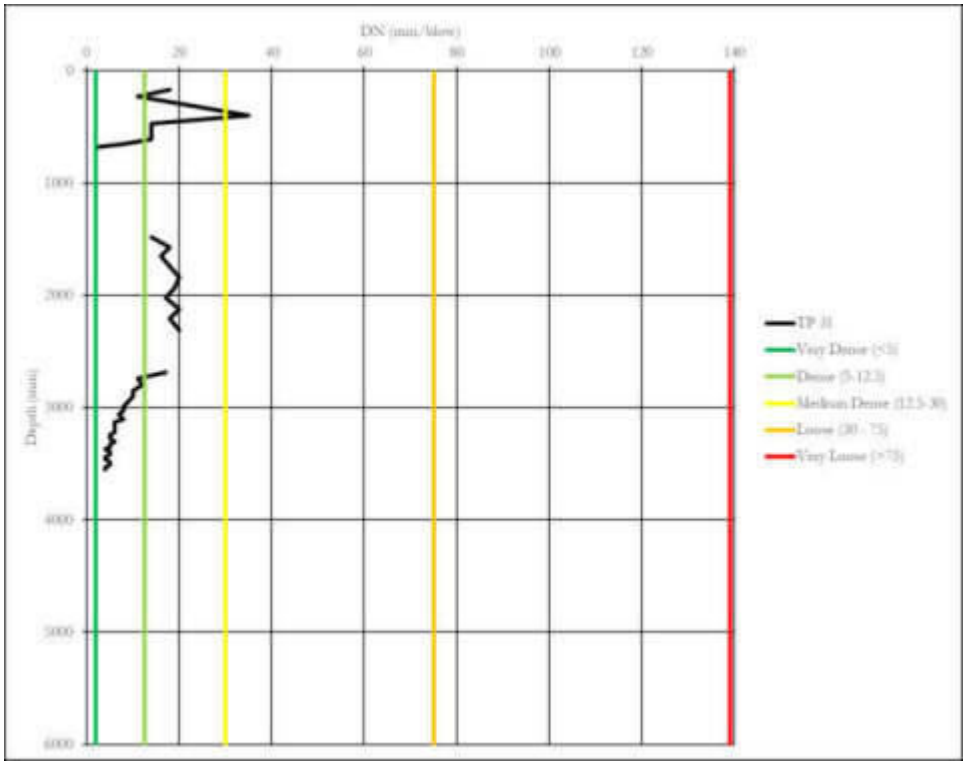



***Figure 80: DCP31 Log.***

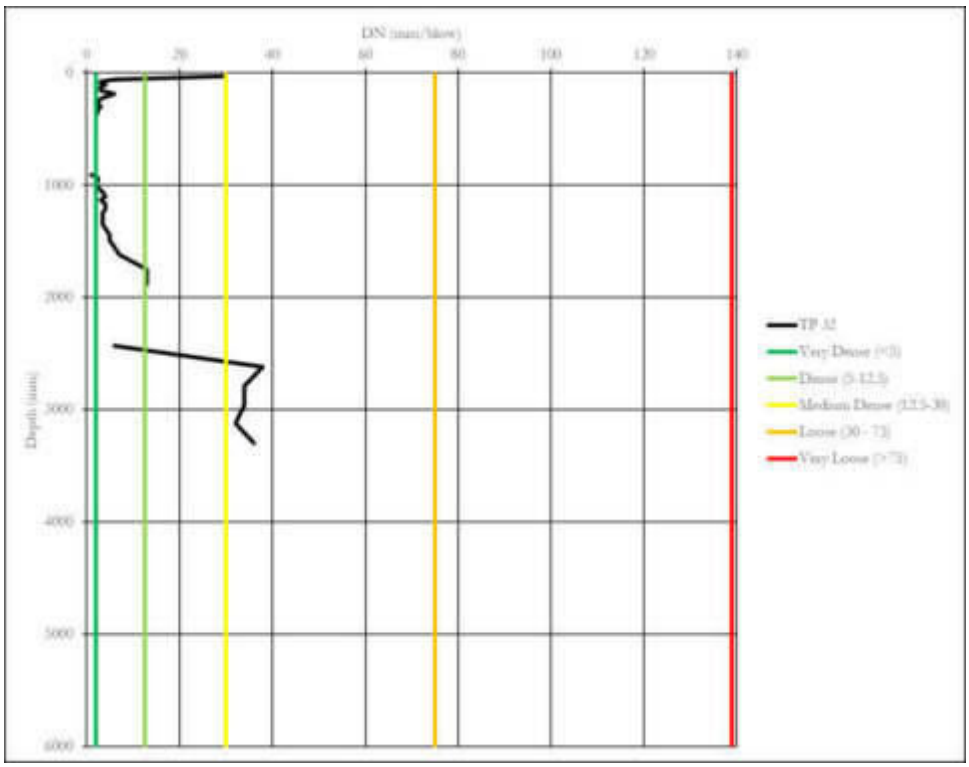



***Figure 81: DCP32 Log.***

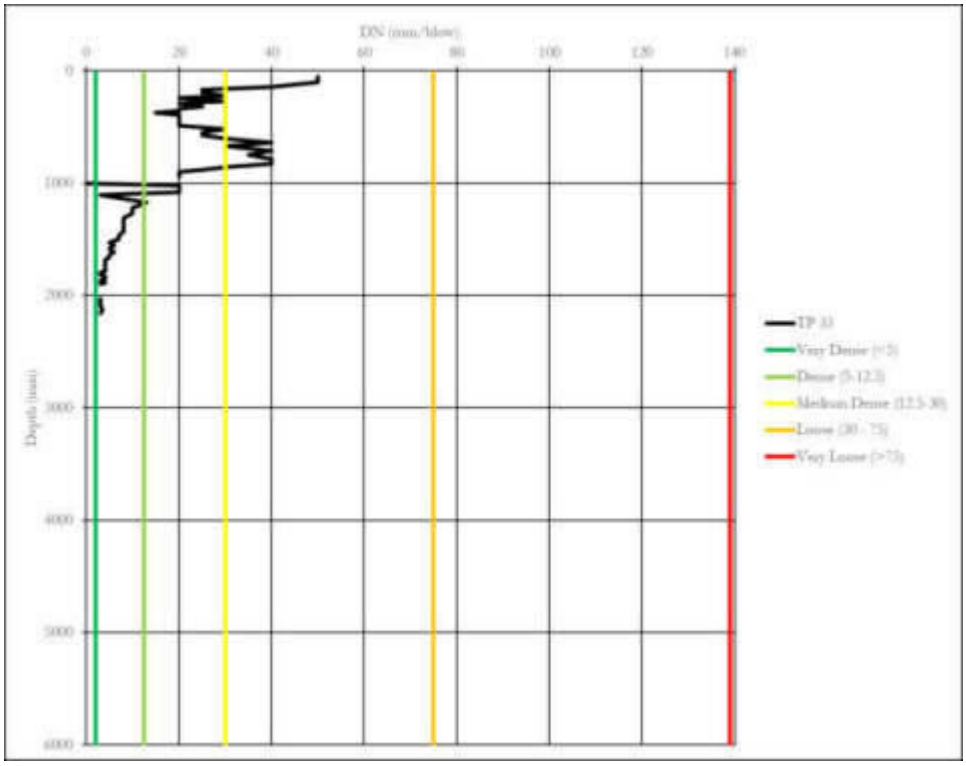



***Figure 82: DCP33 Log.***

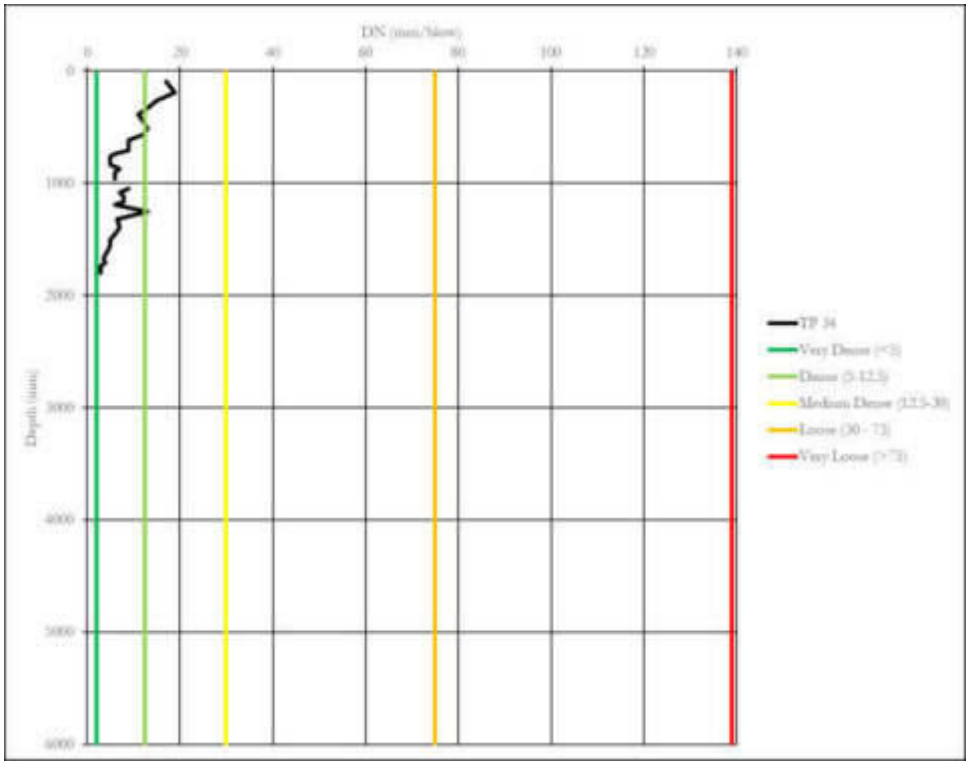



***Figure 83: DCP34 Log.***

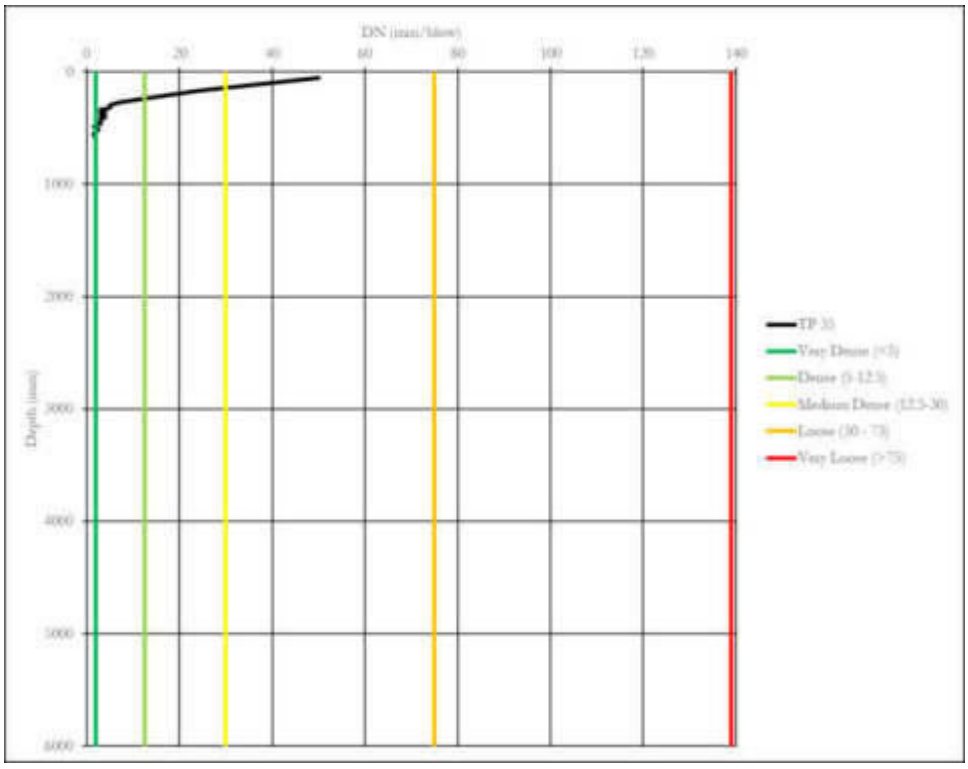



***Figure 84: DCP35 Log.***

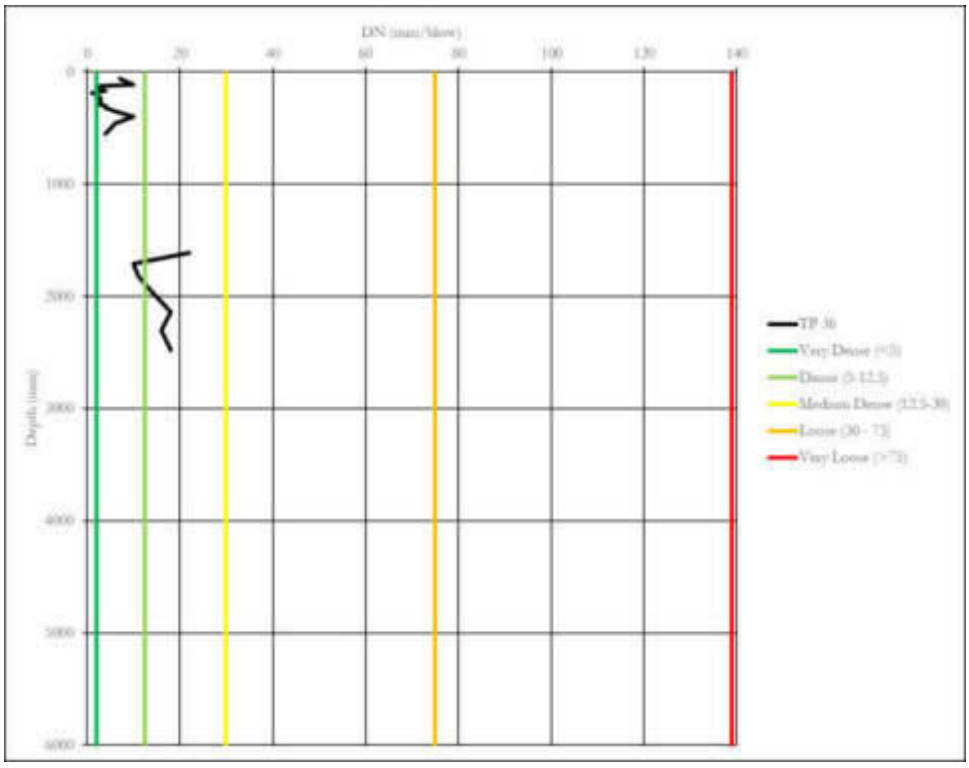



***Figure 85: DCP36 Log.***

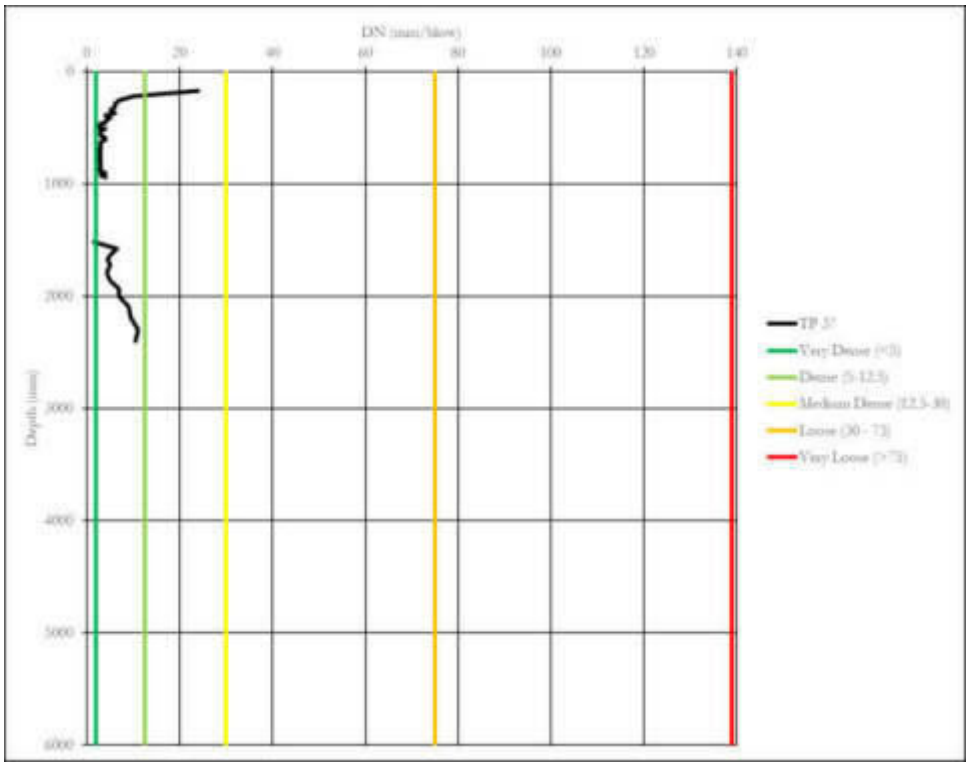



***Figure 86: DCP37 Log.***

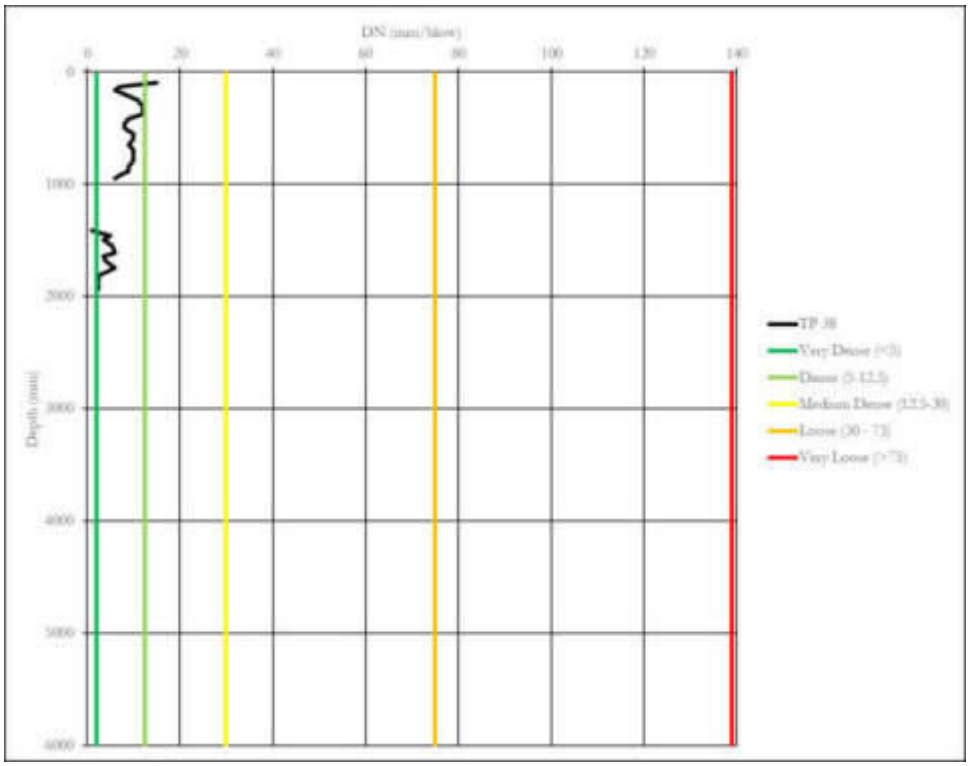



***Figure 87: DCP38 Log.***

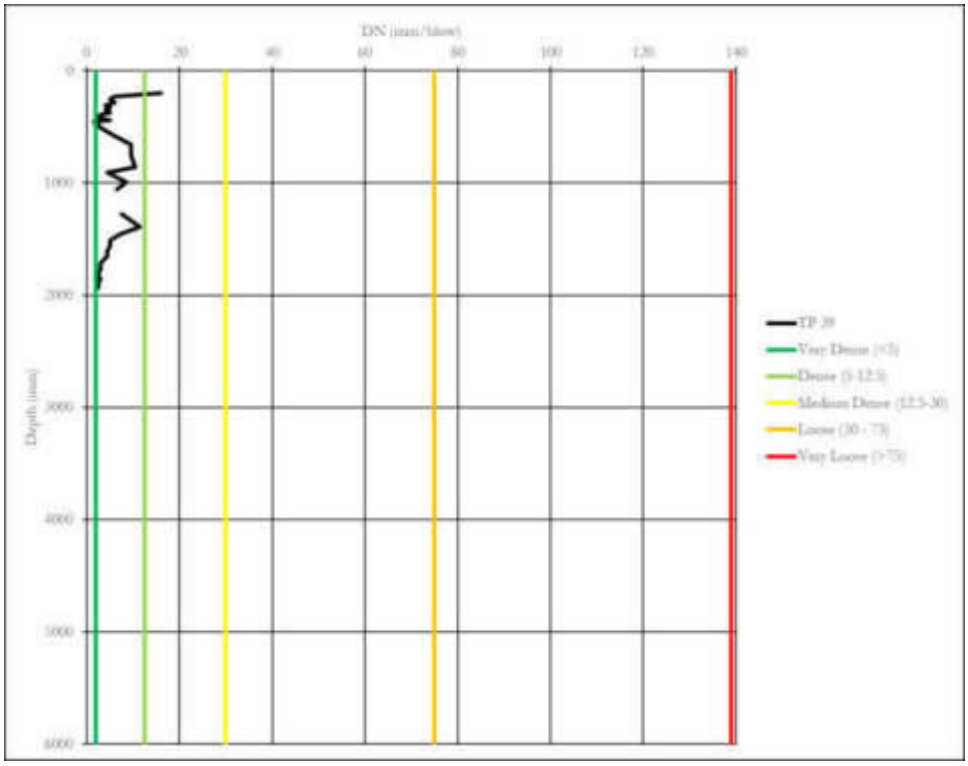



***Figure 88: DCP39 Log.***

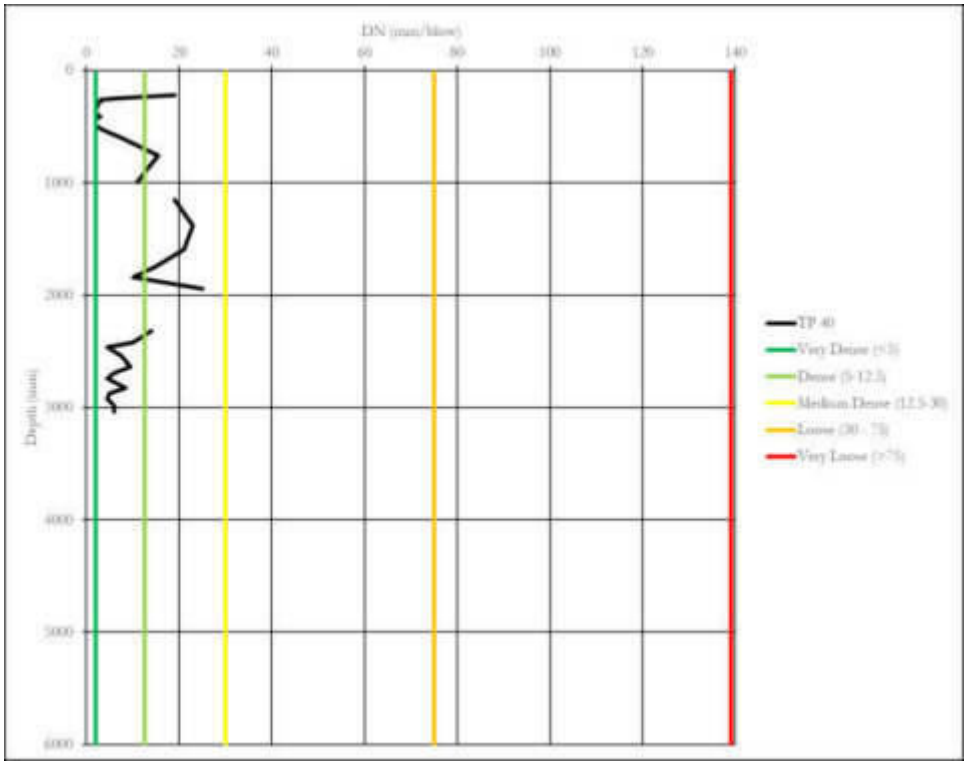



***Figure 89: DCP40 Log.***

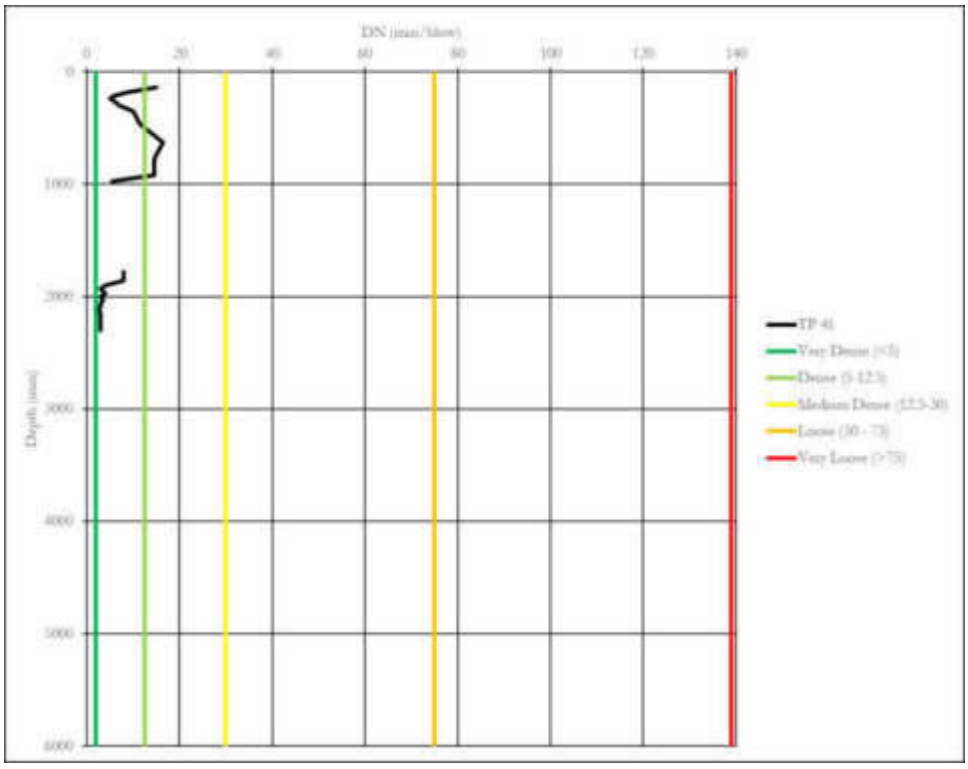



***Figure 90: DCP41 Log.***

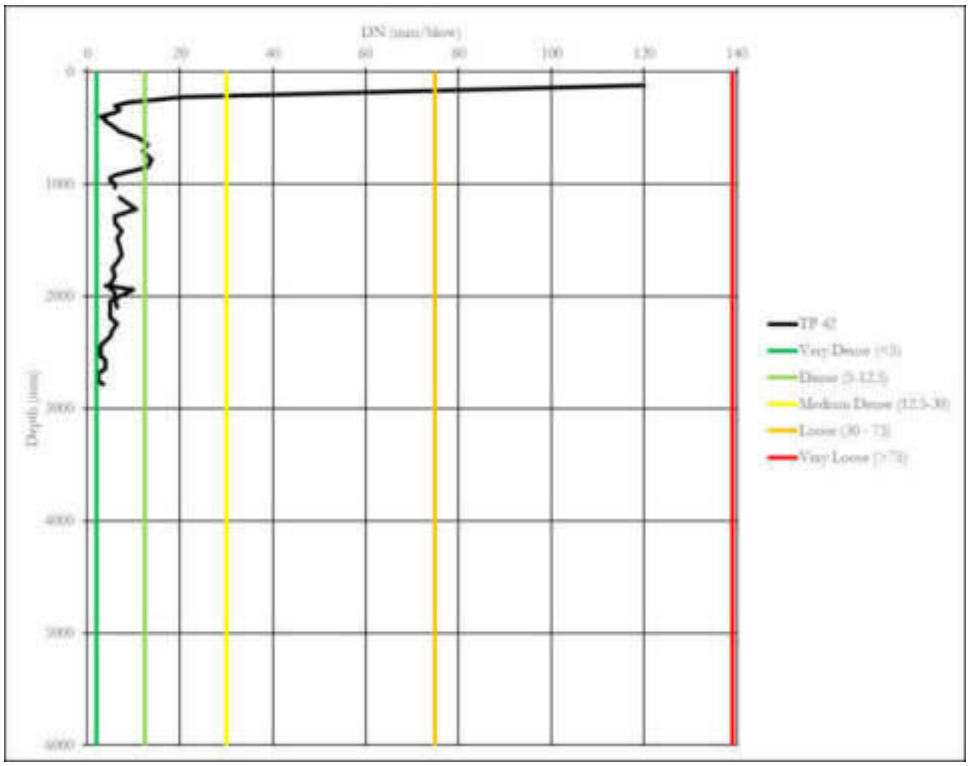



***Figure 91: DCP42 Log.***

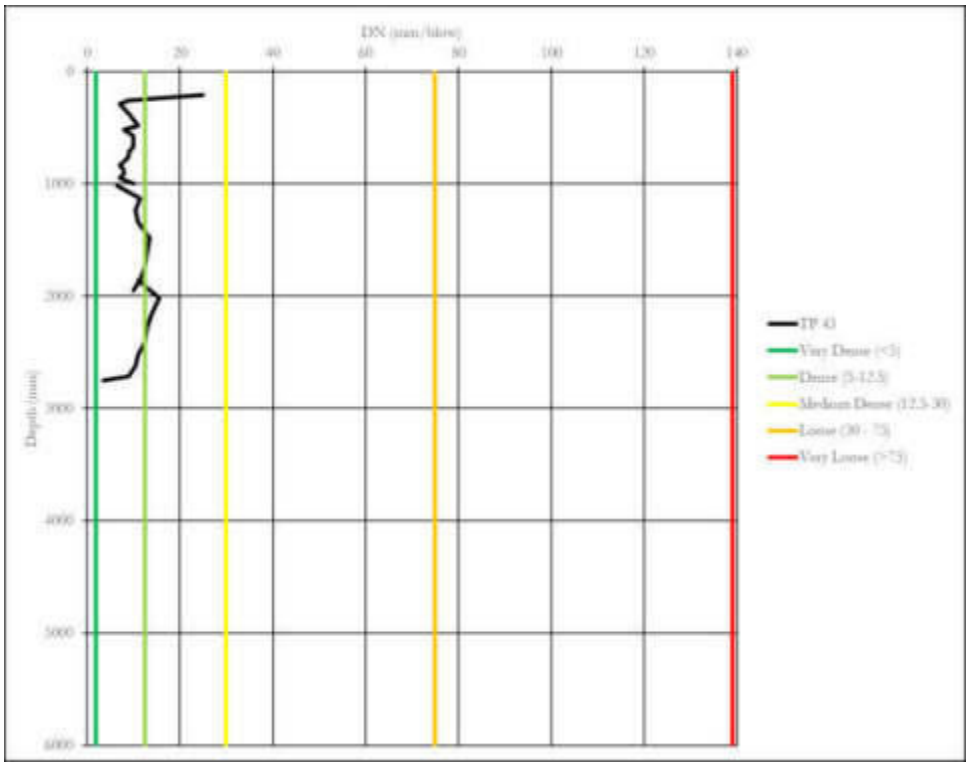



***Figure 92: DCP43 Log.***

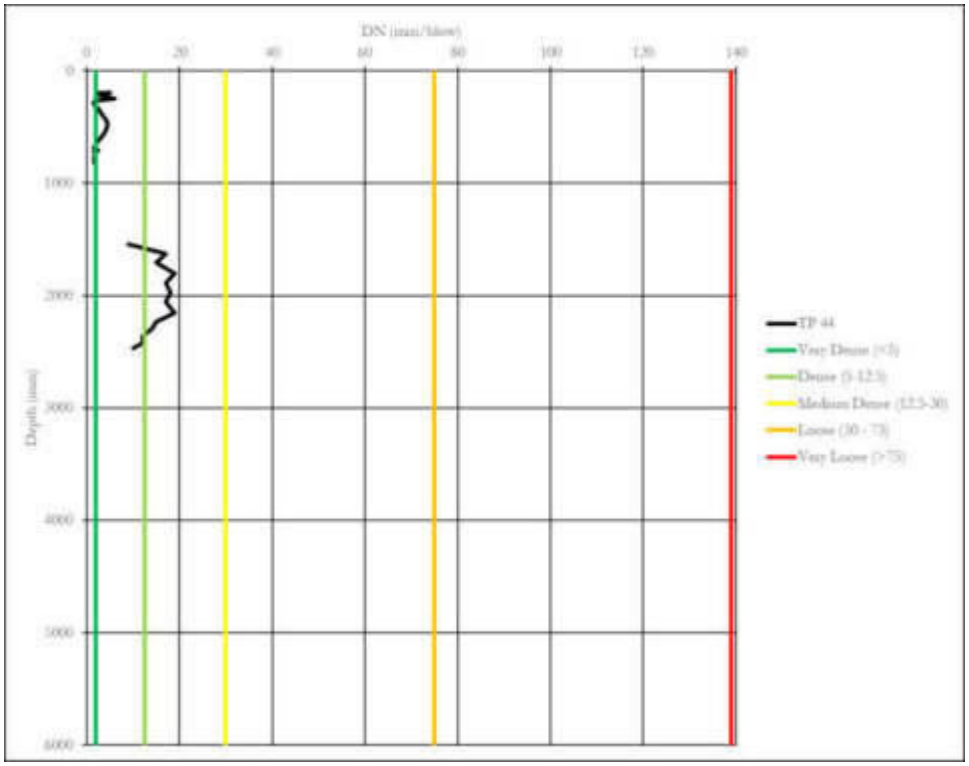



***Figure 93: DCP44 Log.***

# 13. APPENDIX E: LABORATORY ANALYSIS RESULTS

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

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Email: admin@steynwilson.co.za
Web: www.steynwilson.co.za

| | |
|---|---|
| Client: | **GEOSS South Africa** |
| Project: | Fisantekraal Airport |
| Attention: | Mr Shane Teek |
| Your Ref. No: | 4505 |
| Date Reported | 16/02/22 |

**TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL19674**

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

***Test Requested***

*4 x MOD / CBR / FOUNDATION INDICATOR*

***Site Sampling and Materials Information***

| | |
|---|---|
| *Sampling Method* | *Specimens delivered to Steyn Wilson Laboratory.* |
| *Environmental Condition* | *Sunny & Hot* |

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

**Mr. R.Wilson**
**Technical Signatory**

**Remarks:**

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.

DIRECTORS: Mr. J. Steyn ND Civil (Managing) | Mr. R. Wilson B.Tech Civil (Operations)
FINANCIAL MANAGER: Mr. D. Erasmus (SAICA Reg No: 20052562)
LABORATORY MANAGER: Mr. K. Booysen

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|---|---|---|---|
| Customer : | **GEOSS South Africa** | Project : | Fisantekraal Airport |
| | 9 Quantum Street, Techno Park, Unit 12 Technodell Building | Date Received : | 25/01/22 |
| | Stellenbosch | Date Reported : | 16/02/22 |
| | 7600 | Req. Number : | 4505 |
| Attention : | Mr Shane Teek | | |

**MOD / CBR / FOUNDATION INDICATOR** – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Reddish White Clayey SAND | Sample Number: | 18589 | | |
| Position: | TP 4 | Liquid Limit | 33 | Linear Shrinkage | 8,1 |
| Depth: | 1.7m | Plasticity Index | 15 | Insitu M/C% | 1,5 |

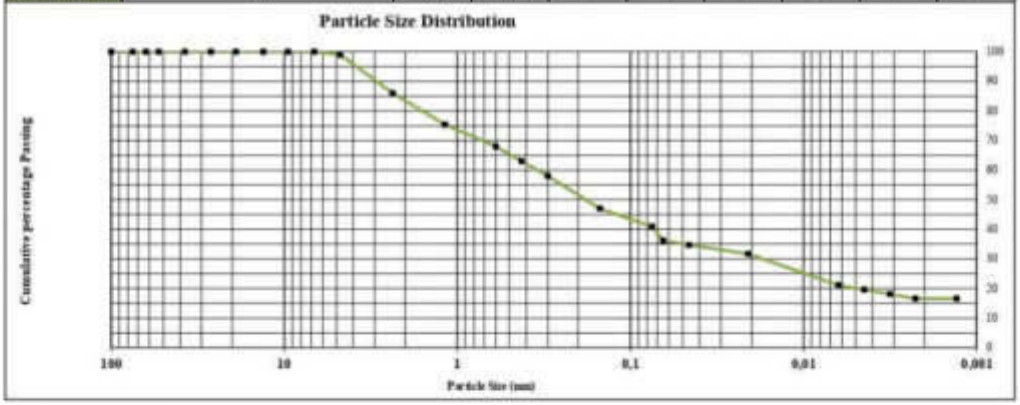
| pH (TMH1 A20)* | | Conductivity s/m* (TMH1 A21T)* | | SG (TMH1 A12T)* | 2,660 |
|---|---|---|---|---|---|

**SIEVE ANALYSIS (TMH 1 A1a)*** | **HYDROMETER ASTM D422**

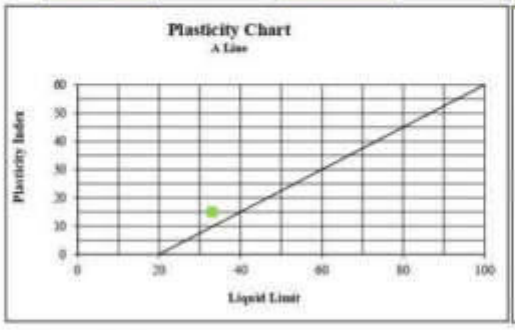
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,065 | 0,046 | 0,021 | 0,006 | 0,004 | 0,003 | 0,002 | 0,001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 86 | 75,4 | 68 | 63 | 58 | 47 | 40,9 | 36,19 | 34,68 | 31,67 | 21,11 | 19,6 | 18,1 | 16,58 | 16,59 |

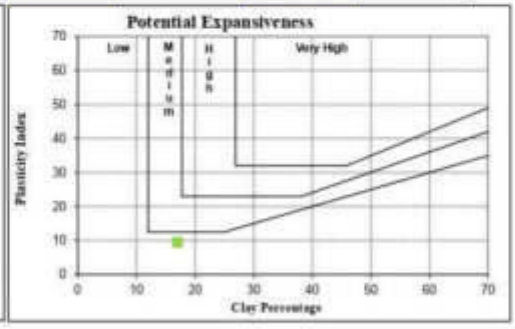
% Passing

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 10,2 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M³) | 2102 | 10,6 | 1,19 | 4 | 3 | 2 | 2 | 1 | 1 |




| % Gravel | 17 | % Sand | 47 | % Silt | 19 | % Clay | 17 |
|---|---|---|---|---|---|---|---|




NOTE: All tests marked with (*) means that those test methods are not accredited.

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| Attention: | Mr Shane Teek | | |

**MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40**

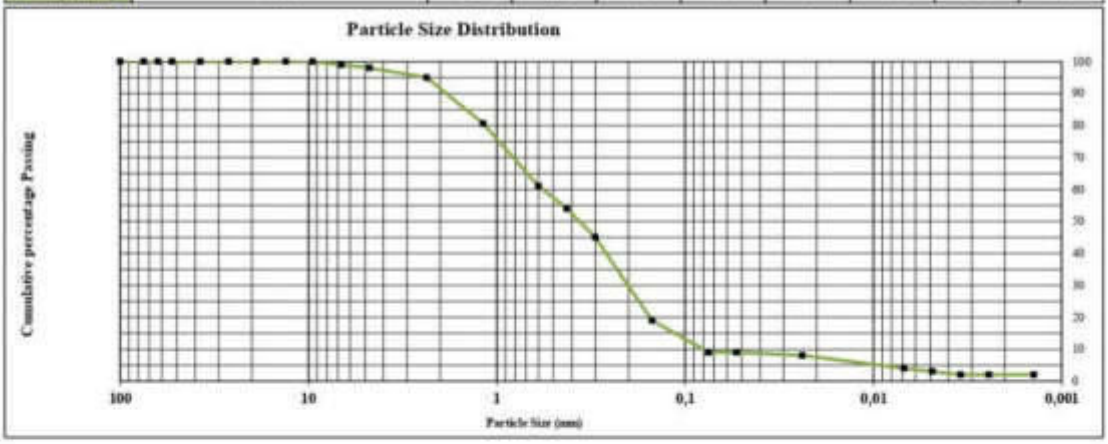
| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Sand | Sample Number: | 18590 | | |
| Position: | TH 12 | Liquid Limit | NP | Linear Shrinkage | 0,0 |
| Depth: | 0.0 - 0.6m | Plasticity Index | NP | Insitu M/C% | 2,1 |

| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,604 |
|---|---|---|---|---|---|

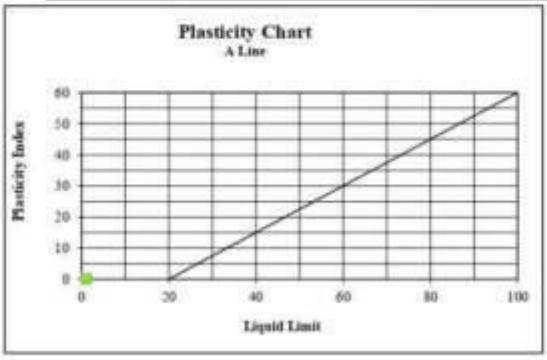
| SIEVE ANALYSIS (TMH 1 A1a)* | | | | | | | | | | | | | | | | | HYDROMETER ASTM D422 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,075 | 0,053 | 0,024 | 0,007 | 0,005 | 0,003 | 0,002 | 0,001 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 95 | 80,6 | 61 | 54 | 45 | 19 | 9 | 9 | 9 | 8 | 4 | 3 | 2 | 2 | 2 |

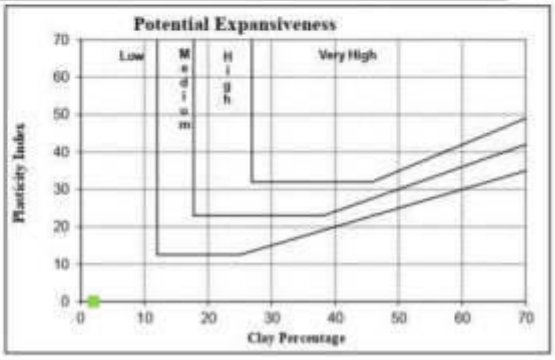
% Passing

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 12,1 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 1909 | 12,4 | 0,0 | 17 | 14 | 12 | 10 | 8 | 5 |




| % Gravel | 9 | % Sand | 82 | % Silt | 7 | % Clay | 2 |
|---|---|---|---|---|---|---|---|




NOTE: All tests marked with (*) means that those test methods are not accredited.

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|---|---|---|---|
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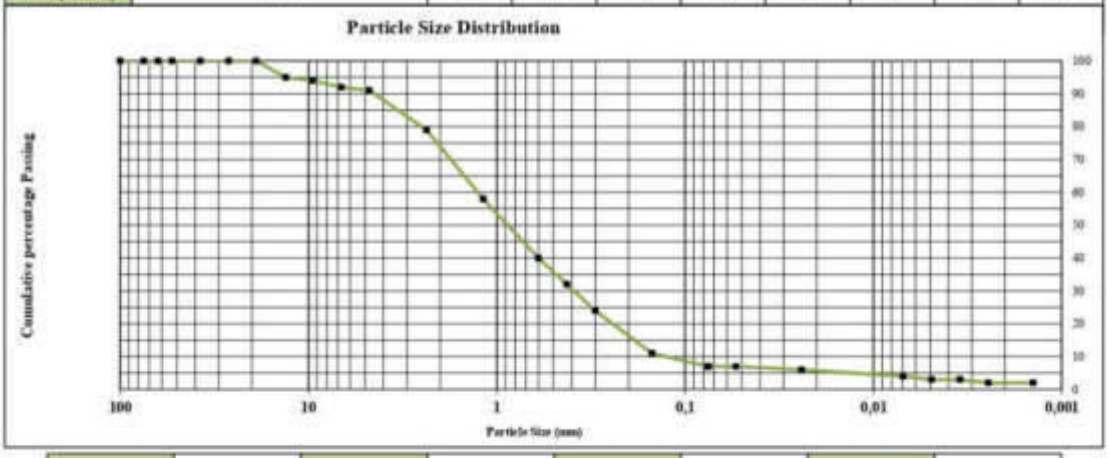
**MOD / CBR / FOUNDATION INDICATOR** – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Coarse Sand | Sample Number: | 18591 | | |
| Position: | TP 12 | Liquid Limit | NP | Linear Shrinkage | 0,0 |
| Depth: | 0.75 - 1.2m | Plasticity Index | NP | Insitu M/C% | 1,2 |

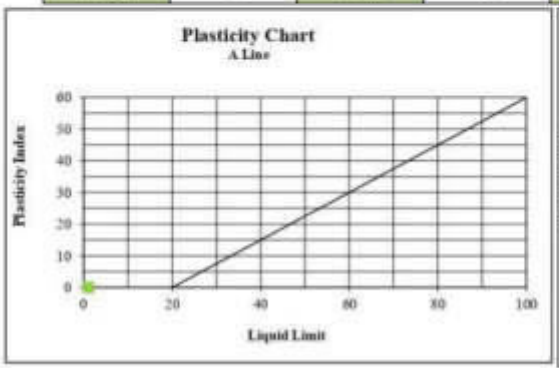
| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,577 |
|---|---|---|---|---|---|

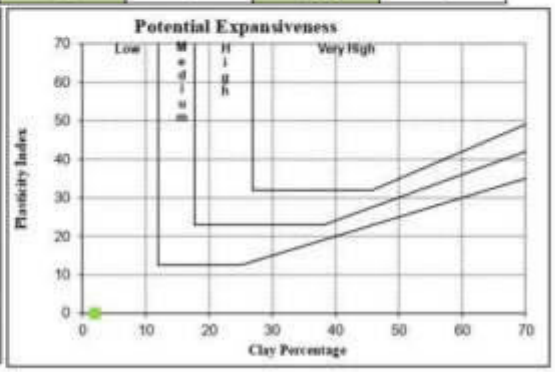
| SIEVE ANALYSIS (TMH 1 A1a)* | | | | | | | | | | | | | | | | | HYDROMETER ASTM D422 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,076 | 0,054 | 0,024 | 0,007 | 0,005 | 0,003 | 0,002 | 0,001 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 95 | 94 | 92 | 91 | 79 | 58 | 40 | 32 | 24 | 11 | 7 | 7 | 7 | 6 | 4 | 3 | 3 | 2 | 2 |
| % Passing | | | | | | | | | | | | | | | | | | | | | | | | | |

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 9,2 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 2030 | 9,6 | 0,0 | 16 | 13 | 12 | 9 | 7 | 5 |




| % Gravel | 27 | % Sand | 66 | % Silt | 5 | % Clay | 2 |
|---|---|---|---|---|---|---|---|




NOTE: All tests marked with (*) means that those test methods are not accredited.

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Customer: **GEOSS South Africa**
9 Quantum Street, Techno Park, Unit 12 Technostell Building
Stellenbosch
7600
Attention: Mr Shane Teek

Project: Fisantekraal Airport
Date Received: 25/01/22
Date Reported: 16/02/22
Req. Number: 4505

## MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Orange Soil with Femicrete | Sample Number: | 18592 | | |
| Position: | TP 14 | Liquid Limit | NP | Linear Shrinkage | 0,0 |
| Depth: | 0.0 - 0.45m | Plasticity Index | NP | Insitu M/C% | 1,2 |

| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,604 |
|---|---|---|---|---|---|

**SIEVE ANALYSIS (TMH 1 A1a)***

| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 100 | 100 | 100 | 100 | 95 | 94 | 89 | 86 | 82 | 74 | 43 | 28,1 | 21 | 17 | 13 | 7 | 4,7 |

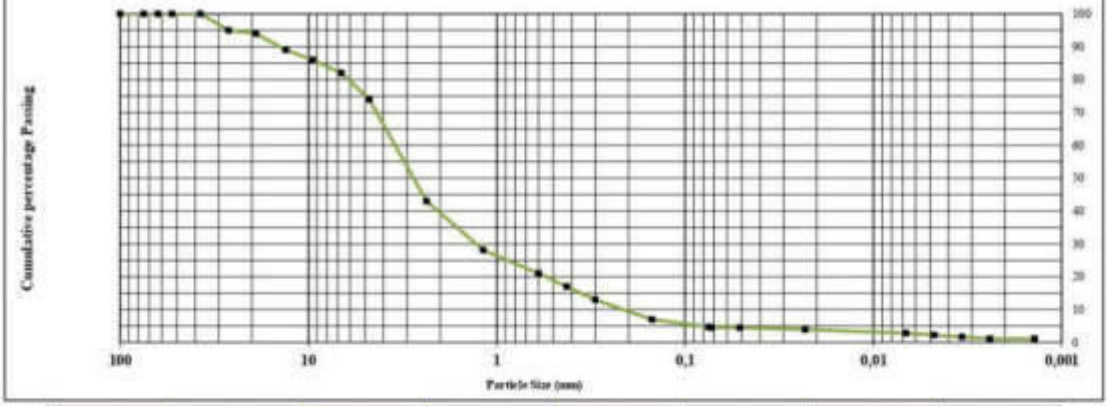
**HYDROMETER ASTM D422**

| 0,072 | 0,051 | 0,023 | 0,007 | 0,005 | 0,003 | 0,002 | 0,001 |
|---|---|---|---|---|---|---|---|
| 4,496 | 4,496 | 3,934 | 2,81 | 2,248 | 1,686 | 1,124 | 1,124 |

% Passing

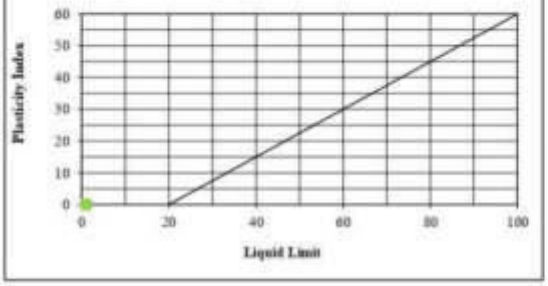
| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 8,3 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 2120 | 8,0 | 0,0 | 75 | 59 | 50 | 40 | 30 | 21 |

**Particle Size Distribution**

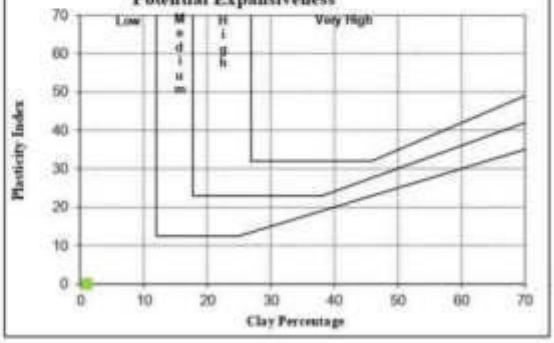



| % Gravel | 62 | % Sand | 34 | % Silt | 3 | % Clay | 1 |
|---|---|---|---|---|---|---|---|

**Plasticity Chart**
A Line




**Potential Expansiveness**




NOTE: All tests marked with (*) means that those test methods are not accredited

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|---|---|---|---|
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| | 7600 | Req. Number : | 4505 |
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## MOD / CBR / FOUNDATION INDICATOR - TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Whiteish Silty Clay Soil | Sample Number: | 18593 | | |
| Position: | TP 14 | Liquid Limit | 32,2 | Linear Shrinkage | 7,9 |
| Depth: | 1.5-2.0m | Plasticity Index | 15,7 | Insitu M/C% | 4,2 |

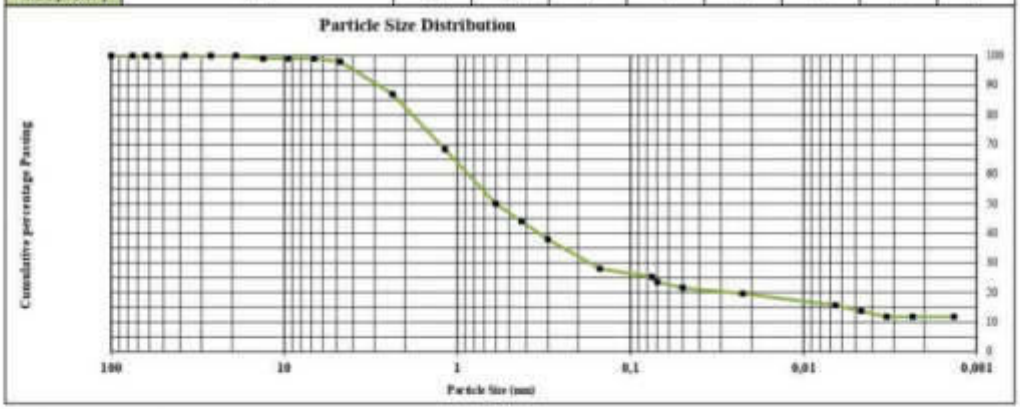
| pH (TMH1 A20)* | | Conductivity s/m* (TMH1 A21T)* | | SG (TMH1 A12T)* | 2,632 |
|---|---|---|---|---|---|

**SIEVE ANALYSIS (TMH 1 A1a)*** — **HYDROMETER ASTM D422**

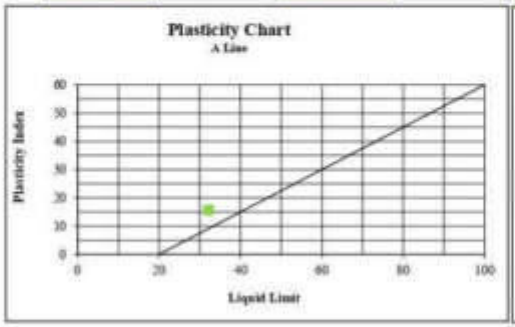
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 12,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,070 | 0,050 | 0,022 | 0,007 | 0,005 | 0,003 | 0,002 | 0,001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 98 | 96 | 87 | 68,4 | 50 | 44 | 36 | 28 | 25,3 | 23,52 | 21,56 | 19,6 | 15,68 | 13,72 | 11,76 | 11,76 | 11,76 |

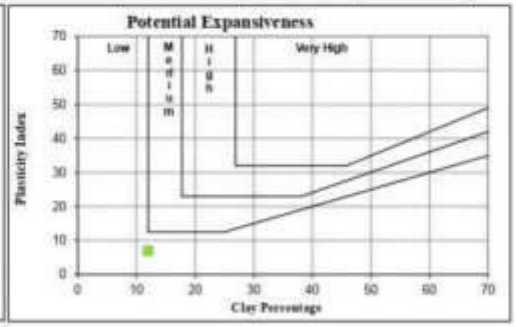
% Passing

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 12,2 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M³) | 2026 | 11,8 | 1,14 | 19 | 14 | 11 | 8 | 5 | 3 |




| % Gravel | 19 | % Sand | 58 | % Silt | 11 | % Clay | 12 |
|---|---|---|---|---|---|---|---|




NOTE: All tests marked with (*) means that those test methods are not accredited.

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| | Stellenbosch | Date Reported: | 16/02/22 |
| | 7600 | Req. Number: | 4505 |
| Attention: | Mr Shane Teek | | |

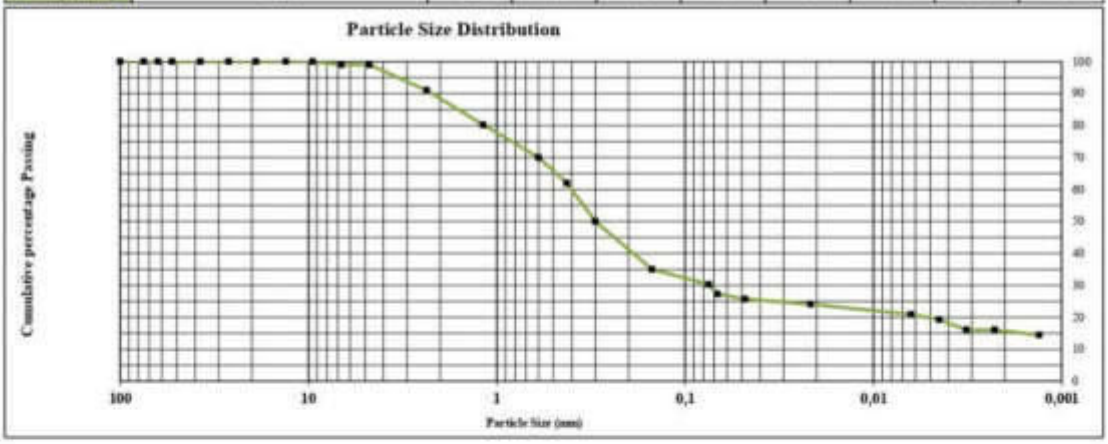
**MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40**

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Whitish Silty Soil with Sandstone | Sample Number: | 18594 | | |
| Position: | TP 15 | Liquid Limit | **27** | Linear Shrinkage | **6** |
| Depth: | 0.9-1.7m | Plasticity Index | **9,8** | Insitu M/C% | **7,3** |

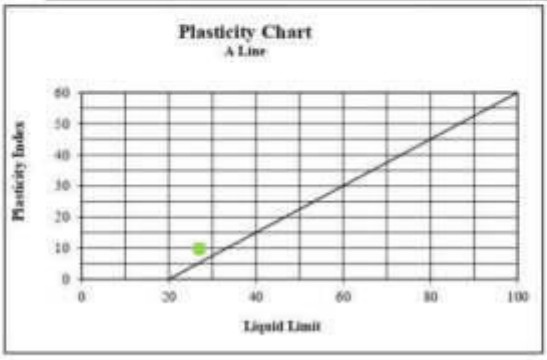
| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,660 |
|---|---|---|---|---|---|

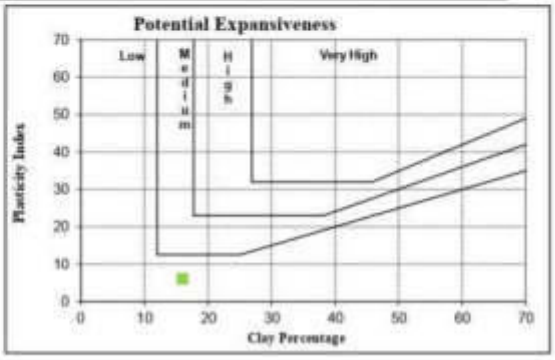
| SIEVE ANALYSIS (TMH 1 A1a)* | | | | | | | | | | | | | | | | | HYDROMETER ASTM D422 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,067 | 0,048 | 0,022 | 0,006 | 0,004 | 0,003 | 0,002 | 0,001 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 91 | 80,2 | 70 | 62 | 50 | 35 | 30,3 | 27,27 | 25,68 | 24,06 | 20,85 | 19,25 | 16,04 | 16,04 | 14,44 |
| % Passing | | | | | | | | | | | | | | | | | | | | | | | | | |

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 12,5 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 2022 | 12,1 | 0,87 | 17 | 11 | 8 | 5 | 3 | 2 |




| % Gravel | 12 | % Sand | 61 | % Silt | 11 | % Clay | 16 |
|---|---|---|---|---|---|---|---|




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Stellenbosch
7600
Attention: Mr Shane Teek

Project: Fisantekraal Airport
Date Received: 25/01/22
Date Reported: 16/02/22
Req. Number: 4505

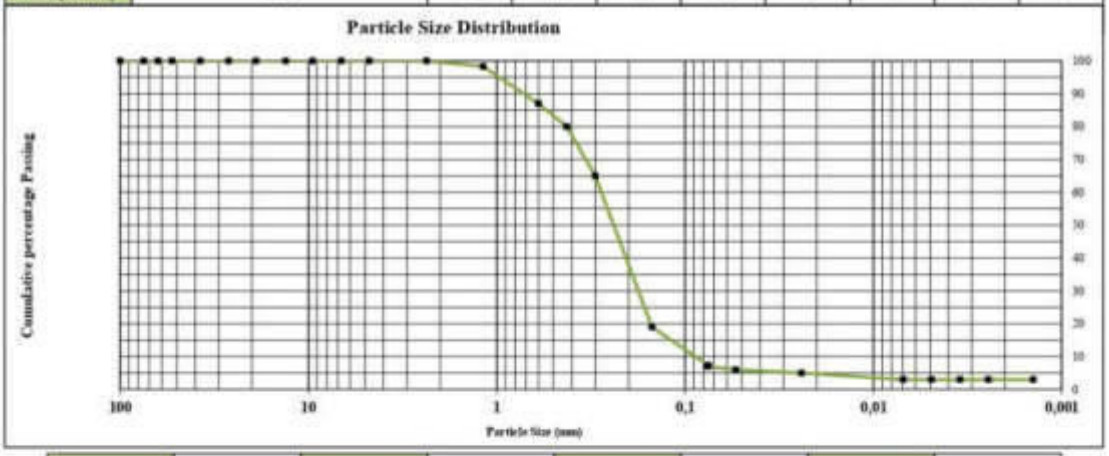
**MOD / CBR / FOUNDATION INDICATOR** – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Sand | Sample Number: | 18595 | | |
| Position: | TP 17 | Liquid Limit | NP | Linear Shrinkage | 0,0 |
| Depth: | 0.0-1.9m | Plasticity Index | NP | Insitu M/C% | 4,5 |

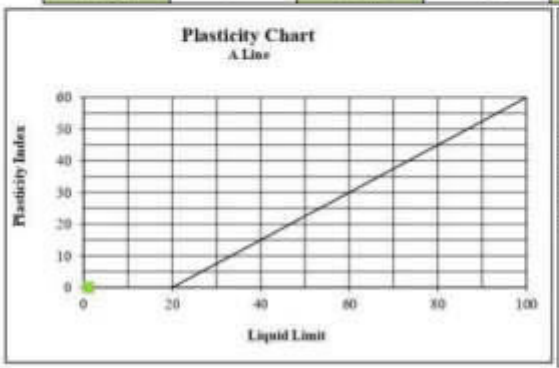
| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,577 |
|---|---|---|---|---|---|

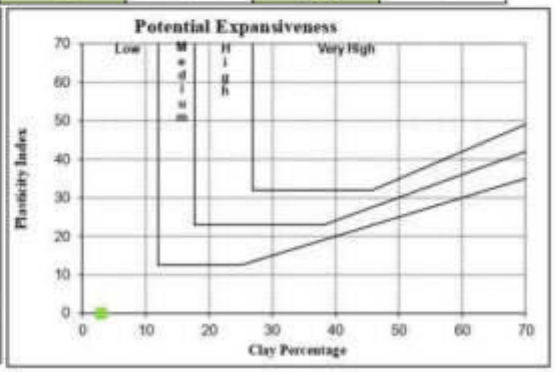
| SIEVE ANALYSIS (TMH 1 A1a)* | | | | | | | | | | | | | | | | | HYDROMETER ASTM D422 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,076 | 0,054 | 0,024 | 0,007 | 0,005 | 0,003 | 0,002 | 0,001 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 98,3 | 87 | 80 | 65 | 19 | 7,3 | 7 | 6 | 5 | 3 | 3 | 3 | 3 | 3 |
| % Passing | | | | | | | | | | | | | | | | | | | | | | | | | |

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 12,3 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 1808 | 12,4 | 0,0 | 14 | 10 | 9 | 7 | 6 | 4 |




| % Gravel | 1 | % Sand | 93 | % Silt | 3 | % Clay | 3 |
|---|---|---|---|---|---|---|---|




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| | Stellenbosch | Date Reported: | 16/02/22 |
| | 7600 | Req. Number: | 4505 |
| Attention: | Mr Shane Teek | | |

**MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40**

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Dark Bown Sandy GRAVEL | Sample Number: | 18596 | | |
| Position: | TP 18 | Liquid Limit | NP | Linear Shrinkage | 0,0 |
| Depth: | 0.2-0.6m | Plasticity Index | NP | Insitu M/C% | 4,5 |

| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,632 |
|---|---|---|---|---|---|

**SIEVE ANALYSIS (TMH 1 A1a)***

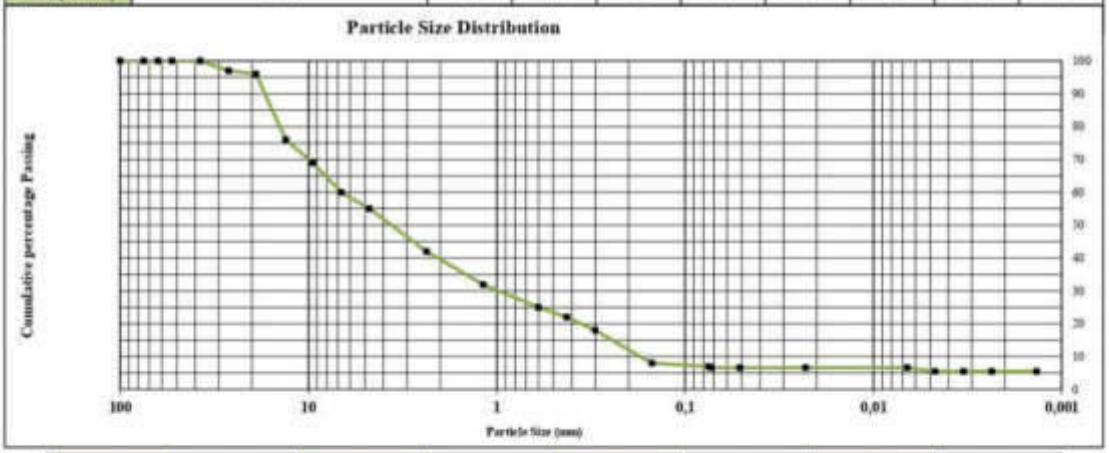
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 100 | 100 | 100 | 100 | 97 | 96 | 76 | 69 | 60 | 55 | 42 | 31,9 | 25 | 22 | 18 | 8 | 7 |

**HYDROMETER ASTM D422**

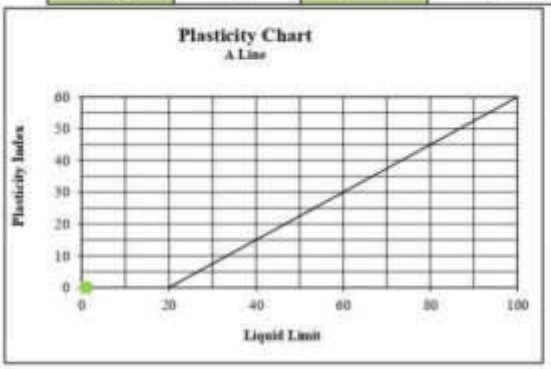
| 0,072 | 0,051 | 0,023 | 0,007 | 0,005 | 0,003 | 0,002 | 0,001 |
|---|---|---|---|---|---|---|---|
| 6,6 | 6,6 | 6,6 | 6,6 | 5,5 | 5,5 | 5,5 | 5,5 |

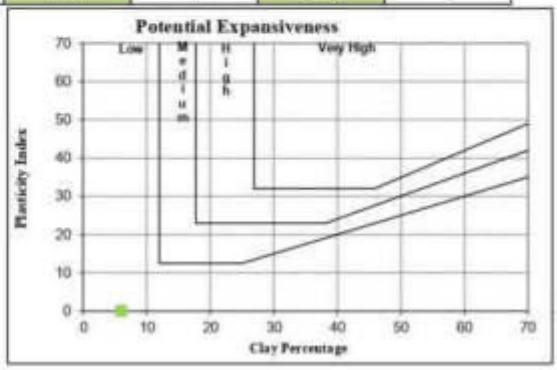
% Passing

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 7,3 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 2240 | 7,0 | 0,0 | 50 | 39 | 33 | 26 | 20 | 13 |




| % Gravel | 61 | % Sand | 32 | % Silt | 1 | % Clay | 6 |
|---|---|---|---|---|---|---|---|




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| | Stellenbosch | Date Reported : | 16/02/22 |
| | 7600 | Req. Number : | 4505 |
| Attention : | Mr S Teek | | |

**MOD / CBR / FOUNDATION INDICATOR** – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Reddish Brown CLAY | Sample Number: | 18597 | | |
| Position: | TP 18 | Liquid Limit | 77,9 | Linear Shrinkage | 18,9 |
| Depth: | 0.6-1.0m | Plasticity Index | 41,8 | Insitu M/C% | 15,8 |

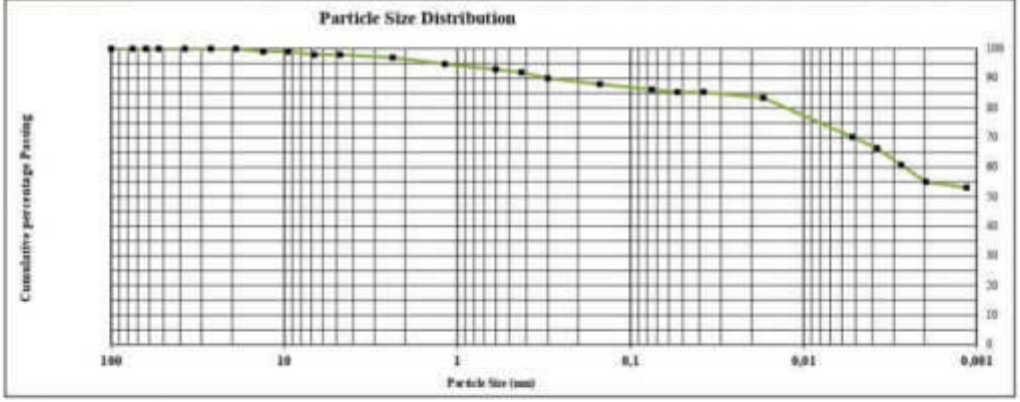
| pH (TMH1 A20)* | | Conductivity s/m* (TMH1 A21T)* | | SG (TMH1 A12T)* | 2,747 |
|---|---|---|---|---|---|

**SIEVE ANALYSIS (TMH 1 A1a)*** — **HYDROMETER ASTM D422**

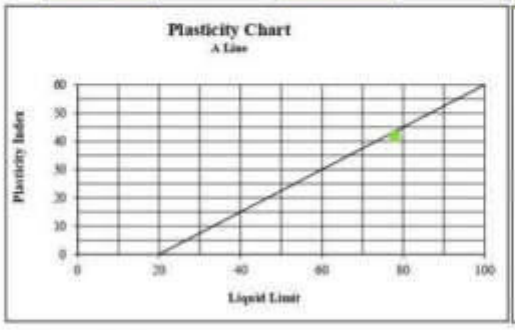
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,053 | 0,038 | 0,027 | 0,005 | 0,004 | 0,003 | 0,002 | 0,001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 98 | 98 | 97 | 94,8 | 93 | 92 | 90 | 88 | 86,2 | 85,32 | 83,32 | 83,42 | 70,15 | 60,36 | 60,67 | 54,98 | 53,09 |

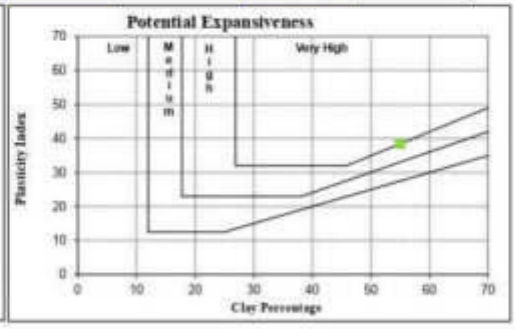
% Passing

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 14,3 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M³) | 1788 | 14,0 | 1,87 | 1 | 1 | 1 | 1 | 1 | 1 |




| % Gravel | 4 | % Sand | 11 | % Silt | 30 | % Clay | 55 |
|---|---|---|---|---|---|---|---|




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| | Stellenbosch | Date Reported: | 16/02/22 |
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**MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40**

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | White Clayey SILT | Sample Number: | 18598 | | |
| Position: | TP 22 | Liquid Limit | 48 | Linear Shrinkage | 6,2 |
| Depth: | 0.5-2.0m | Plasticity Index | 16,8 | Insitu M/C% | 15,6 |

| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,747 |
|---|---|---|---|---|---|

**SIEVE ANALYSIS (TMH 1 A1a)***

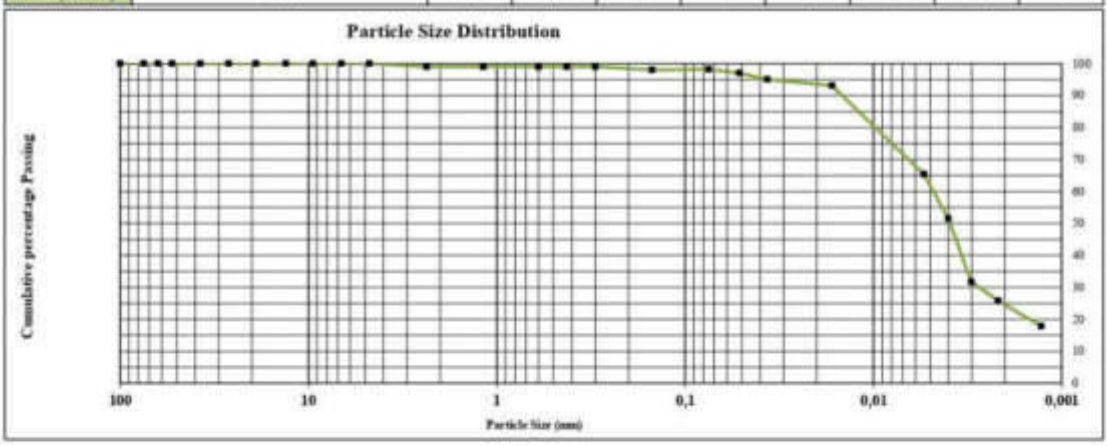
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 99 | 99 | 99 | 98 | 98,2 |

**HYDROMETER ASTM D422**

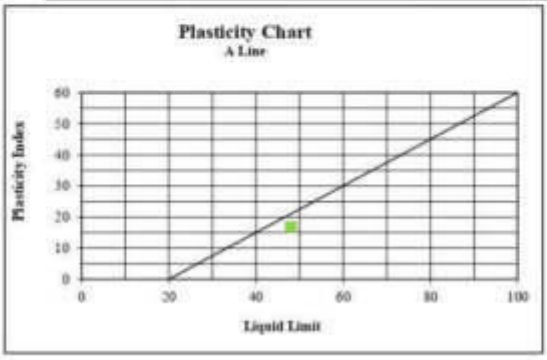
| 0,052 | 0,037 | 0,017 | 0,005 | 0,004 | 0,003 | 0,002 | 0,001 |
|---|---|---|---|---|---|---|---|
| 97,02 | 95,04 | 93,06 | 65,34 | 51,48 | 31,68 | 25,74 | 17,82 |

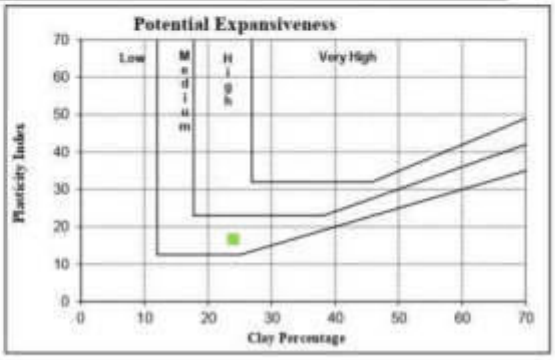
**% Passing**

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 13,4 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 1745 | 13,1 | 0,94 | 1 | 1 | 1 | 1 | 1 | 1 |




| % Gravel | 1 | % Sand | 1 | % Silt | 74 | % Clay | 24 |
|---|---|---|---|---|---|---|---|




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Attention: Mr S Teek

Project: Fisantekraal Airport
Date Received: 25/01/22
Date Reported: 16/02/22
Req. Number: 4505

**MOD / CBR / FOUNDATION INDICATOR** – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Dark Brown Soil with Reddish Orange Ferricrete | Sample Number: | 18599 | | |
| Position: | TP 25 | Liquid Limit | NP | Linear Shrinkage | 0,0 |
| Depth: | 0.0-0.7m | Plasticity Index | NP | Insitu M/C% | 4,4 |

| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,577 |
|---|---|---|---|---|---|

**SIEVE ANALYSIS (TMH 1 A1a)***

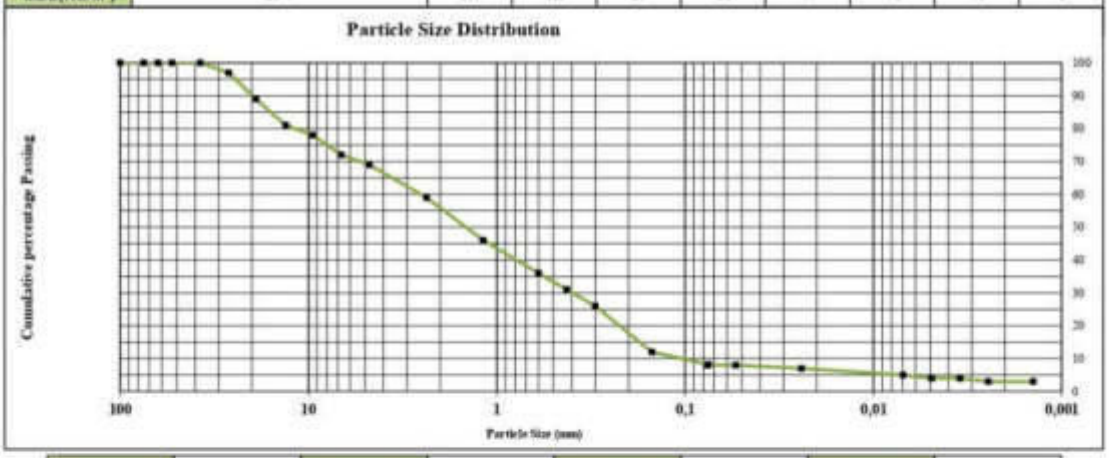
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 100 | 100 | 100 | 100 | 97 | 89 | 81 | 78 | 72 | 69 | 59 | 46 | 36 | 31 | 26 | 12 | 8,2 |

**HYDROMETER ASTM D422**

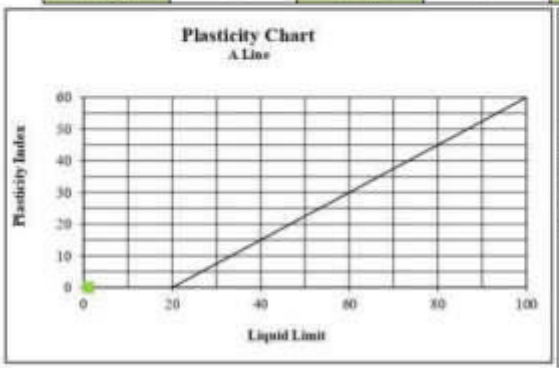
| 0,076 | 0,054 | 0,024 | 0,007 | 0,005 | 0,003 | 0,002 | 0,001 |
|---|---|---|---|---|---|---|---|
| 8 | 8 | 7 | 5 | 4 | 4 | 3 | 3 |

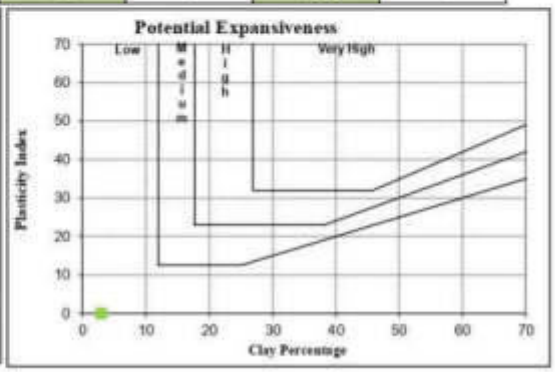
% Passing

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 9,2 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 2047 | 9,0 | 0,0 | 27 | 20 | 17 | 13 | 10 | 6 |




| % Gravel | 45 | % Sand | 47 | % Silt | 8 | % Clay | 3 |
|---|---|---|---|---|---|---|---|




NOTE: All tests marked with (*) means that those test methods are not accredited.

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| | | | |
|---|---|---|---|
| Customer: | **GEOSS South Africa** | Project: | Fisantekraal Airport |
| | 9 Quantum Street, Techno Park, Unit 12 Technostell Building | Date Received: | 25/01/22 |
| | Stellenbosch | Date Reported: | 16/02/22 |
| | 7600 | Req. Number: | 4505 |
| Attention: | Mr S Teek | | |

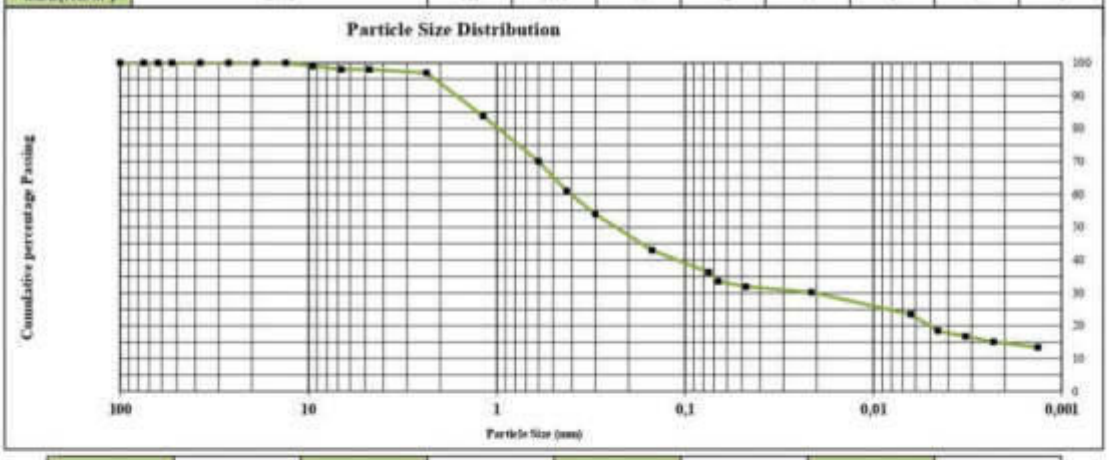
**MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40**

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Whitish Silty Sand | Sample Number: | 18600 | | |
| Position: | TP 25 | Liquid Limit | **24** | Linear Shrinkage | **4,5** |
| Depth: | 0.9-1.4m | Plasticity Index | **8,6** | Insitu M/C% | **4,4** |

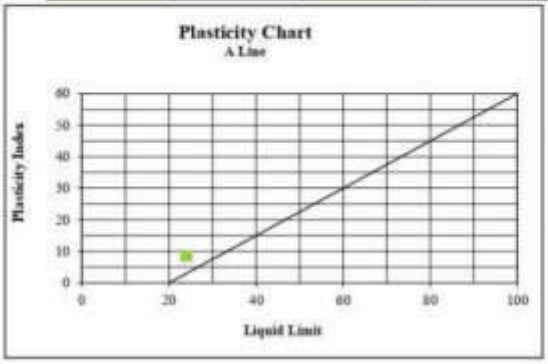
| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,632 |
|---|---|---|---|---|---|

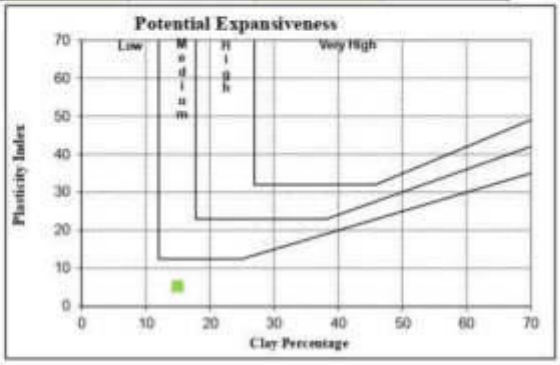
| SIEVE ANALYSIS (TMH 1 A1a)* | | | | | | | | | | | | | | | | | HYDROMETER ASTM D422 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,067 | 0,048 | 0,021 | 0,006 | 0,005 | 0,003 | 0,002 | 0,001 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 98 | 97 | 83,8 | 70 | 61 | 54 | 43 | 36,3 | 33,52 | 31,84 | 30,17 | 23,46 | 18,44 | 16,76 | 15,08 | 13,41 |
| % Passing | | | | | | | | | | | | | | | | | | | | | | | | | |

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 8,2 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M$^3$) | 2143 | 7,8 | 0,58 | 14 | 12 | 11 | 9 | 7 | 5 |




| % Gravel | 7 | % Sand | 60 | % Silt | 18 | % Clay | 15 |
|---|---|---|---|---|---|---|---|




NOTE: All tests marked with (*) means that those test methods are not accredited

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| | | | |
|---|---|---|---|
| Customer : | **GEOSS South Africa** | Project : | Fisantekraal Airport |
| | 9 Quantum Street, Techno Park, Unit 12 Technodell Building | Date Received : | 25/01/22 |
| | Stellenbosch | Date Reported : | 16/02/22 |
| | 7600 | Req. Number : | 4505 |
| Attention : | Mr Shane Teek | | |

**MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40**

| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Orange Silty Soil with Sandstone | Sample Number: | 18601 | | |
| Position: | TP 26 | Liquid Limit | 36,9 | Linear Shrinkage | 7,3 |
| Depth: | 1.0-1.7m | Plasticity Index | 13 | Insitu M/C% | 5,9 |

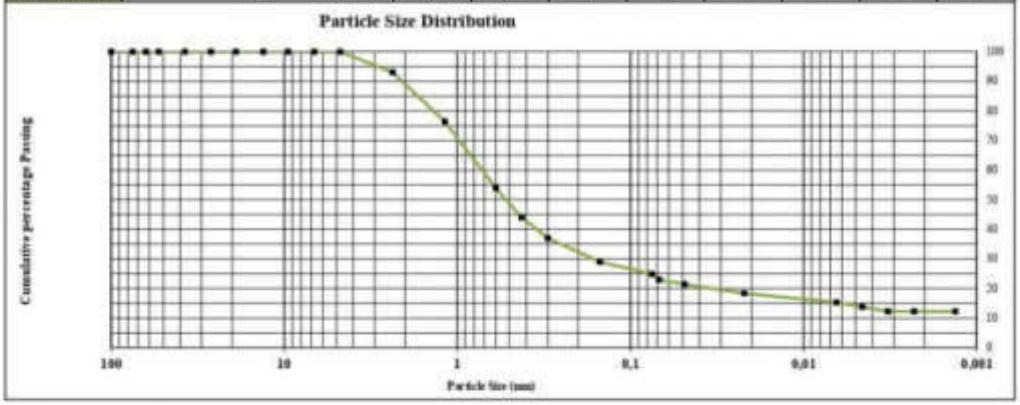
| pH (TMH1 A20)* | | Conductivity s/m* (TMH1 A21T)* | | SG (TMH1 A12T)* | 2,632 |
|---|---|---|---|---|---|

**SIEVE ANALYSIS (TMH 1 A1a)*** | **HYDROMETER ASTM D422**

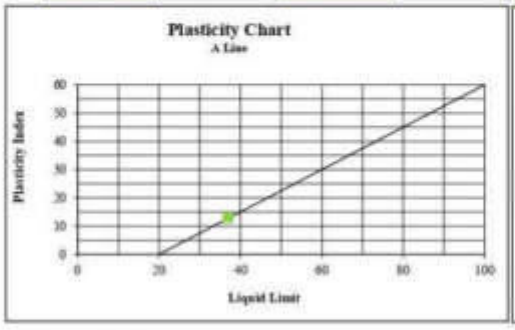
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,068 | 0,049 | 0,022 | 0,006 | 0,005 | 0,003 | 0,002 | 0,001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 93 | 76,4 | 54 | 44 | 37 | 29 | 24,9 | 22,92 | 21,39 | 16,34 | 15,29 | 13,75 | 13,22 | 12,23 | 12,22 |

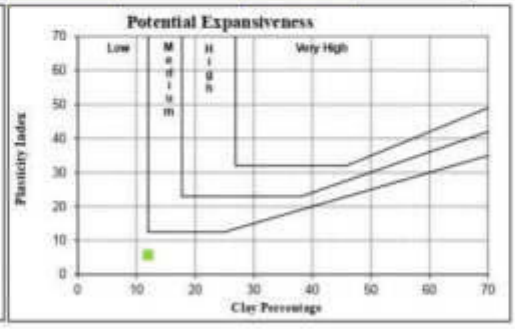
% Passing

| MOD AASHTO SANS 3001 GR30 | | CBR SANS 3001 GR40 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OMC% | 12,4 | COMP MC | % SWELL | 100% | 98% | 97% | 95% | 93% | 90% |
| MDD(KG/M³) | 2008 | 12,1 | 0,95 | 15 | 11 | 10 | 8 | 6 | 4 |




| % Gravel | 12 | % Sand | 66 | % Silt | 10 | % Clay | 12 |
|---|---|---|---|---|---|---|---|




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| | |
|---|---|
| Client: | **GEOSS South Africa** |
| Project: | 4505 |
| Attention: | Mr S Teek |
| Your Ref. No: | 4505 |
| Date Reported | 11/05/22 |

**TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL21614**

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

***Test Requested***

3 x *FOUNDATION INDICATOR*

***Site Sampling and Materials Information***

| | |
|---|---|
| *Sampling Method* | *Specimens delivered to Steyn Wilson Laboratory* |
| *Environmental Condition* | *Sunny* |
| *Deviation from the prescribed test method* | |
| *Responsibility of information disclaimer* | *The sample information was received from the customer. Results apply to the sample as received from the Customer.* |

**FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

**Remarks:**

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request, It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

**Mr. J.Steyn**
**Technical Signatory**

**DIRECTORS:** **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

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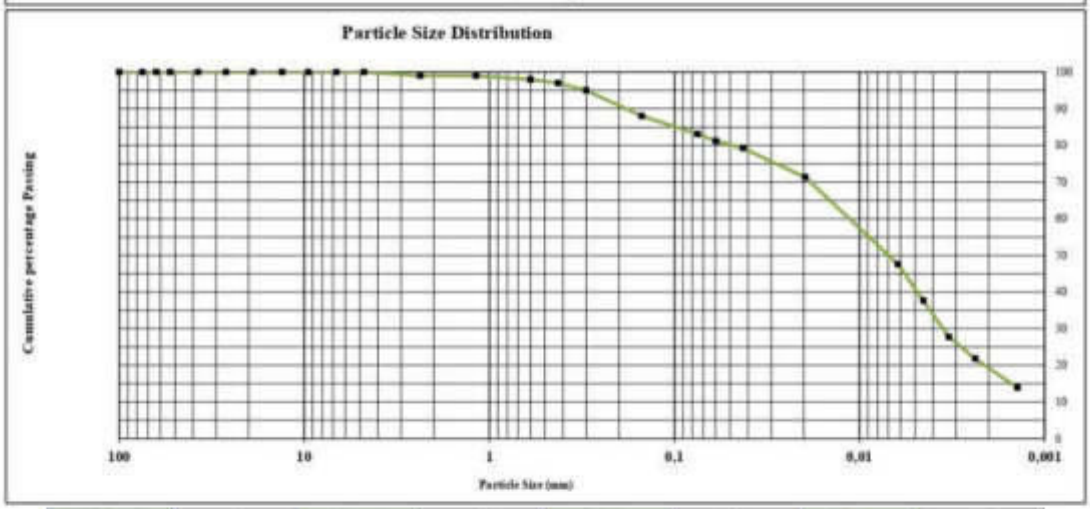
| | | | |
|---|---|---|---|
| Customer: | GEOSS South Africa | Project: | 4505 |
| | 9 Quantum Street, Techno Park, Unit 12 Technostell Building | Date Received: | 19/04/22 |
| | Stellenbosch | Date Reported: | 11/05/22 |
| | 7600 | Req. Number: | 4505 |
| Attention: | Mr S Teek | Date Sampled: | 19/04/22 |

## FOUNDATION INDICATOR ASTM D422

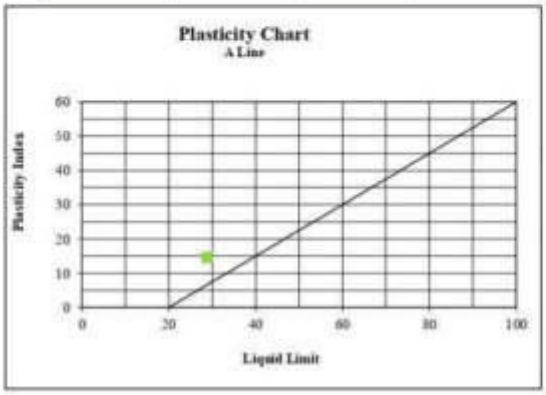
| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Orange Clay | Sample Number: | 20001 | | |
| Position: | TP 40 | Liquid Limit (Casagrande SANS 3001 GR12) | 28,8 | Linear Shrinkage | 7,8 |
| Depth: | 0.5 - 1.1m | Plasticity Index | 14,6 | Insitu M/C% | 15,7 |

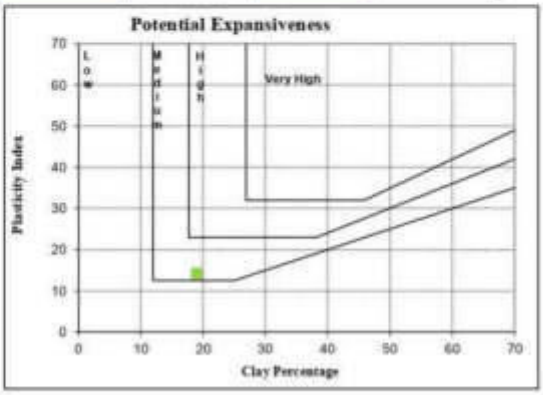
| PH (TMH1 A20) | | (TMH1 A21T) Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,660 |
|---|---|---|---|---|---|

| SIEVE ANALYSIS (TMH 1 A1a)* | | | | | | | | | | | | | | | | | HYDROMETER ASTM D422 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,060 | 0,042 | 0,020 | 0,006 | 0,005 | 0,003 | 0,002 | 0,001 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 98 | 97 | 95 | 88 | 83,1 | 81,18 | 79,2 | 71,28 | 47,52 | 37,62 | 27,72 | 21,78 | 13,86 |
| % Passing | | | | | | | | | | | | | | | | | | | | | | | | | |




| % Gravel | 1 | % Sand | 18 | % Silt | 62 | % Clay | 19 |
|---|---|---|---|---|---|---|---|




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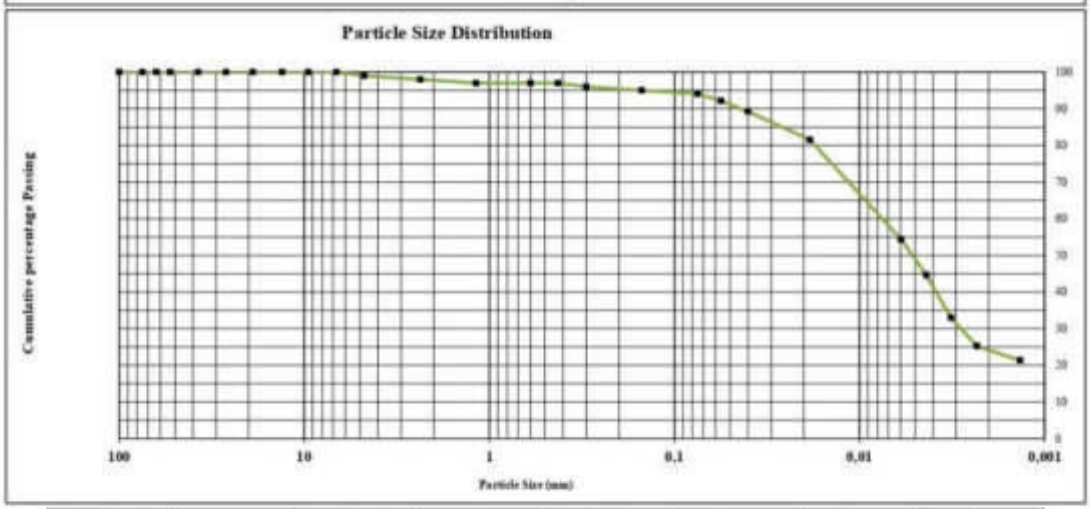
| | | | |
|---|---|---|---|
| Customer: | GEOSS South Africa | Project: | 4505 |
| | 9 Quantum Street, Techno Park, Unit 12 Technostell Building | Date Received: | 19/04/22 |
| | Stellenbosch | Date Reported: | 11/05/22 |
| | 7600 | Req. Number: | 4505 |
| Attention: | Mr S Teek | | |

## FOUNDATION INDICATOR ASTM D422

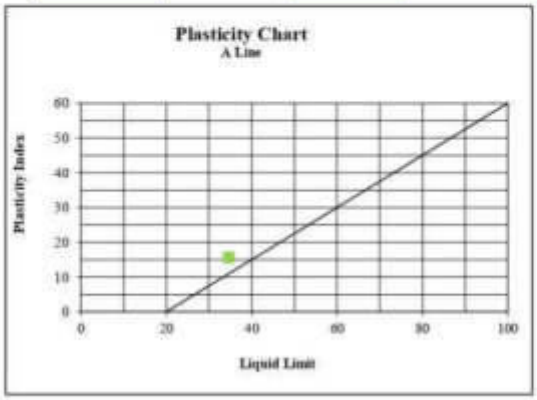
| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Orange Clay | Sample Number: | 20002 | | |
| Position: | TP 42 | Liquid Limit (Casagrande SANS 3001 GR12) | 34,6 | Linear Shrinkage | 7,6 |
| Depth: | 0.8m | Plasticity Index | 15,6 | Insitu M/C% | 11,4 |

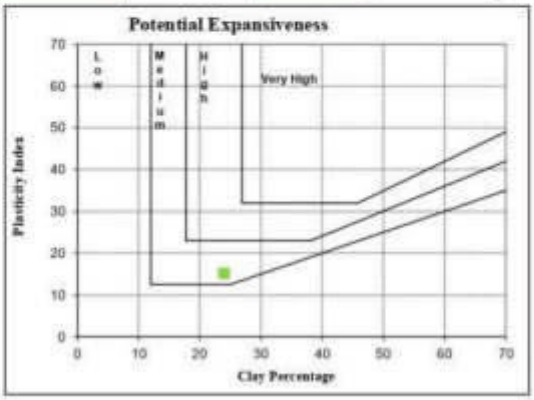
| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,688 |
|---|---|---|---|---|---|

| SIEVE ANALYSIS (TMH 1 A1a)* | | | | | | | | | | | | | | | | HYDROMETER ASTM D422 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,056 | 0,040 | 0,019 | 0,006 | 0,004 | 0,003 | 0,002 | 0,001 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 97 | 97 | 97 | 96 | 95 | 94,1 | 92,15 | 89,24 | 81,48 | 54,32 | 44,82 | 32,98 | 25,22 | 21,34 |
| % Passing | | | | | | | | | | | | | | | | | | | | | | | | | |




| % Gravel | 2 | % Sand | 5 | % Silt | 69 | % Clay | 24 |
|---|---|---|---|---|---|---|---|




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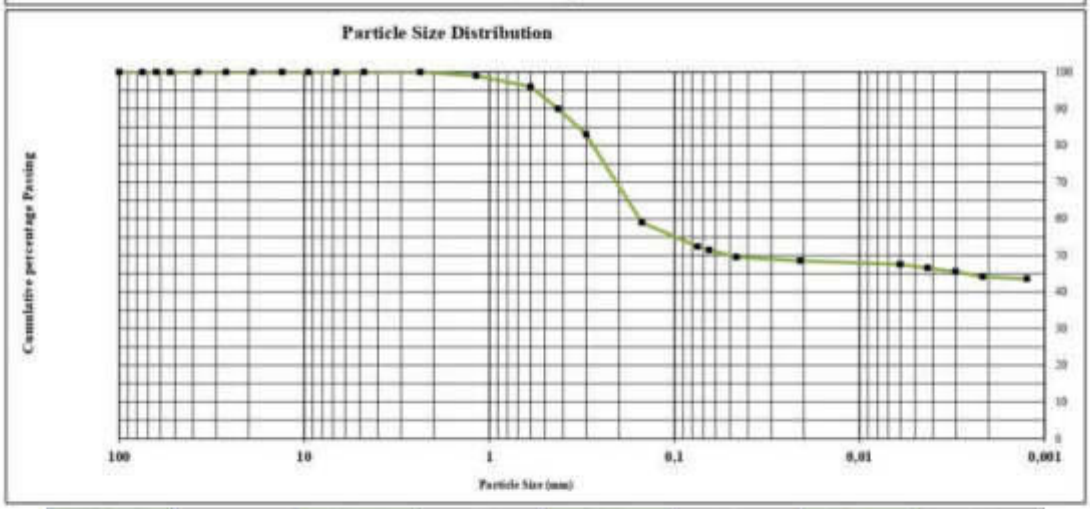
| | | | |
|---|---|---|---|
| Customer: | GEOSS South Africa | Project: | 4505 |
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| | Stellenbosch | Date Reported: | 11/05/22 |
| | 7600 | Req. Number: | 4505 |
| Attention: | Mr S Teek | | |

## FOUNDATION INDICATOR ASTM D422

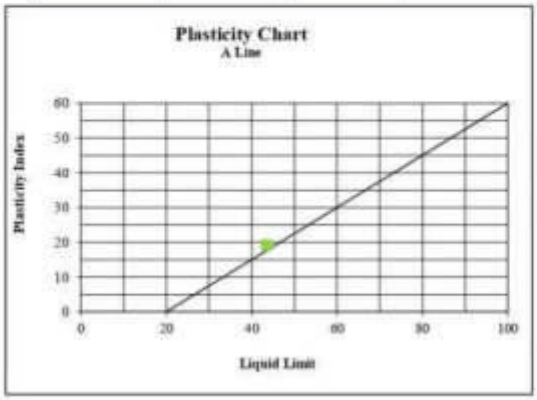
| | | | | | |
|---|---|---|---|---|---|
| Material Description: | Light Brown Silty Clay | Sample Number: | 20003 | | |
| Position: | TP 34 | Liquid Limit (Casagrande SANS 3001 GR12) | 43,5 | Linear Shrinkage | 9,2 |
| Depth: | 1,2m | Plasticity Index | 19,2 | Insitu M/C% | 13,5 |

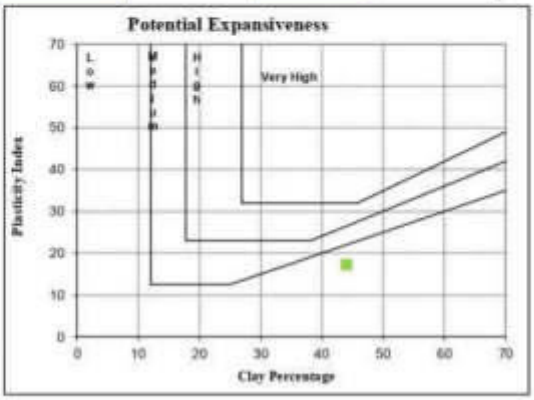
| PH (TMH1 A20)* | | (TMH1 A21T)* Conductivity s.m$^{-1}$ | | SG (TMH1 A12T)* | 2,747 |
|---|---|---|---|---|---|

| SIEVE ANALYSIS (TMH 1 A1a)* | | | | | | | | | | | | | | | | | HYDROMETER ASTM D422 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 75 | 63 | 53 | 37,5 | 26,5 | 19,0 | 13,2 | 9,5 | 6,7 | 4,75 | 2,36 | 1,18 | 0,60 | 0,425 | 0,300 | 0,150 | 0,075 | 0,065 | 0,046 | 0,021 | 0,006 | 0,004 | 0,003 | 0,002 | 0,001 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 96 | 90 | 83 | 59 | 52,4 | 51,5 | 49,5 | 48,5 | 47,5 | 46,5 | 45,5 | 44,2 | 43,6 |
| % Passing | | | | | | | | | | | | | | | | | | | | | | | | | |




| % Gravel | | % Sand | 49 | % Silt | 7 | % Clay | 44 |
|---|---|---|---|---|---|---|---|




NOTE: All tests marked with (*) means that those test methods are not accredited.

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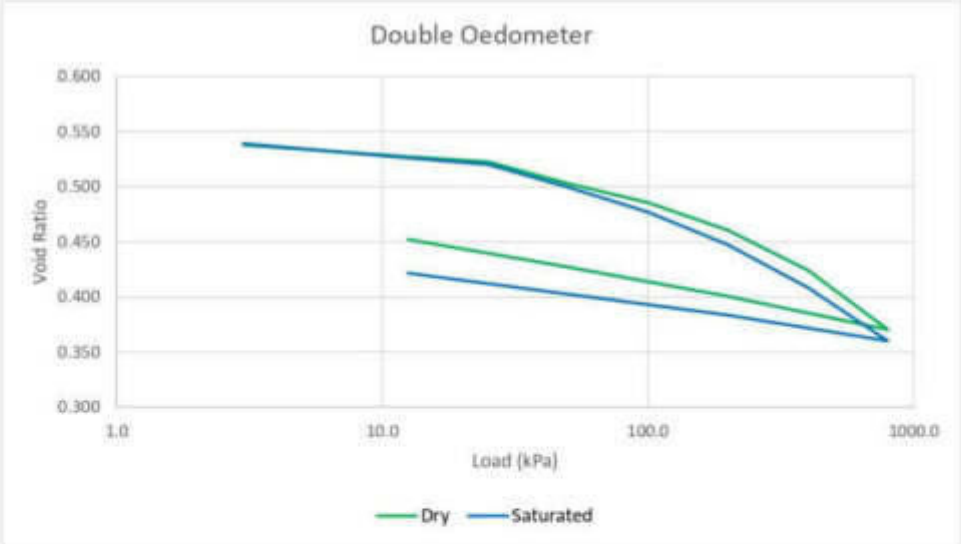
## Double Oedometer Test

| Dry Sample Detail | | Initial | Final |
|---|---|---|---|
| Height | (mm) | 20.3 | 19.2 |
| Diameter | (mm) | 63.5 | 63.5 |
| Weight | (g) | 125.7 | 130.5 |
| Moisture | (%) | 13.5 | 13.9 |
| Dry Density | ($Mg/m^3$) | 1.72 | 1.89 |
| Bulk Density | ($Mg/m^3$) | 1.96 | 2.15 |
| Void Ratio | | 0.538 | 0.452 |
| Particle Density | ($Mg/m^3$) | 2.65 | |
| Disturbed/Undisturbed | | Undisturbed | |
| Remoulded Density | ($Mg/m^3$) | - | |

| Saturated Sample Detail | | Initial | Final |
|---|---|---|---|
| Height | (mm) | 20.3 | 18.8 |
| Diameter | (mm) | 63.5 | 63.5 |
| Weight | (g) | 125.6 | 120.2 |
| Moisture | (%) | 13.5 | 28.1 |
| Dry Density | ($Mg/m^3$) | 1.72 | 1.58 |
| Bulk Density | ($Mg/m^3$) | 1.95 | 2.02 |
| Void Ratio | | 0.539 | 0.421 |
| Particle Density | ($Mg/m^3$) | 2.65 | |
| Disturbed/Undisturbed | | Undisturbed | |
| Remoulded Density | ($Mg/m^3$) | - | |

| Dry Sample | | |
|---|---|---|
| Load (kPa) | Height (mm) | Void Ratio |
| 3.0 | 20.300 | 0.538 |
| 12.5 | 20.160 | 0.527 |
| 25.0 | 20.100 | 0.523 |
| 50.0 | 19.840 | 0.503 |
| 100.0 | 19.610 | 0.486 |
| 200.0 | 19.280 | 0.461 |
| 400.0 | 18.800 | 0.424 |
| 800.0 | 18.090 | 0.370 |
| 200.0 | 18.490 | 0.401 |
| 50.0 | 18.840 | 0.427 |
| 12.5 | 19.170 | 0.452 |

| Saturated Sample | | |
|---|---|---|
| Load (kPa) | Height (mm) | Void Ratio |
| 3.0 | 20.300 | 0.539 |
| 12.5 | 20.130 | 0.526 |
| 25.0 | 20.050 | 0.520 |
| 50.0 | 19.780 | 0.500 |
| 100.0 | 19.480 | 0.477 |
| 200.0 | 19.090 | 0.447 |
| 400.0 | 18.580 | 0.409 |
| 800.0 | 17.940 | 0.360 |
| 200.0 | 18.250 | 0.384 |
| 50.0 | 18.500 | 0.403 |
| 12.5 | 18.750 | 0.421 |




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| Project | Fisantekraal | | |
|---|---|---|---|
| Sample | TP42_0.8m | | |
| Client | Geoss | Test Method | BS1377 - 5: 1990 |
| Jobfile | SWG0036 | Test Date | 16/05/2022 |

01/02/2021 Rev2 TR\GEO-SW0011 Compiled: M. Steyn Approved: R. Wilson

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## CERTIFICATE OF ANALYSES
## GENERAL WATER QUALITY PARAMETERS

**Date received:** 2022 - 02 - 16 **Date completed:** 2022 - 03 - 25
**Project number:** 1000 **Report number:** 107382 **Order number:**
**Client name:** Geoss South Africa Pty Ltd **Contact person:** Ms. A. Mcduling
**Address:** P.O Box 12412 Die Boord Stellenbosch **e-mail:** amcduling@geoss.co.za
**Telephone:** 021 880 1079 **Facsimile:** **Mobile:**

| Analyses in mg/ℓ (Unless specified otherwise) | Method Identification | Sample Identification: 4505_C_TP25_27 Jan 2022 |
|---|---|---|
| Sample Number | | 153126 |
| pH Value at 25°C | WLAB001 | 6.7 |
| Electrical Conductivity in mS/m at 25°C | WLAB002 | 31.8 |
| Total Dissolved Solids at 180°C | WLAB003 | 284 |
| Total Alkalinity as $CaCO_3$ | WLAB007 | 32 |
| Total Hardness as $CaCO_3$ | WLAB051 | 86 |
| Calcium Hardness as $CaCO_3$ | WLAB051 | 65 |
| pH Saturation (pHs) at 20°C | WLAB053 | 8.6 |
| Chloride as Cl | WLAB046 | 31 |
| Sulphate as $SO_4$ | WLAB046 | 34 |
| Free & Saline Ammonia as N | WLAB046 | 0.1 |
| Ammonium as $NH_4$ | WLAB046 | 0.1 |
| Calcium as Ca | WLAB015 | 26 |
| Magnesium as Mg | WLAB015 | 5 |
| Langelier Index at 20°C (calc) | --- | -2.0 |
| Ryznar Index at 20°C (calc) | --- | 10.7 |
| Corrosivity Ratio (calc) | --- | 2.5 |
| Leaching Index [LCSI] * | --- | 1 772 |
| Spalling Index [SCSI] * | --- | 5 |
| Aggressiveness Index [N] * | --- | 1 777 |

*** = Not SANAS Accredited**
**Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this Laboratory.**

Important notes:

1. The above aggressiveness index is only applicable for conditions of laminar flow at a mean annual temperature of 20°C.
2. For stagnant/turbulent conditions the aggressiveness index must be corrected.
3. For wet/dry cycling conditions (for example in tidal zones) the aggressiveness index must be corrected.
4. For mean annual temperatures lower/higher than 20°C the aggressiveness index must be corrected.

**J. Ngobeza**
Technical Signatory:

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## CERTIFICATE OF ANALYSES
## GENERAL WATER QUALITY PARAMETERS

**Date received:** 2022 - 02 - 16 **Date completed:** 2022 - 03 - 25
**Project number: 1000** **Report number: 107382** **Order number:**
**Client name: Geoss South Africa Pty Ltd** **Contact person: Ms. A. Mcduling**
**Address: P.O Box 12412 Die Boord Stellenbosch** **e-mail: amcduling@geoss.co.za**
**Telephone: 021 880 1079** **Facsimile:** **Mobile:**

**Guidelines for assessing overall aggressiveness ($N_c$):**

| $N_c$ | Aggressiveness |
|---|---|
| Not greater than 300 | None to mild |
| 400-700 | Mild to moderate |
| 800-1000 | High |
| = or > 1 100 | Very high |

| Aggressiveness Towards *Concrete and Fibre Cement Pipes* | | | |
|---|---|---|---|
| Index | Aggressive | Neutral | Non- Aggressive |
| a) Stability pH (pHs) | > pH | = pH | <pH |
| b) Langelier Index | Neg. Value | Zero | Pos. Value |
| c) Ryznar Index | >7.5 | 6-7 | <6 |

| Corrosiveness Towards metals | |
|---|---|
| Corrosivity | >0.2 |

**J. Ngobeza**

Technical Signatory:

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## CERTIFICATE OF ANALYSES
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**Date received:** 2022 - 02 - 16 **Date completed:** 2022 - 03 - 25
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**Address: P.O Box 12412 Die Boord Stellenbosch** **e-mail: amcduling@geoss.co.za**
**Telephone: 021 880 1079** **Facsimile:** **Mobile:**

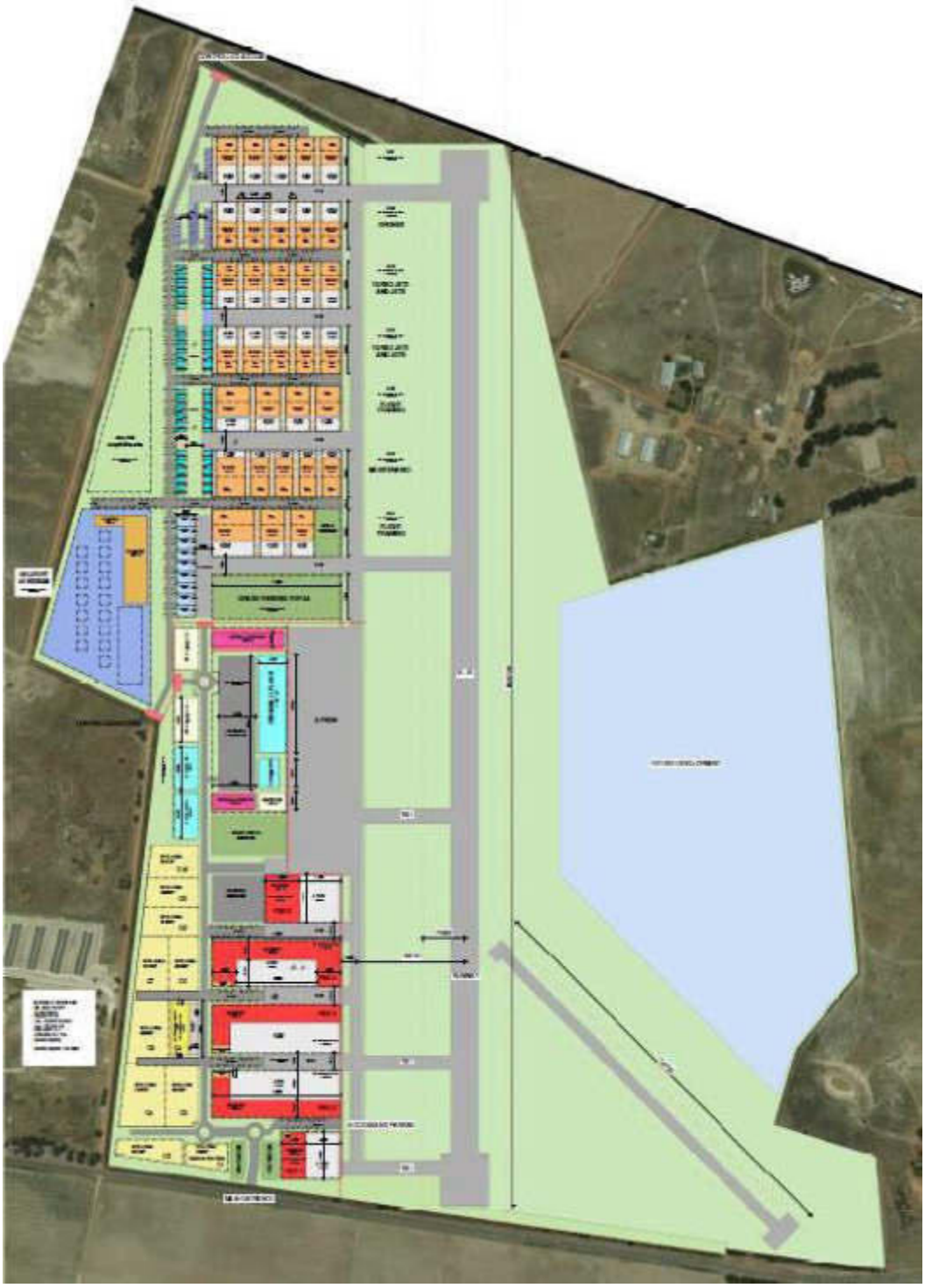
| To correct for: | Multiply | By: (see Notes 2 to 5 below) |
|---|---|---|
| Turbulence | LCSI | 1.75 |
| Stagnance | LCSI | 0.5 |
| Temperature | LCSI, SCSI, N7<br>Where N7=0.2 x Cl in mg/l | (1+ [0.05 x (T-20)]) |
| Wet-dry cycles | SCSI | $0.23 \times 10^{-6}$ x TDS x DTF x CPA<br>Where:<br>DTF = Dry Time Fraction<br>CPA = wet-dry cycles per annum |

**Note 1:** Only if the concrete contains embedded steel.
**Note 2:** To preserve the correct logical relationships when dealing with the negative sub-indices (i.e. LCSI or SCSI having minus values) they should be multiplied by the reciprocal of the relevant factor indicated in this column
**Note 3:** If more than one correction is required, multiply by the product of the individual correction factors
**Note 4:** Use subscript c to indicate that the index has been corrected, e.g. for turbulent conditions $LCSI_C$ = LCSI x 1.75
**Note 5:** Round off corrected indices to the nearest 100.

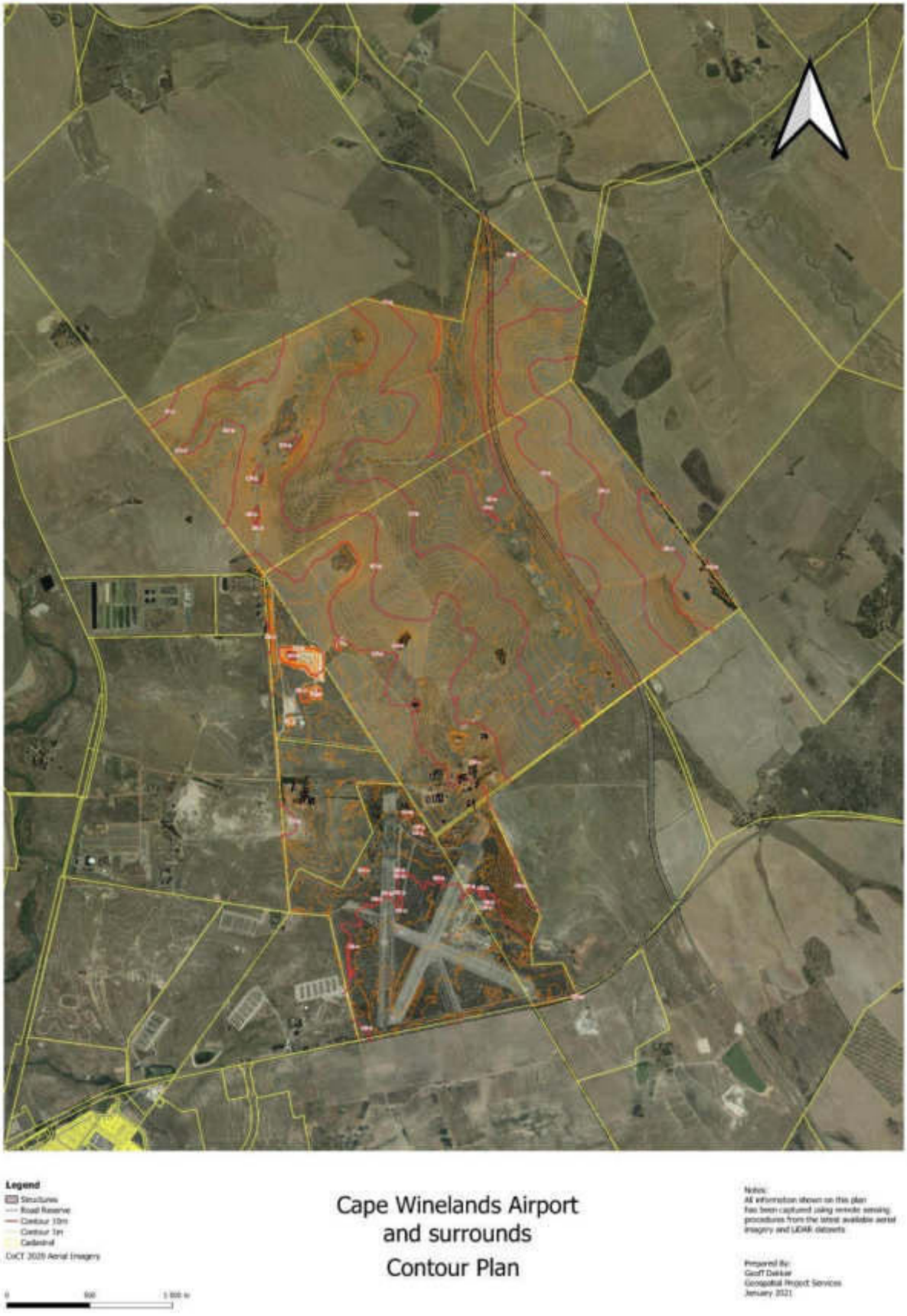
**J. Ngobeza**
Technical Signatory:

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# 14. APPENDIX F: AVAILABLE PLANS AND SKETCHES



***Map 8: Site development plan (Ver. 21D).***




***Map 9: LiDAR Data.***

# 15. APPENDIX G: OTHER SUPPORTING INFORMATION

***Table 14: Laboratory results for the region surrounding the site (after Stapelberg (2009).***

| Profile number and depth (m) | Origin | Landform | Indicator tests | | | | | | Clay minerals (%) | Heave potential | Collapse potential | Dispersiveness | pH/ cond. (mS/m) | Lab. | Permeability (cm/s) | Unifi ed class | PRA Class | Fm | Gm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | LL CC | PI | | LS | Clay | Act % | | | | | | | | | | | |
| | | | | <425 µm total | Total | | | | | | | | | | | | | | |
| 5/8 (0,4) | Colluvium (granite) | Plain | - | - | - | - | - | - | N.T. | Low | No | - | - | Geos. Lab. | $3.6 \times 10^{-3}$ | SM | A.2.4 | 2.0 | 1.49 |
| 5/3 (3,0) | Residual shale | Plain | 30 0,18 | 7 | 6,9 | 3 | 2 | 3.5 | Ka/Cl(34) Il/Sm(2) | Low | No | ND3,CT2 SCS 19% | 6.79 2232 | Geos. Lab. | $7.8 \times 10^{-6}$ | ML | A.2.6 (4) | 0.09 | 0.28 |
| 5/10 (0,5) | Residual sh. (slight ferr.) | Convex slope | 42 0,29 | 12 | 11.9 | 4 | 40.5 | 0.3 | N.T. | Low | No | - | - | Geos. Lab. | $<4 \times 10^{-6}$ | ML | A.7.5 (9) | 0.04 | 0.05 |

***Table 15: General limits for assessment of aggressiveness (Basson, 1989).***

| Property of water | Degree of aggressiveness of water | | | |
|---|---|---|---|---|
| | Moderate | High | Very high | Excessive |
| pH | 6,0 to 8,0 | 5,0 to 6,0 | 4,5 to 5,0 | less than 4,5 |
| pH minus $CaCO_3$-saturated pH | –0,2 to –0,3 | –0,3 to –0,4 | –0,4 to –0,5 | less than –0,5 |
| Calcium hardness as mg $CaCO_3$/ℓ | 200 to 300 | 100 to 200 | 50 to 100 | less than 50 |
| Total ammonium ion as mg $NH_4$/ℓ | 30 to 50 | 50 to 80 | 80 to 100 | greater than 100 |
| Magnesium ion as mg Mg/ℓ | 100 to 500 | 500 to 1 000 | 1 000 to 1 500 | greater than 1 500 |
| Total sulphate ion as mg $SO_4$/ℓ | 150 to 1 000 | 1 000 to 2 000 | 2 000 to 3 000 | greater than 3 000 |
| Chloride ion as mg Cl/ℓ | 500 to 1 000 | 1 000 to 2 500 | 2 500 to 5 000 | greater than 5 000 |
| Other (see Note (b) under *Analytical tests required and methods of analysis* pp. 5–6) | | | | |

***Table 16: Guide for assessing Final Basson Index (Basson, 1989).***

| Final index | Aggressiveness | Recommendation |
|---|---|---|
| Under 350 | Non- to mildly aggressive | Use concrete class as required for structural design, but see *Remarks* in Table 9. |
| 350 to 750 | Mildly to fairly aggressive | Good concrete design and construction essential. Read *Remarks* in Table 9. |
| 750 to 1 000 | Highly aggressive | Identify dominant corrosion sub-index and follow applicable recommendations. |
| Over 1 000 | Very highly aggressive | Do not use in contact with unprotected concrete unless recommended anti-corrosive measures can be carried out in full. |

# Appendix D

## Bella Riva Stormwater Management Plan

ZUTARI
IMPACT. ENGINEERED.





Concept Stormwater Master Plan

# Bella Riva SW Investigation

**Sagewise 67 (Pty) Ltd**

Submission date: 2024/01/31

Document number: 504584-0000-REP-CC-0001
Revision: B

# Appendix E

## PCSWMM Simulation Model Output Results

**CAPE WINELANDS AIRPORT (CWA) CONCEPT STORMWATER MANAGEMENT PLAN** -
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

**********

Element Count

**********

Number of rain gages ..... 9

Number of subcatchments ... 559

Number of nodes ..... 276

Number of links ..... 287

Number of pollutants ..... 0

Number of land uses ..... 0

**********

Raingage Summary

**********

| Name | Data Source | Data Type | Recording Interval |
|---|---|---|---|
| (1)_6month_RI_SCS_Type_II_(20.1mm) | (1)_6month_RI_SCS_Type_II_(20.1mm) | INTENSITY | 6 min. |
| (2)_1year_RI_SCS_Type_II_(32.9mm) | (2)_1year_RI_SCS_Type_II_(32.9mm) | INTENSITY | 6 min. |
| (3)_2year_RI_SCS_Type_II_(44.9mm) | (3)_2year_RI_SCS_Type_II_(44.9mm) | INTENSITY | 6 min. |
| (4)_5year_RI_SCS_Type_II_(60.3mm) | (4)_5year_RI_SCS_Type_II_(60.3mm) | INTENSITY | 6 min. |
| (5)_10year_RI_SCS_Type_II_(71.4mm) | (5)_10year_RI_SCS_Type_II_(71.4mm) | INTENSITY | 6 min. |
| (6)_20year_RI_SCS_Type_II_(83mm) | (6)_20year_RI_SCS_Type_II_(83mm) | INTENSITY | 6 min. |
| (7)_50year_RI_SCS_Type_II_(99.4mm) | (7)_50year_RI_SCS_Type_II_(99.4mm) | INTENSITY | 6 min. |
| (8)_100year_RI_SCS_Type_II_(112.7mm) | (8)_100year_RI_SCS_Type_II_(112.7mm) | INTENSITY | 6 min. |
| (9)_200year_RI_SCS_Type_II_(127mm) | (9)_200year_RI_SCS_Type_II_(127mm) | INTENSITY | 6 min. |

**********

Subcatchment Summary

**********

| Name | Area | Width | %Imperv | %Slope | Rain Gage | Outlet |
|---|---|---|---|---|---|---|
| S_Pond1 | 0.21 | 41.96 | 0.00 | 0.5000 | (4)_5year_RI_SCS_Type_II_(60.3mm) | SU1_Pond1 |
| S_Pond2 | 3.29 | 411.29 | 0.00 | 0.5000 | (4)_5year_RI_SCS_Type_II_(60.3mm) | SU2_Pond2 |
| S_Pond3 | 0.61 | 76.19 | 0.00 | 0.5000 | (4)_5year_RI_SCS_Type_II_(60.3mm) | SU3_Pond3 |
| S_Pond4 | 0.13 | 31.32 | 0.00 | 0.5000 | (4)_5year_RI_SCS_Type_II_(60.3mm) | SU4_Pond4 |
| S_Pond5 | 0.45 | 64.07 | 0.00 | 0.5000 | (4)_5year_RI_SCS_Type_II_(60.3mm) | SU5_Pond5 |
| S_Pond6 | 0.09 | 45.90 | 0.00 | 0.5000 | (4)_5year_RI_SCS_Type_II_(60.3mm) | SU6_Pond6 |

| | | | | | |
|---|---|---|---|---|---|
| S_Pond7 | 0.27 | 90.10 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | SU7_Pond7 |
| S_Pond8 | 0.20 | 102.25 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | SU8_Pond8 |
| S1 | 0.29 | 29.34 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J327 |
| S1_4 | 0.33 | 66.14 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J231 |
| S1_8 | 1.24 | 35.42 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | S7_46 |
| S10 | 0.03 | 13.70 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | OF_Pond4 |
| S11 | 0.01 | 7.20 | 100.00 | 1.0000 (4)_5year_RI_SCS_Type_II_(60.3mm) | S45_27 |
| S11_1 | 0.11 | 10.71 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J17 |
| S11_10 | 0.09 | 8.81 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J179 |
| S11_11 | 0.07 | 7.48 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J168 |
| S11_12 | 0.12 | 11.93 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J218 |
| S11_2 | 0.08 | 8.42 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | S39_2 |
| S11_4 | 0.17 | 16.61 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J186 |
| S11_5 | 0.11 | 11.33 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J26 |
| S11_6 | 0.14 | 13.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J174 |
| S11_7 | 0.12 | 12.12 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J190 |
| S11_8 | 0.13 | 12.91 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J230 |
| S11_9 | 0.10 | 9.93 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J168 |
| S12 | 0.08 | 8.15 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J35 |
| S12_1 | 0.46 | 30.87 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J17 |
| S12_2 | 0.33 | 33.07 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | S39_2 |
| S12_3 | 0.81 | 36.74 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J186 |
| S12_5 | 0.49 | 32.55 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J163 |
| S12_6 | 0.44 | 31.64 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J179 |
| S12_7 | 0.64 | 32.00 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | OF_Pond7 |
| S12_8 | 0.38 | 34.23 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | OF_Pond7 |
| S13 | 4.46 | 222.99 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J231 |
| S13_11 | 3.30 | 194.01 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J72 |
| S13_12 | 2.86 | 143.16 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J267 |
| S13_14 | 2.18 | 128.41 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J270 |
| S13_2 | 3.71 | 217.98 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J143 |
| S13_8 | 2.29 | 134.74 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J72 |
| S136_1 | 0.87 | 87.16 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J351 |
| S136_3 | 0.59 | 58.61 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J351 |
| S136_4 | 1.14 | 114.21 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J244 |
| S136_5 | 1.77 | 176.65 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J13 |
| S139_1 | 0.19 | 19.00 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J351 |
| S139_2 | 0.25 | 17.86 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J13 |
| S14 | 0.43 | 43.24 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J351 |
| S140_1 | 0.25 | 20.46 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) | J69 |

| | | | | |
|---|---|---|---|---|
| S140_2 | 0.20 | 15.14 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J244 |
| S141_1 | 0.20 | 19.78 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J145 |
| S141_2 | 0.16 | 16.38 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260 |
| S141_4 | 0.27 | 27.05 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359 |
| S141_5 | 0.10 | 10.37 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J145 |
| S143_1 | 0.12 | 12.35 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34 |
| S143_2 | 0.20 | 15.03 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J18 |
| S143_3 | 0.15 | 15.26 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J242 |
| S144_1 | 0.18 | 23.11 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J257 |
| S144_3 | 0.31 | 14.16 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J277 |
| S144_4 | 0.13 | 13.35 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J141 |
| S144_5 | 0.15 | 10.13 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J144 |
| S145_2 | 0.11 | 10.74 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J131 |
| S147 | 0.42 | 28.26 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J305 |
| S148_1 | 0.20 | 10.98 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J140 |
| S15 | 0.21 | 10.36 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J150 |
| S15_3 | 0.61 | 30.66 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J230 |
| S15_4 | 0.61 | 30.36 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J218 |
| S150 | 0.36 | 12.75 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J124 |
| S152 | 0.02 | 9.90 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J24 |
| S153 | 1.29 | 129.38 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J143 |
| S155 | 0.11 | 11.33 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J92 |
| S156_1 | 0.17 | 17.18 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J43 |
| S157 | 0.08 | 8.07 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J96 |
| S158_1 | 0.09 | 8.81 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J89 |
| S158_2 | 0.15 | 10.09 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37 |
| S16 | 0.23 | 28.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J91 |
| S160_2 | 0.15 | 10.54 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98 |
| S161_1 | 0.04 | 4.18 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J93 |
| S161_2 | 0.10 | 10.13 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77 |
| S161_3 | 0.14 | 9.40 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77 |
| S161_5 | 0.09 | 9.40 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J54 |
| S161_6 | 0.16 | 10.48 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J321 |
| S163 | 0.17 | 13.23 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J65 |
| S164_1 | 0.15 | 9.62 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J160 |
| S164_3 | 0.11 | 8.96 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J61 |
| S164_4 | 0.10 | 9.38 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J88 |
| S164_5 | 0.05 | 6.80 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J103 |
| S165 | 0.10 | 10.17 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J70 |
| S166_1 | 0.11 | 9.91 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J44 |

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|---|---|---|---|---|
| S166_3 | 0.12 | 9.62 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J42 |
| S166_4 | 0.19 | 9.56 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J111 |
| S167_1 | 0.13 | 5.47 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J74 |
| S167_2 | 0.26 | 10.89 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J51 |
| S168_1 | 0.08 | 8.82 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J116 |
| S168_2 | 0.12 | 9.67 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J9 |
| S168_3 | 0.08 | 8.71 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J112 |
| S168_4 | 0.12 | 9.36 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J49 |
| S17 | 0.10 | 10.38 | 100.00 | 0.5420 (4)_5year_RI_SCS_Type_II_(60.3mm) J32 |
| S170_1 | 0.27 | 27.26 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J349 |
| S170_2 | 0.09 | 9.20 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302 |
| S170_3 | 0.27 | 13.28 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J95 |
| S170_4 | 0.60 | 29.79 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J154 |
| S170_5 | 0.09 | 9.17 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J154 |
| S170_7 | 0.17 | 9.11 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J23 |
| S170_8 | 0.24 | 23.87 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J101 |
| S171_1 | 0.12 | 12.44 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J79 |
| S171_10 | 0.12 | 12.48 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J358 |
| S171_13 | 0.17 | 17.41 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J223 |
| S171_14 | 0.14 | 13.70 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J230 |
| S171_16 | 0.20 | 19.52 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J161 |
| S171_17 | 0.13 | 12.92 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J17 |
| S171_18 | 0.15 | 14.67 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S39_2 |
| S171_19 | 0.13 | 12.90 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25 |
| S171_2 | 0.21 | 21.01 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J164 |
| S171_3 | 0.10 | 10.36 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J73 |
| S171_4 | 0.11 | 11.19 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J239 |
| S171_5 | 0.18 | 17.79 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237 |
| S171_7 | 0.10 | 9.81 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J223 |
| S171_8 | 0.14 | 14.16 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237 |
| S173_1 | 0.13 | 12.63 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J74 |
| S173_2 | 0.28 | 27.99 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J78 |
| S173_3 | 0.27 | 27.05 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J46 |
| S173_5 | 0.31 | 31.34 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J156 |
| S173_6 | 0.39 | 38.54 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J113 |
| S173_7 | 0.65 | 65.22 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J108 |
| S174_1 | 0.30 | 30.36 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J44 |
| S174_2 | 0.12 | 12.25 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J42 |
| S175_1 | 0.65 | 64.58 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J67 |
| S175_3 | 0.42 | 41.75 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J83 |

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| S175_4 | 0.55 | 54.60 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J157 |
| S176_1 | 0.65 | 65.18 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J63 |
| S176_3 | 0.41 | 41.28 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J86 |
| S176_4 | 0.55 | 54.68 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J158 |
| S177_1 | 0.97 | 96.74 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97 |
| S177_2 | 1.36 | 136.16 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98 |
| S178_1 | 0.97 | 97.46 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J89 |
| S178_2 | 1.36 | 135.80 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37 |
| S179_1 | 0.77 | 77.30 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J60 |
| S179_2 | 0.32 | 31.55 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37 |
| S179_3 | 0.23 | 22.67 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J321 |
| S18 | 2.14 | 107.15 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J17 |
| S18_3 | 0.19 | 6.18 | 100.00 | 1.0000 (4)_5year_RI_SCS_Type_II_(60.3mm) J76 |
| S18_6 | 3.24 | 323.86 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J110 |
| S180 | 0.14 | 14.34 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37 |
| S181 | 0.37 | 36.93 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77 |
| S182_2 | 0.27 | 27.30 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J160 |
| S182_3 | 0.90 | 89.96 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97 |
| S182_4 | 0.70 | 69.64 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98 |
| S183 | 0.55 | 55.14 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J265 |
| S184_1 | 0.08 | 8.08 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J42 |
| S184_3 | 0.08 | 8.04 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J42 |
| S184_4 | 0.64 | 63.83 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J107 |
| S185 | 0.17 | 16.87 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25 |
| S186 | 0.29 | 28.72 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J70 |
| S187 | 0.40 | 39.72 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J76 |
| S188_1 | 0.12 | 11.64 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J74 |
| S188_2 | 0.19 | 19.18 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J80 |
| S189 | 0.09 | 9.03 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J65 |
| S19 | 0.05 | 5.43 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31 |
| S190 | 0.79 | 79.08 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J94 |
| S191 | 0.38 | 38.45 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J93 |
| S192 | 0.01 | 0.78 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J109 |
| S193_2 | 0.42 | 70.50 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J105 |
| S193_3 | 0.76 | 75.55 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J106 |
| S193_4 | 0.70 | 87.34 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J103 |
| S193_5 | 0.21 | 34.60 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J106 |
| S193_6 | 0.52 | 74.07 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J112 |
| S193_7 | 0.74 | 92.06 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J106 |
| S194_1 | 0.18 | 18.45 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J61 |

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| S194_3 | 0.11 | 11.37 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J88 |
| S194_4 | 0.15 | 14.85 | 75.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J160 |
| S195_1 | 0.55 | 54.57 | 0.00 | 0.7500 (4)_5year_RI_SCS_Type_II_(60.3mm) J112 |
| S195_2 | 0.91 | 91.04 | 0.00 | 0.7500 (4)_5year_RI_SCS_Type_II_(60.3mm) J109 |
| S196_1 | 0.11 | 9.31 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J99 |
| S196_2 | 0.07 | 8.60 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J84 |
| S196_3 | 0.06 | 8.11 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J102 |
| S197_1 | 0.55 | 55.32 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31 |
| S197_3 | 0.36 | 36.29 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34 |
| S197_4 | 0.20 | 20.28 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J240 |
| S197_5 | 0.12 | 11.60 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68 |
| S197_6 | 0.31 | 30.71 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J91 |
| S198_1 | 0.34 | 33.80 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34 |
| S198_10 | 0.07 | 7.43 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33 |
| S198_2 | 0.36 | 36.01 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68 |
| S198_3 | 0.32 | 31.97 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J146 |
| S198_4 | 0.12 | 12.22 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J119 |
| S198_5 | 0.15 | 14.67 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J132 |
| S198_6 | 0.33 | 33.09 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J146 |
| S198_7 | 0.19 | 19.41 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J242 |
| S198_8 | 0.13 | 13.24 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68 |
| S199 | 0.31 | 30.90 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S198_10 |
| S2 | 1.27 | 36.36 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J327 |
| S2_1 | 1.08 | 28.50 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J231 |
| S2_11 | 2.26 | 59.53 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J334 |
| S2_12 | 0.54 | 14.32 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J348 |
| S2_2 | 0.32 | 8.31 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_122 |
| S2_21 | 0.90 | 23.64 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J351 |
| S2_22 | 1.09 | 28.76 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J258 |
| S2_23 | 0.38 | 9.89 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J273 |
| S2_24 | 0.93 | 24.57 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J317 |
| S2_25 | 0.57 | 15.03 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J319 |
| S2_26 | 1.48 | 39.03 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S4 |
| S2_27 | 0.86 | 22.75 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J265 |
| S2_28 | 0.23 | 6.11 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359 |
| S2_3 | 2.66 | 70.10 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J331 |
| S2_4 | 0.58 | 15.13 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_127 |
| S2_5 | 1.48 | 38.87 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J348 |
| S2_6 | 2.61 | 68.60 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J299 |
| S2_7 | 0.72 | 19.06 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_32 |

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| S2_8 | 0.76 | 20.05 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J338 |
| S20 | 5.36 | 536.01 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J59 |
| S200_1 | 0.35 | 34.74 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33 |
| S200_2 | 0.47 | 46.85 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J207 |
| S201 | 0.27 | 24.55 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J310 |
| S202 | 0.54 | 54.47 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75 |
| S203 | 0.15 | 15.18 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75 |
| S204 | 0.17 | 15.20 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75 |
| S205 | 0.16 | 16.20 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J140 |
| S206_1 | 0.29 | 23.76 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J306 |
| S206_2 | 0.41 | 34.50 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J140 |
| S206_3 | 0.21 | 21.17 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J310 |
| S207 | 0.45 | 45.30 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J310 |
| S208_1 | 0.56 | 70.54 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J95 |
| S208_2 | 0.13 | 12.72 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36 |
| S208_3 | 0.31 | 31.20 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J101 |
| S208_4 | 0.24 | 23.59 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J57 |
| S209 | 0.68 | 67.81 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J56 |
| S21 | 3.49 | 348.82 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J13 |
| S210_1 | 0.22 | 21.53 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J55 |
| S210_3 | 0.28 | 28.28 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J152 |
| S210_4 | 0.11 | 10.65 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J95 |
| S210_5 | 0.23 | 22.99 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J24 |
| S211_1 | 0.96 | 95.71 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J100 |
| S211_2 | 2.11 | 210.91 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J99 |
| S212_1 | 0.24 | 23.61 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J100 |
| S212_2 | 1.57 | 156.63 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J102 |
| S213_1 | 0.47 | 47.12 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J48 |
| S213_2 | 0.14 | 14.44 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J316 |
| S213_3 | 1.45 | 90.76 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J54 |
| S214 | 0.14 | 13.55 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J48 |
| S215 | 0.34 | 33.75 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J316 |
| S216 | 1.20 | 66.57 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J141 |
| S217_1 | 0.39 | 39.00 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J41 |
| S217_2 | 0.53 | 44.37 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77 |
| S217_3 | 0.89 | 88.50 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J58 |
| S218 | 0.20 | 20.00 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36 |
| S219 | 0.19 | 19.02 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J40 |
| S22 | 4.49 | 448.70 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J79 |
| S220 | 0.03 | 2.74 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36 |

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| S221 | 0.30 | 30.31 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J39 |
| S222 | 0.12 | 12.32 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120 |
| S223_1 | 0.15 | 18.94 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J134 |
| S223_2 | 1.27 | 79.34 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J127 |
| S224 | 0.05 | 4.99 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S223_2 |
| S225 | 0.03 | 2.97 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120 |
| S226 | 0.40 | 39.87 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J154 |
| S227 | 0.48 | 47.56 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J47 |
| S228 | 0.05 | 5.37 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J121 |
| S229_1 | 0.13 | 13.44 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J150 |
| S229_2 | 0.11 | 10.93 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J123 |
| S229_3 | 0.27 | 26.84 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J194 |
| S229_4 | 0.07 | 6.90 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J124 |
| S23 | 0.19 | 18.72 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253 |
| S23_2 | 1.87 | 58.30 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243 |
| S23_3 | 0.35 | 11.05 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S29 |
| S23_4 | 0.09 | 2.78 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J22 |
| S230_1 | 0.34 | 33.60 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J87 |
| S230_2 | 0.29 | 29.26 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J121 |
| S231 | 0.16 | 15.66 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302 |
| S232 | 0.03 | 2.52 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302 |
| S233 | 0.05 | 4.76 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S232 |
| S234 | 0.06 | 5.72 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J124 |
| S235 | 0.30 | 30.20 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J136 |
| S236 | 0.02 | 1.57 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J127 |
| S237 | 0.17 | 16.74 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J267 |
| S238 | 0.09 | 8.74 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S237 |
| S239 | 0.47 | 47.24 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J130 |
| S24 | 0.17 | 16.88 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J234 |
| S24_2 | 0.39 | 32.58 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J156 |
| S24_3 | 0.52 | 34.85 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J113 |
| S24_4 | 0.45 | 34.97 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J46 |
| S240_1 | 0.23 | 25.36 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J139 |
| S240_2 | 0.38 | 42.42 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J134 |
| S241 | 0.23 | 29.30 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J280 |
| S242 | 0.89 | 52.55 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J130 |
| S25 | 0.07 | 6.88 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J81 |
| S26 | 0.32 | 31.61 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J133 |
| S27 | 0.08 | 8.32 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J137 |
| S28 | 0.61 | 61.37 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J230 |

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|---|---|---|---|---|
| S29 | 2.33 | 116.53 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243 |
| S3 | 4.46 | 446.30 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J73 |
| S3_1 | 0.63 | 41.69 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J67 |
| S3_11 | 0.11 | 10.77 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J258 |
| S3_119 | 1.53 | 85.18 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J281 |
| S3_122 | 1.92 | 80.04 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J357 |
| S3_124 | 3.59 | 94.58 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J357 |
| S3_126 | 2.98 | 149.24 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J327 |
| S3_127 | 3.10 | 154.93 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J330 |
| S3_17 | 2.93 | 101.08 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J299 |
| S3_18 | 1.17 | 65.24 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J273 |
| S3_19 | 0.92 | 45.94 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J331 |
| S3_20 | 2.93 | 146.39 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J338 |
| S3_21 | 1.66 | 83.10 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J348 |
| S3_23 | 1.65 | 91.86 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J308 |
| S3_24 | 1.22 | 121.64 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J319 |
| S3_27 | 2.99 | 90.52 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J281 |
| S3_3 | 0.18 | 18.39 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243 |
| S3_32 | 1.33 | 74.02 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J282 |
| S3_4 | 0.40 | 39.78 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J86 |
| S3_42 | 0.44 | 43.77 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J203 |
| S3_5 | 0.66 | 43.79 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J157 |
| S3_69 | 1.38 | 138.00 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359 |
| S3_7 | 0.26 | 26.14 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J257 |
| S3_8 | 1.66 | 83.09 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J311 |
| S30 | 0.33 | 32.77 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36 |
| S31 | 0.09 | 9.34 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J40 |
| S32 | 0.10 | 10.18 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31 |
| S32_1 | 0.21 | 21.38 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J164 |
| S32_10 | 1.02 | 40.68 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J163 |
| S32_11 | 0.66 | 32.94 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J17 |
| S32_12 | 0.55 | 39.14 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S39_2 |
| S32_13 | 0.08 | 7.56 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25 |
| S32_3 | 0.53 | 29.28 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J27 |
| S32_4 | 0.80 | 106.81 | 75.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J50 |
| S32_6 | 0.59 | 32.54 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) OF_Pond6 |
| S32_8 | 0.65 | 32.62 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J358 |
| S33 | 0.16 | 16.20 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J48 |
| S34 | 0.22 | 22.28 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J56 |
| S35 | 0.09 | 9.36 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97 |

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| S36 | 3.22 | 161.22 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J223 |
| S37 | 0.74 | 30.91 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J162 |
| S38 | 6.00 | 300.09 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J162 |
| S39 | 0.13 | 43.20 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J10 |
| S39_1 | 0.10 | 5.89 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J10 |
| S39_2 | 3.20 | 188.19 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J10 |
| S39_4 | 0.09 | 5.32 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J10 |
| S4 | 1.18 | 65.35 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J275 |
| S40 | 0.04 | 18.60 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S39_2 |
| S43 | 0.26 | 25.85 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J325 |
| S45_1 | 0.26 | 8.58 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J14 |
| S45_10 | 0.20 | 9.24 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J29 |
| S45_11 | 0.17 | 16.60 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J16 |
| S45_12 | 0.15 | 15.15 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J16 |
| S45_13 | 0.21 | 11.66 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J20 |
| S45_14 | 0.12 | 9.62 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J207 |
| S45_15 | 0.16 | 8.86 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J207 |
| S45_16 | 0.10 | 5.71 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J15 |
| S45_17 | 0.10 | 5.58 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J203 |
| S45_18 | 0.14 | 7.58 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J15 |
| S45_19 | 0.10 | 9.96 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115 |
| S45_2 | 0.07 | 8.82 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J118 |
| S45_20 | 0.10 | 9.68 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115 |
| S45_21 | 0.13 | 7.37 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115 |
| S45_22 | 0.13 | 7.83 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J85 |
| S45_23 | 0.06 | 11.20 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J205 |
| S45_24 | 0.16 | 8.56 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J85 |
| S45_25 | 0.12 | 7.79 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J47 |
| S45_26 | 0.12 | 7.66 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J203 |
| S45_27 | 0.15 | 7.90 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J47 |
| S45_28 | 0.12 | 8.01 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115 |
| S45_29 | 0.11 | 7.36 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115 |
| S45_3 | 0.07 | 10.10 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33 |
| S45_30 | 0.15 | 8.60 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115 |
| S45_31 | 0.16 | 9.90 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J147 |
| S45_32 | 0.03 | 6.47 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J85 |
| S45_33 | 0.21 | 9.42 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J203 |
| S45_34 | 0.11 | 8.62 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J206 |
| S45_36 | 0.15 | 9.93 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J205 |
| S45_37 | 0.10 | 10.57 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J30 |

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| S45_38 | 0.07 | 8.24 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J30 |
| S45_39 | 0.12 | 10.11 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J30 |
| S45_4 | 0.09 | 9.26 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33 |
| S45_40 | 0.07 | 8.18 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J119 |
| S45_41 | 0.09 | 9.74 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J119 |
| S45_42 | 0.29 | 16.21 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31 |
| S45_43 | 0.03 | 6.70 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J194 |
| S45_44 | 0.37 | 18.39 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31 |
| S45_45 | 0.08 | 9.62 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J47 |
| S45_46 | 0.03 | 6.53 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J35 |
| S45_47 | 0.09 | 9.59 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J194 |
| S45_48 | 0.05 | 9.56 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J7 |
| S45_49 | 0.09 | 4.60 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J32 |
| S45_5 | 0.16 | 10.96 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J29 |
| S45_6 | 0.12 | 8.59 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J208 |
| S45_7 | 0.07 | 8.65 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J119 |
| S45_8 | 0.13 | 10.97 | 0.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J29 |
| S48_1 | 0.73 | 40.64 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97 |
| S48_2 | 1.27 | 48.67 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98 |
| S49 | 0.37 | 11.69 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J338 |
| S5 | 1.68 | 167.90 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243 |
| S50 | 0.90 | 89.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J325 |
| S51_1 | 0.31 | 20.56 | 0.00 | 0.8680 (4)_5year_RI_SCS_Type_II_(60.3mm) J14 |
| S51_2 | 0.29 | 19.33 | 0.00 | 0.8680 (4)_5year_RI_SCS_Type_II_(60.3mm) J149 |
| S52 | 0.27 | 26.88 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S18 |
| S52_1 | 0.98 | 39.20 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S7_48 |
| S52_11 | 1.33 | 41.48 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J189 |
| S52_12 | 0.38 | 11.79 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J209 |
| S52_13 | 1.54 | 48.21 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S7_53 |
| S52_14 | 0.84 | 26.35 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S7_41 |
| S52_15 | 1.34 | 41.79 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J282 |
| S52_17 | 1.46 | 45.73 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J22 |
| S52_18 | 0.83 | 25.91 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_21 |
| S52_19 | 1.71 | 53.56 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_20 |
| S52_2 | 1.72 | 53.71 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J353 |
| S52_20 | 0.61 | 18.98 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J357 |
| S52_21 | 1.52 | 47.54 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J333 |
| S52_22 | 1.09 | 33.93 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J169 |
| S52_23 | 1.10 | 34.50 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_17 |
| S52_3 | 0.61 | 18.98 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J176 |

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| S52_4 | 1.51 | 47.05 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S7_45 |
| S52_5 | 1.24 | 38.69 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J170 |
| S52_8 | 1.00 | 39.87 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_127 |
| S52_9 | 1.24 | 38.77 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_124 |
| S54 | 7.40 | 369.75 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J26 |
| S55 | 0.70 | 18.45 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J327 |
| S56 | 1.05 | 27.59 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J19 |
| S6 | 3.82 | 212.40 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25 |
| S66_3 | 7.97 | 796.83 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237 |
| S66_4 | 5.66 | 566.38 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J79 |
| S66_5 | 2.44 | 244.06 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237 |
| S67 | 6.20 | 310.09 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J7 |
| S7 | 1.37 | 42.89 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S38 |
| S7_1 | 0.54 | 66.92 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237 |
| S7_11 | 1.65 | 82.71 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J190 |
| S7_12 | 0.48 | 23.80 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J223 |
| S7_2 | 0.21 | 6.89 | 100.00 | 1.0000 (4)_5year_RI_SCS_Type_II_(60.3mm) J110 |
| S7_3 | 3.85 | 192.47 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J173 |
| S7_39 | 0.45 | 22.62 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J235 |
| S7_4 | 1.22 | 121.87 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J125 |
| S7_41 | 4.35 | 217.65 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J218 |
| S7_44 | 3.27 | 163.38 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J179 |
| S7_45 | 8.10 | 404.81 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J169 |
| S7_46 | 6.31 | 315.46 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J17 |
| S7_48 | 5.24 | 262.05 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J358 |
| S7_5 | 1.30 | 130.15 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J110 |
| S7_50 | 6.91 | 345.61 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J185 |
| S7_51 | 2.02 | 101.13 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J27 |
| S7_53 | 7.99 | 399.62 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J230 |
| S7_6 | 0.37 | 45.70 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J239 |
| S7_7 | 0.58 | 72.56 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J235 |
| S7_8 | 8.45 | 422.47 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J169 |
| S70 | 1.24 | 69.05 | 100.00 | 1.0000 (4)_5year_RI_SCS_Type_II_(60.3mm) J13 |
| S70_1 | 0.06 | 6.29 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J255 |
| S70_3 | 0.10 | 24.95 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243 |
| S70_4 | 2.16 | 179.96 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J360 |
| S71_1 | 0.17 | 16.97 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J69 |
| S71_10 | 0.21 | 20.56 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J258 |
| S71_11 | 0.50 | 50.37 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359 |
| S71_3 | 0.23 | 22.87 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260 |

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|---|---|---|---|---|
| S71_5 | 0.50 | 50.07 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253 |
| S71_6 | 0.91 | 90.87 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J361 |
| S71_7 | 0.46 | 45.84 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260 |
| S71_8 | 2.06 | 206.17 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J244 |
| S71_9 | 1.20 | 120.04 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31 |
| S72 | 0.16 | 32.44 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J317 |
| S8 | 2.49 | 177.85 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J164 |
| S8_1 | 0.34 | 34.46 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J351 |
| S8_2 | 0.04 | 3.85 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J351 |
| S8_4 | 0.44 | 44.17 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J142 |
| S8_6 | 0.06 | 15.70 | 100.00 | 1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J351 |
| S824_1 | 0.54 | 54.28 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J74 |
| S824_2 | 1.32 | 132.02 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J156 |
| S825 | 1.23 | 123.28 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J54 |
| S826 | 1.96 | 122.44 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J92 |
| S827 | 0.04 | 4.40 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J141 |
| S828 | 1.83 | 131.06 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J137 |
| S829 | 0.18 | 30.45 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J134 |
| S830 | 0.33 | 46.43 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J136 |
| S831_1 | 0.97 | 96.70 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J136 |
| S831_2 | 0.98 | 98.44 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J134 |
| S832_1 | 0.73 | 72.94 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J310 |
| S832_2 | 1.52 | 152.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J140 |
| S833 | 3.32 | 332.16 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J81 |
| S834 | 0.05 | 4.60 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J141 |
| S835_1 | 0.23 | 23.46 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J139 |
| S835_2 | 0.53 | 53.13 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J137 |
| S836_1 | 0.54 | 53.95 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J150 |
| S836_2 | 0.58 | 57.75 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J123 |
| S837_1 | 0.49 | 49.18 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J87 |
| S837_2 | 0.42 | 42.26 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J121 |
| S838_1 | 0.42 | 41.54 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J123 |
| S838_2 | 0.49 | 49.21 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J121 |
| S839 | 1.74 | 174.35 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J306 |
| S840 | 1.40 | 140.43 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J133 |
| S841 | 0.35 | 35.00 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J144 |
| S842 | 0.26 | 43.72 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302 |
| S843 | 0.75 | 94.30 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302 |
| S844 | 1.65 | 165.38 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J154 |
| S845 | 0.20 | 24.99 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302 |

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|---|---|---|---|---|
| S846 | 1.17 | 58.33 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J136 |
| S847 | 0.17 | 34.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J127 |
| S848 | 0.18 | 36.86 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J129 |
| S849 | 0.45 | 44.68 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J129 |
| S850 | 0.76 | 63.65 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J267 |
| S851 | 0.41 | 41.26 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J267 |
| S852_1 | 1.27 | 63.56 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J129 |
| S852_2 | 1.15 | 57.44 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J316 |
| S853 | 0.06 | 30.00 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J130 |
| S854 | 0.94 | 94.10 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J39 |
| S855 | 0.26 | 43.72 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120 |
| S856 | 0.20 | 24.99 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120 |
| S857_1 | 0.59 | 59.44 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75 |
| S857_2 | 0.49 | 49.31 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75 |
| S858_1 | 0.75 | 74.58 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J131 |
| S858_2 | 0.71 | 70.87 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J265 |
| S859 | 0.84 | 84.32 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J132 |
| S860_1 | 2.20 | 219.68 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J240 |
| S860_2 | 0.89 | 89.11 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J146 |
| S861 | 1.10 | 109.92 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J242 |
| S862 | 0.10 | 10.00 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33 |
| S863 | 0.10 | 10.00 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33 |
| S864 | 0.12 | 12.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68 |
| S865 | 0.12 | 12.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34 |
| S866 | 0.12 | 12.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34 |
| S867 | 0.25 | 25.00 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34 |
| S868_1 | 0.48 | 48.10 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31 |
| S868_2 | 0.43 | 42.84 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34 |
| S869_1 | 0.24 | 23.81 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253 |
| S869_2 | 0.24 | 24.38 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34 |
| S870_1 | 0.57 | 56.59 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253 |
| S870_3 | 0.52 | 52.13 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J69 |
| S870_4 | 0.59 | 59.05 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J244 |
| S870_5 | 0.62 | 61.83 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253 |
| S871_1 | 0.22 | 21.74 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260 |
| S871_2 | 0.50 | 50.41 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260 |
| S872 | 1.00 | 100.41 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68 |
| S873 | 0.64 | 64.00 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359 |
| S874 | 1.00 | 99.96 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359 |
| S875 | 1.36 | 135.94 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J18 |

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|---|---|---|---|---|
| S876_1 | 0.85 | 84.86 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36 |
| S876_2 | 0.62 | 61.90 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J57 |
| S876_3 | 0.49 | 48.86 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36 |
| S877_1 | 0.49 | 48.82 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J95 |
| S877_2 | 0.86 | 85.87 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J57 |
| S878 | 0.59 | 59.28 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J40 |
| S879 | 0.56 | 69.61 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120 |
| S880 | 0.93 | 46.45 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J92 |
| S881 | 0.63 | 31.54 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J316 |
| S882 | 0.59 | 29.55 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J259 |
| S883_1 | 1.34 | 133.83 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J41 |
| S883_2 | 1.37 | 136.98 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J217 |
| S884 | 0.79 | 79.19 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J53 |
| S885 | 0.62 | 62.20 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77 |
| S886 | 0.70 | 70.17 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37 |
| S887 | 0.70 | 70.17 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J89 |
| S888 | 0.62 | 62.20 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J160 |
| S889 | 0.70 | 70.17 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98 |
| S890 | 0.70 | 70.17 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97 |
| S891_1 | 1.13 | 113.07 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J63 |
| S891_3 | 0.70 | 70.50 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J86 |
| S891_4 | 0.94 | 94.08 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J158 |
| S892_1 | 1.11 | 111.03 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J67 |
| S892_3 | 0.73 | 72.57 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J83 |
| S892_4 | 0.94 | 93.89 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J157 |
| S893 | 0.63 | 50.52 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J49 |
| S894_1 | 0.75 | 75.28 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J78 |
| S894_2 | 1.11 | 111.02 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J156 |
| S895 | 0.46 | 46.36 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J113 |
| S896 | 0.85 | 85.12 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J46 |
| S897 | 0.52 | 52.04 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25 |
| S898 | 0.30 | 24.89 | 100.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J107 |
| S9 | 0.12 | 57.50 | 0.00 | 0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) OF_Pond4 |

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LID Control Summary

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| Subcatchment | LID Control | No. of Units | Unit Area | Unit Width | % Area Covered | % Imperv Treated | % Perv Treated |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| S_Pond1 | Pond1 | 1 | 2098.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| S_Pond4 | Pond4 | 1 | 1253.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| S_Pond5 | Pond5 | 1 | 4485.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| S_Pond6 | Pond6 | 1 | 918.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| S_Pond7 | Pond7 | 1 | 2703.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| S_Pond8 | Pond8 | 1 | 2045.00 | 0.00 | 100.00 | 0.00 | 0.00 |

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Node Summary

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| Name | Type | Invert Elev. | Max. Depth | Ponded Area | External Inflow |
|---|---|---|---|---|---|
| J1 | JUNCTION | 98.89 | 2.50 | 0.0 | |
| J10 | JUNCTION | 122.20 | 2.77 | 0.0 | |
| J100 | JUNCTION | 116.42 | 2.50 | 0.0 | |
| J101 | JUNCTION | 112.90 | 2.50 | 0.0 | |
| J102 | JUNCTION | 117.71 | 2.50 | 0.0 | |
| J103 | JUNCTION | 117.52 | 2.50 | 0.0 | |
| J104 | JUNCTION | 117.90 | 2.56 | 0.0 | |
| J105 | JUNCTION | 117.30 | 2.46 | 0.0 | |
| J106 | JUNCTION | 118.40 | 2.50 | 0.0 | |
| J107 | JUNCTION | 119.57 | 2.50 | 0.0 | |
| J108 | JUNCTION | 120.56 | 2.14 | 0.0 | |
| J109 | JUNCTION | 118.54 | 2.50 | 0.0 | |
| J11 | JUNCTION | 119.20 | 3.30 | 0.0 | |
| J110 | JUNCTION | 119.36 | 2.50 | 0.0 | |
| J111 | JUNCTION | 120.20 | 2.46 | 0.0 | |
| J112 | JUNCTION | 117.70 | 2.50 | 0.0 | |
| J113 | JUNCTION | 120.59 | 2.41 | 0.0 | |
| J114 | JUNCTION | 120.66 | 2.39 | 0.0 | |
| J115 | JUNCTION | 110.23 | 3.82 | 0.0 | |
| J116 | JUNCTION | 118.34 | 2.50 | 0.0 | |
| J117 | JUNCTION | 118.19 | 2.50 | 0.0 | |
| J118 | JUNCTION | 109.94 | 2.50 | 0.0 | |
| J119 | JUNCTION | 109.78 | 2.24 | 0.0 | |
| J12 | JUNCTION | 110.41 | 2.50 | 0.0 | |
| J120 | JUNCTION | 116.65 | 2.50 | 0.0 | |
| J121 | JUNCTION | 114.66 | 2.50 | 0.0 | |
| J122 | JUNCTION | 114.64 | 2.50 | 0.0 | |

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|---|---|---|---|---|
| J123 | JUNCTION | 113.89 | 2.74 | 0.0 |
| J124 | JUNCTION | 113.28 | 2.72 | 0.0 |
| J125 | JUNCTION | 117.58 | 2.74 | 0.0 |
| J127 | JUNCTION | 115.39 | 2.50 | 0.0 |
| J128 | JUNCTION | 109.18 | 3.19 | 0.0 |
| J129 | JUNCTION | 115.58 | 2.50 | 0.0 |
| J13 | JUNCTION | 96.15 | 3.97 | 0.0 |
| J130 | JUNCTION | 113.51 | 1.97 | 0.0 |
| J131 | JUNCTION | 109.89 | 2.50 | 0.0 |
| J132 | JUNCTION | 109.71 | 2.63 | 0.0 |
| J133 | JUNCTION | 113.23 | 2.50 | 0.0 |
| J134 | JUNCTION | 113.79 | 1.87 | 0.0 |
| J136 | JUNCTION | 113.71 | 2.65 | 0.0 |
| J137 | JUNCTION | 114.05 | 2.50 | 0.0 |
| J139 | JUNCTION | 113.68 | 2.84 | 0.0 |
| J14 | JUNCTION | 115.50 | 2.54 | 0.0 |
| J140 | JUNCTION | 112.85 | 2.70 | 0.0 |
| J141 | JUNCTION | 110.75 | 2.34 | 0.0 |
| J142 | JUNCTION | 101.10 | 2.50 | 0.0 |
| J143 | JUNCTION | 112.21 | 2.50 | 0.0 |
| J144 | JUNCTION | 111.17 | 2.72 | 0.0 |
| J145 | JUNCTION | 105.44 | 2.50 | 0.0 |
| J146 | JUNCTION | 111.09 | 2.50 | 0.0 |
| J147 | JUNCTION | 109.73 | 3.77 | 0.0 |
| J148 | JUNCTION | 116.65 | 2.50 | 0.0 |
| J149 | JUNCTION | 116.22 | 2.50 | 0.0 |
| J15 | JUNCTION | 109.08 | 3.65 | 0.0 |
| J150 | JUNCTION | 111.47 | 2.48 | 0.0 |
| J151 | JUNCTION | 115.81 | 2.50 | 0.0 |
| J152 | JUNCTION | 115.17 | 2.50 | 0.0 |
| J153 | JUNCTION | 114.04 | 2.50 | 0.0 |
| J154 | JUNCTION | 116.13 | 2.24 | 0.0 |
| J155 | JUNCTION | 121.42 | 2.50 | 0.0 |
| J156 | JUNCTION | 120.89 | 1.96 | 0.0 |
| J157 | JUNCTION | 119.71 | 2.50 | 0.0 |
| J158 | JUNCTION | 119.57 | 2.50 | 0.0 |
| J159 | JUNCTION | 120.65 | 2.50 | 0.0 |
| J16 | JUNCTION | 93.44 | 2.50 | 0.0 |
| J160 | JUNCTION | 119.66 | 2.50 | 0.0 |
| J161 | JUNCTION | 109.39 | 3.86 | 0.0 |

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|---|---|---|---|---|
| J162 | JUNCTION | 97.86 | 2.73 | 0.0 |
| J163 | JUNCTION | 107.19 | 2.62 | 0.0 |
| J164 | JUNCTION | 122.13 | 2.80 | 0.0 |
| J165 | JUNCTION | 105.81 | 7.31 | 0.0 |
| J168 | JUNCTION | 104.75 | 2.53 | 0.0 |
| J169 | JUNCTION | 111.10 | 2.50 | 0.0 |
| J17 | JUNCTION | 114.34 | 2.50 | 0.0 |
| J170 | JUNCTION | 102.64 | 8.91 | 0.0 |
| J171 | JUNCTION | 101.76 | 2.42 | 0.0 |
| J172 | JUNCTION | 108.92 | 2.50 | 0.0 |
| J173 | JUNCTION | 106.00 | 4.76 | 0.0 |
| J174 | JUNCTION | 105.24 | 2.50 | 0.0 |
| J176 | JUNCTION | 108.15 | 2.50 | 0.0 |
| J179 | JUNCTION | 104.37 | 2.56 | 0.0 |
| J18 | JUNCTION | 110.59 | 2.50 | 0.0 |
| J182 | JUNCTION | 104.25 | 3.06 | 0.0 |
| J183 | JUNCTION | 105.03 | 3.97 | 0.0 |
| J185 | JUNCTION | 98.91 | 2.29 | 0.0 |
| J186 | JUNCTION | 103.50 | 3.84 | 0.0 |
| J189 | JUNCTION | 106.08 | 2.50 | 0.0 |
| J19 | JUNCTION | 119.01 | 2.79 | 0.0 |
| J190 | JUNCTION | 95.51 | 2.92 | 0.0 |
| J194 | JUNCTION | 111.63 | 2.50 | 0.0 |
| J2 | JUNCTION | 92.20 | 2.80 | 0.0 |
| J20 | JUNCTION | 85.14 | 2.50 | 0.0 |
| J203 | JUNCTION | 109.37 | 3.37 | 0.0 |
| J205 | JUNCTION | 109.59 | 2.74 | 0.0 |
| J206 | JUNCTION | 109.33 | 2.67 | 0.0 |
| J207 | JUNCTION | 109.48 | 2.40 | 0.0 |
| J208 | JUNCTION | 109.65 | 2.00 | 0.0 |
| J209 | JUNCTION | 101.20 | 3.33 | 0.0 |
| J21 | JUNCTION | 94.80 | 2.50 | 0.0 |
| J212 | JUNCTION | 119.57 | 2.33 | 0.0 |
| J217 | JUNCTION | 115.32 | 2.50 | 0.0 |
| J218 | JUNCTION | 99.25 | 3.06 | 0.0 |
| J22 | JUNCTION | 99.92 | 2.70 | 0.0 |
| J223 | JUNCTION | 101.98 | 2.50 | 0.0 |
| J23 | JUNCTION | 115.08 | 2.50 | 0.0 |
| J230 | JUNCTION | 96.20 | 2.30 | 0.0 |
| J231 | JUNCTION | 98.31 | 3.62 | 0.0 |

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|---|---|---|---|---|
| J233 | JUNCTION | 107.68 | 2.50 | 0.0 |
| J234 | JUNCTION | 101.30 | 2.50 | 0.0 |
| J235 | JUNCTION | 99.66 | 2.50 | 0.0 |
| J237 | JUNCTION | 96.61 | 2.72 | 0.0 |
| J239 | JUNCTION | 93.36 | 2.50 | 0.0 |
| J24 | JUNCTION | 113.90 | 2.50 | 0.0 |
| J240 | JUNCTION | 107.22 | 2.50 | 0.0 |
| J242 | JUNCTION | 105.27 | 2.50 | 0.0 |
| J243 | JUNCTION | 102.01 | 2.50 | 0.0 |
| J244 | JUNCTION | 98.75 | 3.33 | 0.0 |
| J25 | JUNCTION | 122.32 | 2.28 | 0.0 |
| J253 | JUNCTION | 101.61 | 2.50 | 0.0 |
| J255 | JUNCTION | 101.87 | 2.50 | 0.0 |
| J256 | JUNCTION | 101.44 | 2.50 | 0.0 |
| J257 | JUNCTION | 106.75 | 2.50 | 0.0 |
| J258 | JUNCTION | 106.34 | 2.50 | 0.0 |
| J259 | JUNCTION | 115.66 | 2.50 | 0.0 |
| J26 | JUNCTION | 100.82 | 1.77 | 0.0 |
| J260 | JUNCTION | 101.88 | 2.50 | 0.0 |
| J263 | JUNCTION | 108.87 | 3.78 | 0.0 |
| J265 | JUNCTION | 109.49 | 2.30 | 0.0 |
| J267 | JUNCTION | 113.97 | 2.50 | 0.0 |
| J27 | JUNCTION | 100.46 | 2.84 | 0.0 |
| J270 | JUNCTION | 115.40 | 2.50 | 0.0 |
| J273 | JUNCTION | 110.09 | 2.58 | 0.0 |
| J274 | JUNCTION | 111.23 | 2.50 | 0.0 |
| J275 | JUNCTION | 111.54 | 2.50 | 0.0 |
| J277 | JUNCTION | 108.72 | 2.56 | 0.0 |
| J279 | JUNCTION | 108.91 | 2.28 | 0.0 |
| J28 | JUNCTION | 104.67 | 2.50 | 0.0 |
| J280 | JUNCTION | 112.89 | 2.71 | 0.0 |
| J281 | JUNCTION | 105.38 | 3.24 | 0.0 |
| J282 | JUNCTION | 109.07 | 2.20 | 0.0 |
| J285 | JUNCTION | 110.31 | 2.16 | 0.0 |
| J289 | JUNCTION | 114.60 | 2.50 | 0.0 |
| J29 | JUNCTION | 93.75 | 3.44 | 0.0 |
| J299 | JUNCTION | 110.83 | 2.34 | 0.0 |
| J30 | JUNCTION | 94.07 | 3.50 | 0.0 |
| J301 | JUNCTION | 112.68 | 2.55 | 0.0 |
| J302 | JUNCTION | 115.01 | 2.50 | 0.0 |

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|---|---|---|---|---|
| J305 | JUNCTION | 111.05 | 2.21 | 0.0 |
| J306 | JUNCTION | 112.03 | 2.24 | 0.0 |
| J308 | JUNCTION | 113.04 | 2.48 | 0.0 |
| J309 | JUNCTION | 111.84 | 2.50 | 0.0 |
| J31 | JUNCTION | 99.77 | 2.49 | 0.0 |
| J310 | JUNCTION | 110.66 | 2.10 | 0.0 |
| J311 | JUNCTION | 112.49 | 2.76 | 0.0 |
| J312 | JUNCTION | 114.21 | 2.50 | 0.0 |
| J316 | JUNCTION | 116.50 | 2.50 | 0.0 |
| J317 | JUNCTION | 114.58 | 2.49 | 0.0 |
| J319 | JUNCTION | 116.19 | 2.50 | 0.0 |
| J32 | JUNCTION | 101.04 | 4.33 | 0.0 |
| J321 | JUNCTION | 117.23 | 4.02 | 0.0 |
| J325 | JUNCTION | 117.25 | 2.76 | 0.0 |
| J327 | JUNCTION | 118.67 | 2.50 | 0.0 |
| J33 | JUNCTION | 108.18 | 2.50 | 0.0 |
| J330 | JUNCTION | 116.64 | 2.23 | 0.0 |
| J331 | JUNCTION | 114.36 | 2.50 | 0.0 |
| J333 | JUNCTION | 113.38 | 2.50 | 0.0 |
| J334 | JUNCTION | 104.28 | 2.78 | 0.0 |
| J336 | JUNCTION | 103.29 | 2.62 | 0.0 |
| J338 | JUNCTION | 102.00 | 2.88 | 0.0 |
| J34 | JUNCTION | 102.82 | 2.49 | 0.0 |
| J345 | JUNCTION | 101.31 | 3.02 | 0.0 |
| J348 | JUNCTION | 100.32 | 2.48 | 0.0 |
| J349 | JUNCTION | 113.69 | 2.78 | 0.0 |
| J35 | JUNCTION | 109.78 | 3.71 | 0.0 |
| J350 | JUNCTION | 99.16 | 2.87 | 0.0 |
| J351 | JUNCTION | 101.61 | 2.50 | 0.0 |
| J353 | JUNCTION | 103.92 | 2.82 | 0.0 |
| J357 | JUNCTION | 109.62 | 2.09 | 0.0 |
| J358 | JUNCTION | 112.52 | 4.81 | 0.0 |
| J359 | JUNCTION | 103.85 | 2.50 | 0.0 |
| J36 | JUNCTION | 115.40 | 2.18 | 0.0 |
| J360 | JUNCTION | 83.89 | 2.25 | 0.0 |
| J361 | JUNCTION | 93.63 | 3.56 | 0.0 |
| J37 | JUNCTION | 118.62 | 2.50 | 0.0 |
| J38 | JUNCTION | 120.01 | 2.86 | 0.0 |
| J39 | JUNCTION | 116.08 | 2.50 | 0.0 |
| J4 | JUNCTION | 88.00 | 4.00 | 0.0 |

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|---|---|---|---|---|
| J40 | JUNCTION | 116.27 | 2.50 | 0.0 |
| J41 | JUNCTION | 115.90 | 3.16 | 0.0 |
| J42 | JUNCTION | 122.57 | 2.50 | 0.0 |
| J43 | JUNCTION | 118.55 | 2.50 | 0.0 |
| J44 | JUNCTION | 122.39 | 2.67 | 0.0 |
| J45 | JUNCTION | 119.22 | 2.50 | 0.0 |
| J46 | JUNCTION | 120.98 | 2.50 | 0.0 |
| J47 | JUNCTION | 112.53 | 2.50 | 0.0 |
| J48 | JUNCTION | 118.56 | 2.50 | 0.0 |
| J49 | JUNCTION | 119.08 | 2.50 | 0.0 |
| J5 | JUNCTION | 80.00 | 6.02 | 0.0 |
| J50 | JUNCTION | 118.66 | 2.50 | 0.0 |
| J51 | JUNCTION | 118.90 | 2.31 | 0.0 |
| J52 | JUNCTION | 109.02 | 3.71 | 0.0 |
| J53 | JUNCTION | 116.97 | 2.50 | 0.0 |
| J54 | JUNCTION | 117.45 | 2.50 | 0.0 |
| J55 | JUNCTION | 114.20 | 2.50 | 0.0 |
| J56 | JUNCTION | 115.01 | 2.44 | 0.0 |
| J57 | JUNCTION | 115.30 | 2.02 | 0.0 |
| J58 | JUNCTION | 114.69 | 2.50 | 0.0 |
| J59 | JUNCTION | 117.72 | 2.20 | 0.0 |
| J6 | JUNCTION | 90.11 | 2.50 | 0.0 |
| J60 | JUNCTION | 117.47 | 2.76 | 0.0 |
| J61 | JUNCTION | 122.62 | 1.56 | 0.0 |
| J62 | JUNCTION | 122.56 | 1.60 | 0.0 |
| J63 | JUNCTION | 122.66 | 1.32 | 0.0 |
| J64 | JUNCTION | 110.83 | 2.50 | 0.0 |
| J65 | JUNCTION | 122.53 | 1.62 | 0.0 |
| J66 | JUNCTION | 110.15 | 2.50 | 0.0 |
| J67 | JUNCTION | 122.53 | 1.47 | 0.0 |
| J68 | JUNCTION | 104.52 | 2.50 | 0.0 |
| J69 | JUNCTION | 101.87 | 2.50 | 0.0 |
| J7 | JUNCTION | 107.73 | 2.50 | 0.0 |
| J70 | JUNCTION | 122.47 | 1.65 | 0.0 |
| J71 | JUNCTION | 102.23 | 2.50 | 0.0 |
| J72 | JUNCTION | 113.01 | 2.50 | 0.0 |
| J73 | JUNCTION | 95.71 | 3.72 | 0.0 |
| J74 | JUNCTION | 122.52 | 1.39 | 0.0 |
| J75 | JUNCTION | 109.65 | 2.72 | 0.0 |
| J76 | JUNCTION | 122.42 | 1.67 | 0.0 |

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|---|---|---|---|---|
| J77 | JUNCTION | 116.77 | 3.31 | 0.0 |
| J78 | JUNCTION | 121.25 | 2.23 | 0.0 |
| J79 | JUNCTION | 93.49 | 2.50 | 0.0 |
| J8 | JUNCTION | 118.02 | 2.50 | 0.0 |
| J80 | JUNCTION | 121.66 | 2.50 | 0.0 |
| J81 | JUNCTION | 110.20 | 2.03 | 0.0 |
| J82 | JUNCTION | 112.40 | 2.60 | 0.0 |
| J83 | JUNCTION | 120.48 | 2.50 | 0.0 |
| J84 | JUNCTION | 116.14 | 2.50 | 0.0 |
| J85 | JUNCTION | 111.05 | 2.40 | 0.0 |
| J86 | JUNCTION | 120.49 | 2.50 | 0.0 |
| J87 | JUNCTION | 113.74 | 3.25 | 0.0 |
| J88 | JUNCTION | 120.74 | 2.50 | 0.0 |
| J89 | JUNCTION | 118.70 | 2.50 | 0.0 |
| J9 | JUNCTION | 117.27 | 2.50 | 0.0 |
| J90 | JUNCTION | 117.68 | 2.57 | 0.0 |
| J91 | JUNCTION | 111.01 | 2.50 | 0.0 |
| J92 | JUNCTION | 117.36 | 2.50 | 0.0 |
| J93 | JUNCTION | 118.03 | 2.36 | 0.0 |
| J94 | JUNCTION | 118.31 | 2.76 | 0.0 |
| J95 | JUNCTION | 113.36 | 2.50 | 0.0 |
| J96 | JUNCTION | 116.73 | 3.88 | 0.0 |
| J97 | JUNCTION | 118.66 | 2.50 | 0.0 |
| J98 | JUNCTION | 118.38 | 2.80 | 0.0 |
| J99 | JUNCTION | 117.02 | 2.74 | 0.0 |
| OF1 | JUNCTION | 115.95 | 3.70 | 0.0 |
| OF_Pond1 | OUTFALL | 116.05 | 1.35 | 0.0 |
| OF_Pond2 | OUTFALL | 108.25 | 2.00 | 0.0 |
| OF_Pond3 | OUTFALL | 93.00 | 1.00 | 0.0 |
| OF_Pond4 | OUTFALL | 83.50 | 1.00 | 0.0 |
| OF_Pond5 | OUTFALL | 96.00 | 1.05 | 0.0 |
| OF_Pond6 | OUTFALL | 94.00 | 1.00 | 0.0 |
| OF_Pond7 | OUTFALL | 100.50 | 1.00 | 0.0 |
| OF_Pond8 | OUTFALL | 122.00 | 1.00 | 0.0 |
| OF2 | OUTFALL | 106.50 | 1.00 | 0.0 |
| OF3 | OUTFALL | 87.00 | 1.00 | 0.0 |
| OF4 | OUTFALL | 78.00 | 1.00 | 0.0 |
| OF5 | OUTFALL | 87.00 | 1.00 | 0.0 |
| OF6 | OUTFALL | 92.00 | 1.00 | 0.0 |
| OF7 | OUTFALL | 98.00 | 1.00 | 0.0 |

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|---|---|---|---|---|
| OF8 | OUTFALL | 115.00 | 2.00 | 0.0 |
| SU1_Pond1 | STORAGE | 116.00 | 2.50 | 0.0 |
| SU2_Pond2 | STORAGE | 105.00 | 5.30 | 0.0 |
| SU3_Pond3 | STORAGE | 93.00 | 2.00 | 0.0 |
| SU4_Pond4 | STORAGE | 83.50 | 1.50 | 0.0 |
| SU5_Pond5 | STORAGE | 96.00 | 2.50 | 0.0 |
| SU6_Pond6 | STORAGE | 94.00 | 1.00 | 0.0 |
| SU7_Pond7 | STORAGE | 100.50 | 2.50 | 0.0 |
| SU8_Pond8 | STORAGE | 122.00 | 2.00 | 0.0 |

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Link Summary

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| Name | From Node | To Node | Type | Length | %Slope | Roughness |
|---|---|---|---|---|---|---|
| C1 | J44 | J25 | CONDUIT | 127.2 | 0.0582 | 0.0120 |
| C10 | J171 | OF_Pond7 | CONDUIT | 107.6 | 1.1679 | 0.0120 |
| C100 | J51 | J50 | CONDUIT | 25.7 | 0.9217 | 0.0120 |
| C101 | J139 | J140 | CONDUIT | 91.4 | 0.9141 | 0.0120 |
| C102 | J101 | J47 | CONDUIT | 38.5 | 0.9439 | 0.0120 |
| C103_1 | J78 | J156 | CONDUIT | 168.2 | 0.2194 | 0.0120 |
| C103_2 | J156 | J108 | CONDUIT | 134.2 | 0.2415 | 0.0120 |
| C104 | J150 | J85 | CONDUIT | 30.4 | 1.3771 | 0.0120 |
| C105 | J360 | OF_Pond4 | CONDUIT | 23.3 | 1.6663 | 0.0120 |
| C106 | J140 | J306 | CONDUIT | 166.7 | 0.4884 | 0.0120 |
| C107 | J130 | J133 | CONDUIT | 70.1 | 0.4080 | 0.0120 |
| C108 | J263 | OF_Pond2 | CONDUIT | 28.1 | 2.2257 | 0.0120 |
| C109 | SU5_Pond5 | J4 | CONDUIT | 28.7 | 38.4931 | 0.0120 |
| C11 | J244 | J13 | CONDUIT | 195.0 | 1.3337 | 0.0120 |
| C110 | SU6_Pond6 | J2 | CONDUIT | 32.1 | 7.8058 | 0.0120 |
| C111 | SU8_Pond8 | J11 | CONDUIT | 68.2 | 6.9081 | 0.0120 |
| C112 | SU7_Pond7 | J1 | CONDUIT | 40.5 | 6.8374 | 0.0120 |
| C113 | J1 | OF7 | CONDUIT | 21.4 | 4.1331 | 0.0120 |
| C114 | J2 | OF6 | CONDUIT | 12.4 | 1.6178 | 0.0120 |
| C115 | J4 | OF5 | CONDUIT | 8.8 | 11.4774 | 0.0120 |
| C116 | J5 | OF4 | CONDUIT | 35.0 | 5.7297 | 0.0120 |
| C117 | J6 | OF3 | CONDUIT | 34.4 | 9.0774 | 0.0120 |
| C118 | J7 | OF2 | CONDUIT | 35.7 | 3.4323 | 0.0120 |
| C119_1 | J83 | J157 | CONDUIT | 132.7 | 0.5810 | 0.0120 |

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|---|---|---|---|---|---|---|
| C119_2 | J157 | J106 | CONDUIT | 225.7 | 0.5805 | 0.0120 |
| C12 | J84 | OF_Pond1 | CONDUIT | 8.5 | 1.1127 | 0.0120 |
| C12_1 | J25 | J164 | CONDUIT | 399.1 | 0.0476 | 0.0120 |
| C12_2 | J164 | J10 | CONDUIT | 113.0 | -0.0611 | 0.0120 |
| C120 | J106 | J104 | CONDUIT | 93.0 | 0.5353 | 0.0120 |
| C121 | J104 | J103 | CONDUIT | 73.9 | 0.5158 | 0.0120 |
| C122 | J9 | J148 | CONDUIT | 130.2 | 0.4739 | 0.0120 |
| C122_1 | J103 | J105 | CONDUIT | 46.7 | 0.4860 | 0.0120 |
| C122_2 | J105 | J9 | CONDUIT | 5.7 | 0.5410 | 0.0120 |
| C123 | J116 | J117 | CONDUIT | 36.0 | 0.4278 | 0.0120 |
| C124 | J117 | J8 | CONDUIT | 35.8 | 0.4783 | 0.0120 |
| C125 | J8 | J112 | CONDUIT | 64.9 | 0.4980 | 0.0120 |
| C126 | J112 | J9 | CONDUIT | 89.1 | 0.4835 | 0.0120 |
| C127 | J102 | J99 | CONDUIT | 80.9 | 0.8613 | 0.0120 |
| C128 | J97 | J94 | CONDUIT | 117.4 | 0.3007 | 0.0120 |
| C129 | J98 | J99 | CONDUIT | 313.1 | 0.4366 | 0.0120 |
| C13 | J68 | J34 | CONDUIT | 147.2 | 1.1537 | 0.0120 |
| C130 | J99 | J100 | CONDUIT | 154.2 | 0.3885 | 0.0120 |
| C131 | J100 | J84 | CONDUIT | 102.9 | 0.2654 | 0.0120 |
| C132 | J37 | J100 | CONDUIT | 314.5 | 0.6995 | 0.0120 |
| C133 | J89 | J93 | CONDUIT | 127.9 | 0.5271 | 0.0120 |
| C134 | J94 | J93 | CONDUIT | 155.0 | 0.1807 | 0.0120 |
| C135 | J93 | J90 | CONDUIT | 100.9 | 0.3468 | 0.0120 |
| C136 | J90 | J60 | CONDUIT | 58.2 | 0.3560 | 0.0120 |
| C137 | J23 | J58 | CONDUIT | 79.9 | 0.4842 | 0.0120 |
| C138 | J58 | J55 | CONDUIT | 101.2 | 0.4790 | 0.0120 |
| C139 | J57 | J56 | CONDUIT | 38.9 | 0.7450 | 0.0120 |
| C14 | J34 | J32 | CONDUIT | 169.4 | 1.0555 | 0.0120 |
| C140 | J56 | J58 | CONDUIT | 59.8 | 0.5370 | 0.0120 |
| C141 | J95 | J47 | CONDUIT | 173.3 | 0.4777 | 0.0120 |
| C142 | J40 | J41 | CONDUIT | 97.6 | 0.3790 | 0.0120 |
| C143 | J41 | J56 | CONDUIT | 167.9 | 0.5278 | 0.0120 |
| C144 | J302 | J87 | CONDUIT | 68.7 | 1.8590 | 0.0120 |
| C145 | J43 | J96 | CONDUIT | 50.9 | 3.5825 | 0.0120 |
| C146 | J96 | J41 | CONDUIT | 168.7 | 0.4926 | 0.0120 |
| C147 | J82 | J150 | CONDUIT | 75.1 | 1.2430 | 0.0120 |
| C148 | J47 | J194 | CONDUIT | 191.1 | 0.4742 | 0.0120 |
| C149 | J194 | J85 | CONDUIT | 139.1 | 0.4133 | 0.0120 |
| C15 | J33 | J32 | CONDUIT | 173.5 | 4.1236 | 0.0120 |
| C150 | J92 | J96 | CONDUIT | 146.5 | 0.4286 | 0.0120 |

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|---|---|---|---|---|---|---|
| C151 | J48 | J316 | CONDUIT | 212.0 | 0.9719 | 0.0120 |
| C152 | J147 | J203 | CONDUIT | 212.4 | 0.1718 | 0.0120 |
| C153 | J203 | J15 | CONDUIT | 164.2 | 0.1754 | 0.0120 |
| C154 | J205 | J15 | CONDUIT | 103.1 | 0.4906 | 0.0120 |
| C155 | J15 | J52 | CONDUIT | 44.8 | 0.1249 | 0.0120 |
| C156 | J316 | J259 | CONDUIT | 83.2 | 1.0019 | 0.0120 |
| C157 | J53 | J259 | CONDUIT | 237.5 | 0.5500 | 0.0120 |
| C158 | J39 | J36 | CONDUIT | 77.9 | 0.8720 | 0.0120 |
| C159 | J36 | J349 | CONDUIT | 194.6 | 0.8776 | 0.0120 |
| C16_1 | J79 | J73 | CONDUIT | 300.8 | -0.7387 | 0.0120 |
| C160 | J289 | J349 | CONDUIT | 55.6 | 1.6383 | 0.0120 |
| C161 | J133 | J280 | CONDUIT | 63.3 | 0.5370 | 0.0120 |
| C162 | J129 | J133 | CONDUIT | 325.0 | 0.7252 | 0.0120 |
| C163 | J127 | J136 | CONDUIT | 163.1 | 1.0293 | 0.0120 |
| C164 | J136 | J280 | CONDUIT | 82.4 | 0.9951 | 0.0120 |
| C165 | J137 | J82 | CONDUIT | 99.1 | 1.6618 | 0.0120 |
| C166 | J122 | J123 | CONDUIT | 87.1 | 0.8656 | 0.0120 |
| C167 | J123 | J124 | CONDUIT | 79.9 | 0.7593 | 0.0120 |
| C168 | J124 | J82 | CONDUIT | 132.3 | 0.6614 | 0.0120 |
| C169 | J134 | J136 | CONDUIT | 139.4 | 0.0588 | 0.0120 |
| C17 | J71 | J13 | CONDUIT | 245.4 | 2.4762 | 0.0120 |
| C170 | J120 | J154 | CONDUIT | 66.7 | 0.7786 | 0.0120 |
| C171 | J154 | J87 | CONDUIT | 297.8 | 0.8026 | 0.0120 |
| C172 | J87 | J124 | CONDUIT | 52.3 | 0.8750 | 0.0120 |
| C173 | J121 | J349 | CONDUIT | 87.2 | 1.1122 | 0.0120 |
| C174_1 | J86 | J158 | CONDUIT | 129.8 | 0.7101 | 0.0120 |
| C174_2 | J158 | J104 | CONDUIT | 226.7 | 0.7350 | 0.0120 |
| C175_1 | J88 | J160 | CONDUIT | 117.8 | 0.9151 | 0.0120 |
| C175_2 | J160 | J103 | CONDUIT | 234.1 | 0.9152 | 0.0120 |
| C176_1 | J18 | J240 | CONDUIT | 263.1 | 1.2805 | 0.0120 |
| C177 | J148 | J149 | CONDUIT | 89.8 | 0.4797 | 0.0120 |
| C178 | J149 | J151 | CONDUIT | 90.0 | 0.4567 | 0.0120 |
| C179 | J151 | J14 | CONDUIT | 53.5 | 0.5724 | 0.0120 |
| C18 | J125 | J325 | CONDUIT | 54.0 | 0.6115 | 0.0120 |
| C18_2 | J243 | J22 | CONDUIT | 234.5 | 0.8932 | 0.0200 |
| C182 | J118 | J119 | CONDUIT | 76.7 | 0.2165 | 0.0120 |
| C183 | J119 | J208 | CONDUIT | 72.0 | 0.1806 | 0.0120 |
| C184 | J208 | J207 | CONDUIT | 90.1 | 0.1787 | 0.0120 |
| C185 | J207 | J206 | CONDUIT | 90.0 | 0.1744 | 0.0120 |
| C186 | J206 | J205 | CONDUIT | 89.9 | -0.2871 | 0.0120 |

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|---|---|---|---|---|---|---|
| C19 | J327 | J330 | CONDUIT | 237.8 | 0.8554 | 0.0200 |
| C2 | SU1_Pond1 | OF1 | CONDUIT | 8.5 | 24.9917 | 0.0120 |
| C20 | J240 | J242 | CONDUIT | 153.2 | 1.2693 | 0.0120 |
| C21 | J14 | J217 | CONDUIT | 46.6 | 0.3781 | 0.0120 |
| C21_1 | J12 | J66 | CONDUIT | 28.4 | 0.9267 | 0.0120 |
| C21_2 | J66 | J263 | CONDUIT | 116.3 | 1.0928 | 0.0120 |
| C217 | J349 | J101 | CONDUIT | 98.7 | 0.8044 | 0.0120 |
| C22 | J310 | J35 | CONDUIT | 120.0 | 0.7360 | 0.0120 |
| C227 | J17 | J358 | CONDUIT | 220.0 | 0.8254 | 0.0120 |
| C23 | J79 | J360 | CONDUIT | 204.3 | 4.7017 | 0.0120 |
| C235 | J330 | J331 | CONDUIT | 291.7 | 0.7817 | 0.0200 |
| C236 | J331 | J333 | CONDUIT | 140.7 | 0.6945 | 0.0120 |
| C237 | J333 | J311 | CONDUIT | 121.0 | 0.7423 | 0.0200 |
| C238 | J311 | J309 | CONDUIT | 101.1 | 0.6412 | 0.0120 |
| C239 | J309 | J299 | CONDUIT | 170.3 | 0.5890 | 0.0200 |
| C24 | J64 | J12 | CONDUIT | 59.0 | 0.7064 | 0.0120 |
| C240 | J299 | J285 | CONDUIT | 148.4 | 0.3524 | 0.0120 |
| C241 | J285 | J357 | CONDUIT | 295.2 | 0.2327 | 0.0200 |
| C242 | J357 | J282 | CONDUIT | 282.1 | 0.1953 | 0.0200 |
| C243 | J282 | J279 | CONDUIT | 95.4 | 0.1730 | 0.0120 |
| C244 | J279 | J277 | CONDUIT | 127.9 | 0.1501 | 0.0120 |
| C245 | J277 | J263 | CONDUIT | 142.0 | -0.1112 | 0.0120 |
| C246 | J281 | J334 | CONDUIT | 192.9 | 0.5706 | 0.0200 |
| C247 | J334 | J336 | CONDUIT | 145.7 | 0.6793 | 0.0120 |
| C248 | J336 | J338 | CONDUIT | 180.8 | 0.7150 | 0.0200 |
| C249 | J338 | J345 | CONDUIT | 88.9 | 0.7740 | 0.0120 |
| C25 | J35 | J147 | CONDUIT | 4.8 | 0.9099 | 0.0120 |
| C250 | J345 | J348 | CONDUIT | 124.1 | 0.7987 | 0.0200 |
| C251 | J348 | J350 | CONDUIT | 148.9 | 0.7759 | 0.0120 |
| C252 | J350 | J231 | CONDUIT | 96.3 | 0.8859 | 0.0200 |
| C256 | J231 | J230 | CONDUIT | 364.8 | 0.5790 | 0.0120 |
| C257 | J255 | J351 | CONDUIT | 197.8 | 0.1294 | 0.0120 |
| C258 | J351 | J256 | CONDUIT | 132.4 | 0.1284 | 0.0120 |
| C259 | J256 | J234 | CONDUIT | 123.4 | 0.1183 | 0.0120 |
| C26 | J61 | J62 | CONDUIT | 115.0 | 0.0591 | 0.0120 |
| C260_1 | J234 | J142 | CONDUIT | 13.1 | 1.4619 | 0.0120 |
| C260_2 | J142 | J231 | CONDUIT | 113.6 | 2.4575 | 0.0120 |
| C261 | J325 | J319 | CONDUIT | 168.9 | 0.6224 | 0.0200 |
| C262 | J319 | J317 | CONDUIT | 253.3 | 0.6389 | 0.0200 |
| C263 | J317 | J312 | CONDUIT | 64.2 | 0.5729 | 0.0120 |

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|---|---|---|---|---|---|---|
| C264 | J312 | J308 | CONDUIT | 238.9 | 0.4910 | 0.0200 |
| C265 | J308 | J301 | CONDUIT | 68.4 | 0.5223 | 0.0120 |
| C266 | J301 | J275 | CONDUIT | 239.5 | 0.4752 | 0.0200 |
| C267 | J275 | J274 | CONDUIT | 61.4 | 0.5114 | 0.0120 |
| C268 | J274 | J273 | CONDUIT | 245.0 | 0.4632 | 0.0120 |
| C269 | J273 | J265 | CONDUIT | 137.6 | 0.4396 | 0.0120 |
| C27 | J259 | J270 | CONDUIT | 47.3 | 0.5514 | 0.0120 |
| C270 | J265 | J277 | CONDUIT | 184.5 | 0.4173 | 0.0120 |
| C271 | J233 | J257 | CONDUIT | 110.2 | 0.8461 | 0.0120 |
| C272 | J257 | J258 | CONDUIT | 56.8 | 0.7178 | 0.0120 |
| C273_1 | J258 | J145 | CONDUIT | 102.1 | 0.8826 | 0.0120 |
| C273_2 | J145 | J359 | CONDUIT | 204.7 | 0.7800 | 0.0120 |
| C274 | J359 | J260 | CONDUIT | 278.6 | 0.7067 | 0.0120 |
| C275 | J260 | J234 | CONDUIT | 169.4 | 0.3435 | 0.0120 |
| C276 | J163 | J165 | CONDUIT | 152.9 | 0.9001 | 0.0120 |
| C277 | J165 | J168 | CONDUIT | 115.6 | 0.9224 | 0.0120 |
| C278 | J168 | J171 | CONDUIT | 261.6 | 1.1439 | 0.0120 |
| C28 | J62 | J65 | CONDUIT | 75.0 | 0.0333 | 0.0120 |
| C283 | J169 | J170 | CONDUIT | 390.9 | 2.1635 | 0.0120 |
| C284 | J170 | J171 | CONDUIT | 40.1 | 2.2101 | 0.0120 |
| C285 | J172 | J173 | CONDUIT | 165.7 | 1.7667 | 0.0120 |
| C286 | J173 | J174 | CONDUIT | 40.6 | 1.8669 | 0.0120 |
| C287 | J174 | J171 | CONDUIT | 193.3 | 1.8013 | 0.0120 |
| C288 | J176 | J183 | CONDUIT | 337.2 | 0.9232 | 0.0120 |
| C29 | J270 | J267 | CONDUIT | 256.2 | 0.5569 | 0.0120 |
| C293 | J183 | J185 | CONDUIT | 142.5 | 4.3002 | 0.0120 |
| C294 | J186 | J185 | CONDUIT | 89.0 | 5.1656 | 0.0120 |
| C295 | J185 | J190 | CONDUIT | 187.5 | 1.8163 | 0.0120 |
| C296 | J189 | J353 | CONDUIT | 228.7 | 0.9426 | 0.0120 |
| C297 | J353 | J209 | CONDUIT | 265.3 | 1.0266 | 0.0120 |
| C3 | J11 | OF8 | CONDUIT | 60.5 | 6.9635 | 0.0120 |
| C30 | J267 | J72 | CONDUIT | 177.8 | 0.5432 | 0.0120 |
| C302 | J218 | J230 | CONDUIT | 414.4 | 0.7354 | 0.0120 |
| C306 | J13 | J361 | CONDUIT | 52.2 | 4.8262 | 0.0120 |
| C31 | J32 | J31 | CONDUIT | 104.1 | 1.2162 | 0.0120 |
| C310 | J235 | J237 | CONDUIT | 240.2 | 1.2672 | 0.0120 |
| C311 | J237 | J239 | CONDUIT | 279.4 | 1.1644 | 0.0120 |
| C32 | J253 | J31 | CONDUIT | 270.0 | 0.6810 | 0.0120 |
| C33 | J69 | J244 | CONDUIT | 245.2 | 1.2713 | 0.0120 |
| C34 | J29 | J361 | CONDUIT | 20.0 | 0.6000 | 0.0120 |

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|---|---|---|---|---|---|---|
| C35 | J65 | J70 | CONDUIT | 93.0 | 0.0645 | 0.0120 |
| C36 | J242 | J68 | CONDUIT | 60.8 | 1.2334 | 0.0120 |
| C37 | J72 | J143 | CONDUIT | 180.3 | 0.4410 | 0.0120 |
| C38 | J143 | J144 | CONDUIT | 203.6 | 0.5142 | 0.0120 |
| C39 | J31 | J30 | CONDUIT | 286.5 | 1.9882 | 0.0120 |
| C4 | OF1 | J14 | CONDUIT | 6.7 | 0.7481 | 0.0120 |
| C41 | J21 | J29 | CONDUIT | 203.5 | 0.5151 | 0.0120 |
| C42 | J46 | J114 | CONDUIT | 152.5 | 0.2098 | 0.0120 |
| C43 | J114 | J113 | CONDUIT | 14.0 | 0.4650 | 0.0120 |
| C44 | J113 | J111 | CONDUIT | 150.0 | 0.2587 | 0.0120 |
| C45 | J107 | J108 | CONDUIT | 38.0 | -2.6140 | 0.0120 |
| C46 | J108 | J111 | CONDUIT | 48.3 | 0.7390 | 0.0120 |
| C47 | J111 | J38 | CONDUIT | 29.6 | 0.6689 | 0.0120 |
| C48 | J54 | J321 | CONDUIT | 137.8 | 0.1604 | 0.0120 |
| C49 | J59 | J60 | CONDUIT | 147.4 | 0.1675 | 0.0120 |
| C5 | SU2_Pond2 | J7 | CONDUIT | 108.8 | 2.0910 | 0.0120 |
| C50_1 | J42 | J155 | CONDUIT | 155.7 | 0.7378 | 0.0120 |
| C50_2 | J155 | J38 | CONDUIT | 142.5 | 0.9903 | 0.0120 |
| C51 | J60 | J321 | CONDUIT | 109.8 | 0.2205 | 0.0120 |
| C52 | J38 | J212 | CONDUIT | 43.1 | 1.0065 | 0.0120 |
| C53_1 | J321 | J77 | CONDUIT | 161.9 | 0.2817 | 0.0120 |
| C53_2 | J77 | J84 | CONDUIT | 200.4 | 0.3144 | 0.0120 |
| C54 | J212 | J45 | CONDUIT | 24.9 | 1.4053 | 0.0120 |
| C55 | J70 | J76 | CONDUIT | 78.4 | 0.0638 | 0.0120 |
| C56 | J76 | J25 | CONDUIT | 214.7 | 0.0461 | 0.0120 |
| C57 | J110 | J19 | CONDUIT | 50.7 | 0.6879 | 0.0120 |
| C58 | J19 | J125 | CONDUIT | 237.1 | 0.6036 | 0.0120 |
| C6 | SU3_Pond3 | J6 | CONDUIT | 34.8 | 13.2939 | 0.0120 |
| C62 | J358 | J161 | CONDUIT | 382.7 | 0.8180 | 0.0120 |
| C63 | J239 | J360 | CONDUIT | 383.1 | 2.4736 | 0.0120 |
| C64 | J28 | J179 | CONDUIT | 117.0 | 0.2598 | 0.0120 |
| C65 | J131 | J75 | CONDUIT | 78.5 | 0.2981 | 0.0120 |
| C66 | J146 | J132 | CONDUIT | 191.7 | 0.7206 | 0.0120 |
| C67 | J132 | J205 | CONDUIT | 20.2 | 0.6296 | 0.0120 |
| C68 | J22 | J231 | CONDUIT | 185.9 | 0.8632 | 0.0200 |
| C69 | J30 | J361 | CONDUIT | 20.0 | 2.2005 | 0.0120 |
| C69_1 | J217 | J152 | CONDUIT | 20.1 | 0.7569 | 0.0120 |
| C69_2 | J152 | J23 | CONDUIT | 20.0 | 0.4810 | 0.0120 |
| C7 | SU4_Pond4 | J5 | CONDUIT | 61.8 | 7.2195 | 0.0120 |
| C70 | J74 | J76 | CONDUIT | 110.7 | 0.0940 | 0.0120 |

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|---|---|---|---|---|---|---|
| C71 | J20 | J360 | CONDUIT | 30.0 | 4.1803 | 0.0120 |
| C71_1 | J55 | J153 | CONDUIT | 34.7 | 0.4646 | 0.0120 |
| C71_2 | J153 | J24 | CONDUIT | 34.6 | 0.4072 | 0.0120 |
| C72 | J24 | J95 | CONDUIT | 129.0 | 0.4193 | 0.0120 |
| C73 | J161 | J163 | CONDUIT | 253.5 | 0.8681 | 0.0120 |
| C74_1 | J223 | J162 | CONDUIT | 362.7 | 1.1360 | 0.0120 |
| C74_2 | J162 | J230 | CONDUIT | 248.8 | 0.6672 | 0.0120 |
| C75 | J26 | J27 | CONDUIT | 192.3 | 0.1862 | 0.0120 |
| C76 | J182 | J186 | CONDUIT | 209.3 | 0.3550 | 0.0120 |
| C77 | J45 | J49 | CONDUIT | 27.2 | 0.5363 | 0.0120 |
| C78 | J67 | J70 | CONDUIT | 113.1 | 0.0540 | 0.0120 |
| C79 | J209 | J27 | CONDUIT | 62.6 | 1.1871 | 0.0120 |
| C8 | J230 | OF_Pond5 | CONDUIT | 16.1 | 1.2393 | 0.0120 |
| C80 | J27 | J218 | CONDUIT | 115.6 | 1.0477 | 0.0120 |
| C81 | J179 | J182 | CONDUIT | 35.8 | 0.3465 | 0.0120 |
| C82 | J16 | J20 | CONDUIT | 179.9 | 4.6174 | 0.0120 |
| C83 | J91 | J64 | CONDUIT | 69.7 | 0.2697 | 0.0120 |
| C83_1 | J75 | J128 | CONDUIT | 61.7 | 0.7586 | 0.0120 |
| C83_2 | J128 | J263 | CONDUIT | 113.5 | 0.2721 | 0.0120 |
| C84 | J52 | J263 | CONDUIT | 251.3 | 0.0593 | 0.0120 |
| C85 | J10 | OF_Pond8 | CONDUIT | 36.5 | 0.5479 | 0.0120 |
| C86 | J63 | J65 | CONDUIT | 112.4 | 0.1157 | 0.0120 |
| C87 | J361 | OF_Pond3 | CONDUIT | 24.1 | 2.6279 | 0.0120 |
| C88 | J85 | J115 | CONDUIT | 258.2 | 0.3164 | 0.0120 |
| C89 | J115 | J147 | CONDUIT | 198.8 | 0.2526 | 0.0120 |
| C9 | J190 | OF_Pond6 | CONDUIT | 94.8 | 1.5882 | 0.0120 |
| C90 | J305 | J141 | CONDUIT | 79.2 | 0.3786 | 0.0120 |
| C91 | J141 | J81 | CONDUIT | 107.2 | 0.5141 | 0.0120 |
| C92 | J49 | J50 | CONDUIT | 92.3 | 0.4516 | 0.0120 |
| C93 | J50 | J109 | CONDUIT | 30.2 | 0.4110 | 0.0120 |
| C94 | J280 | J306 | CONDUIT | 143.5 | 0.5958 | 0.0120 |
| C95 | J306 | J305 | CONDUIT | 216.8 | 0.4510 | 0.0120 |
| C96 | J144 | J141 | CONDUIT | 74.3 | 0.5542 | 0.0120 |
| C97 | J81 | J75 | CONDUIT | 85.0 | 0.6474 | 0.0120 |
| C98 | J109 | J116 | CONDUIT | 39.2 | 0.4900 | 0.0120 |
| C99_1 | J80 | J159 | CONDUIT | 119.5 | 0.8484 | 0.0120 |
| C99_2 | J159 | J51 | CONDUIT | 229.4 | 0.7643 | 0.0120 |
| OR1 | SU1_Pond1 | OF1 | ORIFICE | | | |
| OR10 | SU6_Pond6 | J2 | ORIFICE | | | |
| OR11 | SU2_Pond2 | J7 | ORIFICE | | | |

| | | | |
|---|---|---|---|
| OR12 | SU6_Pond6 | J2 | ORIFICE |
| OR13 | SU5_Pond5 | J4 | ORIFICE |
| OR14 | SU5_Pond5 | J4 | ORIFICE |
| OR15 | SU5_Pond5 | J4 | ORIFICE |
| OR16 | SU4_Pond4 | J5 | ORIFICE |
| OR17 | SU4_Pond4 | J5 | ORIFICE |
| OR18 | SU4_Pond4 | J5 | ORIFICE |
| OR19 | SU3_Pond3 | J6 | ORIFICE |
| OR2 | SU1_Pond1 | OF1 | ORIFICE |
| OR20 | SU3_Pond3 | J6 | ORIFICE |
| OR21 | SU3_Pond3 | J6 | ORIFICE |
| OR22 | SU2_Pond2 | J7 | ORIFICE |
| OR23 | SU2_Pond2 | J7 | ORIFICE |
| OR24 | SU2_Pond2 | J7 | ORIFICE |
| OR25 | SU1_Pond1 | OF1 | ORIFICE |
| OR26 | SU8_Pond8 | J11 | ORIFICE |
| OR3 | SU1_Pond1 | OF1 | ORIFICE |
| OR4 | SU8_Pond8 | J11 | ORIFICE |
| OR5 | SU3_Pond3 | J6 | ORIFICE |
| OR6 | SU8_Pond8 | J11 | ORIFICE |
| OR7 | SU7_Pond7 | J1 | ORIFICE |
| OR8 | SU7_Pond7 | J1 | ORIFICE |
| OR9 | SU7_Pond7 | J1 | ORIFICE |

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Cross Section Summary

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| Conduit | Shape | Full Depth | Full Area | Hyd. Rad. | Max. Width | No. of Barrels | Full Flow |
|---|---|---|---|---|---|---|---|
| C1 | CIRCULAR | 1.00 | 0.79 | 0.25 | 1.00 | 1 | 0.63 |
| C10 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 57.16 |
| C100 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.84 |
| C101 | CIRCULAR | 1.00 | 0.79 | 0.25 | 1.00 | 1 | 2.48 |
| C102 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 9.59 |
| C103_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.39 |
| C103_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.45 |
| C104 | CIRCULAR | 2.00 | 3.14 | 0.50 | 2.00 | 1 | 19.36 |
| C105 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 48.11 |
| C106 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 4.04 |

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|---|---|---|---|---|---|---|---|
| C107 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.89 |
| C108 | TRAPEZOIDAL | 2.00 | 18.00 | 1.15 | 15.00 | 1 | 245.71 |
| C109 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 231.25 |
| C11 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.42 |
| C110 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 104.14 |
| C111 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 97.96 |
| C112 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 97.46 |
| C113 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 75.78 |
| C114 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 47.41 |
| C115 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 126.27 |
| C116 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 89.22 |
| C117 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 112.30 |
| C118 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 69.05 |
| C119_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.26 |
| C119_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.25 |
| C12 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 6.10 |
| C12_1 | TRAPEZOIDAL | 1.35 | 5.87 | 0.86 | 5.70 | 1 | 9.67 |
| C12_2 | TRAPEZOIDAL | 1.35 | 5.87 | 0.86 | 5.70 | 1 | 10.95 |
| C120 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.16 |
| C121 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.13 |
| C122 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 6.80 |
| C122_1 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 6.88 |
| C122_2 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 7.26 |
| C123 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.76 |
| C124 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.92 |
| C125 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.98 |
| C126 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.94 |
| C127 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.75 |
| C128 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.62 |
| C129 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.96 |
| C13 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.18 |
| C130 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.63 |
| C131 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.18 |
| C132 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.47 |
| C133 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.15 |
| C134 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.26 |
| C135 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.49 |
| C136 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.52 |
| C137 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 6.87 |
| C138 | CIRCULAR | 1.85 | 2.69 | 0.46 | 1.85 | 1 | 9.27 |

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|---|---|---|---|---|---|---|---|
| C139 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.55 |
| C14 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.04 |
| C140 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.17 |
| C141 | CIRCULAR | 1.85 | 2.69 | 0.46 | 1.85 | 1 | 9.26 |
| C142 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.82 |
| C143 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.15 |
| C144 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 4.03 |
| C145 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 5.60 |
| C146 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.08 |
| C147 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 6.45 |
| C148 | CIRCULAR | 2.05 | 3.30 | 0.51 | 2.05 | 1 | 12.13 |
| C149 | CIRCULAR | 2.05 | 3.30 | 0.51 | 2.05 | 1 | 11.33 |
| C15 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 6.01 |
| C150 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.94 |
| C151 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.92 |
| C152 | CIRCULAR | 2.40 | 4.52 | 0.60 | 2.40 | 1 | 11.12 |
| C153 | CIRCULAR | 2.40 | 4.52 | 0.60 | 2.40 | 1 | 11.23 |
| C154 | CIRCULAR | 1.85 | 2.69 | 0.46 | 1.85 | 1 | 9.38 |
| C155 | CIRCULAR | 2.40 | 4.52 | 0.60 | 2.40 | 1 | 9.48 |
| C156 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.96 |
| C157 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.19 |
| C158 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.76 |
| C159 | CIRCULAR | 1.50 | 1.77 | 0.38 | 1.50 | 1 | 7.18 |
| C16_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.54 |
| C160 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.79 |
| C161 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.17 |
| C162 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.52 |
| C163 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.00 |
| C164 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.95 |
| C165 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 7.46 |
| C166 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.75 |
| C167 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.58 |
| C168 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.41 |
| C169 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 0.72 |
| C17 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 4.66 |
| C170 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.61 |
| C171 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.65 |
| C172 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.77 |
| C173 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.12 |
| C174_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.49 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C174_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.54 |
| C175_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.83 |
| C175_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.83 |
| C176_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.35 |
| C177 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 6.84 |
| C178 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 6.67 |
| C179 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 7.47 |
| C18 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.31 |
| C18_2 | TRAPEZOIDAL | 2.00 | 28.00 | 1.48 | 18.00 | 1 | 171.70 |
| C182 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.38 |
| C183 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.26 |
| C184 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 1.79 |
| C185 | CIRCULAR | 1.50 | 1.77 | 0.38 | 1.50 | 1 | 3.20 |
| C186 | CIRCULAR | 1.85 | 2.69 | 0.46 | 1.85 | 1 | 7.18 |
| C19 | TRAPEZOIDAL | 1.00 | 12.00 | 0.83 | 14.00 | 1 | 48.99 |
| C2 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 186.33 |
| C20 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.33 |
| C21 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.60 |
| C21_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.85 |
| C21_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.09 |
| C217 | CIRCULAR | 1.50 | 1.77 | 0.38 | 1.50 | 1 | 6.87 |
| C22 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.54 |
| C227 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 11.35 |
| C23 | CIRCULAR | 0.37 | 0.11 | 0.09 | 0.37 | 1 | 0.39 |
| C235 | TRAPEZOIDAL | 1.00 | 12.00 | 0.83 | 14.00 | 1 | 46.83 |
| C236 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.47 |
| C237 | TRAPEZOIDAL | 1.00 | 12.00 | 0.83 | 14.00 | 1 | 45.63 |
| C238 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.37 |
| C239 | TRAPEZOIDAL | 1.00 | 12.00 | 0.83 | 14.00 | 1 | 40.65 |
| C24 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.49 |
| C240 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.76 |
| C241 | TRAPEZOIDAL | 1.00 | 12.00 | 0.83 | 14.00 | 1 | 25.55 |
| C242 | TRAPEZOIDAL | 1.00 | 12.00 | 0.83 | 14.00 | 1 | 23.41 |
| C243 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 22.00 |
| C244 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.15 |
| C245 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 0.99 |
| C246 | TRAPEZOIDAL | 2.00 | 28.00 | 1.48 | 18.00 | 1 | 137.25 |
| C247 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 3.48 |
| C248 | TRAPEZOIDAL | 2.00 | 28.00 | 1.48 | 18.00 | 1 | 153.63 |
| C249 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.60 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C25 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.82 |
| C250 | TRAPEZOIDAL | 2.00 | 28.00 | 1.48 | 18.00 | 1 | 162.37 |
| C251 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.61 |
| C252 | TRAPEZOIDAL | 2.00 | 28.00 | 1.48 | 18.00 | 1 | 171.01 |
| C256 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.25 |
| C257 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.06 |
| C258 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.06 |
| C259 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.02 |
| C26 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 1.03 |
| C260_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.58 |
| C260_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 4.64 |
| C261 | TRAPEZOIDAL | 1.00 | 12.00 | 0.83 | 14.00 | 1 | 41.79 |
| C262 | TRAPEZOIDAL | 1.00 | 12.00 | 0.83 | 14.00 | 1 | 42.34 |
| C263 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.24 |
| C264 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.24 |
| C265 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.14 |
| C266 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.22 |
| C267 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.12 |
| C268 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.01 |
| C269 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.96 |
| C27 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 3.14 |
| C270 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.91 |
| C271 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.72 |
| C272 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.51 |
| C273_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.78 |
| C273_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.61 |
| C274 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.49 |
| C275 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.73 |
| C276 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 11.85 |
| C277 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 50.80 |
| C278 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 56.57 |
| C28 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 0.77 |
| C283 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 77.79 |
| C284 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 78.63 |
| C285 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 70.30 |
| C286 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 72.26 |
| C287 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 70.98 |
| C288 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 50.82 |
| C29 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 4.32 |
| C293 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 109.67 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C294 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 28.39 |
| C295 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 71.28 |
| C296 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 51.35 |
| C297 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 53.59 |
| C3 | TRAPEZOIDAL | 2.00 | 22.00 | 1.25 | 17.00 | 1 | 560.44 |
| C30 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 4.26 |
| C302 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 10.71 |
| C306 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 6.50 |
| C31 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.26 |
| C310 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 14.06 |
| C311 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 13.48 |
| C32 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.44 |
| C33 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.34 |
| C34 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.29 |
| C35 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 1.07 |
| C36 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 3.29 |
| C37 | CIRCULAR | 1.50 | 1.77 | 0.38 | 1.50 | 1 | 5.09 |
| C38 | CIRCULAR | 1.50 | 1.77 | 0.38 | 1.50 | 1 | 5.49 |
| C39 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 4.17 |
| C4 | TRAPEZOIDAL | 1.05 | 8.56 | 0.74 | 11.30 | 1 | 50.25 |
| C41 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.12 |
| C42 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.36 |
| C43 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.88 |
| C44 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.15 |
| C45 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 4.78 |
| C46 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.54 |
| C47 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 3.45 |
| C48 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.18 |
| C49 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 1.73 |
| C5 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 53.90 |
| C50_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.54 |
| C50_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.94 |
| C51 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 2.72 |
| C52 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 4.24 |
| C53_1 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 3.07 |
| C53_2 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 3.24 |
| C54 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 5.01 |
| C55 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 1.07 |
| C56 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 0.91 |
| C57 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.45 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C58 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.30 |
| C6 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 135.90 |
| C62 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 11.30 |
| C63 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 19.65 |
| C64 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 6.37 |
| C65 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.62 |
| C66 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.51 |
| C67 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.35 |
| C68 | TRAPEZOIDAL | 2.00 | 28.00 | 1.48 | 18.00 | 1 | 168.80 |
| C69 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 4.39 |
| C69_1 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 3.68 |
| C69_2 | CIRCULAR | 1.65 | 2.14 | 0.41 | 1.65 | 1 | 6.85 |
| C7 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 100.15 |
| C70 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 0.91 |
| C71 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 6.05 |
| C71_1 | CIRCULAR | 1.85 | 2.69 | 0.46 | 1.85 | 1 | 9.13 |
| C71_2 | CIRCULAR | 1.85 | 2.69 | 0.46 | 1.85 | 1 | 8.55 |
| C72 | CIRCULAR | 1.85 | 2.69 | 0.46 | 1.85 | 1 | 8.68 |
| C73 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 11.64 |
| C74_1 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 13.32 |
| C74_2 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 10.20 |
| C75 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 22.82 |
| C76 | TRIANGULAR | 1.00 | 2.50 | 0.46 | 5.00 | 1 | 7.44 |
| C77 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 3.09 |
| C78 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 0.69 |
| C79 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 57.62 |
| C8 | TRAPEZOIDAL | 1.05 | 6.46 | 0.67 | 9.30 | 1 | 45.87 |
| C80 | TRAPEZOIDAL | 1.00 | 8.00 | 0.71 | 11.00 | 1 | 54.14 |
| C81 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.74 |
| C82 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 6.36 |
| C83 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.54 |
| C83_1 | TRAPEZOIDAL | 2.00 | 18.00 | 1.15 | 15.00 | 1 | 143.45 |
| C83_2 | TRAPEZOIDAL | 2.00 | 18.00 | 1.15 | 15.00 | 1 | 85.92 |
| C84 | TRAPEZOIDAL | 2.00 | 18.00 | 1.15 | 15.00 | 1 | 40.11 |
| C85 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 27.59 |
| C86 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 1.01 |
| C87 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 60.42 |
| C88 | CIRCULAR | 2.05 | 3.30 | 0.51 | 2.05 | 1 | 9.91 |
| C89 | CIRCULAR | 2.40 | 4.52 | 0.60 | 2.40 | 1 | 13.48 |
| C9 | TRAPEZOIDAL | 1.00 | 6.00 | 0.64 | 9.00 | 1 | 46.97 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C90 | CIRCULAR | 1.80 | 2.54 | 0.45 | 1.80 | 1 | 7.66 |
| C91 | CIRCULAR | 1.80 | 2.54 | 0.45 | 1.80 | 1 | 8.93 |
| C92 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.84 |
| C93 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.71 |
| C94 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.28 |
| C95 | CIRCULAR | 1.35 | 1.43 | 0.34 | 1.35 | 1 | 3.88 |
| C96 | CIRCULAR | 1.80 | 2.54 | 0.45 | 1.80 | 1 | 9.27 |
| C97 | CIRCULAR | 1.80 | 2.54 | 0.45 | 1.80 | 1 | 10.02 |
| C98 | CIRCULAR | 1.20 | 1.13 | 0.30 | 1.20 | 1 | 2.96 |
| C99_1 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.73 |
| C99_2 | CIRCULAR | 1.05 | 0.87 | 0.26 | 1.05 | 1 | 2.59 |

**********

Analysis Options

**********

Flow Units ..... CMS

Process Models:

  Rainfall/Runoff ..... YES

  RDII ..... NO

  Snowmelt ..... NO

  Groundwater ..... NO

  Flow Routing ..... YES

  Ponding Allowed ..... NO

  Water Quality ..... NO

Infiltration Method ..... MODIFIED_GREEN_AMPT

Flow Routing Method ..... DYNWAVE

Surcharge Method ..... EXTRAN

Starting Date ..... 08/08/2024 00:00:00

Ending Date ..... 08/10/2024 00:00:00

Antecedent Dry Days ..... 0.0

Report Time Step ..... 00:00:05

Wet Time Step ..... 00:00:05

Dry Time Step ..... 00:00:05

Routing Time Step ..... 5.00 sec

Variable Time Step ..... YES

Maximum Trials ..... 8

Number of Threads ..... 8

Head Tolerance ..... 0.001500 m

| ********** | Volume | Depth |
|---|---|---|
| Runoff Quantity Continuity | hectare-m | mm |
| ********** | --- | --- |
| Initial LID Storage ..... | 0.046 | 0.107 |
| Total Precipitation ..... | 25.904 | 60.300 |
| Outfall Runon ..... | 10.899 | 25.370 |
| Evaporation Loss ..... | 0.000 | 0.000 |
| Infiltration Loss ..... | 20.697 | 48.177 |
| Surface Runoff ..... | 15.432 | 35.923 |
| LID Drainage ..... | 0.176 | 0.410 |
| Final Storage ..... | 0.544 | 1.267 |
| Continuity Error (%) ..... | -0.000 | |

| ********** | Volume | Volume |
|---|---|---|
| Flow Routing Continuity | hectare-m | 10^6 ltr |
| ********** | --- | --- |
| Dry Weather Inflow ..... | 0.000 | 0.000 |
| Wet Weather Inflow ..... | 15.612 | 156.121 |
| Groundwater Inflow ..... | 0.000 | 0.000 |
| RDII Inflow ..... | 0.000 | 0.000 |
| External Inflow ..... | 0.000 | 0.000 |
| External Outflow ..... | 14.224 | 142.238 |
| Flooding Loss ..... | 0.000 | 0.000 |
| Evaporation Loss ..... | 0.000 | 0.000 |
| Exfiltration Loss ..... | 0.000 | 0.000 |
| Initial Stored Volume .... | 3.875 | 38.748 |
| Final Stored Volume ..... | 5.264 | 52.641 |
| Continuity Error (%) ..... | -0.005 | |

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Highest Continuity Errors

**********

Node J107 (8.26%)

Node J206 (3.18%)

Node J164 (1.44%)

Node J207 (1.24%)

**********

Time-Step Critical Elements

**********

Link C115 (59.21%)

Link C12 (26.11%)

Link C25 (2.60%)

**********

Highest Flow Instability Indexes

**********

Link C155 (3)

Link C25 (3)

**********

Most Frequent Nonconverging Nodes

**********

Node J35 (0.02%)

Node OF_Pond1 (0.02%)

Node OF_Pond2 (0.02%)

Node OF_Pond3 (0.02%)

Node OF_Pond4 (0.02%)

**********

Routing Time Step Summary

**********

Minimum Time Step : 0.50 sec

Average Time Step : 3.13 sec

Maximum Time Step : 5.00 sec

% of Time in Steady State : 0.00

Average Iterations per Step : 2.00

% of Steps Not Converging : 0.02

Time Step Frequencies :

5.000 - 3.155 sec : 43.65 %

3.155 - 1.991 sec : 46.22 %

1.991 - 1.256 sec : 6.69 %

1.256 - 0.792 sec : 3.04 %

0.792 - 0.500 sec : 0.39 %

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Subcatchment Runoff Summary

**********

| Subcatchment | Total Precip mm | Total Runon mm | Total Evap mm | Total Infil mm | Imperv Runoff mm | Perv Runoff mm | Total Runoff mm | Total Runoff 10^6 ltr | Peak Runoff CMS | Runoff Coeff |
|---|---|---|---|---|---|---|---|---|---|---|
| S_Pond1 | 60.30 | 5432.59 | 0.00 | 20.15 | 0.00 | 0.00 | 5273.61 | 11.06 | 3.86 | 0.960 |
| S_Pond2 | 60.30 | 2080.78 | 0.00 | 1401.61 | 0.00 | 739.48 | 739.48 | 24.33 | 10.16 | 0.345 |
| S_Pond3 | 60.30 | 1608.34 | 0.00 | 1027.51 | 0.00 | 641.14 | 641.14 | 3.91 | 2.72 | 0.384 |
| S_Pond4 | 60.30 | 407.81 | 0.00 | 17.24 | 0.00 | 0.00 | 266.69 | 0.33 | 0.18 | 0.570 |
| S_Pond5 | 60.30 | 2920.88 | 0.00 | 18.90 | 0.00 | 0.00 | 2752.63 | 12.35 | 2.71 | 0.923 |
| S_Pond6 | 60.30 | 0.00 | 0.00 | 0.62 | 0.00 | 0.00 | 6.50 | 0.01 | 0.01 | 0.108 |
| S_Pond7 | 60.30 | 693.53 | 0.00 | 17.87 | 0.00 | 0.00 | 541.72 | 1.46 | 0.53 | 0.719 |
| S_Pond8 | 60.30 | 1876.20 | 0.00 | 18.65 | 0.00 | 0.00 | 1719.28 | 3.52 | 0.97 | 0.888 |
| S1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.17 | 0.06 | 0.975 |
| S1_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S1_8 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.73 | 0.19 | 0.975 |
| S10 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S11 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.01 | 0.00 | 0.975 |
| S11_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S11_10 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.02 | 0.975 |
| S11_11 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.04 | 0.01 | 0.975 |
| S11_12 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S11_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.02 | 0.975 |
| S11_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S11_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S11_6 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.03 | 0.975 |
| S11_7 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S11_8 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.02 | 0.975 |
| S11_9 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S12 | 60.30 | 0.00 | 0.00 | 0.00 | 58.45 | 0.00 | 58.45 | 0.05 | 0.02 | 0.969 |
| S12_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S12_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S12_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S12_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S12_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S12_7 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S12_8 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S13 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S13_11 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 1.94 | 0.63 | 0.975 |
| S13_12 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 1.68 | 0.52 | 0.975 |
| S13_14 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 1.28 | 0.41 | 0.975 |
| S13_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 2.18 | 0.70 | 0.975 |
| S13_8 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 1.35 | 0.43 | 0.975 |
| S136_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.52 | 0.16 | 0.983 |
| S136_3 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.35 | 0.11 | 0.983 |
| S136_4 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.68 | 0.22 | 0.983 |
| S136_5 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 1.05 | 0.33 | 0.983 |
| S139_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.11 | 0.04 | 0.975 |
| S139_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.15 | 0.04 | 0.975 |
| S14 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.25 | 0.09 | 0.975 |
| S140_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.14 | 0.04 | 0.975 |
| S140_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.12 | 0.03 | 0.975 |
| S141_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.12 | 0.04 | 0.975 |
| S141_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S141_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.16 | 0.05 | 0.975 |
| S141_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S143_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S143_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.11 | 0.03 | 0.975 |
| S143_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |
| S144_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.11 | 0.04 | 0.975 |
| S144_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.18 | 0.05 | 0.975 |
| S144_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.03 | 0.975 |
| S144_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |
| S145_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S147 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.25 | 0.07 | 0.975 |
| S148_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.12 | 0.03 | 0.975 |
| S15 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.12 | 0.03 | 0.975 |
| S15_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S15_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S150 | 60.30 | 0.00 | 0.00 | 0.00 | 58.77 | 0.00 | 58.77 | 0.21 | 0.05 | 0.975 |
| S152 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.01 | 0.00 | 0.975 |
| S153 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.76 | 0.24 | 0.975 |
| S155 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S156_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S157 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.02 | 0.975 |
| S158_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.02 | 0.975 |
| S158_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S16 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.13 | 0.05 | 0.975 |
| S160_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |
| S161_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.02 | 0.01 | 0.975 |
| S161_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S161_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.02 | 0.975 |
| S161_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S161_6 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |
| S163 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S164_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |
| S164_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S164_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S164_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.03 | 0.01 | 0.975 |
| S165 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S166_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S166_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S166_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.11 | 0.03 | 0.975 |
| S167_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.07 | 0.02 | 0.975 |
| S167_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.15 | 0.04 | 0.975 |
| S168_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.05 | 0.02 | 0.975 |
| S168_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S168_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.05 | 0.02 | 0.975 |
| S168_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S17 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S170_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.16 | 0.05 | 0.975 |
| S170_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.02 | 0.975 |
| S170_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.16 | 0.04 | 0.975 |
| S170_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.35 | 0.09 | 0.975 |
| S170_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.02 | 0.975 |
| S170_7 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S170_8 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.14 | 0.05 | 0.975 |
| S171_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S171_10 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S171_13 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S171_14 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.03 | 0.975 |
| S171_16 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.11 | 0.04 | 0.975 |
| S171_17 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.02 | 0.975 |
| S171_18 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |
| S171_19 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.02 | 0.975 |
| S171_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.12 | 0.04 | 0.975 |
| S171_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S171_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S171_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S171_7 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S171_8 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.03 | 0.975 |
| S173_1 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.06 | 0.02 | 0.731 |
| S173_2 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.12 | 0.04 | 0.731 |
| S173_3 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.12 | 0.04 | 0.731 |
| S173_5 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.14 | 0.05 | 0.731 |
| S173_6 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.17 | 0.06 | 0.731 |
| S173_7 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.29 | 0.10 | 0.731 |
| S174_1 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.13 | 0.05 | 0.731 |
| S174_2 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.05 | 0.02 | 0.731 |
| S175_1 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.28 | 0.10 | 0.731 |
| S175_3 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.18 | 0.06 | 0.731 |
| S175_4 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.24 | 0.08 | 0.731 |
| S176_1 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.29 | 0.10 | 0.731 |
| S176_3 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.18 | 0.06 | 0.731 |
| S176_4 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.24 | 0.08 | 0.731 |
| S177_1 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.43 | 0.15 | 0.731 |
| S177_2 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.60 | 0.20 | 0.731 |
| S178_1 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.43 | 0.15 | 0.731 |
| S178_2 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.60 | 0.20 | 0.731 |
| S179_1 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.34 | 0.12 | 0.731 |
| S179_2 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.14 | 0.05 | 0.731 |
| S179_3 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.10 | 0.03 | 0.731 |
| S18 | 60.30 | 7.38 | 0.00 | 67.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S18_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.11 | 0.03 | 0.975 |
| S18_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S180 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.06 | 0.02 | 0.731 |
| S181 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.16 | 0.06 | 0.731 |
| S182_2 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.12 | 0.04 | 0.731 |
| S182_3 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.40 | 0.13 | 0.731 |
| S182_4 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.31 | 0.10 | 0.731 |
| S183 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S184_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S184_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S184_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S185 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S186 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S187 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S188_1 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.05 | 0.02 | 0.731 |
| S188_2 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.08 | 0.03 | 0.731 |
| S189 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S19 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S190 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S191 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S192 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.00 | 0.00 | 0.975 |
| S193_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S193_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S193_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S193_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S193_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S193_7 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S194_1 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.08 | 0.03 | 0.731 |
| S194_3 | 60.30 | 0.00 | 0.00 | 15.08 | 44.10 | 0.00 | 44.10 | 0.05 | 0.02 | 0.731 |
| S194_4 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.07 | 0.02 | 0.731 |
| S195_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S195_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S196_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.07 | 0.02 | 0.975 |
| S196_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.04 | 0.01 | 0.975 |
| S196_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.04 | 0.01 | 0.975 |
| S197_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S197_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S197_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S197_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S197_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_10 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_7 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S198_8 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S199 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.75 | 0.20 | 0.975 |
| S2_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.64 | 0.17 | 0.975 |
| S2_11 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 1.33 | 0.35 | 0.975 |
| S2_12 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.32 | 0.08 | 0.975 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S2_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.19 | 0.05 | 0.975 |
| S2_21 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.53 | 0.14 | 0.975 |
| S2_22 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.64 | 0.17 | 0.975 |
| S2_23 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.22 | 0.06 | 0.975 |
| S2_24 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.55 | 0.14 | 0.975 |
| S2_25 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.34 | 0.09 | 0.975 |
| S2_26 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.87 | 0.23 | 0.975 |
| S2_27 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.51 | 0.13 | 0.975 |
| S2_28 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.14 | 0.04 | 0.975 |
| S2_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 1.57 | 0.41 | 0.975 |
| S2_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.34 | 0.09 | 0.975 |
| S2_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.87 | 0.23 | 0.975 |
| S2_6 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 1.53 | 0.40 | 0.975 |
| S2_7 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.43 | 0.11 | 0.975 |
| S2_8 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.45 | 0.12 | 0.975 |
| S20 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 3.15 | 1.01 | 0.975 |
| S200_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S200_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S201 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S202 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S203 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S204 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S205 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S206_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S206_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S206_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S207 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S208_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S208_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S208_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S208_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S209 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S21 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S210_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S210_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S210_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S210_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S211_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S211_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S212_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S212_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S213_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S213_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S213_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S214 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S215 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S216 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S217_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S217_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S217_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S218 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S219 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S22 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S220 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S221 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S222 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S223_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S223_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S224 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S225 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S226 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S227 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S228 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S229_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S229_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S229_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S229_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S23 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.11 | 0.04 | 0.975 |
| S23_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 1.10 | 0.30 | 0.975 |
| S23_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.21 | 0.06 | 0.975 |
| S23_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.01 | 0.975 |
| S230_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S230_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S231 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S232 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S233 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S234 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S235 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S236 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S237 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S238 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S239 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S24 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S24_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.23 | 0.07 | 0.975 |
| S24_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.31 | 0.09 | 0.975 |
| S24_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.27 | 0.08 | 0.975 |
| S240_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S240_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S241 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S242 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S25 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.04 | 0.01 | 0.975 |
| S26 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.19 | 0.06 | 0.975 |
| S27 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.02 | 0.975 |
| S28 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S29 | 60.30 | 8.92 | 0.00 | 69.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.37 | 0.11 | 0.975 |
| S3_11 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.06 | 0.02 | 0.975 |
| S3_119 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_122 | 60.30 | 9.66 | 0.00 | 69.96 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_124 | 60.30 | 20.29 | 0.00 | 80.59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_126 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_127 | 60.30 | 29.82 | 0.00 | 90.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_17 | 60.30 | 22.14 | 0.00 | 82.44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_18 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_19 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_20 | 60.30 | 34.41 | 0.00 | 94.71 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_21 | 60.30 | 29.33 | 0.00 | 89.63 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_23 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_24 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_27 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.11 | 0.04 | 0.975 |
| S3_32 | 60.30 | 31.95 | 0.00 | 92.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.23 | 0.08 | 0.975 |
| S3_42 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.39 | 0.11 | 0.975 |
| S3_69 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_7 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S3_8 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S30 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.19 | 0.06 | 0.975 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S31 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.05 | 0.02 | 0.975 |
| S32 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S32_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S32_10 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S32_11 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S32_12 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S32_13 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S32_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S32_4 | 60.30 | 0.00 | 0.00 | 15.07 | 44.10 | 0.00 | 44.10 | 0.35 | 0.13 | 0.731 |
| S32_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S32_8 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S33 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S34 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.13 | 0.04 | 0.975 |
| S35 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.06 | 0.02 | 0.975 |
| S36 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S37 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S38 | 60.30 | 13.44 | 0.00 | 73.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S39 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S39_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S39_2 | 60.30 | 4.24 | 0.00 | 64.54 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S39_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S4 | 60.30 | 74.12 | 0.00 | 134.42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S40 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S43 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.15 | 0.05 | 0.975 |
| S45_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.15 | 0.04 | 0.975 |
| S45_10 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.12 | 0.04 | 0.975 |
| S45_11 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_12 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_13 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.12 | 0.04 | 0.975 |
| S45_14 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_15 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |
| S45_16 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_17 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_18 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.03 | 0.975 |
| S45_19 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_20 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_21 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.08 | 0.02 | 0.975 |
| S45_22 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_23 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S45_24 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.10 | 0.03 | 0.975 |
| S45_25 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_26 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_27 | 60.30 | 5.64 | 0.00 | 0.00 | 64.43 | 0.00 | 64.43 | 0.10 | 0.03 | 0.977 |
| S45_28 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_29 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_30 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.09 | 0.03 | 0.975 |
| S45_31 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_32 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_33 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.12 | 0.04 | 0.975 |
| S45_34 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_36 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.09 | 0.03 | 0.975 |
| S45_37 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_38 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_39 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.07 | 0.02 | 0.975 |
| S45_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.05 | 0.02 | 0.975 |
| S45_40 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_41 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.05 | 0.02 | 0.975 |
| S45_42 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_43 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_44 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.22 | 0.07 | 0.975 |
| S45_45 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_46 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_47 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_48 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_49 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_7 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S45_8 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S48_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.43 | 0.12 | 0.975 |
| S48_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.74 | 0.19 | 0.975 |
| S49 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.22 | 0.06 | 0.975 |
| S5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S50 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.53 | 0.17 | 0.975 |
| S51_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S51_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S52 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.16 | 0.06 | 0.975 |
| S52_1 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.58 | 0.17 | 0.975 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S52_11 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.78 | 0.21 | 0.975 |
| S52_12 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.22 | 0.06 | 0.975 |
| S52_13 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.91 | 0.25 | 0.975 |
| S52_14 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.50 | 0.13 | 0.975 |
| S52_15 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.79 | 0.21 | 0.975 |
| S52_17 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.86 | 0.23 | 0.975 |
| S52_18 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.49 | 0.13 | 0.975 |
| S52_19 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 1.01 | 0.27 | 0.975 |
| S52_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 1.01 | 0.27 | 0.975 |
| S52_20 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.36 | 0.10 | 0.975 |
| S52_21 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.89 | 0.24 | 0.975 |
| S52_22 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.64 | 0.17 | 0.975 |
| S52_23 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.65 | 0.18 | 0.975 |
| S52_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.36 | 0.10 | 0.975 |
| S52_4 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.89 | 0.24 | 0.975 |
| S52_5 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.73 | 0.20 | 0.975 |
| S52_8 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.59 | 0.17 | 0.975 |
| S52_9 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.73 | 0.20 | 0.975 |
| S54 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S55 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.41 | 0.11 | 0.975 |
| S56 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.62 | 0.16 | 0.975 |
| S6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S66_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S66_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S66_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S67 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.81 | 0.22 | 0.975 |
| S7_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_11 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_12 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_2 | 60.30 | 0.00 | 0.00 | 0.00 | 58.78 | 0.00 | 58.78 | 0.12 | 0.03 | 0.975 |
| S7_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_39 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_41 | 60.30 | 11.39 | 0.00 | 71.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_44 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_45 | 60.30 | 10.93 | 0.00 | 71.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_46 | 60.30 | 11.55 | 0.00 | 71.85 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_48 | 60.30 | 10.99 | 0.00 | 71.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S7_50 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_51 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_53 | 60.30 | 11.35 | 0.00 | 71.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_7 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S7_8 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S70 | 60.30 | 0.00 | 0.00 | 0.00 | 58.79 | 0.00 | 58.79 | 0.73 | 0.22 | 0.975 |
| S70_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S70_3 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.06 | 0.02 | 0.975 |
| S70_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_10 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_11 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_3 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_5 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_6 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_7 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_8 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S71_9 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S72 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.10 | 0.03 | 0.975 |
| S8 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S8_1 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S8_2 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S8_4 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S8_6 | 60.30 | 0.00 | 0.00 | 0.00 | 58.80 | 0.00 | 58.80 | 0.04 | 0.01 | 0.975 |
| S824_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.32 | 0.10 | 0.983 |
| S824_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.78 | 0.25 | 0.983 |
| S825 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.73 | 0.23 | 0.983 |
| S826 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 1.16 | 0.33 | 0.983 |
| S827 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.03 | 0.01 | 0.983 |
| S828 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 1.09 | 0.32 | 0.983 |
| S829 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.11 | 0.04 | 0.983 |
| S830 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.19 | 0.07 | 0.983 |
| S831_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.57 | 0.18 | 0.983 |
| S831_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.58 | 0.19 | 0.983 |
| S832_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.43 | 0.14 | 0.983 |
| S832_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.90 | 0.29 | 0.983 |
| S833 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 1.97 | 0.63 | 0.983 |
| S834 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.03 | 0.01 | 0.983 |
| S835_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.14 | 0.04 | 0.983 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S835_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.32 | 0.10 | 0.983 |
| S836_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.32 | 0.10 | 0.983 |
| S836_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.34 | 0.11 | 0.983 |
| S837_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.29 | 0.09 | 0.983 |
| S837_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.25 | 0.08 | 0.983 |
| S838_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.25 | 0.08 | 0.983 |
| S838_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.29 | 0.09 | 0.983 |
| S839 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 1.03 | 0.33 | 0.983 |
| S840 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.83 | 0.27 | 0.983 |
| S841 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.21 | 0.07 | 0.983 |
| S842 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.16 | 0.05 | 0.983 |
| S843 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.45 | 0.15 | 0.983 |
| S844 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| S845 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.12 | 0.04 | 0.983 |
| S846 | 60.30 | 0.00 | 0.00 | 0.00 | 59.28 | 0.00 | 59.28 | 0.69 | 0.18 | 0.983 |
| S847 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.10 | 0.04 | 0.983 |
| S848 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.11 | 0.04 | 0.983 |
| S849 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.26 | 0.08 | 0.983 |
| S850 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.45 | 0.14 | 0.983 |
| S851 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.24 | 0.08 | 0.983 |
| S852_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.28 | 0.00 | 59.28 | 0.75 | 0.20 | 0.983 |
| S852_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.28 | 0.00 | 59.28 | 0.68 | 0.18 | 0.983 |
| S853 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.04 | 0.01 | 0.983 |
| S854 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.56 | 0.18 | 0.983 |
| S855 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.16 | 0.05 | 0.983 |
| S856 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.12 | 0.04 | 0.983 |
| S857_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.35 | 0.11 | 0.983 |
| S857_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.29 | 0.09 | 0.983 |
| S858_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.44 | 0.14 | 0.983 |
| S858_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.42 | 0.13 | 0.983 |
| S859 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.50 | 0.16 | 0.983 |
| S860_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 1.30 | 0.41 | 0.983 |
| S860_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.53 | 0.17 | 0.983 |
| S861 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.65 | 0.21 | 0.983 |
| S862 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.06 | 0.02 | 0.983 |
| S863 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.06 | 0.02 | 0.983 |
| S864 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.07 | 0.02 | 0.983 |
| S865 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.07 | 0.02 | 0.983 |
| S866 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.07 | 0.02 | 0.983 |
| S867 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.15 | 0.05 | 0.983 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S868_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.29 | 0.09 | 0.983 |
| S868_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.25 | 0.08 | 0.983 |
| S869_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.14 | 0.04 | 0.983 |
| S869_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.14 | 0.05 | 0.983 |
| S870_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.34 | 0.11 | 0.983 |
| S870_3 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.31 | 0.10 | 0.983 |
| S870_4 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.35 | 0.11 | 0.983 |
| S870_5 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.37 | 0.12 | 0.983 |
| S871_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.13 | 0.04 | 0.983 |
| S871_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.30 | 0.10 | 0.983 |
| S872 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.60 | 0.19 | 0.983 |
| S873 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.38 | 0.12 | 0.983 |
| S874 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.59 | 0.19 | 0.983 |
| S875 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.81 | 0.26 | 0.983 |
| S876_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.50 | 0.16 | 0.983 |
| S876_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.37 | 0.12 | 0.983 |
| S876_3 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.29 | 0.09 | 0.983 |
| S877_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.29 | 0.09 | 0.983 |
| S877_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.51 | 0.16 | 0.983 |
| S878 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.35 | 0.11 | 0.983 |
| S879 | 60.30 | 0.00 | 0.00 | 0.00 | 59.30 | 0.00 | 59.30 | 0.33 | 0.11 | 0.983 |
| S880 | 60.30 | 0.00 | 0.00 | 0.00 | 59.28 | 0.00 | 59.28 | 0.55 | 0.15 | 0.983 |
| S881 | 60.30 | 0.00 | 0.00 | 0.00 | 59.28 | 0.00 | 59.28 | 0.37 | 0.10 | 0.983 |
| S882 | 60.30 | 0.00 | 0.00 | 0.00 | 59.28 | 0.00 | 59.28 | 0.35 | 0.09 | 0.983 |
| S883_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.79 | 0.25 | 0.983 |
| S883_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.81 | 0.26 | 0.983 |
| S884 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.47 | 0.15 | 0.983 |
| S885 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.37 | 0.12 | 0.983 |
| S886 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.42 | 0.13 | 0.983 |
| S887 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.42 | 0.13 | 0.983 |
| S888 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.37 | 0.12 | 0.983 |
| S889 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.42 | 0.13 | 0.983 |
| S890 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.42 | 0.13 | 0.983 |
| S891_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.67 | 0.21 | 0.983 |
| S891_3 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.42 | 0.13 | 0.983 |
| S891_4 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.56 | 0.18 | 0.983 |
| S892_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.66 | 0.21 | 0.983 |
| S892_3 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.43 | 0.14 | 0.983 |
| S892_4 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.56 | 0.18 | 0.983 |
| S893 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.37 | 0.11 | 0.983 |

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|---|---|---|---|---|---|---|---|---|---|---|
| S894_1 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.45 | 0.14 | 0.983 |
| S894_2 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.66 | 0.21 | 0.983 |
| S895 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.27 | 0.09 | 0.983 |
| S896 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.50 | 0.16 | 0.983 |
| S897 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.31 | 0.10 | 0.983 |
| S898 | 60.30 | 0.00 | 0.00 | 0.00 | 59.29 | 0.00 | 59.29 | 0.18 | 0.05 | 0.983 |
| S9 | 60.30 | 0.00 | 0.00 | 60.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |

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LID Performance Summary

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| Subcatchment | LID Control | Total Inflow mm | Evap Loss mm | Infil Loss mm | Surface Outflow mm | Drain Outflow mm | Initial Storage mm | Final Storage mm | Continuity Error % |
|---|---|---|---|---|---|---|---|---|---|
| S_Pond1 | Pond1 | 5492.89 | 0.00 | 20.15 | 5096.03 | 177.58 | 34.00 | 233.13 | -0.00 |
| S_Pond4 | Pond4 | 468.11 | 0.00 | 17.24 | 232.92 | 33.78 | 34.00 | 218.18 | -0.00 |
| S_Pond5 | Pond5 | 2981.18 | 0.00 | 18.90 | 2572.14 | 180.50 | 34.00 | 243.65 | -0.00 |
| S_Pond6 | Pond6 | 60.30 | 0.00 | 0.62 | 6.50 | 0.00 | 34.00 | 87.18 | -0.00 |
| S_Pond7 | Pond7 | 753.83 | 0.00 | 17.87 | 452.37 | 89.35 | 34.00 | 228.24 | -0.00 |
| S_Pond8 | Pond8 | 1936.50 | 0.00 | 18.65 | 1575.63 | 143.65 | 34.00 | 232.57 | -0.00 |

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Node Depth Summary

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| Node | Type | Average Depth Meters | Maximum Depth Meters | Maximum HGL Meters | Time of Max Occurrence days hr:min | Reported Max Depth Meters |
|---|---|---|---|---|---|---|
| J1 | JUNCTION | 0.01 | 0.03 | 98.91 | 0 12:31 | 0.03 |
| J10 | JUNCTION | 0.02 | 0.16 | 122.36 | 0 12:06 | 0.16 |
| J100 | JUNCTION | 0.07 | 0.60 | 117.02 | 0 11:59 | 0.60 |
| J101 | JUNCTION | 0.05 | 0.73 | 113.63 | 0 12:03 | 0.73 |
| J102 | JUNCTION | 0.01 | 0.05 | 117.76 | 0 11:54 | 0.05 |
| J103 | JUNCTION | 0.06 | 0.54 | 118.07 | 0 11:58 | 0.54 |
| J104 | JUNCTION | 0.06 | 0.52 | 118.43 | 0 11:56 | 0.52 |
| J105 | JUNCTION | 0.08 | 0.74 | 118.04 | 0 11:59 | 0.74 |
| J106 | JUNCTION | 0.05 | 0.36 | 118.76 | 0 11:56 | 0.36 |

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|---|---|---|---|---|---|---|---|
| J107 | JUNCTION | 1.03 | 1.44 | 121.01 | 0 | 11:55 | 1.44 |
| J108 | JUNCTION | 0.05 | 0.45 | 121.01 | 0 | 11:55 | 0.45 |
| J109 | JUNCTION | 0.08 | 0.68 | 119.21 | 0 | 11:58 | 0.68 |
| J11 | JUNCTION | 0.01 | 0.02 | 119.22 | 0 | 13:10 | 0.02 |
| J110 | JUNCTION | 0.01 | 0.08 | 119.44 | 0 | 12:00 | 0.08 |
| J111 | JUNCTION | 0.07 | 0.53 | 120.74 | 0 | 11:56 | 0.53 |
| J112 | JUNCTION | 0.08 | 0.70 | 118.39 | 0 | 11:58 | 0.70 |
| J113 | JUNCTION | 0.05 | 0.39 | 120.99 | 0 | 11:55 | 0.39 |
| J114 | JUNCTION | 0.03 | 0.32 | 120.98 | 0 | 11:55 | 0.32 |
| J115 | JUNCTION | 0.21 | 1.21 | 111.44 | 0 | 12:03 | 1.21 |
| J116 | JUNCTION | 0.08 | 0.69 | 119.04 | 0 | 11:58 | 0.69 |
| J117 | JUNCTION | 0.08 | 0.67 | 118.86 | 0 | 11:58 | 0.67 |
| J118 | JUNCTION | 0.01 | 0.45 | 110.40 | 0 | 12:08 | 0.45 |
| J119 | JUNCTION | 0.02 | 0.61 | 110.39 | 0 | 12:08 | 0.61 |
| J12 | JUNCTION | 0.01 | 0.09 | 110.50 | 0 | 11:55 | 0.09 |
| J120 | JUNCTION | 0.02 | 0.20 | 116.84 | 0 | 11:54 | 0.20 |
| J121 | JUNCTION | 0.02 | 0.17 | 114.83 | 0 | 11:54 | 0.17 |
| J122 | JUNCTION | 0.00 | 0.00 | 114.64 | 0 | 00:00 | 0.00 |
| J123 | JUNCTION | 0.02 | 0.19 | 114.08 | 0 | 11:54 | 0.19 |
| J124 | JUNCTION | 0.05 | 0.44 | 113.72 | 0 | 11:55 | 0.44 |
| J125 | JUNCTION | 0.03 | 0.22 | 117.79 | 0 | 12:00 | 0.22 |
| J127 | JUNCTION | 0.01 | 0.08 | 115.46 | 0 | 11:54 | 0.08 |
| J128 | JUNCTION | 0.06 | 0.58 | 109.76 | 0 | 11:59 | 0.58 |
| J129 | JUNCTION | 0.03 | 0.25 | 115.83 | 0 | 11:55 | 0.25 |
| J13 | JUNCTION | 0.04 | 0.31 | 96.46 | 0 | 11:54 | 0.31 |
| J130 | JUNCTION | 0.01 | 0.11 | 113.63 | 0 | 11:55 | 0.11 |
| J131 | JUNCTION | 0.03 | 0.23 | 110.11 | 0 | 11:59 | 0.23 |
| J132 | JUNCTION | 0.04 | 0.68 | 110.39 | 0 | 12:06 | 0.68 |
| J133 | JUNCTION | 0.05 | 0.39 | 113.62 | 0 | 11:56 | 0.39 |
| J134 | JUNCTION | 0.05 | 0.38 | 114.17 | 0 | 11:54 | 0.38 |
| J136 | JUNCTION | 0.04 | 0.34 | 114.05 | 0 | 11:55 | 0.34 |
| J137 | JUNCTION | 0.03 | 0.22 | 114.27 | 0 | 11:54 | 0.22 |
| J139 | JUNCTION | 0.01 | 0.09 | 113.77 | 0 | 11:54 | 0.09 |
| J14 | JUNCTION | 0.19 | 1.01 | 116.51 | 0 | 12:00 | 1.01 |
| J140 | JUNCTION | 0.04 | 0.27 | 113.12 | 0 | 11:55 | 0.27 |
| J141 | JUNCTION | 0.13 | 1.04 | 111.79 | 0 | 11:58 | 1.04 |
| J142 | JUNCTION | 0.05 | 0.38 | 101.49 | 0 | 12:00 | 0.38 |
| J143 | JUNCTION | 0.11 | 0.87 | 113.08 | 0 | 11:56 | 0.87 |
| J144 | JUNCTION | 0.10 | 0.86 | 112.03 | 0 | 11:57 | 0.86 |
| J145 | JUNCTION | 0.03 | 0.23 | 105.67 | 0 | 11:56 | 0.23 |

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|---|---|---|---|---|---|---|---|
| J146 | JUNCTION | 0.02 | 0.18 | 111.28 | 0 | 11:54 | 0.18 |
| J147 | JUNCTION | 0.23 | 1.30 | 111.04 | 0 | 12:05 | 1.30 |
| J148 | JUNCTION | 0.10 | 0.78 | 117.43 | 0 | 11:59 | 0.78 |
| J149 | JUNCTION | 0.10 | 0.80 | 117.02 | 0 | 12:00 | 0.80 |
| J15 | JUNCTION | 0.22 | 1.27 | 110.35 | 0 | 12:08 | 1.27 |
| J150 | JUNCTION | 0.06 | 1.14 | 112.61 | 0 | 12:03 | 1.14 |
| J151 | JUNCTION | 0.09 | 0.84 | 116.64 | 0 | 12:00 | 0.84 |
| J152 | JUNCTION | 0.16 | 0.85 | 116.02 | 0 | 12:00 | 0.85 |
| J153 | JUNCTION | 0.18 | 0.96 | 115.01 | 0 | 12:01 | 0.96 |
| J154 | JUNCTION | 0.03 | 0.24 | 116.37 | 0 | 11:55 | 0.24 |
| J155 | JUNCTION | 0.01 | 0.08 | 121.50 | 0 | 11:57 | 0.08 |
| J156 | JUNCTION | 0.07 | 0.52 | 121.40 | 0 | 11:54 | 0.52 |
| J157 | JUNCTION | 0.04 | 0.36 | 120.07 | 0 | 11:54 | 0.36 |
| J158 | JUNCTION | 0.04 | 0.32 | 119.89 | 0 | 11:55 | 0.32 |
| J159 | JUNCTION | 0.01 | 0.07 | 120.72 | 0 | 11:57 | 0.07 |
| J16 | JUNCTION | 0.00 | 0.00 | 93.44 | 0 | 00:00 | 0.00 |
| J160 | JUNCTION | 0.03 | 0.20 | 119.87 | 0 | 11:55 | 0.20 |
| J161 | JUNCTION | 0.03 | 0.16 | 109.55 | 0 | 12:00 | 0.16 |
| J162 | JUNCTION | 0.03 | 0.13 | 97.99 | 0 | 12:01 | 0.13 |
| J163 | JUNCTION | 0.04 | 0.19 | 107.38 | 0 | 12:02 | 0.19 |
| J164 | JUNCTION | 0.10 | 0.40 | 122.53 | 0 | 12:05 | 0.40 |
| J165 | JUNCTION | 0.00 | 0.02 | 105.84 | 0 | 12:03 | 0.02 |
| J168 | JUNCTION | 0.00 | 0.03 | 104.77 | 0 | 12:04 | 0.03 |
| J169 | JUNCTION | 0.00 | 0.03 | 111.13 | 0 | 12:00 | 0.03 |
| J17 | JUNCTION | 0.02 | 0.12 | 114.46 | 0 | 11:55 | 0.12 |
| J170 | JUNCTION | 0.00 | 0.05 | 102.69 | 0 | 12:00 | 0.05 |
| J171 | JUNCTION | 0.01 | 0.06 | 101.82 | 0 | 12:02 | 0.06 |
| J172 | JUNCTION | 0.00 | 0.00 | 108.92 | 0 | 00:00 | 0.00 |
| J173 | JUNCTION | 0.00 | 0.00 | 106.00 | 0 | 00:00 | 0.00 |
| J174 | JUNCTION | 0.00 | 0.01 | 105.25 | 0 | 11:57 | 0.01 |
| J176 | JUNCTION | 0.00 | 0.03 | 108.17 | 0 | 12:00 | 0.03 |
| J179 | JUNCTION | 0.01 | 0.07 | 104.44 | 0 | 11:54 | 0.07 |
| J18 | JUNCTION | 0.03 | 0.21 | 110.79 | 0 | 11:54 | 0.21 |
| J182 | JUNCTION | 0.02 | 0.10 | 104.34 | 0 | 11:59 | 0.10 |
| J183 | JUNCTION | 0.00 | 0.02 | 105.05 | 0 | 12:01 | 0.02 |
| J185 | JUNCTION | 0.00 | 0.03 | 98.94 | 0 | 12:02 | 0.03 |
| J186 | JUNCTION | 0.02 | 0.11 | 103.61 | 0 | 11:56 | 0.11 |
| J189 | JUNCTION | 0.00 | 0.04 | 106.12 | 0 | 12:00 | 0.04 |
| J19 | JUNCTION | 0.03 | 0.21 | 119.21 | 0 | 12:00 | 0.21 |
| J190 | JUNCTION | 0.00 | 0.04 | 95.54 | 0 | 12:03 | 0.04 |

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|---|---|---|---|---|---|---|---|
| J194 | JUNCTION | 0.18 | 1.07 | 112.69 | 0 | 12:03 | 1.06 |
| J2 | JUNCTION | 0.00 | 0.00 | 92.20 | 0 | 12:03 | 0.00 |
| J20 | JUNCTION | 0.01 | 0.07 | 85.21 | 0 | 11:54 | 0.07 |
| J203 | JUNCTION | 0.23 | 1.28 | 110.65 | 0 | 12:06 | 1.28 |
| J205 | JUNCTION | 0.05 | 0.79 | 110.38 | 0 | 12:07 | 0.79 |
| J206 | JUNCTION | 0.29 | 1.06 | 110.39 | 0 | 12:08 | 1.06 |
| J207 | JUNCTION | 0.14 | 0.91 | 110.39 | 0 | 12:07 | 0.91 |
| J208 | JUNCTION | 0.03 | 0.75 | 110.39 | 0 | 12:06 | 0.75 |
| J209 | JUNCTION | 0.01 | 0.07 | 101.27 | 0 | 12:00 | 0.07 |
| J21 | JUNCTION | 0.00 | 0.00 | 94.80 | 0 | 00:00 | 0.00 |
| J212 | JUNCTION | 0.06 | 0.48 | 120.05 | 0 | 11:56 | 0.48 |
| J217 | JUNCTION | 0.16 | 0.91 | 116.23 | 0 | 12:01 | 0.91 |
| J218 | JUNCTION | 0.08 | 0.35 | 99.60 | 0 | 12:03 | 0.35 |
| J22 | JUNCTION | 0.01 | 0.07 | 99.99 | 0 | 12:00 | 0.07 |
| J223 | JUNCTION | 0.02 | 0.12 | 102.10 | 0 | 11:55 | 0.12 |
| J23 | JUNCTION | 0.16 | 0.86 | 115.94 | 0 | 12:00 | 0.86 |
| J230 | JUNCTION | 0.03 | 0.22 | 96.42 | 0 | 12:06 | 0.22 |
| J231 | JUNCTION | 0.13 | 0.81 | 99.12 | 0 | 12:07 | 0.81 |
| J233 | JUNCTION | 0.00 | 0.00 | 107.68 | 0 | 00:00 | 0.00 |
| J234 | JUNCTION | 0.06 | 0.44 | 101.74 | 0 | 12:00 | 0.44 |
| J235 | JUNCTION | 0.00 | 0.00 | 99.66 | 0 | 00:00 | 0.00 |
| J237 | JUNCTION | 0.02 | 0.13 | 96.74 | 0 | 11:56 | 0.13 |
| J239 | JUNCTION | 0.03 | 0.14 | 93.51 | 0 | 12:00 | 0.14 |
| J24 | JUNCTION | 0.17 | 0.95 | 114.86 | 0 | 12:01 | 0.95 |
| J240 | JUNCTION | 0.04 | 0.32 | 107.54 | 0 | 11:55 | 0.32 |
| J242 | JUNCTION | 0.05 | 0.38 | 105.65 | 0 | 11:55 | 0.38 |
| J243 | JUNCTION | 0.01 | 0.05 | 102.06 | 0 | 11:59 | 0.05 |
| J244 | JUNCTION | 0.03 | 0.27 | 99.02 | 0 | 11:55 | 0.27 |
| J25 | JUNCTION | 0.04 | 0.34 | 122.66 | 0 | 12:02 | 0.34 |
| J253 | JUNCTION | 0.03 | 0.25 | 101.86 | 0 | 11:54 | 0.25 |
| J255 | JUNCTION | 0.01 | 0.27 | 102.14 | 0 | 11:56 | 0.27 |
| J256 | JUNCTION | 0.07 | 0.51 | 101.95 | 0 | 12:00 | 0.51 |
| J257 | JUNCTION | 0.01 | 0.09 | 106.84 | 0 | 11:54 | 0.09 |
| J258 | JUNCTION | 0.03 | 0.20 | 106.54 | 0 | 11:55 | 0.20 |
| J259 | JUNCTION | 0.05 | 0.35 | 116.01 | 0 | 11:57 | 0.35 |
| J26 | JUNCTION | 0.00 | 0.02 | 100.83 | 0 | 12:00 | 0.02 |
| J260 | JUNCTION | 0.06 | 0.50 | 102.37 | 0 | 11:58 | 0.50 |
| J263 | JUNCTION | 0.07 | 0.45 | 109.32 | 0 | 12:03 | 0.45 |
| J265 | JUNCTION | 0.07 | 0.38 | 109.87 | 0 | 12:15 | 0.38 |
| J267 | JUNCTION | 0.07 | 0.58 | 114.55 | 0 | 11:57 | 0.58 |

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|---|---|---|---|---|---|---|---|
| J27 | JUNCTION | 0.01 | 0.07 | 100.53 | 0 | 12:01 | 0.07 |
| J270 | JUNCTION | 0.06 | 0.42 | 115.82 | 0 | 11:57 | 0.42 |
| J273 | JUNCTION | 0.06 | 0.34 | 110.43 | 0 | 12:15 | 0.34 |
| J274 | JUNCTION | 0.06 | 0.33 | 111.56 | 0 | 12:14 | 0.33 |
| J275 | JUNCTION | 0.05 | 0.32 | 111.86 | 0 | 12:13 | 0.32 |
| J277 | JUNCTION | 0.33 | 0.95 | 109.67 | 0 | 12:30 | 0.95 |
| J279 | JUNCTION | 0.16 | 0.82 | 109.72 | 0 | 12:34 | 0.82 |
| J28 | JUNCTION | 0.00 | 0.00 | 104.67 | 0 | 00:00 | 0.00 |
| J280 | JUNCTION | 0.07 | 0.57 | 113.46 | 0 | 11:56 | 0.57 |
| J281 | JUNCTION | 0.00 | 0.00 | 105.38 | 0 | 00:00 | 0.00 |
| J282 | JUNCTION | 0.07 | 0.65 | 109.72 | 0 | 12:34 | 0.65 |
| J285 | JUNCTION | 0.02 | 0.13 | 110.44 | 0 | 12:12 | 0.13 |
| J289 | JUNCTION | 0.00 | 0.00 | 114.60 | 0 | 00:00 | 0.00 |
| J29 | JUNCTION | 0.01 | 0.09 | 93.84 | 0 | 11:55 | 0.09 |
| J299 | JUNCTION | 0.10 | 0.50 | 111.33 | 0 | 12:12 | 0.50 |
| J30 | JUNCTION | 0.07 | 0.48 | 94.55 | 0 | 11:57 | 0.48 |
| J301 | JUNCTION | 0.08 | 0.46 | 113.14 | 0 | 12:12 | 0.46 |
| J302 | JUNCTION | 0.02 | 0.18 | 115.19 | 0 | 11:54 | 0.18 |
| J305 | JUNCTION | 0.08 | 0.74 | 111.80 | 0 | 11:57 | 0.74 |
| J306 | JUNCTION | 0.08 | 0.68 | 112.71 | 0 | 11:57 | 0.68 |
| J308 | JUNCTION | 0.05 | 0.32 | 113.36 | 0 | 12:10 | 0.32 |
| J309 | JUNCTION | 0.01 | 0.08 | 111.92 | 0 | 12:11 | 0.08 |
| J31 | JUNCTION | 0.06 | 0.49 | 100.26 | 0 | 11:57 | 0.49 |
| J310 | JUNCTION | 0.02 | 0.39 | 111.05 | 0 | 12:04 | 0.39 |
| J311 | JUNCTION | 0.08 | 0.39 | 112.88 | 0 | 12:09 | 0.39 |
| J312 | JUNCTION | 0.08 | 0.45 | 114.66 | 0 | 12:09 | 0.45 |
| J316 | JUNCTION | 0.03 | 0.23 | 116.72 | 0 | 12:00 | 0.23 |
| J317 | JUNCTION | 0.05 | 0.32 | 114.89 | 0 | 12:07 | 0.32 |
| J319 | JUNCTION | 0.01 | 0.07 | 116.26 | 0 | 12:01 | 0.07 |
| J32 | JUNCTION | 0.06 | 0.48 | 101.52 | 0 | 11:56 | 0.48 |
| J321 | JUNCTION | 0.10 | 0.83 | 118.06 | 0 | 11:58 | 0.83 |
| J325 | JUNCTION | 0.01 | 0.06 | 117.31 | 0 | 11:57 | 0.06 |
| J327 | JUNCTION | 0.01 | 0.06 | 118.73 | 0 | 11:57 | 0.06 |
| J33 | JUNCTION | 0.01 | 0.07 | 108.26 | 0 | 11:54 | 0.07 |
| J330 | JUNCTION | 0.01 | 0.05 | 116.69 | 0 | 12:02 | 0.05 |
| J331 | JUNCTION | 0.07 | 0.36 | 114.72 | 0 | 12:08 | 0.36 |
| J333 | JUNCTION | 0.01 | 0.08 | 113.46 | 0 | 12:05 | 0.08 |
| J334 | JUNCTION | 0.05 | 0.25 | 104.54 | 0 | 12:03 | 0.25 |
| J336 | JUNCTION | 0.01 | 0.05 | 103.34 | 0 | 12:06 | 0.05 |
| J338 | JUNCTION | 0.05 | 0.28 | 102.28 | 0 | 12:10 | 0.28 |

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|---|---|---|---|---|---|---|---|
| J34 | JUNCTION | 0.06 | 0.49 | 103.32 | 0 | 11:55 | 0.49 |
| J345 | JUNCTION | 0.01 | 0.05 | 101.36 | 0 | 12:11 | 0.05 |
| J348 | JUNCTION | 0.07 | 0.34 | 100.66 | 0 | 12:09 | 0.34 |
| J349 | JUNCTION | 0.04 | 0.32 | 114.01 | 0 | 11:55 | 0.32 |
| J35 | JUNCTION | 0.18 | 1.26 | 111.04 | 0 | 12:05 | 1.26 |
| J350 | JUNCTION | 0.01 | 0.06 | 99.23 | 0 | 12:10 | 0.06 |
| J351 | JUNCTION | 0.07 | 0.52 | 102.13 | 0 | 11:59 | 0.52 |
| J353 | JUNCTION | 0.01 | 0.07 | 103.99 | 0 | 12:00 | 0.07 |
| J357 | JUNCTION | 0.02 | 0.13 | 109.76 | 0 | 12:21 | 0.13 |
| J358 | JUNCTION | 0.03 | 0.14 | 112.66 | 0 | 12:00 | 0.14 |
| J359 | JUNCTION | 0.05 | 0.36 | 104.21 | 0 | 11:57 | 0.36 |
| J36 | JUNCTION | 0.03 | 0.26 | 115.66 | 0 | 11:54 | 0.26 |
| J360 | JUNCTION | 0.00 | 0.04 | 83.93 | 0 | 11:59 | 0.04 |
| J361 | JUNCTION | 0.02 | 0.20 | 93.83 | 0 | 11:57 | 0.20 |
| J37 | JUNCTION | 0.04 | 0.29 | 118.91 | 0 | 11:54 | 0.29 |
| J38 | JUNCTION | 0.06 | 0.48 | 120.49 | 0 | 11:56 | 0.48 |
| J39 | JUNCTION | 0.02 | 0.18 | 116.26 | 0 | 11:54 | 0.18 |
| J4 | JUNCTION | 0.01 | 0.03 | 88.03 | 0 | 13:45 | 0.03 |
| J40 | JUNCTION | 0.02 | 0.19 | 116.45 | 0 | 11:54 | 0.19 |
| J41 | JUNCTION | 0.06 | 0.47 | 116.37 | 0 | 11:57 | 0.47 |
| J42 | JUNCTION | 0.01 | 0.09 | 122.66 | 0 | 11:54 | 0.09 |
| J43 | JUNCTION | 0.01 | 0.06 | 118.61 | 0 | 11:54 | 0.06 |
| J44 | JUNCTION | 0.03 | 0.27 | 122.67 | 0 | 12:01 | 0.27 |
| J45 | JUNCTION | 0.07 | 0.62 | 119.84 | 0 | 11:56 | 0.62 |
| J46 | JUNCTION | 0.04 | 0.33 | 121.30 | 0 | 11:54 | 0.33 |
| J47 | JUNCTION | 0.17 | 1.01 | 113.55 | 0 | 12:02 | 1.01 |
| J48 | JUNCTION | 0.01 | 0.07 | 118.63 | 0 | 11:55 | 0.07 |
| J49 | JUNCTION | 0.08 | 0.65 | 119.73 | 0 | 11:57 | 0.65 |
| J5 | JUNCTION | 0.00 | 0.01 | 80.01 | 0 | 12:31 | 0.01 |
| J50 | JUNCTION | 0.08 | 0.70 | 119.36 | 0 | 11:58 | 0.70 |
| J51 | JUNCTION | 0.02 | 0.46 | 119.36 | 0 | 11:58 | 0.46 |
| J52 | JUNCTION | 0.15 | 0.71 | 109.73 | 0 | 12:07 | 0.71 |
| J53 | JUNCTION | 0.02 | 0.18 | 117.15 | 0 | 11:55 | 0.18 |
| J54 | JUNCTION | 0.05 | 0.62 | 118.07 | 0 | 11:58 | 0.62 |
| J55 | JUNCTION | 0.17 | 0.95 | 115.15 | 0 | 12:01 | 0.95 |
| J56 | JUNCTION | 0.07 | 0.64 | 115.65 | 0 | 12:00 | 0.64 |
| J57 | JUNCTION | 0.03 | 0.33 | 115.63 | 0 | 12:01 | 0.33 |
| J58 | JUNCTION | 0.17 | 0.93 | 115.62 | 0 | 12:00 | 0.93 |
| J59 | JUNCTION | 0.08 | 0.68 | 118.40 | 0 | 11:54 | 0.68 |
| J6 | JUNCTION | 0.01 | 0.02 | 90.14 | 0 | 12:45 | 0.02 |

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|---|---|---|---|---|---|---|---|
| J60 | JUNCTION | 0.10 | 0.82 | 118.29 | 0 | 11:56 | 0.82 |
| J61 | JUNCTION | 0.04 | 0.52 | 123.14 | 0 | 12:01 | 0.52 |
| J62 | JUNCTION | 0.06 | 0.59 | 123.14 | 0 | 12:01 | 0.59 |
| J63 | JUNCTION | 0.05 | 0.50 | 123.16 | 0 | 12:00 | 0.50 |
| J64 | JUNCTION | 0.01 | 0.10 | 110.92 | 0 | 11:55 | 0.10 |
| J65 | JUNCTION | 0.07 | 0.61 | 123.14 | 0 | 12:00 | 0.61 |
| J66 | JUNCTION | 0.01 | 0.09 | 110.23 | 0 | 11:56 | 0.09 |
| J67 | JUNCTION | 0.08 | 0.62 | 123.15 | 0 | 12:00 | 0.62 |
| J68 | JUNCTION | 0.05 | 0.43 | 104.95 | 0 | 11:55 | 0.43 |
| J69 | JUNCTION | 0.02 | 0.15 | 102.01 | 0 | 11:54 | 0.15 |
| J7 | JUNCTION | 0.02 | 0.04 | 107.76 | 0 | 14:05 | 0.04 |
| J70 | JUNCTION | 0.10 | 0.65 | 123.12 | 0 | 12:00 | 0.65 |
| J71 | JUNCTION | 0.00 | 0.00 | 102.23 | 0 | 00:00 | 0.00 |
| J72 | JUNCTION | 0.09 | 0.78 | 113.78 | 0 | 11:55 | 0.78 |
| J73 | JUNCTION | 0.01 | 0.06 | 95.77 | 0 | 11:57 | 0.06 |
| J74 | JUNCTION | 0.06 | 0.53 | 123.06 | 0 | 12:00 | 0.53 |
| J75 | JUNCTION | 0.05 | 0.45 | 110.11 | 0 | 11:58 | 0.45 |
| J76 | JUNCTION | 0.13 | 0.64 | 123.06 | 0 | 12:01 | 0.64 |
| J77 | JUNCTION | 0.10 | 0.83 | 117.60 | 0 | 11:58 | 0.83 |
| J78 | JUNCTION | 0.03 | 0.25 | 121.51 | 0 | 11:54 | 0.25 |
| J79 | JUNCTION | 0.01 | 0.09 | 93.57 | 0 | 11:58 | 0.09 |
| J8 | JUNCTION | 0.08 | 0.67 | 118.69 | 0 | 11:58 | 0.67 |
| J80 | JUNCTION | 0.01 | 0.08 | 121.74 | 0 | 11:54 | 0.08 |
| J81 | JUNCTION | 0.13 | 1.02 | 111.23 | 0 | 11:58 | 1.02 |
| J82 | JUNCTION | 0.05 | 0.41 | 112.81 | 0 | 11:56 | 0.41 |
| J83 | JUNCTION | 0.03 | 0.21 | 120.69 | 0 | 11:54 | 0.21 |
| J84 | JUNCTION | 0.09 | 0.72 | 116.86 | 0 | 11:59 | 0.72 |
| J85 | JUNCTION | 0.20 | 1.30 | 112.36 | 0 | 12:03 | 1.30 |
| J86 | JUNCTION | 0.03 | 0.23 | 120.72 | 0 | 11:54 | 0.23 |
| J87 | JUNCTION | 0.04 | 0.35 | 114.08 | 0 | 11:55 | 0.35 |
| J88 | JUNCTION | 0.01 | 0.08 | 120.83 | 0 | 11:54 | 0.08 |
| J89 | JUNCTION | 0.03 | 0.26 | 118.97 | 0 | 11:54 | 0.26 |
| J9 | JUNCTION | 0.10 | 0.78 | 118.04 | 0 | 11:59 | 0.78 |
| J90 | JUNCTION | 0.06 | 0.62 | 118.30 | 0 | 11:57 | 0.62 |
| J91 | JUNCTION | 0.02 | 0.12 | 111.14 | 0 | 11:54 | 0.12 |
| J92 | JUNCTION | 0.05 | 0.36 | 117.72 | 0 | 11:54 | 0.36 |
| J93 | JUNCTION | 0.06 | 0.48 | 118.51 | 0 | 11:56 | 0.48 |
| J94 | JUNCTION | 0.06 | 0.48 | 118.79 | 0 | 11:55 | 0.48 |
| J95 | JUNCTION | 0.17 | 0.94 | 114.30 | 0 | 12:00 | 0.94 |
| J96 | JUNCTION | 0.05 | 0.36 | 117.09 | 0 | 11:57 | 0.36 |

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|---|---|---|---|---|---|---|---|
| J97 | JUNCTION | 0.05 | 0.42 | 119.08 | 0 | 11:54 | 0.42 |
| J98 | JUNCTION | 0.05 | 0.42 | 118.80 | 0 | 11:54 | 0.42 |
| J99 | JUNCTION | 0.05 | 0.40 | 117.42 | 0 | 11:57 | 0.40 |
| OF1 | JUNCTION | 0.03 | 0.56 | 116.51 | 0 | 12:01 | 0.56 |
| OF_Pond1 | OUTFALL | 0.09 | 0.72 | 116.77 | 0 | 11:59 | 0.72 |
| OF_Pond2 | OUTFALL | 0.07 | 0.45 | 108.70 | 0 | 12:03 | 0.45 |
| OF_Pond3 | OUTFALL | 0.02 | 0.20 | 93.20 | 0 | 11:57 | 0.20 |
| OF_Pond4 | OUTFALL | 0.00 | 0.04 | 83.54 | 0 | 11:59 | 0.04 |
| OF_Pond5 | OUTFALL | 0.03 | 0.22 | 96.22 | 0 | 12:06 | 0.22 |
| OF_Pond6 | OUTFALL | 0.00 | 0.04 | 94.04 | 0 | 12:03 | 0.04 |
| OF_Pond7 | OUTFALL | 0.01 | 0.06 | 100.56 | 0 | 12:02 | 0.06 |
| OF_Pond8 | OUTFALL | 0.02 | 0.16 | 122.16 | 0 | 12:06 | 0.16 |
| OF2 | OUTFALL | 0.02 | 0.04 | 106.54 | 0 | 14:05 | 0.04 |
| OF3 | OUTFALL | 0.01 | 0.02 | 87.02 | 0 | 12:45 | 0.02 |
| OF4 | OUTFALL | 0.00 | 0.01 | 78.01 | 0 | 12:31 | 0.01 |
| OF5 | OUTFALL | 0.01 | 0.03 | 87.03 | 0 | 13:45 | 0.03 |
| OF6 | OUTFALL | 0.00 | 0.00 | 92.00 | 0 | 12:03 | 0.00 |
| OF7 | OUTFALL | 0.01 | 0.03 | 98.03 | 0 | 12:31 | 0.03 |
| OF8 | OUTFALL | 0.01 | 0.02 | 115.02 | 0 | 13:10 | 0.02 |
| SU1_Pond1 | STORAGE | 0.50 | 1.26 | 117.26 | 0 | 13:00 | 1.26 |
| SU2_Pond2 | STORAGE | 3.22 | 3.80 | 108.80 | 0 | 14:04 | 3.80 |
| SU3_Pond3 | STORAGE | 0.23 | 0.80 | 93.80 | 0 | 12:45 | 0.80 |
| SU4_Pond4 | STORAGE | 0.04 | 0.20 | 83.70 | 0 | 12:30 | 0.20 |
| SU5_Pond5 | STORAGE | 0.51 | 1.34 | 97.34 | 0 | 13:45 | 1.34 |
| SU6_Pond6 | STORAGE | 0.00 | 0.03 | 94.03 | 0 | 12:00 | 0.03 |
| SU7_Pond7 | STORAGE | 0.13 | 0.94 | 101.44 | 0 | 12:31 | 0.94 |
| SU8_Pond8 | STORAGE | 0.27 | 0.95 | 122.95 | 0 | 13:09 | 0.95 |

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Node Inflow Summary

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| Node | Type | Maximum Lateral Inflow CMS | Maximum Total Inflow CMS | Time of Max Occurrence days hr:min | Lateral Inflow Volume 10^6 ltr | Total Inflow Volume 10^6 ltr | Flow Balance Error Percent |
|---|---|---|---|---|---|---|---|
| J1 | JUNCTION | 0.000 | 0.120 | 0 12:31 | 0 | 1.46 | 0.007 |
| J10 | JUNCTION | 0.000 | 0.885 | 0 12:06 | 0 | 3.84 | 0.006 |
| J100 | JUNCTION | 0.000 | 1.046 | 0 11:56 | 0 | 3.57 | 0.037 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| J101 | JUNCTION | 0.045 | 1.007 | 0 | 12:05 | 0.14 | 2.45 | 0.034 |
| J102 | JUNCTION | 0.013 | 0.013 | 0 | 11:54 | 0.0382 | 0.0382 | -0.151 |
| J103 | JUNCTION | 0.010 | 1.285 | 0 | 11:56 | 0.028 | 4.21 | 0.005 |
| J104 | JUNCTION | 0.000 | 1.056 | 0 | 11:55 | 0 | 3.43 | 0.017 |
| J105 | JUNCTION | 0.000 | 1.272 | 0 | 11:57 | 0 | 4.21 | 0.003 |
| J106 | JUNCTION | 0.000 | 0.560 | 0 | 11:55 | 0 | 1.8 | 0.010 |
| J107 | JUNCTION | 0.054 | 0.054 | 0 | 11:54 | 0.177 | 0.192 | 9.002 |
| J108 | JUNCTION | 0.098 | 0.887 | 0 | 11:55 | 0.288 | 2.84 | 0.001 |
| J109 | JUNCTION | 0.001 | 1.730 | 0 | 11:58 | 0.00459 | 5.75 | -0.003 |
| J11 | JUNCTION | 0.000 | 0.115 | 0 | 13:09 | 0 | 3.47 | 0.007 |
| J110 | JUNCTION | 0.032 | 0.032 | 0 | 12:00 | 0.122 | 0.122 | -0.010 |
| J111 | JUNCTION | 0.030 | 1.412 | 0 | 11:55 | 0.112 | 4.58 | 0.004 |
| J112 | JUNCTION | 0.015 | 1.760 | 0 | 11:58 | 0.0461 | 5.84 | -0.002 |
| J113 | JUNCTION | 0.234 | 0.502 | 0 | 11:55 | 0.752 | 1.64 | -0.007 |
| J114 | JUNCTION | 0.000 | 0.280 | 0 | 11:54 | 0 | 0.891 | 0.020 |
| J115 | JUNCTION | 0.054 | 6.792 | 0 | 12:03 | 0.169 | 34 | 0.007 |
| J116 | JUNCTION | 0.015 | 1.744 | 0 | 11:58 | 0.0467 | 5.79 | 0.004 |
| J117 | JUNCTION | 0.000 | 1.743 | 0 | 11:58 | 0 | 5.79 | 0.001 |
| J118 | JUNCTION | 0.000 | 0.104 | 0 | 12:02 | 0 | 0.0172 | 2.558 |
| J119 | JUNCTION | 0.019 | 0.177 | 0 | 12:00 | 0.0516 | 0.115 | -0.263 |
| J12 | JUNCTION | 0.000 | 0.044 | 0 | 11:55 | 0 | 0.134 | 0.002 |
| J120 | JUNCTION | 0.204 | 0.204 | 0 | 11:54 | 0.604 | 0.604 | -0.015 |
| J121 | JUNCTION | 0.173 | 0.173 | 0 | 11:54 | 0.542 | 0.542 | -0.015 |
| J122 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J123 | JUNCTION | 0.187 | 0.187 | 0 | 11:54 | 0.589 | 0.589 | -0.017 |
| J124 | JUNCTION | 0.052 | 0.869 | 0 | 11:55 | 0.21 | 2.87 | 0.006 |
| J125 | JUNCTION | 0.000 | 0.194 | 0 | 12:00 | 0 | 0.738 | 0.019 |
| J127 | JUNCTION | 0.037 | 0.037 | 0 | 11:54 | 0.102 | 0.102 | -0.128 |
| J128 | JUNCTION | 0.000 | 6.535 | 0 | 11:58 | 0 | 22.3 | -0.018 |
| J129 | JUNCTION | 0.320 | 0.320 | 0 | 11:54 | 1.13 | 1.13 | -0.004 |
| J13 | JUNCTION | 0.598 | 1.072 | 0 | 11:54 | 1.93 | 3.52 | -0.003 |
| J130 | JUNCTION | 0.014 | 0.014 | 0 | 11:54 | 0.0356 | 0.0356 | -0.219 |
| J131 | JUNCTION | 0.161 | 0.161 | 0 | 11:54 | 0.505 | 0.505 | -0.048 |
| J132 | JUNCTION | 0.159 | 0.321 | 0 | 11:54 | 0.5 | 1.03 | 0.095 |
| J133 | JUNCTION | 0.325 | 0.638 | 0 | 11:55 | 1.02 | 2.18 | 0.005 |
| J134 | JUNCTION | 0.224 | 0.224 | 0 | 11:54 | 0.692 | 0.692 | -0.023 |
| J136 | JUNCTION | 0.429 | 0.676 | 0 | 11:54 | 1.46 | 2.25 | 0.008 |
| J137 | JUNCTION | 0.434 | 0.434 | 0 | 11:54 | 1.45 | 1.45 | -0.010 |
| J139 | JUNCTION | 0.044 | 0.044 | 0 | 11:54 | 0.139 | 0.139 | -0.016 |
| J14 | JUNCTION | 0.042 | 3.212 | 0 | 12:01 | 0.151 | 21 | 0.009 |

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|---|---|---|---|---|---|---|---|---|
| J140 | JUNCTION | 0.320 | 0.363 | 0 | 11:54 | 1.02 | 1.16 | -0.038 |
| J141 | JUNCTION | 0.042 | 5.630 | 0 | 11:58 | 0.132 | 19.2 | 0.005 |
| J142 | JUNCTION | 0.000 | 1.330 | 0 | 12:00 | 0 | 4.68 | -0.023 |
| J143 | JUNCTION | 0.947 | 3.496 | 0 | 11:56 | 2.94 | 11.9 | -0.002 |
| J144 | JUNCTION | 0.092 | 3.593 | 0 | 11:56 | 0.297 | 12.2 | -0.002 |
| J145 | JUNCTION | 0.057 | 0.276 | 0 | 11:55 | 0.177 | 0.992 | 0.009 |
| J146 | JUNCTION | 0.168 | 0.168 | 0 | 11:54 | 0.528 | 0.528 | -0.207 |
| J147 | JUNCTION | 0.000 | 6.505 | 0 | 12:04 | 0 | 34.6 | 0.011 |
| J148 | JUNCTION | 0.000 | 3.050 | 0 | 11:59 | 0 | 10.1 | 0.000 |
| J149 | JUNCTION | 0.000 | 3.055 | 0 | 11:59 | 0 | 10.1 | -0.001 |
| J15 | JUNCTION | 0.026 | 6.483 | 0 | 12:06 | 0.0802 | 36.1 | 0.046 |
| J150 | JUNCTION | 0.134 | 2.491 | 0 | 12:03 | 0.442 | 4.97 | 0.059 |
| J151 | JUNCTION | 0.000 | 3.056 | 0 | 12:00 | 0 | 10.1 | -0.008 |
| J152 | JUNCTION | 0.000 | 3.396 | 0 | 12:01 | 0 | 21.8 | 0.001 |
| J153 | JUNCTION | 0.000 | 4.575 | 0 | 12:01 | 0 | 26 | 0.004 |
| J154 | JUNCTION | 0.109 | 0.312 | 0 | 11:54 | 0.404 | 1.01 | 0.009 |
| J155 | JUNCTION | 0.000 | 0.039 | 0 | 11:54 | 0 | 0.122 | 0.062 |
| J156 | JUNCTION | 0.577 | 0.751 | 0 | 11:54 | 1.81 | 2.38 | -0.005 |
| J157 | JUNCTION | 0.371 | 0.565 | 0 | 11:54 | 1.18 | 1.8 | -0.008 |
| J158 | JUNCTION | 0.260 | 0.524 | 0 | 11:54 | 0.799 | 1.63 | -0.022 |
| J159 | JUNCTION | 0.000 | 0.028 | 0 | 11:54 | 0 | 0.0846 | -0.077 |
| J16 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J160 | JUNCTION | 0.206 | 0.241 | 0 | 11:54 | 0.645 | 0.756 | -0.054 |
| J161 | JUNCTION | 0.037 | 0.094 | 0 | 11:59 | 0.115 | 0.327 | -0.031 |
| J162 | JUNCTION | 0.000 | 0.050 | 0 | 11:56 | 0 | 0.16 | -0.392 |
| J163 | JUNCTION | 0.000 | 0.090 | 0 | 12:00 | 0 | 0.327 | 0.099 |
| J164 | JUNCTION | 0.040 | 0.938 | 0 | 12:02 | 0.124 | 3.89 | 1.459 |
| J165 | JUNCTION | 0.000 | 0.086 | 0 | 12:02 | 0 | 0.327 | 0.008 |
| J168 | JUNCTION | 0.033 | 0.105 | 0 | 12:00 | 0.102 | 0.429 | 0.005 |
| J169 | JUNCTION | 0.173 | 0.173 | 0 | 12:00 | 0.638 | 0.638 | -0.000 |
| J17 | JUNCTION | 0.045 | 0.045 | 0 | 11:54 | 0.139 | 0.139 | -0.145 |
| J170 | JUNCTION | 0.197 | 0.369 | 0 | 12:00 | 0.728 | 1.37 | 0.003 |
| J171 | JUNCTION | 0.000 | 0.481 | 0 | 12:00 | 0 | 1.87 | 0.013 |
| J172 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J173 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J174 | JUNCTION | 0.025 | 0.025 | 0 | 11:54 | 0.0794 | 0.0794 | -0.030 |
| J176 | JUNCTION | 0.097 | 0.097 | 0 | 12:00 | 0.357 | 0.357 | 0.004 |
| J179 | JUNCTION | 0.017 | 0.017 | 0 | 11:54 | 0.0518 | 0.0518 | -0.025 |
| J18 | JUNCTION | 0.291 | 0.291 | 0 | 11:54 | 0.921 | 0.921 | -0.010 |
| J182 | JUNCTION | 0.000 | 0.016 | 0 | 11:54 | 0 | 0.0518 | 0.176 |

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|---|---|---|---|---|---|---|---|---|
| J183 | JUNCTION | 0.000 | 0.095 | 0 | 12:00 | 0 | 0.357 | 0.003 |
| J185 | JUNCTION | 0.000 | 0.134 | 0 | 12:00 | 0 | 0.506 | 0.014 |
| J186 | JUNCTION | 0.031 | 0.044 | 0 | 11:55 | 0.0976 | 0.149 | -0.073 |
| J189 | JUNCTION | 0.211 | 0.211 | 0 | 12:00 | 0.78 | 0.78 | -0.003 |
| J19 | JUNCTION | 0.162 | 0.194 | 0 | 12:00 | 0.616 | 0.738 | -0.016 |
| J190 | JUNCTION | 0.023 | 0.146 | 0 | 12:01 | 0.0713 | 0.578 | 0.010 |
| J194 | JUNCTION | 0.000 | 5.595 | 0 | 12:02 | 0 | 29 | 0.008 |
| J2 | JUNCTION | 0.000 | 0.001 | 0 | 12:00 | 0 | 0.0059 | -0.304 |
| J20 | JUNCTION | 0.039 | 0.039 | 0 | 11:54 | 0.123 | 0.123 | -0.009 |
| J203 | JUNCTION | 0.037 | 6.500 | 0 | 12:05 | 0.122 | 34.6 | 0.011 |
| J205 | JUNCTION | 0.029 | 0.711 | 0 | 12:01 | 0.0875 | 1.67 | -0.062 |
| J206 | JUNCTION | 0.000 | 0.506 | 0 | 12:01 | 0 | 0.538 | 3.280 |
| J207 | JUNCTION | 0.030 | 0.388 | 0 | 12:02 | 0.0938 | 0.378 | 1.259 |
| J208 | JUNCTION | 0.000 | 0.256 | 0 | 12:00 | 0 | 0.189 | -0.006 |
| J209 | JUNCTION | 0.060 | 0.540 | 0 | 12:00 | 0.222 | 2.01 | 0.004 |
| J21 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J212 | JUNCTION | 0.000 | 1.445 | 0 | 11:56 | 0 | 4.71 | -0.002 |
| J217 | JUNCTION | 0.259 | 3.397 | 0 | 12:00 | 0.812 | 21.8 | 0.002 |
| J218 | JUNCTION | 0.023 | 0.563 | 0 | 12:01 | 0.0701 | 2.15 | 0.086 |
| J22 | JUNCTION | 0.247 | 0.592 | 0 | 11:59 | 0.913 | 2.18 | -0.060 |
| J223 | JUNCTION | 0.051 | 0.051 | 0 | 11:54 | 0.16 | 0.16 | -0.262 |
| J23 | JUNCTION | 0.027 | 3.425 | 0 | 12:01 | 0.102 | 21.9 | 0.003 |
| J230 | JUNCTION | 0.050 | 2.400 | 0 | 12:06 | 0.156 | 13.1 | 0.025 |
| J231 | JUNCTION | 0.168 | 2.432 | 0 | 12:00 | 0.637 | 10.7 | 0.221 |
| J233 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J234 | JUNCTION | 0.032 | 1.331 | 0 | 11:59 | 0.0992 | 4.68 | 0.005 |
| J235 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J237 | JUNCTION | 0.060 | 0.060 | 0 | 11:54 | 0.188 | 0.188 | -0.114 |
| J239 | JUNCTION | 0.021 | 0.076 | 0 | 11:56 | 0.0658 | 0.254 | 0.108 |
| J24 | JUNCTION | 0.004 | 4.575 | 0 | 12:01 | 0.0116 | 26 | 0.003 |
| J240 | JUNCTION | 0.415 | 0.695 | 0 | 11:54 | 1.3 | 2.22 | 0.002 |
| J242 | JUNCTION | 0.236 | 0.912 | 0 | 11:54 | 0.741 | 2.96 | 0.003 |
| J243 | JUNCTION | 0.357 | 0.357 | 0 | 11:54 | 1.26 | 1.26 | 0.000 |
| J244 | JUNCTION | 0.362 | 0.498 | 0 | 11:54 | 1.14 | 1.6 | 0.003 |
| J25 | JUNCTION | 0.123 | 0.977 | 0 | 12:00 | 0.384 | 3.77 | -0.019 |
| J253 | JUNCTION | 0.304 | 0.304 | 0 | 11:54 | 0.953 | 0.953 | -0.058 |
| J255 | JUNCTION | 0.000 | 0.050 | 0 | 11:53 | 0 | 0.0212 | 2.071 |
| J256 | JUNCTION | 0.000 | 0.518 | 0 | 11:59 | 0 | 1.8 | 0.008 |
| J257 | JUNCTION | 0.037 | 0.037 | 0 | 11:54 | 0.109 | 0.109 | -0.028 |
| J258 | JUNCTION | 0.187 | 0.221 | 0 | 11:54 | 0.706 | 0.814 | -0.000 |

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|---|---|---|---|---|---|---|---|---|
| J259 | JUNCTION | 0.093 | 0.540 | 0 | 11:56 | 0.35 | 1.97 | 0.021 |
| J26 | JUNCTION | 0.021 | 0.021 | 0 | 11:54 | 0.0666 | 0.0666 | -0.031 |
| J260 | JUNCTION | 0.167 | 0.798 | 0 | 11:56 | 0.524 | 2.78 | 0.005 |
| J263 | JUNCTION | 0.000 | 11.642 | 0 | 12:02 | 0 | 68.5 | 0.009 |
| J265 | JUNCTION | 0.263 | 0.533 | 0 | 12:13 | 0.928 | 3.54 | -0.037 |
| J267 | JUNCTION | 0.739 | 1.618 | 0 | 11:56 | 2.38 | 5.63 | 0.004 |
| J27 | JUNCTION | 0.000 | 0.554 | 0 | 12:00 | 0 | 2.08 | -0.006 |
| J270 | JUNCTION | 0.414 | 0.923 | 0 | 11:56 | 1.28 | 3.25 | -0.001 |
| J273 | JUNCTION | 0.058 | 0.454 | 0 | 12:14 | 0.221 | 2.61 | 0.013 |
| J274 | JUNCTION | 0.000 | 0.434 | 0 | 12:13 | 0 | 2.39 | 0.009 |
| J275 | JUNCTION | 0.000 | 0.435 | 0 | 12:12 | 0 | 2.39 | 0.010 |
| J277 | JUNCTION | 0.048 | 1.070 | 0 | 12:38 | 0.183 | 10.3 | 0.180 |
| J279 | JUNCTION | 0.000 | 0.753 | 0 | 12:39 | 0 | 6.56 | 0.073 |
| J28 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J280 | JUNCTION | 0.000 | 1.291 | 0 | 11:56 | 0 | 4.43 | 0.005 |
| J281 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J282 | JUNCTION | 0.213 | 0.815 | 0 | 12:19 | 0.786 | 6.45 | 0.088 |
| J285 | JUNCTION | 0.000 | 0.761 | 0 | 12:13 | 0 | 5.3 | 0.036 |
| J289 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J29 | JUNCTION | 0.036 | 0.036 | 0 | 11:54 | 0.12 | 0.12 | -0.004 |
| J299 | JUNCTION | 0.403 | 0.803 | 0 | 12:06 | 1.53 | 5.31 | 0.233 |
| J30 | JUNCTION | 0.025 | 1.873 | 0 | 11:57 | 0.0713 | 6.16 | 0.000 |
| J301 | JUNCTION | 0.000 | 0.437 | 0 | 12:10 | 0 | 2.39 | -0.003 |
| J302 | JUNCTION | 0.260 | 0.260 | 0 | 11:54 | 0.775 | 0.775 | -0.015 |
| J305 | JUNCTION | 0.072 | 2.015 | 0 | 11:57 | 0.249 | 6.88 | 0.003 |
| J306 | JUNCTION | 0.329 | 1.946 | 0 | 11:56 | 1.03 | 6.63 | 0.003 |
| J308 | JUNCTION | 0.000 | 0.438 | 0 | 12:10 | 0 | 2.39 | 0.009 |
| J309 | JUNCTION | 0.000 | 0.602 | 0 | 12:09 | 0 | 3.78 | 0.020 |
| J31 | JUNCTION | 0.158 | 1.859 | 0 | 11:56 | 0.501 | 6.09 | 0.008 |
| J310 | JUNCTION | 0.138 | 0.138 | 0 | 11:54 | 0.432 | 0.432 | -0.149 |
| J311 | JUNCTION | 0.000 | 0.623 | 0 | 12:05 | 0 | 3.78 | 0.154 |
| J312 | JUNCTION | 0.000 | 0.440 | 0 | 12:08 | 0 | 2.39 | -0.004 |
| J316 | JUNCTION | 0.280 | 0.308 | 0 | 12:00 | 1.05 | 1.15 | 0.003 |
| J317 | JUNCTION | 0.174 | 0.605 | 0 | 12:00 | 0.644 | 2.4 | 0.257 |
| J319 | JUNCTION | 0.088 | 0.481 | 0 | 11:58 | 0.336 | 1.75 | -0.018 |
| J32 | JUNCTION | 0.020 | 1.423 | 0 | 11:55 | 0.061 | 4.64 | 0.006 |
| J321 | JUNCTION | 0.061 | 2.129 | 0 | 11:58 | 0.192 | 7.12 | 0.005 |
| J325 | JUNCTION | 0.218 | 0.388 | 0 | 11:57 | 0.678 | 1.42 | -0.002 |
| J327 | JUNCTION | 0.362 | 0.362 | 0 | 11:54 | 1.33 | 1.33 | 0.002 |
| J33 | JUNCTION | 0.057 | 0.057 | 0 | 11:54 | 0.173 | 0.173 | -0.082 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| J330 | JUNCTION | 0.000 | 0.361 | 0 | 12:00 | 0 | 1.33 | -0.023 |
| J331 | JUNCTION | 0.412 | 0.711 | 0 | 12:00 | 1.57 | 2.9 | 0.378 |
| J333 | JUNCTION | 0.242 | 0.624 | 0 | 12:04 | 0.894 | 3.78 | -0.000 |
| J334 | JUNCTION | 0.350 | 0.350 | 0 | 12:00 | 1.33 | 1.33 | 0.235 |
| J336 | JUNCTION | 0.000 | 0.256 | 0 | 12:03 | 0 | 1.33 | 0.020 |
| J338 | JUNCTION | 0.177 | 0.376 | 0 | 12:00 | 0.668 | 1.99 | 0.306 |
| J34 | JUNCTION | 0.245 | 1.347 | 0 | 11:55 | 0.768 | 4.4 | 0.000 |
| J345 | JUNCTION | 0.000 | 0.318 | 0 | 12:10 | 0 | 1.99 | 0.023 |
| J348 | JUNCTION | 0.313 | 0.500 | 0 | 12:00 | 1.19 | 3.18 | 0.167 |
| J349 | JUNCTION | 0.051 | 0.702 | 0 | 11:54 | 0.16 | 2.25 | -0.019 |
| J35 | JUNCTION | 0.015 | 0.307 | 0 | 11:55 | 0.0476 | 0.633 | 0.072 |
| J350 | JUNCTION | 0.000 | 0.466 | 0 | 12:09 | 0 | 3.17 | 0.016 |
| J351 | JUNCTION | 0.550 | 0.550 | 0 | 11:54 | 1.8 | 1.82 | -0.037 |
| J353 | JUNCTION | 0.274 | 0.485 | 0 | 12:00 | 1.01 | 1.79 | 0.008 |
| J357 | JUNCTION | 0.097 | 0.818 | 0 | 12:15 | 0.357 | 5.65 | 0.044 |
| J358 | JUNCTION | 0.024 | 0.066 | 0 | 11:54 | 0.0734 | 0.212 | -0.010 |
| J359 | JUNCTION | 0.395 | 0.651 | 0 | 11:55 | 1.27 | 2.26 | -0.013 |
| J36 | JUNCTION | 0.314 | 0.490 | 0 | 11:54 | 0.985 | 1.54 | -0.010 |
| J360 | JUNCTION | 0.000 | 0.147 | 0 | 11:59 | 0 | 0.511 | -0.005 |
| J361 | JUNCTION | 0.000 | 2.945 | 0 | 11:57 | 0 | 9.8 | 0.004 |
| J37 | JUNCTION | 0.431 | 0.431 | 0 | 11:54 | 1.31 | 1.31 | -0.093 |
| J38 | JUNCTION | 0.000 | 1.443 | 0 | 11:56 | 0 | 4.71 | 0.002 |
| J39 | JUNCTION | 0.178 | 0.178 | 0 | 11:54 | 0.558 | 0.558 | -0.006 |
| J4 | JUNCTION | 0.000 | 0.270 | 0 | 13:45 | 0 | 11.9 | 0.002 |
| J40 | JUNCTION | 0.130 | 0.130 | 0 | 11:54 | 0.406 | 0.406 | -0.048 |
| J41 | JUNCTION | 0.253 | 0.891 | 0 | 11:55 | 0.793 | 3.13 | 0.008 |
| J42 | JUNCTION | 0.039 | 0.039 | 0 | 11:54 | 0.122 | 0.122 | -0.050 |
| J43 | JUNCTION | 0.032 | 0.032 | 0 | 11:54 | 0.101 | 0.101 | -0.034 |
| J44 | JUNCTION | 0.066 | 0.066 | 0 | 11:54 | 0.198 | 0.198 | -0.195 |
| J45 | JUNCTION | 0.000 | 1.446 | 0 | 11:56 | 0 | 4.71 | -0.000 |
| J46 | JUNCTION | 0.282 | 0.282 | 0 | 11:54 | 0.891 | 0.891 | -0.021 |
| J47 | JUNCTION | 0.031 | 5.999 | 0 | 12:02 | 0.0967 | 29 | 0.007 |
| J48 | JUNCTION | 0.031 | 0.031 | 0 | 11:54 | 0.0952 | 0.0952 | -0.070 |
| J49 | JUNCTION | 0.134 | 1.575 | 0 | 11:56 | 0.446 | 5.15 | 0.001 |
| J5 | JUNCTION | 0.000 | 0.020 | 0 | 12:30 | 0 | 0.325 | 0.025 |
| J50 | JUNCTION | 0.133 | 1.731 | 0 | 11:57 | 0.353 | 5.75 | 0.001 |
| J51 | JUNCTION | 0.040 | 0.085 | 0 | 11:53 | 0.154 | 0.246 | 0.059 |
| J52 | JUNCTION | 0.000 | 7.523 | 0 | 12:08 | 0 | 35.9 | 0.008 |
| J53 | JUNCTION | 0.150 | 0.150 | 0 | 11:54 | 0.47 | 0.47 | -0.074 |
| J54 | JUNCTION | 0.251 | 0.251 | 0 | 11:54 | 0.786 | 0.786 | -0.028 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| J55 | JUNCTION | 0.000 | 4.573 | 0 | 12:01 | 0 | 26 | 0.001 |
| J56 | JUNCTION | 0.042 | 1.194 | 0 | 11:56 | 0.131 | 4.13 | -0.006 |
| J57 | JUNCTION | 0.279 | 0.279 | 0 | 11:54 | 0.876 | 0.876 | -0.013 |
| J58 | JUNCTION | 0.000 | 4.566 | 0 | 12:00 | 0 | 26 | 0.007 |
| J59 | JUNCTION | 1.012 | 1.012 | 0 | 11:54 | 3.15 | 3.15 | -0.014 |
| J6 | JUNCTION | 0.000 | 0.138 | 0 | 12:45 | 0 | 3.72 | 0.006 |
| J60 | JUNCTION | 0.116 | 1.871 | 0 | 11:55 | 0.341 | 6.14 | 0.005 |
| J61 | JUNCTION | 0.047 | 0.051 | 0 | 11:53 | 0.145 | 0.145 | -0.007 |
| J62 | JUNCTION | 0.000 | 0.067 | 0 | 11:54 | 0 | 0.177 | 0.037 |
| J63 | JUNCTION | 0.311 | 0.311 | 0 | 11:54 | 0.958 | 0.958 | -0.045 |
| J64 | JUNCTION | 0.000 | 0.045 | 0 | 11:54 | 0 | 0.134 | 0.008 |
| J65 | JUNCTION | 0.030 | 0.332 | 0 | 11:58 | 0.101 | 1.24 | 0.029 |
| J66 | JUNCTION | 0.000 | 0.044 | 0 | 11:55 | 0 | 0.134 | -0.240 |
| J67 | JUNCTION | 0.413 | 0.413 | 0 | 11:54 | 1.31 | 1.31 | -0.022 |
| J68 | JUNCTION | 0.213 | 1.115 | 0 | 11:55 | 0.669 | 3.63 | -0.002 |
| J69 | JUNCTION | 0.143 | 0.143 | 0 | 11:54 | 0.453 | 0.453 | -0.009 |
| J7 | JUNCTION | 0.000 | 0.208 | 0 | 14:04 | 0 | 11.8 | 0.023 |
| J70 | JUNCTION | 0.019 | 0.698 | 0 | 11:59 | 0.0598 | 2.57 | 0.005 |
| J71 | JUNCTION | 0.000 | 0.000 | 0 | 00:00 | 0 | 0 | 0.000 ltr |
| J72 | JUNCTION | 1.060 | 2.596 | 0 | 11:56 | 3.29 | 8.92 | -0.000 |
| J73 | JUNCTION | 0.020 | 0.020 | 0 | 11:54 | 0.0609 | 0.0609 | 0.000 |
| J74 | JUNCTION | 0.157 | 0.157 | 0 | 11:54 | 0.503 | 0.503 | -0.031 |
| J75 | JUNCTION | 0.205 | 6.530 | 0 | 11:58 | 0.645 | 22.3 | 0.000 |
| J76 | JUNCTION | 0.029 | 0.846 | 0 | 12:00 | 0.109 | 3.19 | -0.004 |
| J77 | JUNCTION | 0.216 | 2.326 | 0 | 11:58 | 0.674 | 7.79 | 0.000 |
| J78 | JUNCTION | 0.184 | 0.184 | 0 | 11:54 | 0.57 | 0.57 | -0.005 |
| J79 | JUNCTION | 0.023 | 0.040 | 0 | 11:55 | 0.0731 | 0.134 | 0.025 |
| J8 | JUNCTION | 0.000 | 1.745 | 0 | 11:58 | 0 | 5.79 | -0.001 |
| J80 | JUNCTION | 0.029 | 0.029 | 0 | 11:54 | 0.0846 | 0.0846 | -0.053 |
| J81 | JUNCTION | 0.640 | 6.206 | 0 | 11:58 | 2.01 | 21.2 | -0.003 |
| J82 | JUNCTION | 0.000 | 1.291 | 0 | 11:56 | 0 | 4.33 | -0.009 |
| J83 | JUNCTION | 0.200 | 0.200 | 0 | 11:54 | 0.614 | 0.614 | -0.016 |
| J84 | JUNCTION | 0.014 | 3.362 | 0 | 11:59 | 0.043 | 11.4 | 0.004 |
| J85 | JUNCTION | 0.030 | 8.524 | 0 | 12:04 | 0.0956 | 34 | 0.002 |
| J86 | JUNCTION | 0.270 | 0.270 | 0 | 11:54 | 0.834 | 0.834 | -0.011 |
| J87 | JUNCTION | 0.093 | 0.646 | 0 | 11:54 | 0.292 | 2.08 | 0.006 |
| J88 | JUNCTION | 0.036 | 0.036 | 0 | 11:54 | 0.111 | 0.111 | -0.020 |
| J89 | JUNCTION | 0.295 | 0.295 | 0 | 11:54 | 0.898 | 0.898 | -0.033 |
| J9 | JUNCTION | 0.021 | 3.044 | 0 | 11:59 | 0.0682 | 10.1 | 0.002 |
| J90 | JUNCTION | 0.000 | 0.817 | 0 | 11:56 | 0 | 2.65 | 0.003 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| J91 | JUNCTION | 0.045 | 0.045 | 0 | 11:54 | 0.134 | 0.134 | -0.012 |
| J92 | JUNCTION | 0.491 | 0.491 | 0 | 11:54 | 1.78 | 1.78 | -0.007 |
| J93 | JUNCTION | 0.008 | 0.825 | 0 | 11:55 | 0.0246 | 2.65 | 0.014 |
| J94 | JUNCTION | 0.000 | 0.546 | 0 | 11:54 | 0 | 1.72 | 0.003 |
| J95 | JUNCTION | 0.133 | 4.671 | 0 | 12:01 | 0.446 | 26.5 | 0.008 |
| J96 | JUNCTION | 0.015 | 0.540 | 0 | 11:54 | 0.0474 | 1.93 | 0.009 |
| J97 | JUNCTION | 0.548 | 0.548 | 0 | 11:54 | 1.72 | 1.72 | -0.010 |
| J98 | JUNCTION | 0.644 | 0.644 | 0 | 11:54 | 2.15 | 2.15 | -0.029 |
| J99 | JUNCTION | 0.020 | 0.670 | 0 | 11:55 | 0.0657 | 2.26 | 0.022 |
| OF1 | JUNCTION | 0.000 | 0.275 | 0 | 13:00 | 0 | 10.7 | -0.001 |
| OF_Pond1 | OUTFALL | 0.000 | 3.360 | 0 | 11:59 | 0 | 11.4 | 0.000 |
| OF_Pond2 | OUTFALL | 0.000 | 11.637 | 0 | 12:03 | 0 | 68.5 | 0.000 |
| OF_Pond3 | OUTFALL | 0.000 | 2.945 | 0 | 11:57 | 0 | 9.8 | 0.000 |
| OF_Pond4 | OUTFALL | 0.000 | 0.147 | 0 | 11:59 | 0 | 0.511 | 0.000 |
| OF_Pond5 | OUTFALL | 0.000 | 2.399 | 0 | 12:06 | 0 | 13.1 | 0.000 |
| OF_Pond6 | OUTFALL | 0.000 | 0.142 | 0 | 12:03 | 0 | 0.578 | 0.000 |
| OF_Pond7 | OUTFALL | 0.000 | 0.464 | 0 | 12:02 | 0 | 1.87 | 0.000 |
| OF_Pond8 | OUTFALL | 0.000 | 0.885 | 0 | 12:06 | 0 | 3.84 | 0.000 |
| OF2 | OUTFALL | 0.000 | 0.208 | 0 | 14:05 | 0 | 11.8 | 0.000 |
| OF3 | OUTFALL | 0.000 | 0.138 | 0 | 12:45 | 0 | 3.72 | 0.000 |
| OF4 | OUTFALL | 0.000 | 0.020 | 0 | 12:31 | 0 | 0.325 | 0.000 |
| OF5 | OUTFALL | 0.000 | 0.270 | 0 | 13:45 | 0 | 11.9 | 0.000 |
| OF6 | OUTFALL | 0.000 | 0.001 | 0 | 12:03 | 0 | 0.00592 | 0.000 |
| OF7 | OUTFALL | 0.000 | 0.120 | 0 | 12:31 | 0 | 1.46 | 0.000 |
| OF8 | OUTFALL | 0.000 | 0.114 | 0 | 13:10 | 0 | 3.47 | 0.000 |
| SU1_Pond1 | STORAGE | 3.860 | 3.860 | 0 | 11:59 | 11.1 | 11.1 | 0.001 |
| SU2_Pond2 | STORAGE | 10.156 | 10.156 | 0 | 12:05 | 24.3 | 63.1 | 0.002 |
| SU3_Pond3 | STORAGE | 2.720 | 2.720 | 0 | 11:59 | 3.91 | 3.91 | 0.001 |
| SU4_Pond4 | STORAGE | 0.181 | 0.181 | 0 | 11:59 | 0.335 | 0.335 | 0.001 |
| SU5_Pond5 | STORAGE | 2.711 | 2.711 | 0 | 12:03 | 12.4 | 12.4 | 0.001 |
| SU6_Pond6 | STORAGE | 0.011 | 0.011 | 0 | 11:54 | 0.00596 | 0.00596 | 0.001 |
| SU7_Pond7 | STORAGE | 0.533 | 0.533 | 0 | 11:59 | 1.47 | 1.47 | 0.001 |
| SU8_Pond8 | STORAGE | 0.965 | 0.965 | 0 | 12:03 | 3.52 | 3.52 | 0.001 |

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Node Surcharge Summary

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No nodes were surcharged.

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Node Flooding Summary

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No nodes were flooded.

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Storage Volume Summary

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| Storage Unit | Average Volume 1000 m³ | Avg Pcnt Full | Evap Pcnt Loss | Exfil Pcnt Loss | Maximum Volume 1000 m³ | Max Pcnt Full | Time of Max Occurrence days hr:min | Maximum Outflow CMS |
|---|---|---|---|---|---|---|---|---|
| SU1_Pond1 | 2.461 | 17.1 | 0.0 | 0.0 | 6.478 | 45.1 | 0 13:00 | 0.275 |
| SU2_Pond2 | 51.468 | 56.5 | 0.0 | 0.0 | 61.797 | 67.9 | 0 14:04 | 0.208 |
| SU3_Pond3 | 0.967 | 10.0 | 0.0 | 0.0 | 3.469 | 35.8 | 0 12:45 | 0.138 |
| SU4_Pond4 | 0.041 | 1.9 | 0.0 | 0.0 | 0.213 | 10.1 | 0 12:30 | 0.020 |
| SU5_Pond5 | 2.506 | 17.8 | 0.0 | 0.0 | 6.856 | 48.8 | 0 13:45 | 0.270 |
| SU6_Pond6 | 0.001 | 0.2 | 0.0 | 0.0 | 0.006 | 1.6 | 0 12:00 | 0.001 |
| SU7_Pond7 | 0.074 | 2.9 | 0.0 | 0.0 | 0.624 | 24.5 | 0 12:31 | 0.120 |
| SU8_Pond8 | 0.488 | 10.6 | 0.0 | 0.0 | 1.831 | 39.8 | 0 13:09 | 0.115 |

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Outfall Loading Summary

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| Outfall Node | Flow Freq Pcnt | Avg Flow CMS | Max Flow CMS | Total Volume 10^6 ltr |
|---|---|---|---|---|
| OF_Pond1 | 96.74 | 0.142 | 3.360 | 11.398 |
| OF_Pond2 | 99.32 | 0.749 | 11.637 | 68.466 |
| OF_Pond3 | 93.99 | 0.125 | 2.945 | 9.803 |
| OF_Pond4 | 72.11 | 0.009 | 0.147 | 0.511 |
| OF_Pond5 | 99.43 | 0.149 | 2.399 | 13.101 |
| OF_Pond6 | 79.59 | 0.009 | 0.142 | 0.578 |
| OF_Pond7 | 88.71 | 0.025 | 0.464 | 1.875 |
| OF_Pond8 | 87.34 | 0.051 | 0.885 | 3.837 |
| OF2 | 73.15 | 0.109 | 0.208 | 11.772 |

| | | | | |
|---|---|---|---|---|
| OF3 | 75.98 | 0.040 | 0.138 | 3.719 |
| OF4 | 77.96 | 0.004 | 0.020 | 0.325 |
| OF5 | 90.49 | 0.100 | 0.270 | 11.916 |
| OF6 | 28.86 | 0.000 | 0.001 | 0.006 |
| OF7 | 81.95 | 0.017 | 0.120 | 1.458 |
| OF8 | 89.14 | 0.032 | 0.114 | 3.475 |
| System | 82.32 | 1.561 | 21.240 | 142.237 |

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Link Flow Summary

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| Link | Type | Maximum \|Flow\| CMS | Time of Max Occurrence days hr:min | Maximum \|Veloc\| m/sec | Max/ Full Flow | Max/ Full Depth |
|---|---|---|---|---|---|---|
| C1 | CONDUIT | 0.060 | 0 11:54 | 0.46 | 0.10 | 0.31 |
| C10 | CONDUIT | 0.464 | 0 12:02 | 1.40 | 0.01 | 0.06 |
| C100 | CONDUIT | 0.122 | 0 12:04 | 0.32 | 0.04 | 0.55 |
| C101 | CONDUIT | 0.044 | 0 11:54 | 0.45 | 0.02 | 0.18 |
| C102 | CONDUIT | 1.408 | 0 12:04 | 1.57 | 0.15 | 0.50 |
| C103_1 | CONDUIT | 0.178 | 0 11:54 | 0.62 | 0.13 | 0.37 |
| C103_2 | CONDUIT | 0.742 | 0 11:55 | 1.92 | 0.51 | 0.46 |
| C104 | CONDUIT | 3.325 | 0 12:04 | 2.16 | 0.17 | 0.58 |
| C105 | CONDUIT | 0.147 | 0 11:59 | 1.21 | 0.00 | 0.04 |
| C106 | CONDUIT | 0.354 | 0 11:55 | 0.83 | 0.09 | 0.35 |
| C107 | CONDUIT | 0.018 | 0 12:02 | 0.14 | 0.01 | 0.24 |
| C108 | CONDUIT | 11.637 | 0 12:03 | 5.98 | 0.05 | 0.22 |
| C109 | CONDUIT | 0.000 | 0 00:00 | 0.00 | 0.00 | 0.02 |
| C11 | CONDUIT | 0.487 | 0 11:55 | 2.54 | 0.14 | 0.27 |
| C110 | CONDUIT | 0.000 | 0 00:00 | 0.00 | 0.00 | 0.00 |
| C111 | CONDUIT | 0.000 | 0 00:00 | 0.00 | 0.00 | 0.01 |
| C112 | CONDUIT | 0.000 | 0 00:00 | 0.00 | 0.00 | 0.01 |
| C113 | CONDUIT | 0.120 | 0 12:31 | 1.48 | 0.00 | 0.03 |
| C114 | CONDUIT | 0.001 | 0 12:03 | 0.00 | 0.00 | 0.00 |
| C115 | CONDUIT | 0.270 | 0 13:45 | 2.76 | 0.00 | 0.03 |
| C116 | CONDUIT | 0.020 | 0 12:31 | 0.81 | 0.00 | 0.01 |
| C117 | CONDUIT | 0.138 | 0 12:45 | 1.98 | 0.00 | 0.02 |
| C118 | CONDUIT | 0.208 | 0 14:05 | 1.72 | 0.00 | 0.04 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C119_1 | CONDUIT | 0.196 | 0 | 11:54 | 1.05 | 0.09 | 0.27 |
| C119_2 | CONDUIT | 0.560 | 0 | 11:55 | 2.16 | 0.25 | 0.34 |
| C12 | CONDUIT | 3.360 | 0 | 11:59 | 4.36 | 0.55 | 0.53 |
| C12_1 | CONDUIT | 0.915 | 0 | 12:02 | 0.75 | 0.09 | 0.27 |
| C12_2 | CONDUIT | 0.885 | 0 | 12:06 | 0.97 | 0.08 | 0.21 |
| C120 | CONDUIT | 0.549 | 0 | 11:56 | 1.59 | 0.25 | 0.42 |
| C121 | CONDUIT | 1.048 | 0 | 11:57 | 2.39 | 0.49 | 0.51 |
| C122 | CONDUIT | 3.050 | 0 | 11:59 | 3.08 | 0.45 | 0.47 |
| C122_1 | CONDUIT | 1.272 | 0 | 11:57 | 1.69 | 0.18 | 0.39 |
| C122_2 | CONDUIT | 1.267 | 0 | 11:58 | 1.35 | 0.17 | 0.46 |
| C123 | CONDUIT | 1.743 | 0 | 11:58 | 2.63 | 0.63 | 0.57 |
| C124 | CONDUIT | 1.745 | 0 | 11:58 | 2.68 | 0.60 | 0.56 |
| C125 | CONDUIT | 1.747 | 0 | 11:58 | 2.62 | 0.59 | 0.57 |
| C126 | CONDUIT | 1.764 | 0 | 11:59 | 2.43 | 0.60 | 0.61 |
| C127 | CONDUIT | 0.012 | 0 | 11:54 | 0.10 | 0.00 | 0.22 |
| C128 | CONDUIT | 0.546 | 0 | 11:54 | 1.55 | 0.34 | 0.43 |
| C129 | CONDUIT | 0.638 | 0 | 11:55 | 2.08 | 0.33 | 0.39 |
| C13 | CONDUIT | 1.113 | 0 | 11:55 | 3.05 | 0.35 | 0.44 |
| C130 | CONDUIT | 0.645 | 0 | 11:57 | 1.47 | 0.24 | 0.42 |
| C131 | CONDUIT | 1.019 | 0 | 11:59 | 1.62 | 0.47 | 0.55 |
| C132 | CONDUIT | 0.417 | 0 | 11:54 | 1.34 | 0.17 | 0.42 |
| C133 | CONDUIT | 0.291 | 0 | 11:54 | 1.12 | 0.14 | 0.35 |
| C134 | CONDUIT | 0.535 | 0 | 11:55 | 1.40 | 0.43 | 0.45 |
| C135 | CONDUIT | 0.817 | 0 | 11:56 | 1.63 | 0.33 | 0.46 |
| C136 | CONDUIT | 0.821 | 0 | 11:57 | 1.20 | 0.33 | 0.60 |
| C137 | CONDUIT | 3.427 | 0 | 12:01 | 2.96 | 0.50 | 0.54 |
| C138 | CONDUIT | 4.573 | 0 | 12:01 | 3.35 | 0.49 | 0.51 |
| C139 | CONDUIT | 0.278 | 0 | 11:54 | 0.97 | 0.11 | 0.46 |
| C14 | CONDUIT | 1.351 | 0 | 11:56 | 3.43 | 0.44 | 0.46 |
| C140 | CONDUIT | 1.164 | 0 | 11:57 | 1.89 | 0.54 | 0.74 |
| C141 | CONDUIT | 4.689 | 0 | 12:01 | 3.48 | 0.51 | 0.53 |
| C142 | CONDUIT | 0.127 | 0 | 11:54 | 0.58 | 0.07 | 0.31 |
| C143 | CONDUIT | 0.884 | 0 | 11:57 | 2.01 | 0.41 | 0.52 |
| C144 | CONDUIT | 0.259 | 0 | 11:54 | 1.56 | 0.06 | 0.25 |
| C145 | CONDUIT | 0.032 | 0 | 11:54 | 0.28 | 0.01 | 0.20 |
| C146 | CONDUIT | 0.530 | 0 | 11:57 | 1.67 | 0.26 | 0.40 |
| C147 | CONDUIT | 1.290 | 0 | 11:56 | 3.60 | 0.20 | 0.55 |
| C148 | CONDUIT | 5.595 | 0 | 12:02 | 3.42 | 0.46 | 0.50 |
| C149 | CONDUIT | 5.390 | 0 | 12:03 | 2.96 | 0.48 | 0.58 |
| C15 | CONDUIT | 0.056 | 0 | 11:54 | 0.34 | 0.01 | 0.26 |

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|---|---|---|---|---|---|---|---|
| C150 | CONDUIT | 0.494 | 0 | 11:55 | 1.89 | 0.25 | 0.34 |
| C151 | CONDUIT | 0.029 | 0 | 11:55 | 0.38 | 0.01 | 0.14 |
| C152 | CONDUIT | 6.482 | 0 | 12:05 | 2.62 | 0.58 | 0.54 |
| C153 | CONDUIT | 6.452 | 0 | 12:06 | 2.70 | 0.57 | 0.53 |
| C154 | CONDUIT | 0.537 | 0 | 12:17 | 0.62 | 0.06 | 0.56 |
| C155 | CONDUIT | 7.523 | 0 | 12:08 | 4.33 | 0.79 | 0.41 |
| C156 | CONDUIT | 0.307 | 0 | 12:00 | 1.58 | 0.10 | 0.28 |
| C157 | CONDUIT | 0.144 | 0 | 11:55 | 0.85 | 0.07 | 0.25 |
| C158 | CONDUIT | 0.176 | 0 | 11:54 | 1.33 | 0.06 | 0.21 |
| C159 | CONDUIT | 0.481 | 0 | 11:54 | 1.99 | 0.07 | 0.20 |
| C16_1 | CONDUIT | 0.018 | 0 | 11:57 | 0.66 | 0.01 | 0.07 |
| C160 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.15 |
| C161 | CONDUIT | 0.628 | 0 | 11:56 | 1.62 | 0.29 | 0.46 |
| C162 | CONDUIT | 0.312 | 0 | 11:55 | 1.40 | 0.12 | 0.31 |
| C163 | CONDUIT | 0.035 | 0 | 11:54 | 0.29 | 0.01 | 0.20 |
| C164 | CONDUIT | 0.668 | 0 | 11:55 | 1.88 | 0.23 | 0.43 |
| C165 | CONDUIT | 0.432 | 0 | 11:54 | 1.74 | 0.06 | 0.23 |
| C166 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.09 |
| C167 | CONDUIT | 0.184 | 0 | 11:54 | 0.87 | 0.07 | 0.30 |
| C168 | CONDUIT | 0.870 | 0 | 11:56 | 2.66 | 0.36 | 0.40 |
| C169 | CONDUIT | 0.218 | 0 | 11:55 | 0.82 | 0.30 | 0.34 |
| C17 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.15 |
| C170 | CONDUIT | 0.203 | 0 | 11:54 | 1.57 | 0.08 | 0.21 |
| C171 | CONDUIT | 0.302 | 0 | 11:55 | 1.53 | 0.11 | 0.28 |
| C172 | CONDUIT | 0.638 | 0 | 11:55 | 2.16 | 0.23 | 0.37 |
| C173 | CONDUIT | 0.171 | 0 | 11:54 | 1.13 | 0.05 | 0.23 |
| C174_1 | CONDUIT | 0.267 | 0 | 11:54 | 1.48 | 0.11 | 0.26 |
| C174_2 | CONDUIT | 0.512 | 0 | 11:55 | 1.63 | 0.20 | 0.40 |
| C175_1 | CONDUIT | 0.035 | 0 | 11:54 | 0.50 | 0.01 | 0.14 |
| C175_2 | CONDUIT | 0.233 | 0 | 11:55 | 0.93 | 0.08 | 0.35 |
| C176_1 | CONDUIT | 0.285 | 0 | 11:54 | 1.67 | 0.09 | 0.25 |
| C177 | CONDUIT | 3.055 | 0 | 11:59 | 3.02 | 0.45 | 0.48 |
| C178 | CONDUIT | 3.056 | 0 | 12:00 | 2.89 | 0.46 | 0.50 |
| C179 | CONDUIT | 3.053 | 0 | 12:00 | 2.51 | 0.41 | 0.56 |
| C18 | CONDUIT | 0.193 | 0 | 12:00 | 2.81 | 0.08 | 0.13 |
| C18_2 | CONDUIT | 0.344 | 0 | 11:59 | 0.58 | 0.00 | 0.03 |
| C182 | CONDUIT | 0.104 | 0 | 12:02 | 0.52 | 0.08 | 0.51 |
| C183 | CONDUIT | 0.165 | 0 | 12:00 | 0.59 | 0.13 | 0.64 |
| C184 | CONDUIT | 0.256 | 0 | 12:00 | 0.53 | 0.14 | 0.69 |
| C185 | CONDUIT | 0.369 | 0 | 12:02 | 0.43 | 0.12 | 0.65 |

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|---|---|---|---|---|---|---|---|
| C186 | CONDUIT | 0.506 | 0 | 12:01 | 0.62 | 0.07 | 0.50 |
| C19 | CONDUIT | 0.361 | 0 | 12:00 | 0.71 | 0.01 | 0.05 |
| C2 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.28 |
| C20 | CONDUIT | 0.683 | 0 | 11:55 | 2.70 | 0.21 | 0.33 |
| C21 | CONDUIT | 3.206 | 0 | 12:01 | 3.35 | 1.23 | 0.80 |
| C21_1 | CONDUIT | 0.044 | 0 | 11:55 | 1.25 | 0.02 | 0.08 |
| C21_2 | CONDUIT | 0.044 | 0 | 11:56 | 0.31 | 0.01 | 0.25 |
| C217 | CONDUIT | 0.699 | 0 | 11:55 | 2.55 | 0.10 | 0.33 |
| C22 | CONDUIT | 0.135 | 0 | 11:54 | 0.37 | 0.05 | 0.69 |
| C227 | CONDUIT | 0.043 | 0 | 11:55 | 1.04 | 0.00 | 0.13 |
| C23 | CONDUIT | 0.039 | 0 | 11:58 | 3.18 | 0.10 | 0.17 |
| C235 | CONDUIT | 0.319 | 0 | 12:02 | 0.16 | 0.01 | 0.20 |
| C236 | CONDUIT | 0.488 | 0 | 12:08 | 3.79 | 0.20 | 0.21 |
| C237 | CONDUIT | 0.623 | 0 | 12:05 | 0.27 | 0.01 | 0.23 |
| C238 | CONDUIT | 0.602 | 0 | 12:09 | 4.11 | 0.25 | 0.23 |
| C239 | CONDUIT | 0.600 | 0 | 12:11 | 0.20 | 0.01 | 0.29 |
| C24 | CONDUIT | 0.044 | 0 | 11:55 | 1.14 | 0.02 | 0.09 |
| C240 | CONDUIT | 0.761 | 0 | 12:13 | 3.52 | 0.43 | 0.30 |
| C241 | CONDUIT | 0.787 | 0 | 12:15 | 0.60 | 0.03 | 0.13 |
| C242 | CONDUIT | 0.759 | 0 | 12:21 | 0.21 | 0.03 | 0.39 |
| C243 | CONDUIT | 0.753 | 0 | 12:39 | 0.15 | 0.03 | 0.73 |
| C244 | CONDUIT | 0.771 | 0 | 12:39 | 1.01 | 0.67 | 0.84 |
| C245 | CONDUIT | 1.080 | 0 | 12:37 | 2.18 | 1.09 | 0.59 |
| C246 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.06 |
| C247 | CONDUIT | 0.256 | 0 | 12:03 | 3.15 | 0.07 | 0.12 |
| C248 | CONDUIT | 0.251 | 0 | 12:06 | 0.15 | 0.00 | 0.08 |
| C249 | CONDUIT | 0.318 | 0 | 12:10 | 3.65 | 0.12 | 0.16 |
| C25 | CONDUIT | 0.346 | 0 | 11:57 | 0.45 | 0.12 | 1.00 |
| C250 | CONDUIT | 0.317 | 0 | 12:11 | 0.15 | 0.00 | 0.10 |
| C251 | CONDUIT | 0.466 | 0 | 12:09 | 3.96 | 0.18 | 0.19 |
| C252 | CONDUIT | 0.465 | 0 | 12:10 | 0.10 | 0.00 | 0.22 |
| C256 | CONDUIT | 1.831 | 0 | 12:07 | 4.37 | 0.81 | 0.49 |
| C257 | CONDUIT | 0.050 | 0 | 11:53 | 0.22 | 0.05 | 0.37 |
| C258 | CONDUIT | 0.518 | 0 | 11:59 | 1.23 | 0.49 | 0.49 |
| C259 | CONDUIT | 0.517 | 0 | 12:00 | 1.35 | 0.51 | 0.46 |
| C26 | CONDUIT | 0.055 | 0 | 12:04 | 0.12 | 0.05 | 0.46 |
| C260_1 | CONDUIT | 1.330 | 0 | 12:00 | 4.19 | 0.37 | 0.39 |
| C260_2 | CONDUIT | 1.329 | 0 | 12:00 | 3.32 | 0.29 | 0.54 |
| C261 | CONDUIT | 0.393 | 0 | 11:58 | 0.62 | 0.01 | 0.06 |
| C262 | CONDUIT | 0.444 | 0 | 12:01 | 0.25 | 0.01 | 0.19 |

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|---|---|---|---|---|---|---|---|
| C263 | CONDUIT | 0.440 | 0 | 12:08 | 1.54 | 0.20 | 0.37 |
| C264 | CONDUIT | 0.438 | 0 | 12:10 | 1.51 | 0.35 | 0.37 |
| C265 | CONDUIT | 0.437 | 0 | 12:10 | 1.51 | 0.20 | 0.37 |
| C266 | CONDUIT | 0.435 | 0 | 12:12 | 1.49 | 0.36 | 0.37 |
| C267 | CONDUIT | 0.434 | 0 | 12:13 | 1.89 | 0.21 | 0.31 |
| C268 | CONDUIT | 0.432 | 0 | 12:14 | 1.81 | 0.21 | 0.32 |
| C269 | CONDUIT | 0.452 | 0 | 12:15 | 1.72 | 0.23 | 0.34 |
| C27 | CONDUIT | 0.540 | 0 | 11:57 | 1.73 | 0.17 | 0.32 |
| C270 | CONDUIT | 0.530 | 0 | 12:15 | 1.03 | 0.28 | 0.61 |
| C271 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.04 |
| C272 | CONDUIT | 0.035 | 0 | 11:54 | 0.50 | 0.01 | 0.14 |
| C273_1 | CONDUIT | 0.221 | 0 | 11:55 | 1.76 | 0.08 | 0.20 |
| C273_2 | CONDUIT | 0.273 | 0 | 11:56 | 1.36 | 0.10 | 0.28 |
| C274 | CONDUIT | 0.642 | 0 | 11:57 | 1.93 | 0.26 | 0.41 |
| C275 | CONDUIT | 0.791 | 0 | 11:58 | 2.13 | 0.46 | 0.45 |
| C276 | CONDUIT | 0.086 | 0 | 12:02 | 2.95 | 0.01 | 0.11 |
| C277 | CONDUIT | 0.086 | 0 | 12:03 | 0.66 | 0.00 | 0.03 |
| C278 | CONDUIT | 0.101 | 0 | 12:04 | 0.46 | 0.00 | 0.04 |
| C28 | CONDUIT | 0.090 | 0 | 12:03 | 0.17 | 0.12 | 0.50 |
| C283 | CONDUIT | 0.172 | 0 | 12:00 | 0.89 | 0.00 | 0.04 |
| C284 | CONDUIT | 0.367 | 0 | 12:00 | 1.36 | 0.00 | 0.05 |
| C285 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| C286 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |
| C287 | CONDUIT | 0.023 | 0 | 11:57 | 0.15 | 0.00 | 0.04 |
| C288 | CONDUIT | 0.095 | 0 | 12:00 | 0.84 | 0.00 | 0.02 |
| C29 | CONDUIT | 0.920 | 0 | 11:57 | 1.91 | 0.21 | 0.37 |
| C293 | CONDUIT | 0.092 | 0 | 12:01 | 0.85 | 0.00 | 0.02 |
| C294 | CONDUIT | 0.044 | 0 | 11:57 | 4.31 | 0.00 | 0.07 |
| C295 | CONDUIT | 0.130 | 0 | 12:02 | 0.79 | 0.00 | 0.03 |
| C296 | CONDUIT | 0.211 | 0 | 12:00 | 0.75 | 0.00 | 0.06 |
| C297 | CONDUIT | 0.480 | 0 | 12:00 | 1.35 | 0.01 | 0.07 |
| C3 | CONDUIT | 0.114 | 0 | 13:10 | 1.40 | 0.00 | 0.01 |
| C30 | CONDUIT | 1.611 | 0 | 11:57 | 2.27 | 0.38 | 0.50 |
| C302 | CONDUIT | 0.537 | 0 | 12:04 | 2.69 | 0.05 | 0.28 |
| C306 | CONDUIT | 1.072 | 0 | 11:55 | 6.79 | 0.16 | 0.24 |
| C31 | CONDUIT | 1.421 | 0 | 11:56 | 3.61 | 0.44 | 0.46 |
| C310 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.06 |
| C311 | CONDUIT | 0.056 | 0 | 11:56 | 1.26 | 0.00 | 0.14 |
| C32 | CONDUIT | 0.295 | 0 | 11:54 | 1.16 | 0.12 | 0.35 |
| C33 | CONDUIT | 0.139 | 0 | 11:54 | 1.16 | 0.04 | 0.20 |

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|---|---|---|---|---|---|---|---|
| C34 | CONDUIT | 0.035 | 0 | 11:55 | 0.50 | 0.02 | 0.14 |
| C35 | CONDUIT | 0.317 | 0 | 12:03 | 0.57 | 0.30 | 0.53 |
| C36 | CONDUIT | 0.910 | 0 | 11:55 | 2.97 | 0.28 | 0.38 |
| C37 | CONDUIT | 2.609 | 0 | 11:56 | 2.64 | 0.51 | 0.55 |
| C38 | CONDUIT | 3.506 | 0 | 11:56 | 3.32 | 0.64 | 0.58 |
| C39 | CONDUIT | 1.851 | 0 | 11:57 | 4.73 | 0.44 | 0.46 |
| C4 | CONDUIT | 0.434 | 0 | 12:07 | 1.00 | 0.01 | 0.55 |
| C41 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.04 |
| C42 | CONDUIT | 0.280 | 0 | 11:54 | 1.24 | 0.21 | 0.31 |
| C43 | CONDUIT | 0.276 | 0 | 11:55 | 0.98 | 0.10 | 0.30 |
| C44 | CONDUIT | 0.497 | 0 | 11:55 | 1.24 | 0.23 | 0.39 |
| C45 | CONDUIT | 0.054 | 0 | 11:54 | 0.08 | 0.01 | 0.71 |
| C46 | CONDUIT | 0.885 | 0 | 11:55 | 2.24 | 0.35 | 0.47 |
| C47 | CONDUIT | 1.406 | 0 | 11:56 | 3.08 | 0.41 | 0.42 |
| C48 | CONDUIT | 0.234 | 0 | 11:58 | 0.42 | 0.20 | 0.69 |
| C49 | CONDUIT | 0.990 | 0 | 11:54 | 1.40 | 0.57 | 0.62 |
| C5 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.02 |
| C50_1 | CONDUIT | 0.039 | 0 | 11:54 | 1.15 | 0.02 | 0.08 |
| C50_2 | CONDUIT | 0.037 | 0 | 11:57 | 0.20 | 0.01 | 0.27 |
| C51 | CONDUIT | 1.856 | 0 | 11:56 | 2.04 | 0.68 | 0.61 |
| C52 | CONDUIT | 1.445 | 0 | 11:56 | 3.40 | 0.34 | 0.40 |
| C53_1 | CONDUIT | 2.132 | 0 | 11:58 | 2.32 | 0.69 | 0.61 |
| C53_2 | CONDUIT | 2.331 | 0 | 11:59 | 2.76 | 0.72 | 0.57 |
| C54 | CONDUIT | 1.446 | 0 | 11:56 | 2.86 | 0.29 | 0.46 |
| C55 | CONDUIT | 0.686 | 0 | 12:00 | 1.11 | 0.64 | 0.54 |
| C56 | CONDUIT | 0.838 | 0 | 12:01 | 1.94 | 0.92 | 0.41 |
| C57 | CONDUIT | 0.032 | 0 | 12:00 | 0.45 | 0.01 | 0.14 |
| C58 | CONDUIT | 0.194 | 0 | 12:00 | 1.56 | 0.08 | 0.20 |
| C6 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.01 |
| C62 | CONDUIT | 0.061 | 0 | 12:00 | 1.09 | 0.01 | 0.15 |
| C63 | CONDUIT | 0.073 | 0 | 12:00 | 3.44 | 0.00 | 0.09 |
| C64 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.04 |
| C65 | CONDUIT | 0.159 | 0 | 11:54 | 0.75 | 0.10 | 0.32 |
| C66 | CONDUIT | 0.164 | 0 | 11:54 | 1.24 | 0.07 | 0.38 |
| C67 | CONDUIT | 0.318 | 0 | 11:55 | 2.06 | 0.14 | 0.69 |
| C68 | CONDUIT | 0.569 | 0 | 12:00 | 0.15 | 0.00 | 0.22 |
| C69 | CONDUIT | 1.869 | 0 | 11:57 | 7.74 | 0.43 | 0.32 |
| C69_1 | CONDUIT | 3.396 | 0 | 12:01 | 3.82 | 0.92 | 0.73 |
| C69_2 | CONDUIT | 3.400 | 0 | 12:01 | 3.18 | 0.50 | 0.52 |
| C7 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.00 |

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|---|---|---|---|---|---|---|---|
| C70 | CONDUIT | 0.139 | 0 | 11:54 | 0.35 | 0.15 | 0.56 |
| C71 | CONDUIT | 0.039 | 0 | 11:54 | 2.50 | 0.01 | 0.05 |
| C71_1 | CONDUIT | 4.575 | 0 | 12:01 | 3.26 | 0.50 | 0.52 |
| C71_2 | CONDUIT | 4.573 | 0 | 12:01 | 3.25 | 0.53 | 0.52 |
| C72 | CONDUIT | 4.574 | 0 | 12:01 | 3.31 | 0.53 | 0.51 |
| C73 | CONDUIT | 0.090 | 0 | 12:00 | 1.19 | 0.01 | 0.18 |
| C74_1 | CONDUIT | 0.050 | 0 | 11:56 | 1.34 | 0.00 | 0.13 |
| C74_2 | CONDUIT | 0.045 | 0 | 12:01 | 0.82 | 0.00 | 0.17 |
| C75 | CONDUIT | 0.018 | 0 | 12:00 | 0.08 | 0.00 | 0.04 |
| C76 | CONDUIT | 0.015 | 0 | 11:59 | 0.60 | 0.00 | 0.10 |
| C77 | CONDUIT | 1.447 | 0 | 11:57 | 2.38 | 0.47 | 0.53 |
| C78 | CONDUIT | 0.398 | 0 | 11:54 | 0.82 | 0.58 | 0.61 |
| C79 | CONDUIT | 0.536 | 0 | 12:00 | 1.46 | 0.01 | 0.07 |
| C8 | CONDUIT | 2.399 | 0 | 12:06 | 2.99 | 0.05 | 0.21 |
| C80 | CONDUIT | 0.547 | 0 | 12:01 | 0.47 | 0.01 | 0.21 |
| C81 | CONDUIT | 0.016 | 0 | 11:54 | 0.52 | 0.01 | 0.08 |
| C82 | CONDUIT | 0.000 | 0 | 00:00 | 0.00 | 0.00 | 0.03 |
| C83 | CONDUIT | 0.045 | 0 | 11:54 | 0.91 | 0.03 | 0.11 |
| C83_1 | CONDUIT | 6.535 | 0 | 11:58 | 2.79 | 0.05 | 0.26 |
| C83_2 | CONDUIT | 6.526 | 0 | 11:59 | 2.94 | 0.08 | 0.25 |
| C84 | CONDUIT | 6.443 | 0 | 12:08 | 2.47 | 0.16 | 0.29 |
| C85 | CONDUIT | 0.885 | 0 | 12:06 | 1.63 | 0.03 | 0.16 |
| C86 | CONDUIT | 0.295 | 0 | 11:54 | 0.80 | 0.29 | 0.53 |
| C87 | CONDUIT | 2.945 | 0 | 11:57 | 4.11 | 0.05 | 0.20 |
| C88 | CONDUIT | 6.762 | 0 | 12:03 | 3.29 | 0.68 | 0.61 |
| C89 | CONDUIT | 6.426 | 0 | 12:04 | 2.71 | 0.48 | 0.52 |
| C9 | CONDUIT | 0.142 | 0 | 12:03 | 1.17 | 0.00 | 0.04 |
| C90 | CONDUIT | 2.027 | 0 | 11:58 | 1.62 | 0.26 | 0.49 |
| C91 | CONDUIT | 5.626 | 0 | 11:58 | 3.74 | 0.63 | 0.57 |
| C92 | CONDUIT | 1.577 | 0 | 11:57 | 2.43 | 0.56 | 0.56 |
| C93 | CONDUIT | 1.729 | 0 | 11:58 | 2.59 | 0.64 | 0.57 |
| C94 | CONDUIT | 1.293 | 0 | 11:57 | 2.41 | 0.57 | 0.59 |
| C95 | CONDUIT | 1.945 | 0 | 11:57 | 2.55 | 0.50 | 0.53 |
| C96 | CONDUIT | 3.590 | 0 | 11:57 | 2.65 | 0.39 | 0.53 |
| C97 | CONDUIT | 6.203 | 0 | 11:58 | 6.29 | 0.62 | 0.41 |
| C98 | CONDUIT | 1.730 | 0 | 11:58 | 2.60 | 0.59 | 0.57 |
| C99_1 | CONDUIT | 0.028 | 0 | 11:54 | 1.06 | 0.01 | 0.07 |
| C99_2 | CONDUIT | 0.026 | 0 | 11:57 | 0.45 | 0.01 | 0.25 |
| OR1 | ORIFICE | 0.113 | 0 | 13:00 | | 1.00 | |
| OR10 | ORIFICE | 0.001 | 0 | 12:00 | | 0.28 | |

| | | | | | |
|---|---|---|---|---|---|
| OR11 | ORIFICE | 0.076 | 0 | 14:04 | 1.00 |
| OR12 | ORIFICE | 0.000 | 0 | 00:00 | |
| OR13 | ORIFICE | 0.101 | 0 | 13:45 | 1.00 |
| OR14 | ORIFICE | 0.169 | 0 | 13:45 | 1.00 |
| OR15 | ORIFICE | 0.000 | 0 | 00:00 | |
| OR16 | ORIFICE | 0.020 | 0 | 12:30 | 1.00 |
| OR17 | ORIFICE | 0.000 | 0 | 00:00 | 0.00 |
| OR18 | ORIFICE | 0.000 | 0 | 00:00 | |
| OR19 | ORIFICE | 0.049 | 0 | 12:45 | 1.00 |
| OR2 | ORIFICE | 0.098 | 0 | 13:00 | 1.00 |
| OR20 | ORIFICE | 0.061 | 0 | 12:45 | 1.00 |
| OR21 | ORIFICE | 0.000 | 0 | 00:00 | |
| OR22 | ORIFICE | 0.128 | 0 | 14:04 | 1.00 |
| OR23 | ORIFICE | 0.005 | 0 | 14:04 | 0.15 |
| OR24 | ORIFICE | 0.000 | 0 | 00:00 | |
| OR25 | ORIFICE | 0.065 | 0 | 13:00 | 0.87 |
| OR26 | ORIFICE | 0.061 | 0 | 13:09 | 1.00 |
| OR3 | ORIFICE | 0.000 | 0 | 00:00 | |
| OR4 | ORIFICE | 0.054 | 0 | 13:09 | 1.00 |
| OR5 | ORIFICE | 0.028 | 0 | 12:45 | 1.00 |
| OR6 | ORIFICE | 0.000 | 0 | 00:00 | |
| OR7 | ORIFICE | 0.054 | 0 | 12:31 | 1.00 |
| OR8 | ORIFICE | 0.066 | 0 | 12:31 | 1.00 |
| OR9 | ORIFICE | 0.000 | 0 | 00:00 | |

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Flow Classification Summary

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| | Adjusted | ---------- Fraction of Time in Flow Class ---------- | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | /Actual | Up | Down | Sub | Sup | Up | Down | Norm | Inlet | |
| Conduit | Length | Dry | Dry | Dry | Crit | Crit | Crit | Crit | Ltd | Ctrl |
| C1 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.90 | 0.00 |
| C10 | 1.00 | 0.01 | 0.00 | 0.00 | 0.02 | 0.97 | 0.00 | 0.00 | 0.21 | 0.00 |
| C100 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C101 | 1.00 | 0.00 | 0.03 | 0.00 | 0.97 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C102 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C103_1 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C103_2 | 1.00 | 0.00 | 0.00 | 0.00 | 0.94 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |

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|---|---|---|---|---|---|---|---|---|---|---|
| C104 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C105 | 1.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.77 | 0.00 | 0.00 | 0.15 | 0.00 |
| C106 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C107 | 1.00 | 0.00 | 0.31 | 0.00 | 0.69 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C108 | 1.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 | 0.00 | 0.31 | 0.00 |
| C109 | 1.00 | 0.12 | 0.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C11 | 1.00 | 0.00 | 0.00 | 0.00 | 0.47 | 0.53 | 0.00 | 0.00 | 1.00 | 0.00 |
| C110 | 1.00 | 0.27 | 0.73 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C111 | 1.00 | 0.13 | 0.87 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C112 | 1.00 | 0.19 | 0.81 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C113 | 1.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.80 | 0.00 | 0.00 | 0.16 | 0.00 |
| C114 | 1.00 | 0.27 | 0.00 | 0.00 | 0.30 | 0.43 | 0.00 | 0.00 | 0.07 | 0.00 |
| C115 | 1.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.88 | 0.00 | 0.00 | 0.00 | 0.00 |
| C116 | 1.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.78 | 0.00 | 0.00 | 0.12 | 0.00 |
| C117 | 1.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.76 | 0.00 | 0.00 | 0.00 | 0.00 |
| C118 | 1.00 | 0.25 | 0.00 | 0.00 | 0.00 | 0.75 | 0.00 | 0.00 | 0.00 | 0.00 |
| C119_1 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C119_2 | 1.00 | 0.00 | 0.00 | 0.00 | 0.53 | 0.47 | 0.00 | 0.00 | 0.93 | 0.00 |
| C12 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| C12_1 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.94 | 0.00 |
| C12_2 | 1.00 | 0.01 | 0.08 | 0.00 | 0.91 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C120 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C121 | 1.00 | 0.00 | 0.00 | 0.00 | 0.52 | 0.47 | 0.00 | 0.00 | 0.22 | 0.00 |
| C122 | 1.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.50 | 0.00 | 0.00 | 0.40 | 0.00 |
| C122_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.75 | 0.25 | 0.00 | 0.00 | 0.40 | 0.00 |
| C122_2 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.57 | 0.00 |
| C123 | 1.00 | 0.00 | 0.00 | 0.00 | 0.56 | 0.44 | 0.00 | 0.00 | 0.08 | 0.00 |
| C124 | 1.00 | 0.00 | 0.00 | 0.00 | 0.54 | 0.46 | 0.00 | 0.00 | 0.12 | 0.00 |
| C125 | 1.00 | 0.00 | 0.00 | 0.00 | 0.54 | 0.46 | 0.00 | 0.00 | 0.90 | 0.00 |
| C126 | 1.00 | 0.00 | 0.00 | 0.00 | 0.96 | 0.03 | 0.00 | 0.00 | 0.99 | 0.00 |
| C127 | 1.00 | 0.00 | 0.18 | 0.00 | 0.82 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C128 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C129 | 1.00 | 0.00 | 0.00 | 0.00 | 0.85 | 0.15 | 0.00 | 0.00 | 0.51 | 0.00 |
| C13 | 1.00 | 0.00 | 0.00 | 0.00 | 0.43 | 0.57 | 0.00 | 0.00 | 1.00 | 0.00 |
| C130 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C131 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C132 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C133 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C134 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.53 | 0.00 |
| C135 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.02 | 0.00 | 0.00 | 0.20 | 0.00 |

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| C136 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C137 | 1.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.91 | 0.00 | 0.00 | 0.48 | 0.00 |
| C138 | 1.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.95 | 0.00 | 0.00 | 0.87 | 0.00 |
| C139 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C14 | 1.00 | 0.00 | 0.00 | 0.00 | 0.40 | 0.60 | 0.00 | 0.00 | 0.18 | 0.00 |
| C140 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C141 | 1.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.95 | 0.00 | 0.00 | 0.48 | 0.00 |
| C142 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C143 | 1.00 | 0.00 | 0.00 | 0.00 | 0.85 | 0.15 | 0.00 | 0.00 | 0.99 | 0.00 |
| C144 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.02 | 0.00 | 0.00 | 1.00 | 0.00 |
| C145 | 1.00 | 0.00 | 0.13 | 0.00 | 0.87 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C146 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C147 | 1.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.69 | 0.00 | 0.00 | 0.01 | 0.00 |
| C148 | 1.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.86 | 0.00 | 0.00 | 0.95 | 0.00 |
| C149 | 1.00 | 0.00 | 0.00 | 0.00 | 0.68 | 0.32 | 0.00 | 0.00 | 0.98 | 0.00 |
| C15 | 1.00 | 0.00 | 0.11 | 0.00 | 0.89 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C150 | 1.00 | 0.00 | 0.00 | 0.00 | 0.87 | 0.13 | 0.00 | 0.00 | 0.51 | 0.00 |
| C151 | 1.00 | 0.00 | 0.08 | 0.00 | 0.92 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C152 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.46 | 0.00 |
| C153 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.63 | 0.00 |
| C154 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C155 | 1.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| C156 | 1.00 | 0.00 | 0.00 | 0.00 | 0.91 | 0.09 | 0.00 | 0.00 | 1.00 | 0.00 |
| C157 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C158 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 1.00 | 0.00 |
| C159 | 1.00 | 0.00 | 0.00 | 0.00 | 0.56 | 0.44 | 0.00 | 0.00 | 1.00 | 0.00 |
| C16_1 | 1.00 | 0.00 | 0.10 | 0.00 | 0.89 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C160 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C161 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C162 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C163 | 1.00 | 0.00 | 0.15 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C164 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 1.00 | 0.00 |
| C165 | 1.00 | 0.00 | 0.00 | 0.00 | 0.96 | 0.04 | 0.00 | 0.00 | 1.00 | 0.00 |
| C166 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C167 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C168 | 1.00 | 0.00 | 0.00 | 0.00 | 0.47 | 0.53 | 0.00 | 0.00 | 0.20 | 0.00 |
| C169 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.45 | 0.00 |
| C17 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C170 | 1.00 | 0.00 | 0.00 | 0.00 | 0.94 | 0.06 | 0.00 | 0.00 | 0.98 | 0.00 |
| C171 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.03 | 0.00 | 0.00 | 1.00 | 0.00 |

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| C172 | 1.00 | 0.00 | 0.00 | 0.00 | 0.51 | 0.49 | 0.00 | 0.00 | 0.99 | 0.00 |
| C173 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C174_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 1.00 | 0.00 |
| C174_2 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C175_1 | 1.00 | 0.00 | 0.02 | 0.00 | 0.98 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C175_2 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C176_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.80 | 0.20 | 0.00 | 0.00 | 1.00 | 0.00 |
| C177 | 1.00 | 0.00 | 0.00 | 0.00 | 0.53 | 0.47 | 0.00 | 0.00 | 0.94 | 0.00 |
| C178 | 1.00 | 0.00 | 0.00 | 0.00 | 0.49 | 0.51 | 0.00 | 0.00 | 0.02 | 0.00 |
| C179 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 0.97 | 0.00 |
| C18 | 1.00 | 0.00 | 0.00 | 0.00 | 0.39 | 0.61 | 0.00 | 0.00 | 0.00 | 0.00 |
| C18_2 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.96 | 0.00 |
| C182 | 1.00 | 0.00 | 0.97 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.74 | 0.00 |
| C183 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| C184 | 1.00 | 0.00 | 0.20 | 0.00 | 0.80 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C185 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 |
| C186 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| C19 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 | 0.00 | 0.00 | 0.78 | 0.00 |
| C2 | 1.00 | 0.07 | 0.93 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C20 | 1.00 | 0.00 | 0.00 | 0.00 | 0.45 | 0.55 | 0.00 | 0.00 | 1.00 | 0.00 |
| C21 | 1.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.94 | 0.00 | 0.00 | 0.38 | 0.00 |
| C21_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.57 | 0.43 | 0.00 | 0.00 | 0.13 | 0.00 |
| C21_2 | 1.00 | 0.00 | 0.11 | 0.00 | 0.88 | 0.01 | 0.00 | 0.00 | 0.98 | 0.00 |
| C217 | 1.00 | 0.00 | 0.00 | 0.00 | 0.48 | 0.52 | 0.00 | 0.00 | 0.01 | 0.00 |
| C22 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C227 | 1.00 | 0.00 | 0.00 | 0.00 | 0.96 | 0.04 | 0.00 | 0.00 | 0.93 | 0.00 |
| C23 | 1.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.72 | 0.00 | 0.00 | 0.26 | 0.00 |
| C235 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C236 | 1.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.94 | 0.00 | 0.00 | 0.02 | 0.00 |
| C237 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C238 | 1.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.95 | 0.00 | 0.00 | 0.00 | 0.00 |
| C239 | 1.00 | 0.00 | 0.04 | 0.00 | 0.96 | 0.00 | 0.00 | 0.00 | 0.96 | 0.00 |
| C24 | 1.00 | 0.00 | 0.01 | 0.00 | 0.71 | 0.28 | 0.00 | 0.00 | 0.30 | 0.00 |
| C240 | 1.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.94 | 0.00 | 0.00 | 0.00 | 0.00 |
| C241 | 1.00 | 0.01 | 0.03 | 0.00 | 0.96 | 0.00 | 0.00 | 0.00 | 0.89 | 0.00 |
| C242 | 1.00 | 0.00 | 0.01 | 0.00 | 0.99 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C243 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.78 | 0.00 |
| C244 | 1.00 | 0.00 | 0.02 | 0.00 | 0.98 | 0.00 | 0.00 | 0.00 | 0.59 | 0.00 |
| C245 | 1.00 | 0.00 | 0.01 | 0.00 | 0.98 | 0.01 | 0.00 | 0.00 | 0.07 | 0.00 |
| C246 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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|---|---|---|---|---|---|---|---|---|---|---|
| C247 | 1.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| C248 | 1.00 | 0.00 | 0.03 | 0.00 | 0.97 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C249 | 1.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.95 | 0.00 | 0.00 | 0.00 | 0.00 |
| C25 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 |
| C250 | 1.00 | 0.00 | 0.03 | 0.00 | 0.97 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C251 | 1.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.97 | 0.00 | 0.00 | 0.00 | 0.00 |
| C252 | 1.00 | 0.00 | 0.02 | 0.00 | 0.98 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C256 | 1.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.97 | 0.00 | 0.00 | 0.01 | 0.00 |
| C257 | 1.00 | 0.00 | 0.88 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.75 | 0.00 |
| C258 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C259 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C26 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.87 | 0.00 |
| C260_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.74 | 0.00 | 0.00 | 0.05 | 0.00 |
| C260_2 | 1.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.16 | 0.00 | 0.00 | 0.94 | 0.00 |
| C261 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.90 | 0.00 |
| C262 | 1.00 | 0.00 | 0.01 | 0.00 | 0.99 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C263 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C264 | 1.00 | 0.01 | 0.00 | 0.00 | 0.99 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C265 | 1.00 | 0.01 | 0.00 | 0.00 | 0.99 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C266 | 1.00 | 0.01 | 0.00 | 0.00 | 0.99 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C267 | 1.00 | 0.02 | 0.00 | 0.00 | 0.58 | 0.41 | 0.00 | 0.00 | 0.85 | 0.00 |
| C268 | 1.00 | 0.00 | 0.02 | 0.00 | 0.86 | 0.13 | 0.00 | 0.00 | 0.98 | 0.00 |
| C269 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.03 | 0.00 | 0.00 | 1.00 | 0.00 |
| C27 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.02 | 0.00 | 0.00 | 0.99 | 0.00 |
| C270 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C271 | 1.00 | 0.08 | 0.92 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C272 | 1.00 | 0.00 | 0.08 | 0.00 | 0.92 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C273_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.55 | 0.45 | 0.00 | 0.00 | 1.00 | 0.00 |
| C273_2 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C274 | 1.00 | 0.00 | 0.00 | 0.00 | 0.95 | 0.05 | 0.00 | 0.00 | 1.00 | 0.00 |
| C275 | 1.00 | 0.00 | 0.00 | 0.00 | 0.87 | 0.13 | 0.00 | 0.00 | 0.01 | 0.00 |
| C276 | 1.00 | 0.01 | 0.00 | 0.00 | 0.16 | 0.83 | 0.00 | 0.00 | 0.01 | 0.00 |
| C277 | 1.00 | 0.00 | 0.06 | 0.00 | 0.91 | 0.03 | 0.00 | 0.00 | 0.94 | 0.00 |
| C278 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C28 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.54 | 0.00 |
| C283 | 1.00 | 0.00 | 0.00 | 0.00 | 0.73 | 0.26 | 0.00 | 0.00 | 1.00 | 0.00 |
| C284 | 1.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.50 | 0.00 | 0.00 | 0.95 | 0.00 |
| C285 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C286 | 1.00 | 0.18 | 0.82 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C287 | 1.00 | 0.00 | 0.17 | 0.00 | 0.82 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |

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|---|---|---|---|---|---|---|---|---|---|---|
| C288 | 1.00 | 0.00 | 0.01 | 0.00 | 0.49 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| C29 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 1.00 | 0.00 |
| C293 | 1.00 | 0.00 | 0.00 | 0.00 | 0.47 | 0.53 | 0.00 | 0.00 | 0.99 | 0.00 |
| C294 | 1.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.65 | 0.00 | 0.00 | 0.32 | 0.00 |
| C295 | 1.00 | 0.00 | 0.01 | 0.00 | 0.90 | 0.09 | 0.00 | 0.00 | 0.99 | 0.00 |
| C296 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 0.98 | 0.00 |
| C297 | 1.00 | 0.00 | 0.00 | 0.00 | 0.54 | 0.45 | 0.00 | 0.00 | 0.91 | 0.00 |
| C3 | 1.00 | 0.13 | 0.00 | 0.00 | 0.00 | 0.87 | 0.00 | 0.00 | 0.09 | 0.00 |
| C30 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.03 | 0.00 | 0.00 | 0.99 | 0.00 |
| C302 | 1.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.96 | 0.00 | 0.00 | 0.00 | 0.00 |
| C306 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C31 | 1.00 | 0.00 | 0.00 | 0.00 | 0.39 | 0.61 | 0.00 | 0.00 | 0.93 | 0.00 |
| C310 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C311 | 1.00 | 0.00 | 0.00 | 0.00 | 0.54 | 0.46 | 0.00 | 0.00 | 0.98 | 0.00 |
| C32 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C33 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C34 | 1.00 | 0.00 | 0.02 | 0.00 | 0.98 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C35 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.71 | 0.00 |
| C36 | 1.00 | 0.00 | 0.00 | 0.00 | 0.43 | 0.57 | 0.00 | 0.00 | 0.99 | 0.00 |
| C37 | 1.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.16 | 0.00 | 0.00 | 0.99 | 0.00 |
| C38 | 1.00 | 0.00 | 0.00 | 0.00 | 0.45 | 0.54 | 0.00 | 0.00 | 0.01 | 0.00 |
| C39 | 1.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.69 | 0.00 | 0.00 | 0.98 | 0.00 |
| C4 | 1.00 | 0.07 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.91 | 0.00 | 0.00 |
| C41 | 1.00 | 0.02 | 0.98 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C42 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C43 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C44 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C45 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 |
| C46 | 1.00 | 0.00 | 0.00 | 0.00 | 0.67 | 0.33 | 0.00 | 0.00 | 0.99 | 0.00 |
| C47 | 1.00 | 0.00 | 0.00 | 0.00 | 0.45 | 0.55 | 0.00 | 0.00 | 0.03 | 0.00 |
| C48 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C49 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C5 | 1.00 | 0.25 | 0.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C50_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.70 | 0.30 | 0.00 | 0.00 | 0.03 | 0.00 |
| C50_2 | 1.00 | 0.00 | 0.09 | 0.00 | 0.91 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C51 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.92 | 0.00 |
| C52 | 1.00 | 0.00 | 0.00 | 0.00 | 0.40 | 0.60 | 0.00 | 0.00 | 0.01 | 0.00 |
| C53_1 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C53_2 | 1.00 | 0.00 | 0.00 | 0.00 | 0.67 | 0.33 | 0.00 | 0.00 | 0.43 | 0.00 |
| C54 | 1.00 | 0.00 | 0.00 | 0.00 | 0.44 | 0.56 | 0.00 | 0.00 | 0.98 | 0.00 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C55 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.52 | 0.00 |
| C56 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| C57 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C58 | 1.00 | 0.00 | 0.00 | 0.00 | 0.94 | 0.05 | 0.00 | 0.00 | 0.99 | 0.00 |
| C6 | 1.00 | 0.24 | 0.76 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C62 | 1.00 | 0.00 | 0.00 | 0.00 | 0.93 | 0.07 | 0.00 | 0.00 | 0.97 | 0.00 |
| C63 | 1.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.73 | 0.00 | 0.00 | 0.23 | 0.00 |
| C64 | 1.00 | 0.09 | 0.91 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C65 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.94 | 0.00 |
| C66 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C67 | 1.00 | 0.00 | 0.00 | 0.00 | 0.52 | 0.48 | 0.00 | 0.00 | 0.47 | 0.00 |
| C68 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C69 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C69_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.99 | 0.00 | 0.00 | 0.58 | 0.00 |
| C69_2 | 1.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.96 | 0.00 | 0.00 | 0.58 | 0.00 |
| C7 | 1.00 | 0.22 | 0.78 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C70 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.65 | 0.00 |
| C71 | 1.00 | 0.00 | 0.00 | 0.00 | 0.38 | 0.62 | 0.00 | 0.00 | 0.44 | 0.00 |
| C71_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.17 | 0.83 | 0.00 | 0.00 | 0.56 | 0.00 |
| C71_2 | 1.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.75 | 0.00 | 0.00 | 0.60 | 0.00 |
| C72 | 1.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.84 | 0.00 | 0.00 | 0.04 | 0.00 |
| C73 | 1.00 | 0.00 | 0.00 | 0.00 | 0.95 | 0.05 | 0.00 | 0.00 | 0.97 | 0.00 |
| C74_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.57 | 0.43 | 0.00 | 0.00 | 0.95 | 0.00 |
| C74_2 | 1.00 | 0.00 | 0.00 | 0.00 | 0.61 | 0.39 | 0.00 | 0.00 | 0.56 | 0.00 |
| C75 | 1.00 | 0.00 | 0.06 | 0.00 | 0.94 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| C76 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C77 | 1.00 | 0.00 | 0.00 | 0.00 | 0.57 | 0.43 | 0.00 | 0.00 | 0.90 | 0.00 |
| C78 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.73 | 0.00 |
| C79 | 1.00 | 0.00 | 0.00 | 0.00 | 0.49 | 0.51 | 0.00 | 0.00 | 0.91 | 0.00 |
| C8 | 1.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.99 | 0.00 | 0.00 | 0.45 | 0.00 |
| C80 | 1.00 | 0.00 | 0.02 | 0.00 | 0.98 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C81 | 1.00 | 0.00 | 0.09 | 0.00 | 0.91 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 |
| C82 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C83 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| C83_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.59 | 0.41 | 0.00 | 0.00 | 0.98 | 0.00 |
| C83_2 | 1.00 | 0.00 | 0.00 | 0.00 | 0.96 | 0.03 | 0.00 | 0.00 | 0.75 | 0.00 |
| C84 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.01 | 0.00 | 0.00 | 0.02 | 0.00 |
| C85 | 1.00 | 0.09 | 0.00 | 0.00 | 0.67 | 0.24 | 0.00 | 0.00 | 0.11 | 0.00 |
| C86 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.96 | 0.00 |
| C87 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.11 | 0.00 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C88 | 1.00 | 0.00 | 0.00 | 0.00 | 0.71 | 0.29 | 0.00 | 0.00 | 0.87 | 0.00 |
| C89 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| C9 | 1.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.98 | 0.00 | 0.00 | 0.14 | 0.00 |
| C90 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.99 | 0.00 |
| C91 | 1.00 | 0.00 | 0.00 | 0.00 | 0.56 | 0.44 | 0.00 | 0.00 | 0.99 | 0.00 |
| C92 | 1.00 | 0.00 | 0.00 | 0.00 | 0.81 | 0.19 | 0.00 | 0.00 | 0.99 | 0.00 |
| C93 | 1.00 | 0.00 | 0.00 | 0.00 | 0.56 | 0.44 | 0.00 | 0.00 | 0.21 | 0.00 |
| C94 | 1.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.16 | 0.00 | 0.00 | 0.99 | 0.00 |
| C95 | 1.00 | 0.00 | 0.00 | 0.00 | 0.51 | 0.49 | 0.00 | 0.00 | 0.06 | 0.00 |
| C96 | 1.00 | 0.00 | 0.00 | 0.00 | 0.85 | 0.15 | 0.00 | 0.00 | 0.98 | 0.00 |
| C97 | 1.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.74 | 0.00 | 0.00 | 0.01 | 0.00 |
| C98 | 1.00 | 0.00 | 0.00 | 0.00 | 0.56 | 0.44 | 0.00 | 0.00 | 0.93 | 0.00 |
| C99_1 | 1.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.16 | 0.00 | 0.00 | 0.68 | 0.00 |
| C99_2 | 1.00 | 0.00 | 0.05 | 0.00 | 0.95 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |

Analysis begun on: Mon Aug 12 08:46:15 2024

Analysis ended on: Mon Aug 12 08:46:39 2024

Total elapsed time: 00:00:24

## ANNEXURE 11: WILDLIFE HAZARD MANAGEMENT PLAN (incl. Birds)

(This will be a condition of approval if Environmental Authorisation is obtained)

# Cape Winelands Airport

*Bird and Wildlife Hazard Management*

*Landscape and Open Space Planning Guidelines*



Albert Froneman

February 2024

**Background & motivation**

Bird and wildlife management on an aerodrome is a critical part of the airport safety management system and an integrated approach is required to adequately address this risk. The purpose of this document is to provide guidance for the pro-active management of bird and wildlife hazards through landscape and open space planning.

The Cape Winelands Airport is located within the Fynbos Biome. The primary vegetation type classification of the aerodrome site is the critically endangered Swartland Granite Renosterveld. Almost 80% of this vegetation type has been transformed as a result of agriculture and urban sprawl.

Fynbos vegetation typically has low animal biomass but very high levels of plan diversity and endemism. In its natural state fynbos vegetation does not support many large bird species that would pose a bird strike risk to aircraft. Most of the larger bird species that at present occur in large numbers (e.g. Egyptian Geese) within the fynbos biome have established and proliferated in the area as a result of agriculture (e.g. grassland type habitats) and the associated establishment of farm dams and other artificial water reservoirs.

As a general rule aerodromes typically establish grasslands on the airfield around the runways, taxiways and outer airfield. Grass is well suited for this purpose as it binds the soil and can easily be maintained, through regular mowing, at a short height.

The short grass habitat that is created and artificially maintained is a significant attractant for hazardous bird species. In the case of the Cape Winelands Airport the sandy soils and low rainfall during the hot dry summer months will make if exceptionally challenging to successfully maintain a dense growth of grass that will bind the soil. Vast open grassland habitats are not native to the western cape. Many or most of the bird species, with a potential high-risk classification for bird strikes with aircraft, that occur in the area (e.g. Egyptian Geese, Spur-winged Geese, Lapwings, Black-headed Herons and Hadada Ibises) are present in unnaturally high numbers as a result of grassland habitats created through agriculture and urbanisation. In addition, every time the grass is cut to maintain it at a short height it creates a significant disturbance event that attracts birds to the area to feed on invertebrates etc. The windrows of cut grass left behind following the grass cutting event also provide ideal micro habitats where invertebrates can proliferate and even rodents can hide under the dense grass mats.

A unique opportunity thus exists where natural fynbos vegetation could be established in stead of the typical grass and in so doing minimise (or to a large degree eliminate) the bird strike risk. Establishing natural renosterveld and fynbos could also contribute towards the conservation of a critically endangered vegetation type. If short growing renosterveld and fynbos species are selected and cultivated for this purpose maintenance costs (i.e. grass cutting) can be eliminated or at least greatly reduced.

The below table provides an overview of the different aerodrome landscapes and open spaces and provides guidance from a bird and wildlife management perspective.

| Airport development area | Vegetation description | Motivation | Implementation & establishment | Management | Other considerations |
|---|---|---|---|---|---|
| **Airside** | | | | | |
| Airside – RWY strip (50m) & TWY strip (23m) | Short growing indigenous fynbos / renosterveld vegetation - 20cm maximum height | Offset initial cost through reduced maintenance over time. | Would need specialist guidance on soil preparation, species composition, cultivation of seedlings(?) and establishment planting of plugs etc? Uncertain about how long establishment would take / weed control etc. | As little as possible if the right vegetation has been established – may require annual or bi-annual 'trim' in case some elements grow a bit too tall.<br><br>Will the fynbos need to burn every few years? i.e. burning regime requirement if any? | Establish a track for use by patrol vehicles on the edge of the short grass section around the runway that delineates the boundary between the runway strip and the rest of the airfield.<br><br>Initial dust suppression during and post initial establishment. |
| Outer airfield – remainder of airfield vegetated area | Shorter growing fynbos vegetation - vegetation species composition can include some slightly taller growing species - not more than 40-50cm maximum. | Offset initial cost through reduced maintenance over time. | Would need specialist guidance on soil preparation, species composition, cultivation of seedlings(?) and establishment planting of plugs etc? Uncertain about how long establishment would take / weed control etc. | Annual or by annual trimming.<br><br>Burning requirement -frequency. | Establish a 2m underground mole barrier fence around the outer perimeter. |

| Airport development area | Vegetation description | Motivation | Implementation & establishment | Management | Other considerations |
|---|---|---|---|---|---|
| **Airport precinct – landside and tenant areas** | | | | | |
| Airport landside precinct gardens and tenant garden areas | Follow the same theme of natural fynbos gardens throughout.<br>No lawns!<br>Do not establish any ponds or water features. | Drastic saving in terms of irrigation costs as most indigenous fynbos species is quite drought resistant. | Options should be more readily available through existing garden and landscaping service providers. | General garden maintenance – no grass cutting or mowing | |
| Stormwater retention ponds | Anything else than grass to cover the base of the stormwater retention ponds. Shorter wetland type fynbos and restios perhaps. Vegetation should not hinder quick drainage of the area. Any water that stands for long will become an attractant for birds | Retention of storm water should not create suitable habitat for birds. The areas should drain fairly rapidly and no residual wetland habitat should remain. | | | |
| Other open areas on land owned by CWA | Eliminate any agricultural or cultivation activities | Agricultural and cultivation activities will attract numerous large | | | |

| | | | | | |
|---|---|---|---|---|---|
| | on land owned or managed by CWA | hazardous birds to the area. | | | |
| Waste management | | | | All waste skips should be covered at all time and waste storage facilities should all be under roofed and closed off. | |

| Airport development area | Vegetation description | Motivation | Implementation & establishment | Management | Other considerations |
|---|---|---|---|---|---|
| **Off-airport habitats and considerations** | | | | | |
| Existing water bodies on site and in immediate surrounds | Specific waterbodies or dams in the landscape are known to attract large numbers of waterbirds. Increase edge depth, remove shallow edges, establish dense typha or phragmites stands along the edge of the water. Remove all islands and eliminate dry tress that would provide roosting and perching space for the birds. | Minimise the attractiveness of existing water bodies to birds and have them move to alternate areas away from risk zones. | Challenges of changing existing dams and water bodies on private land? | Maintain vegetation along edges and monitor that shallow areas or islands don't form again over time. | Permits to do this? |
| Wastewater treatment works (WWTW) | Maintain status quo – short vegetation around evaporation ponds. | Few waterbirds were present during site visit. | | Regular monitoring required. | Future expansion should maintain similar design. |

# ANNEXURE 12: EMERGENCY PREPAREDNESS AND RESPONSE PLAN

(This will be a condition of approval if Environmental Authorisation is obtained)

# ANNEXURE 13: ARCHITECTURAL DESIGN GUIDELINES

**ARCHITECTURAL DESIGN GUIDELINES FOR THE CAPE WINELANDS AIRPORT DEVELOPMENT.**

**Introduction:**

In the pursuit of creating an exceptional and harmonious airport complex, this document outlines comprehensive architectural design guidelines. Envisioned to encompass various facilities catering to a diverse range of needs, from terminal buildings and commercial spaces including hotels and retail establishments, to passenger services like car hire facilities, this development strives for excellence in every aspect.

The airport complex is not only set to serve as a functional hub for travellers but also to establish a vibrant community centre. With a focus on holistic planning, the complex will boast a large public plaza and well-landscaped areas, fostering an environment where aesthetics and functionality intertwine seamlessly. Moreover, recognizing the diverse requirements of modern aviation, this complex will incorporate vital elements such as general aviation facilities, aircraft storage and maintenance hangars, and the full spectrum of support buildings necessary for accommodating aircraft as substantial as the A380.

An integrated approach extends to logistics and commerce, as warehousing and logistics facilities coexist alongside commercial office buildings. The holistic vision of this airport development aligns modernity with sustainability, embraces the local identity, and strives to be a pinnacle of architectural and functional achievement.

**Design Principles:**

**1. Modern Aesthetics:** All structures within the complex should embody a contemporary design language that harmonizes innovation with timeless allure.

**2. Engaging Public Areas**: Spaces that interface with the public, like walkways and plazas, should embrace "active boundaries," cultivating interactive and inviting environments.

**3. Innovative Roofscape:** Recognize rooftops as an integral fifth facet, offering a canvas to infuse creativity into the design, generating an extraordinary visual impact.

**4. Functional Colonnades:** For structures facing the public, incorporate colonnades to provide shelter from the elements. Extending roof eaves can further heighten weather protection, drawing inspiration from successful past examples.

**5. Abundant Landscaping:** Seamlessly intertwine landscaping with the areas encircling buildings, weaving in greenery, pathways, and water features to enhance both visual charm and user **experience.**

**6. Local Material Palette:** Incorporate finishes and materials that pay homage to the local context. Integrate elements like timber and stone cladding to establish a robust link with the region's distinctive identity.

**7. Elevating Traditional Elements:** Employ inventive design solutions to elevate the visual and utilitarian facets of buildings that employ conventional industrial construction methods.

**8. Harmonious Signage:** Adhere to the complex's signage guidelines for any building signs, including tenant logos, ensuring uniformity and visual cohesion throughout the compound.

**9. Enhanced Road Infrastructure and Landscaping for a People-Centric Environment:**

- 9.1 Pedestrian Walkways and Pathways: Craft pedestrian pathways that are secure, well-illuminated, and seamlessly interconnected throughout the complex.
- 9.2 Bicycle Facilities: Integrate designated bicycle lanes and parking zones to encourage sustainable transportation alternatives for travellers and staff.
- 9.3 Landscape-Enhanced Corridors: Ensure roadways are meticulously landscaped with verdant elements and visual motifs that heighten aesthetics, fostering a delightful ambiance.

**10. Sustainable Inclusions:**

- 10.1 Eco-Friendly Design: Incorporate sustainable design practices, including energy-efficient systems, renewable materials, and optimal use of natural light and ventilation.

- 10.2 Water Management: Implement water-saving technologies, such as rainwater harvesting and efficient irrigation systems, to minimize water consumption and promote responsible water use.

- 10.3 Energy Efficiency: Integrate energy-efficient lighting, HVAC systems, and appliances throughout the complex to reduce energy consumption and lower the environmental impact.

- 10.4 Green Building Certification: Strive for recognized green building certifications to ensure the complex meets rigorous sustainability standards and contributes positively to the environment.

- 10.5 Waste Reduction: Implement waste reduction and recycling programs to minimize the **generation of waste and encourage responsible disposal practices.**

**11. Architectural Precedents (Annexure A):** A collection of carefully curated architectural precedents will serve as invaluable sources of inspiration and guidance throughout the design process, aiding in creating a unique and forward-looking airport complex that integrates seamlessly with the surrounding environment.

**12. Height Guidelines (Annexure B):** Refer to Annexure B for detailed height guidelines that provide clarity on the permissible building heights within the airport complex, ensuring visual harmony and effective space utilization.

Conclusion: These comprehensive architectural directives operate as a navigational chart for shaping a contemporary airport complex that reconciles inventive design, pragmatic functionality, sustainable practices, and local integration. By embracing these guiding principles, the airport's development can forge a united and captivating setting that caters to travellers, visitors, and the local community while exalting the very essence of the region's identity.

- **Examples of buildings with large roof overhangs/structural expression/double height curtain wall and public colonnade.**







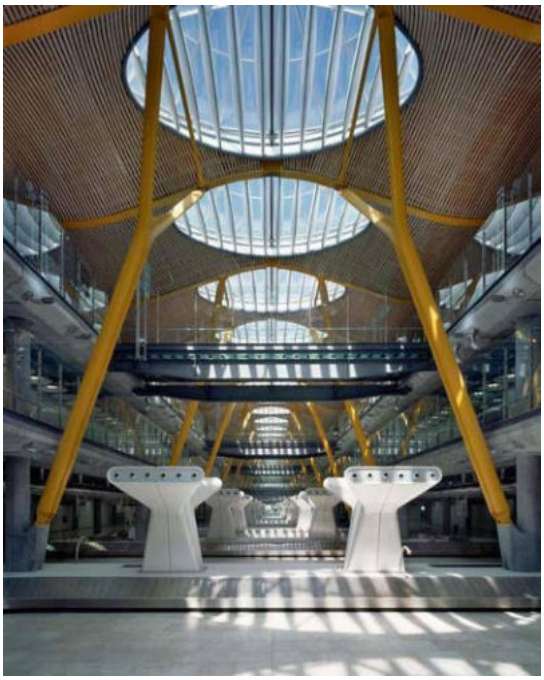



**PRECEDENT**

vivid architects

- **Examples of buildings with large roof overhangs/structural expression/double height curtain wall and public colonnade.**















**PRECEDENT**

vivid architects

- **Examples of commercial hotel low rise buildings and public space**









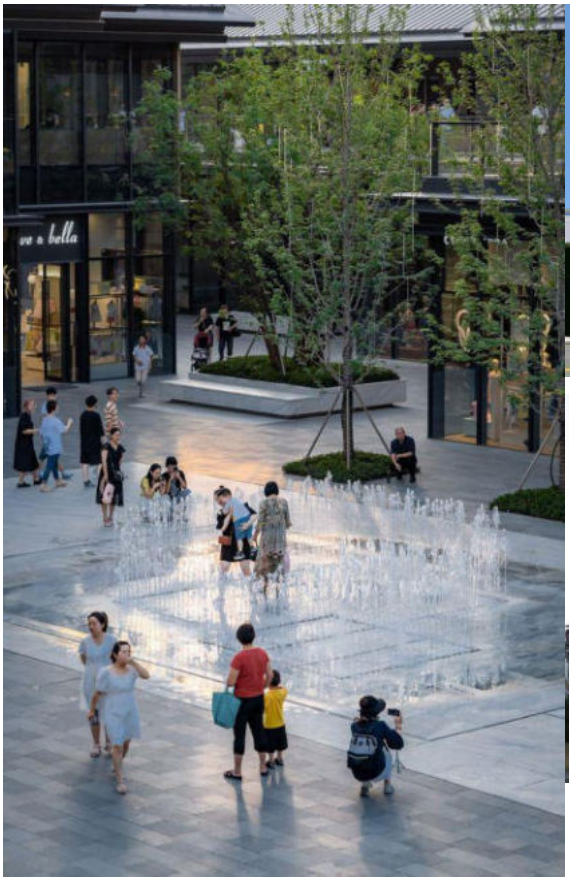



**PRECEDENT**

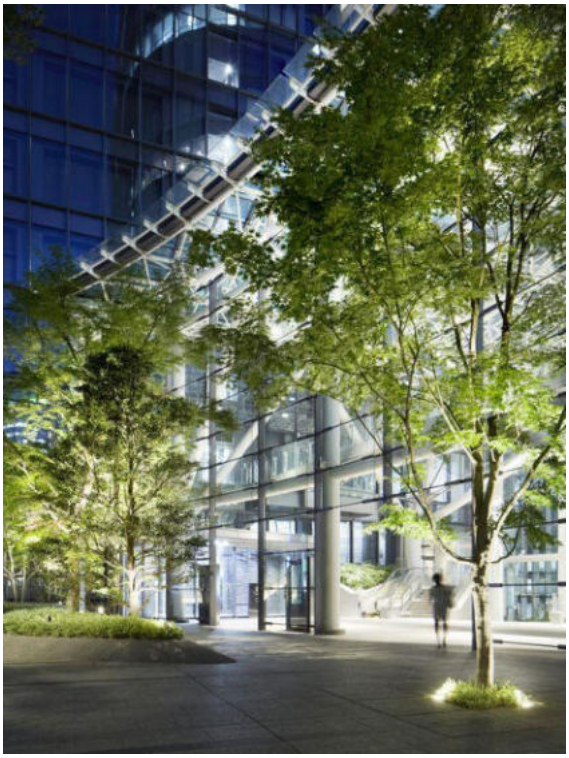
vivid architects

- **Examples of public space design elements/ scale and landscaping**







**Examples of public space with active edges using extensive glazing.**





- **Examples of landscaping design elements to create interest and public space for people to use and enjoy**



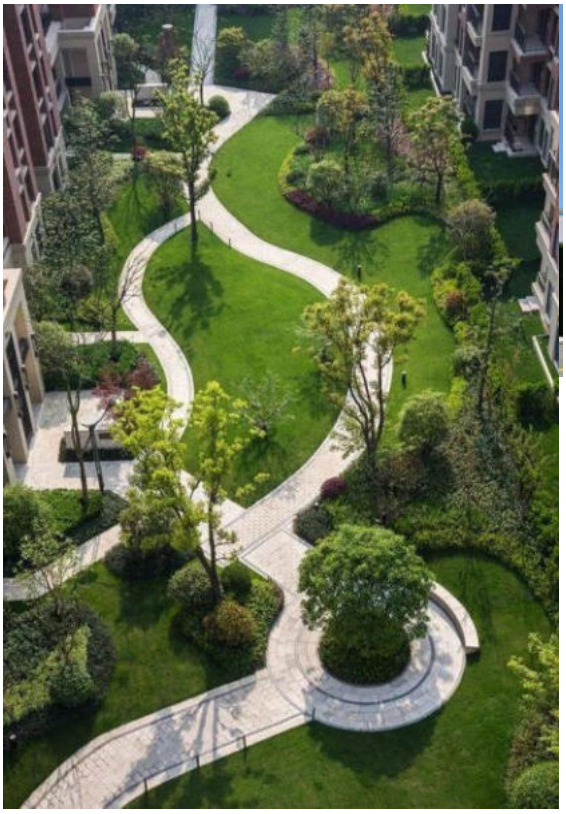


**PRECEDENT**

vivid architects

- **Examples of landscaping design elements to create interest and public space for people to use and enjoy**







- **Examples of landscaping design elements to create interest and public space for people to use and enjoy**





- **Examples of industrial type buildings that use clever design elevate the facades to more than a utilitarian solution. They have visual appeal and interest**






















**PRECEDENT**

vivid architects

- **Examples of buildings with interesting roof profiles and clever use of industrial type materials**









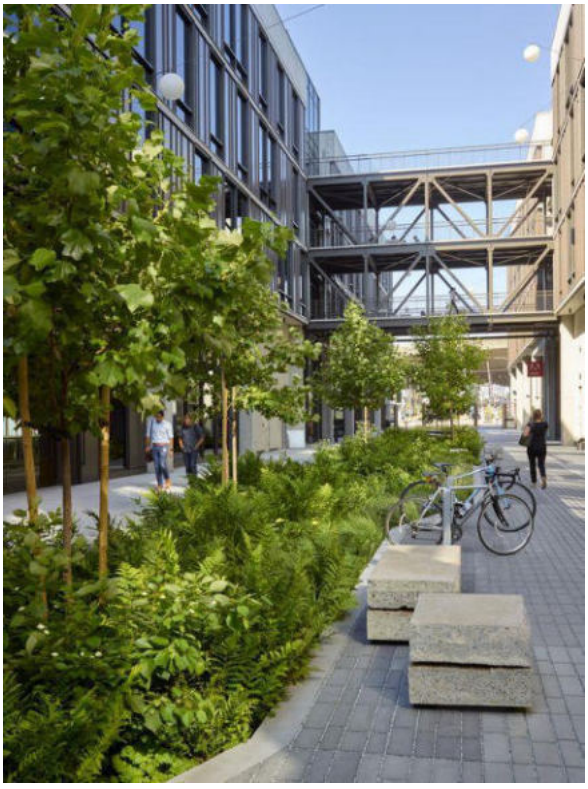




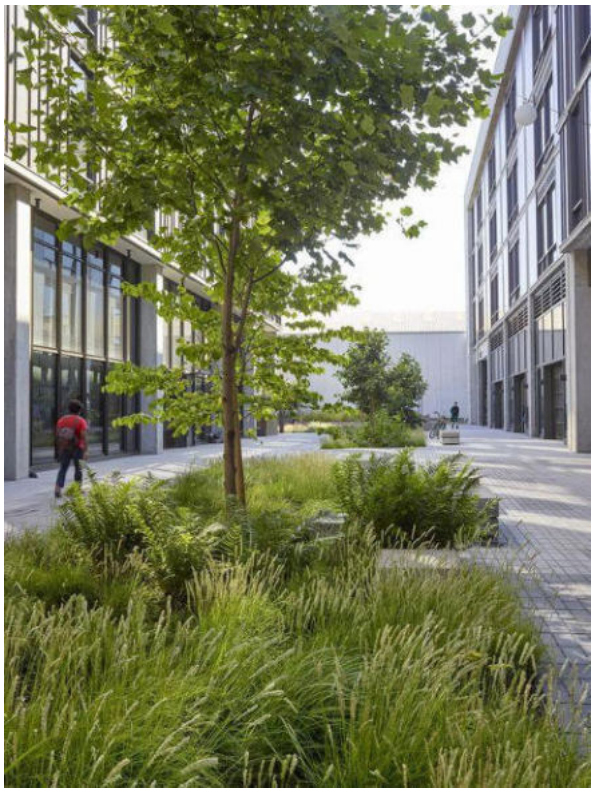


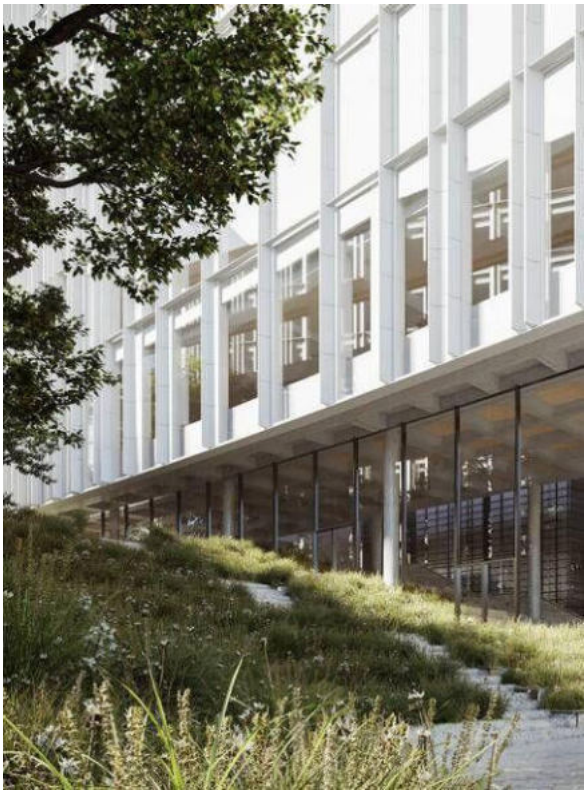



- **Examples of landscaping between buildings to create a user friendly pedestrian interface**

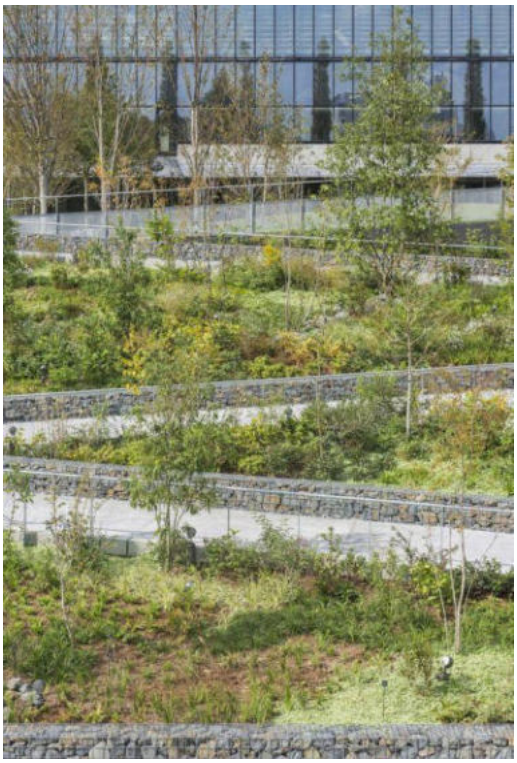
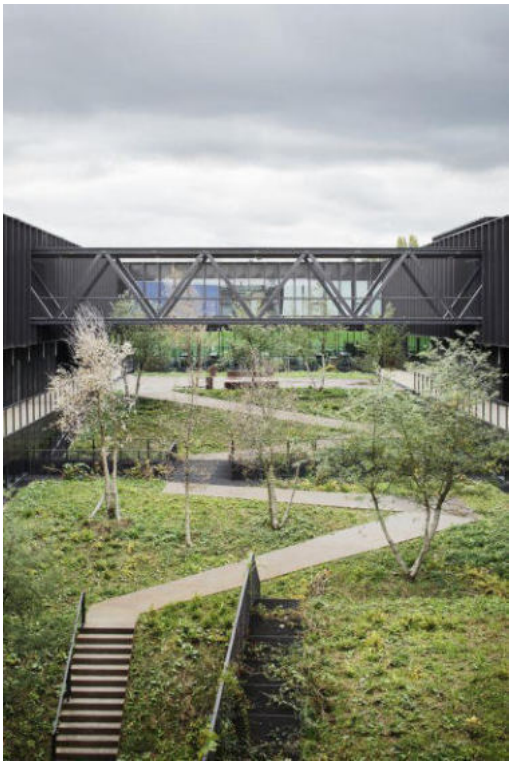








- **Examples of landscaping around buildings to create a user friendly pedestrian interface**




**PRECEDENT**

- **Artist impressions of the terminal building reflecting it 3 storey height and transparent glass facades**








- **Artist impressions of the terminal building reflecting the possibility of a dynamic roof profile**















## ARTIST IMPRESSIONS

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- **Artist impressions of the commercial warehousing and hanger architecture that will be 1-3 storeys in height**

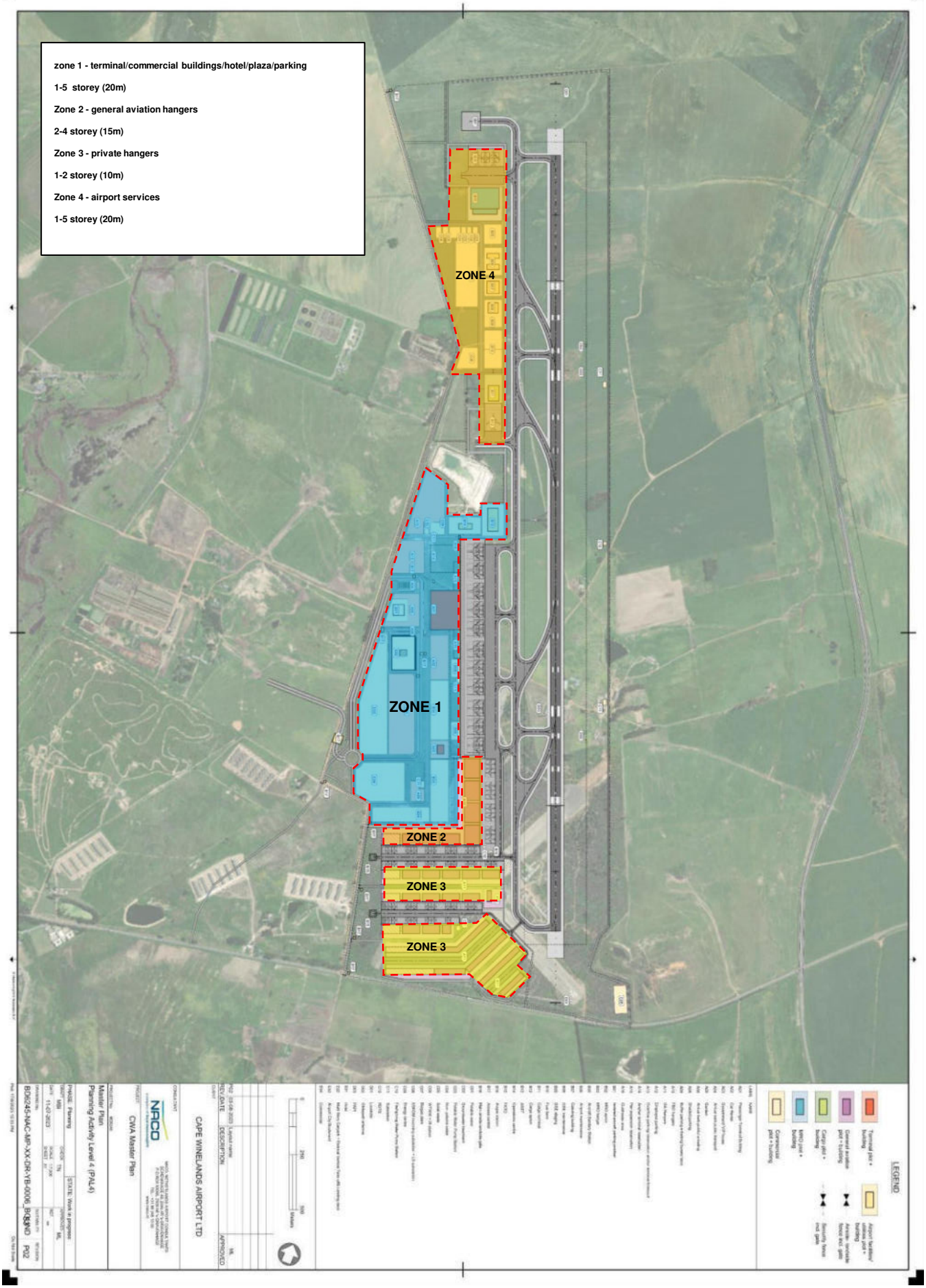






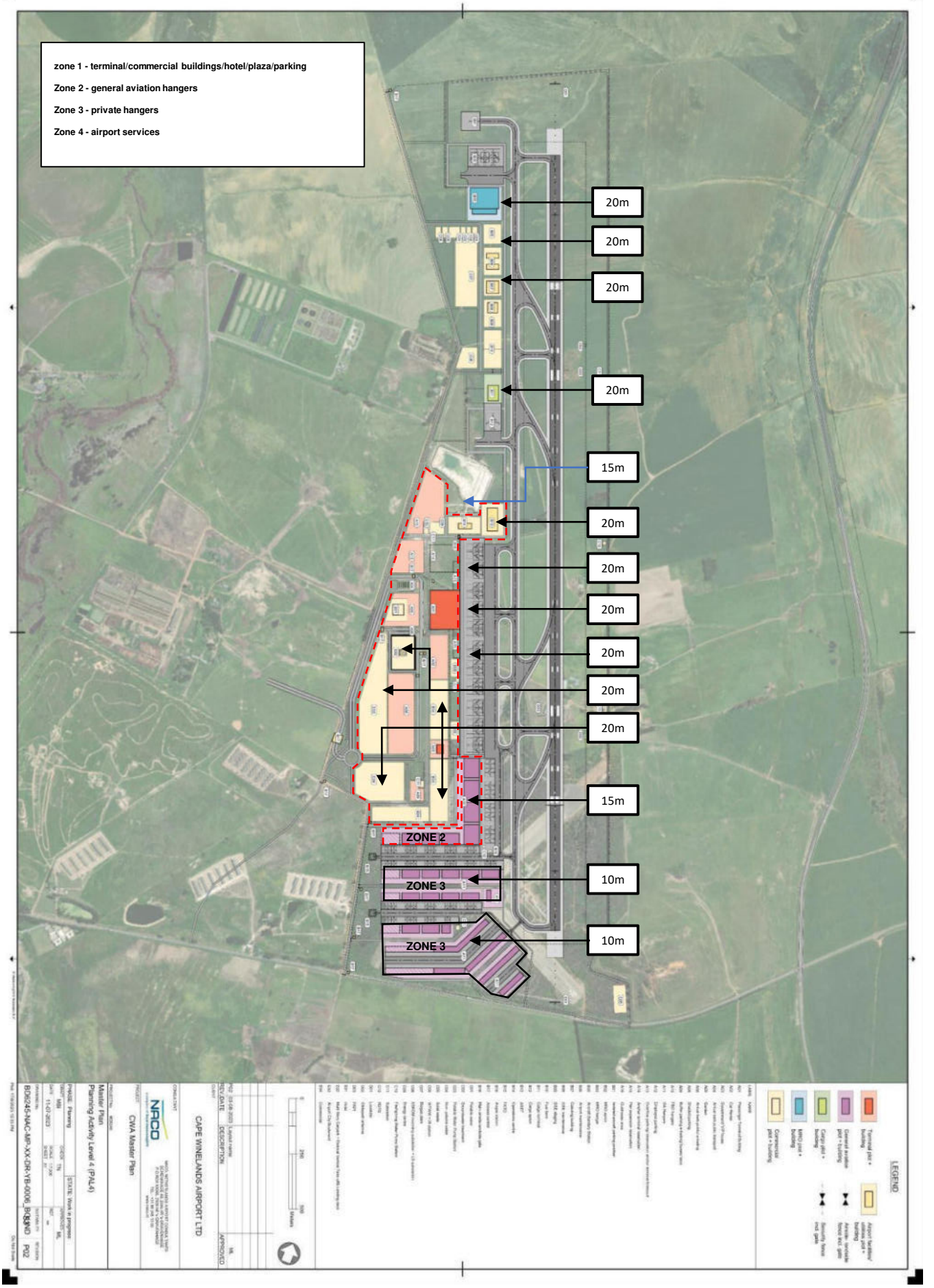






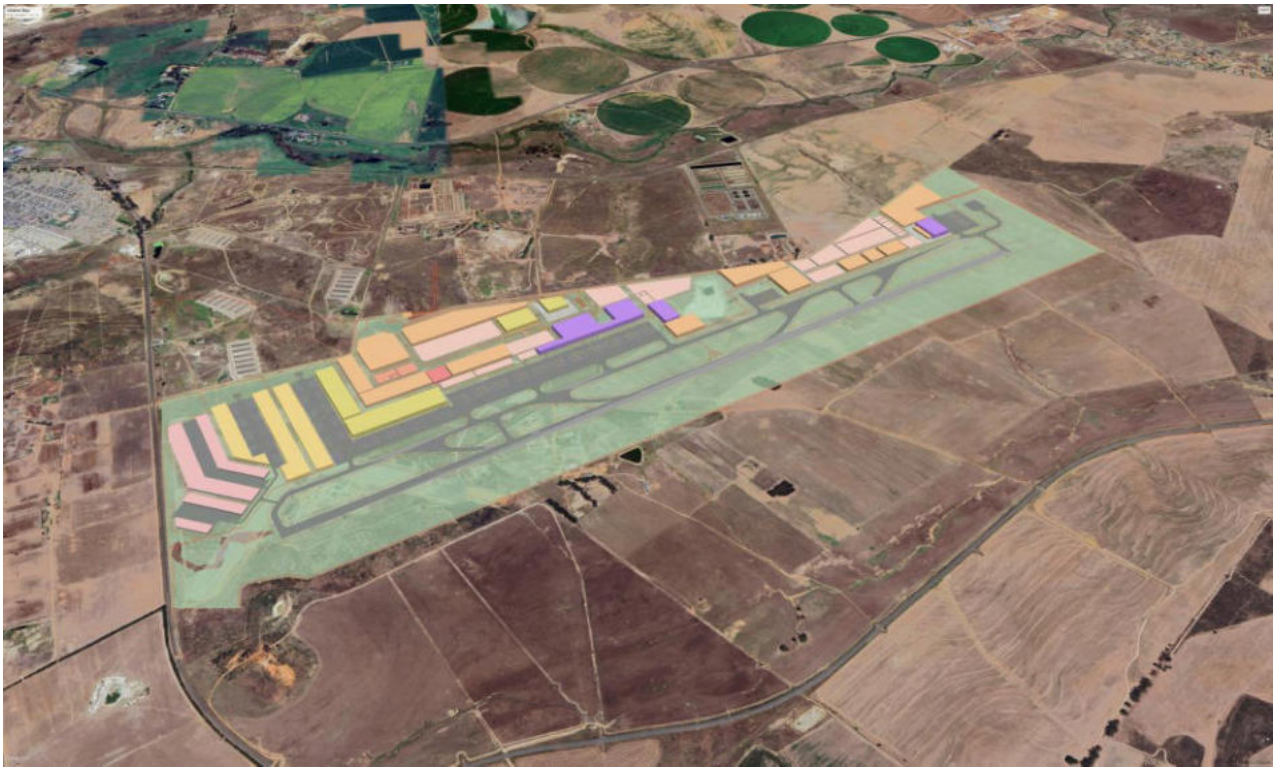

## HEIGHT ZONES

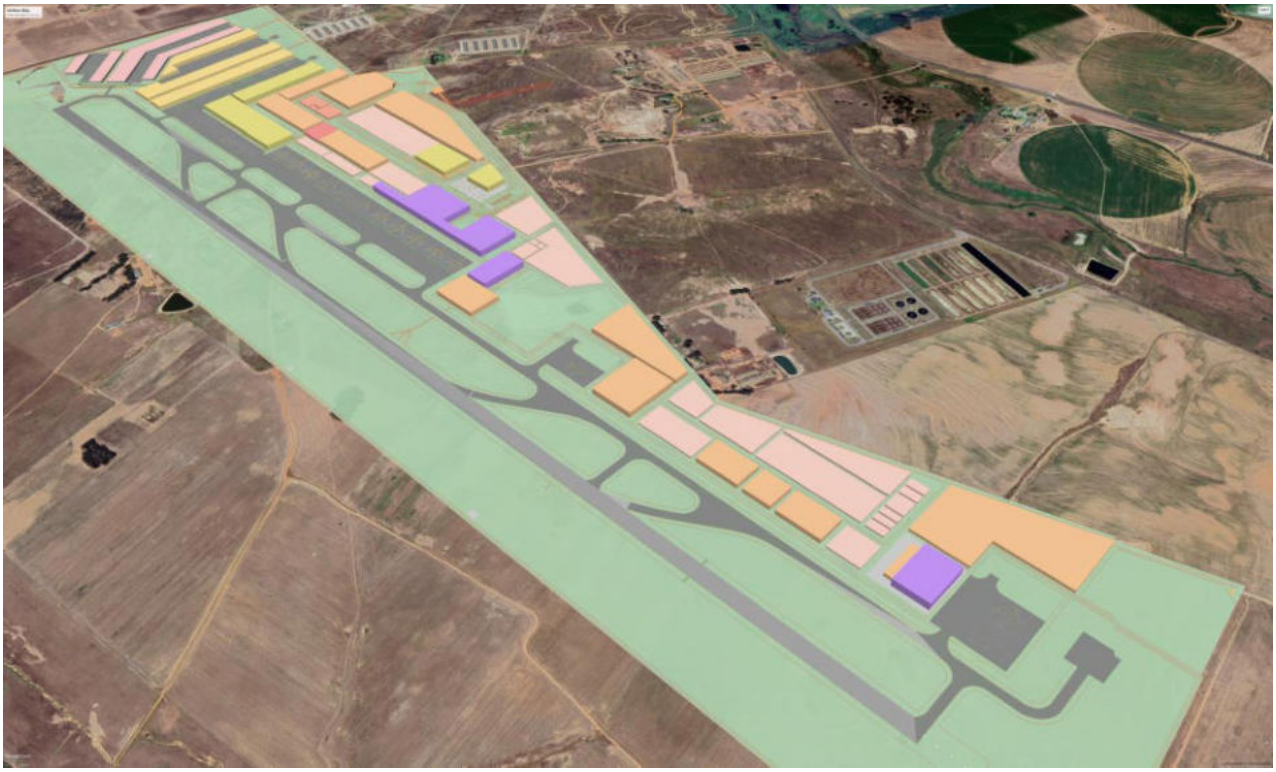
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## ESTIMATED BUILDING HEIGHTS

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**MASSING VIEWS**

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## ANNEXURE 14: OUTDOOR SIGNAGE GUIDELINES / PLAN

CAPE WINELANDS AERO

# Scope & Principles

# Outdoor Advertising Signage



28th September 2024

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| | |
|---|---|
| Document Type | Scope of Outdoor Advertising |
| Project | Cape Winelands Airport EIA |
| Purpose | To provide Outdoor Advertising Principles as input into the EIA process. |
| For | Cape Winelands Airport |
| Version Control | Version 5 A |

| | | | |
|---|---|---|---|
| Document Owner | Zelda Francis | | |
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# 1 Introduction

The Cape Winelands Airport is an exciting new development that embodies environmental consciousness and modern infrastructure. Set in scenic surroundings, this airport takes pride in blending innovation with eco-friendly practices.

As part of this development, the airport will incorporate state-of-the-art advertising signage that highlights its offerings and provides unique opportunities for businesses.

# 2 Purpose of the report

The primary objective of this report is to provide Outdoor Advertising principles that will be integrated into the Environmental Impact Assessment (EIA) process for Cape Winelands Airport.

This report will focus on the types of outdoor advertising signage proposed for implementation at The Cape Winelands Airport. These principles for Outdoor Advertising will be provided in the context of environmental considerations.

These proposed advertising mediums aim to optimize brand visibility, engage travelers, and contribute to the overall ambience and functionality of the airport environment.

## 3 Scope of this report

This report focuses on the **scope and principles** of both 1st party and 3rd party outdoor signage at the Cape Winelands Airport ensuring compliance of the Cape Town Outdoor Signage By-Law 8969, 2023.

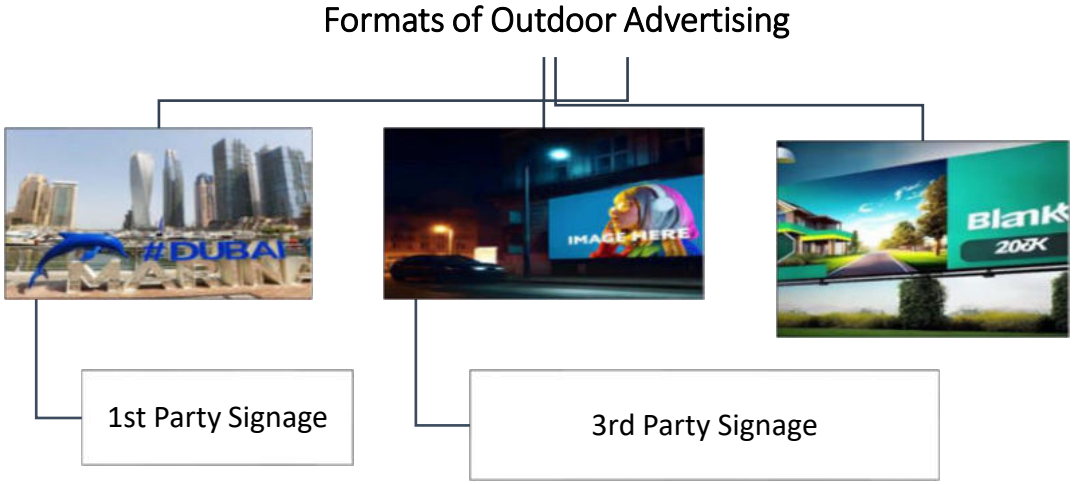
## 4. Formats of Outdoor Advertising Signage

The Cape Winelands Airport will use a variety of advertising signage formats to showcase its offerings and provide business opportunities to interested parties.

The formats include:

- **1st Party Signage**: Signage for Cape Winelands Airport (Naming and / or Welcome to Cape Winelands Airport). Signage that is directly related to the airport's own services and facilities.
- **3rd Party Signage**: Advertising opportunities made available for external businesses to promote their Products and Services

Below images are examples of both 1st & 3rd Party Outdoor Advertising Signage



## 5. City of Cape Town Outdoor Advertising By-Law No. 8969, 2023

### Compliance

Compliance involves adhering to all regulations, guidelines, and specifications set forth in the City of Cape Town Outdoor Advertising By-law No 8969, 2023. This ensures that all signage formats are legally approved, safe, and contribute positively to the visual and functional environment of the Cape Winelands Airport.

5.1 Outdoor Advertising Signage: This includes freestanding billboards, digital boards, custom-made designs, flat signs, etc., must comply with the City of Cape Town Outdoor Advertising By-Law No. 8969, 2023.

5.2 Areas of Control: As set out in the City of Cape Town Outdoor Signage By-Law No. 8969, 2023, Schedule 1 refers to the classification of different landscapes, areas, sites and reflects the degree of control within these areas.

The future proposed Cape Winelands Airport precinct will be classified as a transport interchange/terminal and will only then be designated as "minimum control." This classification dictates the level of regulation and oversight required for signage in this area.

5.3 Approval Process: All outdoor advertising signage, whether 1st Party or 3rd Party must comply with the approval process as per the City of Cape Town Outdoor Signage By-Law 8969, 2023. Approval must be from the City or by its officials in writing before it can be erected.

5.4 Signage Master Plan (SMP): The development of an Outdoor Signage Master Plan is essential. The City requires and approves a SMP in respect of any new development where the erection of numerous signs is proposed.

The SMP must set out the specifics of the location, placement, type and design of signs to be erected on a premises or within a particular area.

This plan should be created in collaboration with the City Officials, Environmental Management Department to ensure all environmental considerations are addressed.

## Components of an Outdoor Signage Master Plan

- Signage Inventory: A detailed list of all proposed outdoor signage, e.g., billboards, digital boards etc. and the locations and conditions
- Design Guidelines: Standards for the visual aspects of signage, such as size, colour, typography, materials, and lighting. Inclusive will be examples of structural details relating to all outdoor signs.
- Placement Strategy: Guidelines for where signs should be located to maximize visibility and effectiveness without causing clutter or obstruction to any traffic signage.
- Regulatory Compliance: Ensuring all signage adheres to local laws e.g. Advertising Standards Authority and regulations, such as the City of Cape Town Outdoor Advertising By-Law No. 8969, 2023.
- Environmental Considerations: Collaboration with environmental management to minimize the impact of signage on the surrounding area.

## Input Required

- Stakeholder Engagement: Input from various stakeholders, including City, Environmental Management, Traffic Engineers, Business and or Landowners
- Site Analysis: Detailed surveys and studies of the area to understand traffic patterns, visibility, and Environmental impact.
- Regulatory Review: Consultation with Environmental Management to ensure compliance with all relevant laws and regulations.
- Design Expertise: Collaboration with Graphic Designers and Architects to develop aesthetically pleasing and functional signage.

## Process Involved

- Initial Assessment: Conducting surveys and audits to gather data on site conditions.
- Stakeholder Consultation: Engaging with stakeholders to gather input and address concerns.
- Drafting the Plan: Developing the signage inventory, location, size, format, illumination, area of control (design guidelines, placement strategy, and maintenance plan).
- Submission of Application to be applied for in writing or electronically to the City on the prescribed application form. The following information must accompany the application.
    - a site plan showing the site on which it is proposed
    - a drawing which complies with National Building Regulations as per the by-law
    - detailed scaled drawings of the sign and a site plan indicating the position of the sign on the site
    - notification to the city when an approved 3rd party fixed graphic sign are to be changed, this must be submitted to the City to check for compliance
- Application fees: Payment to be made to the City on application. The fee is determined by the City in terms of the City's approved tariffs.
- Review and Approval: Submitting the draft plan for pre-scrutiny by relevant authorities and stakeholders, making necessary revisions.
- Implementation: Installing new and approved outdoor signage according to the approved Signage Master Plan.

## Timeframe to Complete

Completion of an Outdoor Signage Master Plan can vary depending on the complexity and scale of the project. Typically, it can take anywhere from 6 months to 1 year to complete the entire process, from initial assessment to final implementation.

## 6. Proposed Outdoor Advertising Signage - Formats and Placements

The outdoor advertising signage at the Cape Winelands Airport will consist of both 1st Party and 3rd Party Outdoor Advertising Signage.

As part of this development, both 1st Party and 3rd Party Outdoor Advertising Signage will be implemented to showcase the airport's offerings, welcome visitors, and provide a unique advertising opportunity for businesses.

Below, we provide a detailed summary of the proposed advertising signage formats, including the ideal placement, principles, and design considerations for each.

### 6.1 1st Party Advertising Signage

**Principles and Placement:**

1. Importance of Clarity: The 1st Party Signage must be clear and legible from a distance, ensuring that visitors and / or motorists can read and understand the message.
2. Compliance: The design and placement of 1st Party Signage should always comply with the City of Cape Town Outdoor Advertising By-law: No 8969, 2023.

    2.1 Compliance Overview: Adhering to all regulations, guidelines, and specifications set forth in the City of Cape Town Outdoor Advertising By-law. This includes, but is not limited to:

    - Ensuring the signage does not obstruct traffic signals or road signs
    - Using materials and lighting that do not cause glare or distraction to motorists
    - Obtaining the necessary permits and approvals before installation of 1st Party signage

- Adhering to the size, height, and placement restrictions as specified in the by-law
- Regular maintenance to ensure the signage remains in good condition and legible
- Conduct an annual inspection to ensure a certificate of compliance is in hand, particularly for electrified signage

3. Size & Style Relevance: Signage will be bespoke "tailor made" for The Cape Winelands Airport. The sign must be designed, located, and sized appropriately to suit the purpose of the signage while integrating the background environment to provide excellent visibility and readability.

4. Minimal Visual Impact: Careful thought should be given to the location of 1st Party Signage to minimize visual impact on the environment and ensure that the sign blend well with the surrounding environment.

5. Branding Consistency: The 1st Party Signage must be consistent with the airport's branding and should be designed with aesthetically pleasing design and colour coordination.

6. Effective Placement: 1st Party Signage should be strategically placed in high visibility areas to achieve maximum effect. The entrance circle following the approach road at The Cape Winelands Airport is an ideal location for 1st Party Signage. This location forms part of the entrance/exit roads for motorists entering and leaving the airport, and it also connects them to the terminal building, parking, drop-off zones, and exit etc.

7. Maintenance: The Signage should be well maintained to ensure it maintains its clarity and visibility, and any damaged sign should be promptly removed or repaired.

8. Welcoming Passengers and Visitors: The signage should be carefully crafted to create a welcoming ambiance and environment for passengers and visitors.

The above principles will ensure that the 1st party signage is effective, safe, and tailored to the unique airport needs. It also ensures airport staff and visitors are safe around the sign and fully engaged with them.

## 6.2 3rd Party Outdoor Advertising Signage

### Principles & Placement:

1. Compliance with By-Law: All 3rd party advertising signage displayed at the airport must comply with the City of Cape Town Outdoor Advertising Signage By-law No 8969, 2023.

1.1 Compliance Overview: Adhering to all regulations, guidelines, and specifications set forth in the City of Cape Town Outdoor Advertising By-law No 8969, 2023.

This includes, but is not limited to:

- Ensuring the signage does not obstruct traffic signals or road signs
- Using materials and lighting that do not cause glare or distraction to motorists
- Obtaining the necessary permits and approvals before installation of 3rd Party signage
- Adhering to the size, height, and placement restrictions as specified in the by-law
- Regular maintenance to ensure the signage remains in good condition and legible
- Conduct an annual inspection to ensure a certificate of compliance is in hand, particularly for electrified signage

2. Impact on Environment: The design and placement of the 3rd party signage should be done with the aim of maintaining or enhancing the aesthetic quality of the environment and ensuring that they do not have any negative impact on the environment.

3. Size & Style Relevance: Outdoor signage should be designed, located, and sized appropriately to suit their purpose whilst integrating with the background environment to provide excellent visibility and readability.

   All advertising signage will have a uniform appearance that complements the airport facilities while incorporating the "vineyard" look and feel. By using a variety of advertising signage formats, the Cape Winelands Airport aims to create an impressive visual impact while still maintaining eco-friendliness and sustainability."

4. Strategic Placement: The placement of 3rd party signage should be strategically located to achieve maximum impact and visibility while ensuring that it does not cause any obstruction to transportation networks around the airport facilities.

5. Safety Considerations: Safety is a vital element in the design and placement of 3rd party signage and should be carefully considered, ensuring that it does not lead to any safety hazards for airport users.

6. Consistency with Airport Theme: The 3rd party signage must be consistent with the airport's aesthetic theme, and the design should blend well with the surrounding environment.

7. Maintenance: The 3rd party signage should be well maintained to ensure they remain clear and visible, and any damaged signs should be promptly removed or repaired.

8. Illumination: Freestanding structures to be internally illuminated. This will ensure that the sign structure has less impact on the greater airport surroundings.

By adhering to these principles, third party signage at The Cape Winelands airport can contribute to the overall success of the facility and enhance the brand image while maintaining respect for the environment and safety of its users.

## 7. 3rd Party Advertising Signage By-Law Requirements

### 7.1 Freestanding Billboards

City of Cape Town Outdoor Advertising By-Law 8969, 2023 Requirements:

Size Restrictions: In terms of Schedule 2 of the Outdoor Advertising By-Law No 8969, 2023 freestanding billboards are restricted to either 18m$^2$ or 36m$^2$ single side **or** 36m$^2$ or 72 m$^2$ for a double-sided sign.

Height and Clearance:

- Landscape format billboard – have a minimum clear height of 2.4 m and a sign structure which does not exceed a maximum height of 7.5 m above natural ground level.

- Portrait format billboards – where a maximum height of 9 m above natural ground level is permitted

Illumination: Freestanding structures to be internally illuminated. This will ensure that the sign structure has less impact on the greater airport surroundings.

Style and Profile: To enhance and complement the urban profile of the airport facility, all freestanding billboard structures must have a uniform appearance. This would be the advertising space, stem of the structure and cladding that embodies the "vineyard" look and feel of the airport.

### 7.2 Custom-Made Designs (Iconic Signage)

City of Cape Town Outdoor Advertising By-Law No 8969, 2023 Requirements:

Size: The chosen location will determine the subsequent size, height, and layout for approval by the Environmental Management Department.

Illumination: Custom-made signage to be internally illuminated. This will ensure that the sign structure has less impact on the greater airport surroundings.

Style and Profile: Custom-made signage will be of bespoke "tailor made" design which features special effects such as character cut outs/shapes or moving parts.

The unique size, combination of shapes and colours, will make this signage attractive and memorable.

Location: Custom-made signage is uniquely designed and / or constructed for erection in a chosen location.

## 7.3 Flat Wall Mounted Signs

City of Cape Town Outdoor Advertising By-Law No 8969, 2023 Requirements:

Size Restrictions: In terms of Schedule 4 of the Outdoor Advertising By-law, flat signs are limited to 54m$^2$. Application can be made to the Environmental Management Department requesting a waiver, to increase the size of the advertisement.

Location: Flat Wall Mounted signage is affixed to a wall or building façade. Advertisers use this opportunity to showcase life-size images and in turn the airport comes alive with boldness and vibrancy to what could otherwise be large concrete walls.

No advertising or part thereof may cover the windows, openings, ventilation apertures or architectural features.

Illumination: Internal illumination to enhance and uplift the unique appeal of the airport precinct.

Style and Profile: The advertising sign is designed, and custom made to fit the exact area of a building and therefore considered custom made.

## 7.4 Digital Format Screens

City of Cape Town Outdoor Advertising By-Law No 8969,2023 Requirements:

Size Restrictions: In terms of Schedule 2 of the Outdoor Advertising and Signage By-Law No 8969, 2023, digital screens are restricted to either 18m$^2$ or 36m$^2$ single side or 36m$^2$ or 72 m$^2$ for a double-sided sign.

Height and Clearance:

- Landscape digital screen – the maximum height of a landscape digital screen may not exceed 7.5m with a minimum clearance above the ground level of 2.4m.
- Portrait shape digital screen – may not exceed a maximum height of 9m above natural ground level.

Illumination: Digital format screens have proven to be more economical to operate. Digital format screens display more graphics than conventional static signs. Graphics are uploaded either on site or remotely.

Style and Profile: In order to enhance and complement the urban profile of the airport facility, digital format screens must have a uniform appearance throughout, e.g. cladding, structure stem and the digital advertising space.

## 7.5 Sky Signage

City of Cape Town Outdoor Advertising By-Law No 8969, 2023 Requirements:

Size: Sky signage is limited to a maximum of 4.5m$^2$. This size can be increased up to 18m$^2$ with an Environmental Impact Assessment submission, providing the sign does not obstruct the view of any other building.

Format: Sky signage must have minimum content which will be measured in "bits" of information as per the table in Schedule 5 of the by-law. Total bits may not exceed 1.5.

Illumination: Due to the nature of these types of signs internal illumination to be used.

Location: Sky Signage can be constructed on roof tops of buildings and / or entry and exit lanes of parking areas.

## 8. Environmental Considerations

The growing importance of sustainability has been one of the key marketing trends of recent years. Out of home advertising has several advantages from a green point of view, e.g. digital screens can be used to showcase multiple messages sequentially, without needing any extra materials. Digital solutions are designed to last several years. LED lighting delivers the same high standards of quality, with lower electricity requirements.

Environmental initiatives such as the use of LED lights, recycling paper, plastic, and monitoring waste sorting, which enables the industry to truly incorporate sustainability into its core processes.

Stakeholders will be encouraged to have an environmentally friendly approach when purchasing outdoor advertising furniture, by making use of recyclable materials such as steel, glass, sourcing or disposing of paper and plastics, that they are most likely to use in their campaigns.

Stakeholders must be committed to reducing the use of PVC where possible by using alternative plastics, or less polluting recyclable materials.

## 9. Advertising Standards Authority

The Advertising Standards Authority of South Africa (ASASA) is an independent body set up to regulate advertising in the public interest through a system of self-regulation. ASASA works closely with government, statutory bodies, consumer organisations and the advertising industry to ensure that the content of advertising meets the requirements of the Code of Advertising Practice.

This Code of Advertising Practice is a voluntary code applicable to the marketing and communication industry. The airport must monitor all content to ensure compliance with the Advertising Standards Authority of South Africa.

## 10. Future Trends of Advertising

The future of advertising looks to involve increasingly sophisticated technology and an ever-greater focus on personalisation across different media platforms.

The use of augmented and virtual reality to create immersive brand experiences, as well as Artificial Intelligence are expected to become more prevalent in the future.

## 11. Summary

The proposed outdoor billboards will be placed on Airport land in the following zones of the Site Development Plan. Refer the attached drawing as a reference for both below zones.

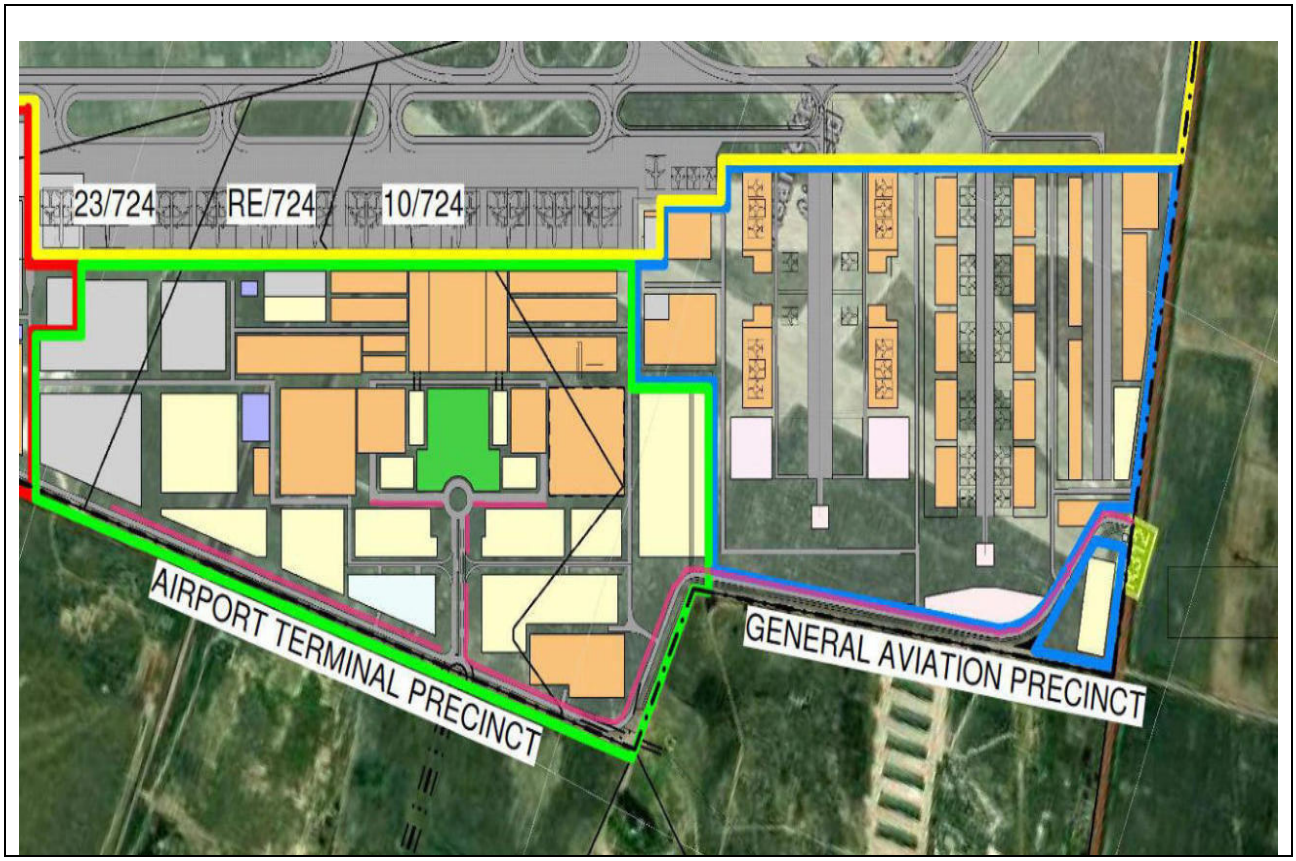
- Airport Precinct (Landside)
- General Aviation Precinct (Landside)

The primary entry and exit road to the Cape Winelands Airport is called Mellish Road. The total number of proposed billboards exceeding $18m^2$ to be erected in Mellish Road is estimated to be x 12 – 15 outdoor billboards. Refer the below drawing showing a "pink" line adjacent to Mellish Road leading from Lichtenburg Road towards the main entrance of the Airport Precinct.

Key points to determine the number of outdoor billboards that can be placed on Mellish Road:

- Minimum Control Area: The controls within a transport / terminal interchange can typically have stricter regulations to ensure safety and visibility.
- Spacing Requirements: The spacing of outdoor billboards must comply with the Road Traffic Safety Requirements as per the Linear spacing road speed limit as per the by-law, Table 3 Linear Spacing between signs.
- Traffic Impact Assessment: The assessment of the impact on traffic and road safety to be conducted by a qualified traffic engineer practitioner.

- **Size and Height Restrictions**: The size and height restrictions to comply with the City of Cape Town Outdoor Signage By-Law No 8969,2023 to avoid interference with aviation operations.
- **Approval Process**: Cape Winelands Airport will need to obtain approval from the local municipality, which will review the application based on the specific criteria outlined in the by-law.




Thank you.

# ANNEXURE 15: ENVIRONMENTAL AWARENESS PLAN

DEA&DP IN-PROCESS NR: 16/3/3/2/A5/20/2046/24

# ENVIRONMENTAL AWARENESS PLAN FOR THE EXPANSION OF THE CAPE WINELANDS AIRPORT

## (P10 OF FARM 724, RE OF FARM 724, P23 OF FARM 724, P7 OF FARM 942, RE OF FARM 474, P3 OF FARM 474 AND P4 OF FARM 474)

MARCH 2025



COVER IMAGE NOT REPRESENTATIVE OF THE PROJECT SITE

**PREPARED FOR**
CAPEWINELANDS AERO (PTY) LTD

**PREPARED BY**
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# ENVIRONMENTAL AWARENESS PLAN

The Environmental Manager (EM) for the operator/owner/applicant will implement an Environmental Awareness Plan at the proposed Cape Winelands Airport (CWA), situated within the administrative district of the City of Cape Town, Western Cape. The material/source of information for the Environmental Awareness Plan will be the approved Environmental Management Programme (EMPr), as well as other relevant specialist reports/ permits/ licences. These documents will be utilised by the EM to compile an electronic database which will contain environmental aspects and issues with medium to high significance. The environmental issues and aspects will be entered into the database with associated mitigation measures and responses, along with the specific legislation that governs such an impact or aspect. The environmental awareness plan is detailed in the sections below.

The purpose of this section is to outline the methodology that will be used to educate employees and contractors of any environmental risks associated with their work and the manner in which these risks must be dealt with so as to avoid pollution and minimize the degradation of the environment.

Once approved, a copy of the EMPr will be handed to the Environmental Manager (EM). Issues such as site establishment, site clearance, protection of sensitive features, erosion control and waste management to name a few will be discussed with the Contractors/ Subcontractors/Operators to ensure that they understand the goals as set out in the EMPr. An induction meeting will also be held with all the site workers to inform them of the basic steps towards environmental awareness regarding the environment.

The EM must ensure that he/she understands the EMPr document and its requirement and commitments. An Environmental Control Officer (ECO) needs to check compliance of the construction and operational activities to the management programmes described in the EMPr.

## 1. INDUCTION & ENVIRONMENTAL MEETINGS

All full-time staff and contractors are required to attend an induction session. Employees are inducted when they start on site and when they return from leave. Any contractor, who works on site for a period of 24 hours or more, is required to undergo the respective induction training. Environmental issues and aspects related to the construction / operation will be addressed in these induction sessions.

All environmental impacts and aspects with their mitigating measures will be discussed, explained and communicated to employees. The induction sessions will be modified according to the level of employee attending the induction session, so that all employees gain a suitable understanding of environmental issues and pollution.

The basic content of the induction programme for full time employees is as follows:

- Welcome and Registration;
- Disciplinary Code;
- Fire Extinguisher;
- Employee Assistance Program;
- Security;
- HIV/Aids Awareness;
- Environmental Issues as per EMPr
- Environmental and Quality Checklists

A Basic Environmental Training Course should be developed by management.

Environmental meetings can be held with management, and selected groups/ teams and/or their Environmental Control Officers (ECO). This will take the form of an open discussion between the relevant department and these individuals. The symposiums will aid in environmental awareness being generated at all levels, as well as assist the relevant department in defining all, and identifying new environmental issues, concerns and pollution sources.

## 2. TRAINING NEEDS

A training needs analysis will be performed through all levels of the organization. Each of the categories / levels of the organization have different responsibilities and roles, accordingly different knowledge requirements are applicable. These are summarized in Table 1 below.

After the training needs have been identified, it is the responsibility of the SHE Office/ EM to ensure that personnel attend the relevant identified training. Training will also address the specific measures and actions as listed in the EMPr. This Environmental Awareness Plan is intended to supplement the Safety, Health and Environmental (SHE) training and awareness requirements.

## 3. SPECIALIZED SKILLS

The Training Department in conjunction with the SHE Officer & EM are responsible for ensuring job specific training for personnel performing tasks, which can cause significant environmental and social impacts (e.g. receipt of bulk hazardous chemicals/fuel, hazardous materials handling, responding to emergency situations, fire management etc.). The EM with the assistance of the SHE Officer must identify relevant personnel and training courses.

### 3.1 In-house Training

In-house training sessions will be held with relevant employees. The training sessions will be determined by the relevant department and will allow for employees to participate in determining what the environmental issues and concerns are with regard to their specific occupation. Education with regard to environmental incident reporting will be detailed at these sessions.

### 3.2 On the Job Training

On the job training is an essential tool in environmental awareness. Employees will be given details of the expected environmental issues and concerns specifically related to their occupation. Employees will be trained on how to respond if an environmental problem or source of environmental pollution arises. The training will be on-going, and all new employees will be provided with the same standard of training as existing employees.

### 3.3 General Training and Skills Development

Human Resources Development Programmes will include appropriate training and skills development programmes as required by the workforce in support of operation specific business plans. Training will be offered in portable skills, being competencies that will enable employees to find jobs elsewhere within similar industries, or to become self-employed.

Basic environmental and pollution control skills will be included in this training.

## 4. REVIEW OF TRAINING MATERIAL

The effectiveness of the environmental management training will be done by the management through task observations and during internal and external audits.

All training material for presentation to personnel and contractors will be reviewed annually to ensure consistency with organizational requirements and best practice guidelines. In addition to this, annual monitoring reports, audit results and all incident reports will be reviewed, any shortcomings and non-compliancy will be highlighted and management measures incorporated or improved upon within the training material.

## 5. RECORDS

Records from the implementation of this environmental awareness plan will be kept and controlled in accordance with the Management System Control of Records Procedure, which is required to be implemented to provide evidence of conformity and effective operation of the relevant requirements of the management system.

## 6. ENVIRONMENTAL COMMUNICATION STRATEGY

Management shall establish and maintain procedures for the internal communication between the various levels and functions of the organisation, and receiving, documenting and responding to relevant communication from external interested & affected parties. The organisation shall consider processes for external communication on its significant environmental aspects and record its decision. Communication is a management responsibility. All supervisors are responsible for effective communication within their own sections. Environmental communication can be divided into two categories, namely internal communication and external communication.

### 6.1 Internal Communication

The following communication channels and media will/can be used to communicate environmental issues.

HOD Meetings: The EM communicates information to senior management on environmental issues.

HSEC/ECO Meetings: Environmental issues should be an item on plant and section monthly safety, health & environmental meeting agendas.

Publications: Leaflets, posters etc. are produced by the relevant department or other designated persons.

Daily/ Weekly Safety Meeting: All meetings are scheduled to commence with a discussion on safety, health & environmental topics.

### 6.2 External Communication

The following communication channels and media will/can be used to communicate environmental issues to individuals who are not employed.

Publications: Selected publications should be produced and used to communicate environmental issues to outside parties. Examples include newsletters and Annual Reports.

E-mail: E-mail communication received must be stored, with replies, in an appropriate folder on a server. E-mail messages, relevant to environmental management, should be kept for a minimum of two years before deletion.

Mail: Correspondence received by mail must be filed, along with the response (where relevant), within the relevant department's filing system for a minimum period of 2 years. Paper correspondence will be archived in this department.

Telephone: A register of telephonic environmental queries should be kept by the relevant department detailing caller, contact details, date, query, action taken and response. Furthermore, the person answering the call will be responsible for logging their particulars against the call, as well as ensuring that all communication that leads to an aspect or an impact, is entered on the database.

Storage of Correspondence: All original correspondence must be retained by the EM for a minimum period of two years.

Environmental Reports: Copies of relevant specialist study reports and Environmental Impact Assessments will be made available by the EM should these be requested by an external party.

Queries from Interested and Affected Parties: Response to queries about environmental impacts and aspects will be addressed by the relevant department and approved by the EM.

## 7. INCIDENT REPORTING STRUCTURE & PROCEDURE

Environmental incident reporting is a vital part of communication. Employees are required to report any and all environmentally related problems, incidents and pollution, so that the appropriate mitigating action can be implemented timeously. Refer to the Incident Report Template in **Annexure A**.

**Table 1:** Environmental incident reporting procedure.

| **ENVIRONMENTAL INCIDENT REPORTING STRUCTURE** | **ACTION REQUIRED** |
|---|---|
| Line Management in relevant area of responsibility where the incident occurred | Shall investigate the incident and record the following information:<br>• How the incident happened;<br>• The reasons the incident happened;<br>• How rehabilitation or clean up needs to take place;<br>• The nature of the impact that occurred;<br>• The type of work, process or equipment involved; and<br>• Recommendations to avoid future such incidents and/or occurrences.<br><br>Shall inform the Environmental Manager on a daily basis of all incidents that were reported in the area/section.<br><br>Shall consult with the relevant department / person for recommendations on actions to be taken or implemented where appropriate (e.g. clean-ups).<br><br>Shall assist the Environmental Manager with applicable data in order to accurately capture the incident into the reporting database. |
| Area / Line Managers | Shall forward a copy of the incident form to other line managers.<br><br>Shall forward a copy of the incident form to the Environmental Manager.<br><br>Shall inform the relevant department / person on a weekly basis of the incident by e-mail or by submitting a copy of the incident report. Once a High-Risk Incident (any incident which results from a significant aspect and has the potential to cause a significant impact on the environment) occurred it must be reported immediately to the Environmental Manager by telephone or email to ensure immediate response / action.<br><br>Shall forward a copy of the completed Incident Reporting Form (and where applicable a copy of the incident investigation) to the relevant department / person |
| Environmental Manager | Shall complete an incident assessment form to assess what level of incident occurred.<br><br>Shall make recommendations for clean-up and / or appropriate alternate actions.<br><br>Shall enter actions necessary to remediate environmental impacts into the database in conjunction with the responsible line manager.<br><br>Shall enter the incident onto the database to monitor the root causes of incidents.<br><br>Shall include the reported incidents in an appropriate monthly / quarterly report.<br><br>Shall highlight all incidents for discussion at meetings |

# APPENDIX A: INCIDENT REPORT TEMPLATE

**Environmental Incident Report**

| | |
|---|---|
| **Date:** | **File reference number:** |
| **Name:** | |
| **Exact location of incident:** | |

Section 1: Description of incident

| |
|---|
| |

Section 2: Remedial action required

| |
|---|
| |

Section 3: Relevant Documentation

| |
|---|
| |

Section 4: Steps to prevent recurrence

| |
|---|
| |

Section 5: Signatures

| | |
|---|---|
| Environmental manager: ..... | Date: ..... |
| ECO: ..... | Date: ..... |
| Landowner: ..... | Date: ..... |

# ANNEXURE 16: MAINTENANCE MANAGEMENT PLAN

**Request for the relevant Competent Authority to define or adopt a Maintenance Management Plan for a watercourse in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), Environmental Impact Assessment Regulations, 2014 (as amended).**

| | | (For official use only) |
|---|---|---|
| File Reference Number: | 16/3/3/2/A5/20/2046/24 | |
| Date Received by Department: | | |
| Date Received by Component: | | |
| Form Duly Signed and Dated: | | Yes No |

**PROJECT TITLE**

# Proposed Expansion of Cape Winelands Airport on P10/Farm 724, RE/Farm 724, P23/Farm 724, P7/Farm 942, RE/Farm 474, P3/Farm 474 & P4/Farm 474, Fisantekraal, Western Cape

## July 2025

**cell:082 327 2100 | Tel:(028) 312 1734 | Fax:086 508 3249 | amanda@phsconsulting.co.za | | PO Box 1752 | Hermanus 7200**

PLEASE NOTE THAT ALL CHANGES FROM THE NOVEMBER 2024 DRAFT CWA MMP ARE UNDERLINED IN BLACK WHILE ALL CHANGES FROM THE MARCH 2025 DRAFT CWA MMP ARE UNDERLINED IN GREEN. GENERAL TEXT CHANGES ARE NOT UNDERLINED.

## A. SCOPE AND IMPORTANT INFORMATION

1) This document is to be used to ensure that the request for adopting or defining a Maintenance Management Plan (MMP) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA"), Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) is undertaken to the sufficient standard and requirements as defined by the competent authority, the Department of Environmental Affairs and Development Planning of the Western Cape Government (henceforth the Department). It is advised that the determination of applicability regarding the scale of the proposed maintenance/management activity(ies) be undertaken through a pre-application consultation with the Department.

2) The geographical scope of the MMP is limited to watercourses as defined in the EIA Regulations, 2014(as amended). The document does not relate to coastal activities or activities to be undertaken in an estuary.

3) The use of this document for the development of a MMP for a watercourse **will only** be considered when the proposed maintenance activities constitute any one of the following listed activities identified in terms of the NEMA EIA Regulations, 2014 (as amended):

*EIA Regulations Listing Notice 1 of 2014 (as amended)*

- Activity 19, Listing Notice 1: The infilling or depositing of any material of more than 10 cubic meters into, or the dredging, excavation, removal or moving of soil, sand, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving-
  (a) will occur behind a development setback;
  (b) is for maintenance purposes undertaken in accordance with a maintenance management plan;
  (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;
  (N.B. Points (d) and (e) does not apply as these activities fall within the coastal zone)

- Activity 27, Listing Notice 1: The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for-
  i. The undertaking of a linear activity; or
  ii. Maintenance purposes undertaken in accordance with a MMP.

*EIA Regulations Listing Notice 2 of 2014 (as amended)*

- Activity 15, Listing Notice 2: The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-
  I. The undertaking of a linear activity; or
  II. Maintenance purposes undertaken in accordance with a MMP.

- Activity 24, Listing Notice 2: The extraction or removal of peat or peat soils, including the disturbance of vegetation or soils in anticipation of the extraction or removal of peat or peat soils, but excluding where such extraction or removal is for the rehabilitation of wetlands in accordance with a MMP.

*EIA Regulations Listing Notice 3 of 2014 (as amended)*

- Activity 12, Listing Notice 3: The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a MMP.

  **i. Western Cape**

  i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;
  ii. Within critical biodiversity areas identified in bioregional plans;
  iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or
  v. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister.

  (NB. Point iii does not apply as this activity falls within the coastal zone)

4) In deciding the request, the competent authority may define conditions related to auditing compliance with the MMP; monitoring requirements; reporting requirements, review; updating and amending the document and period for which the MMP is defined/adopted.

5) The purpose of the MMP is to maintain both man-made and ecological infrastructure in a manner that either improves the current state of, and/or reduces the negative impacts on a watercourse to ensure that ecosystems services are preserved/improved and to prevent further deterioration of the watercourse.

6) Notwithstanding the MMP possibly being defined or adopted by the Competent Authority, any other applicable statutory requirement must still be complied with (e.g. any obligations under the National Water Act, 1998 (Act 36 of 1998) or the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)).

7) The proponent must note that a MMP for a watercourse **must** be undertaken through consultation with the Department of Water and Sanitation and/or the relevant Catchment Management Agency (responsible water authority). This is to ensure compliance in terms of a Permissible Water Use as set out in the National Water Act, 1998 (Act No. 36 of 1998). It is recommended that this process for authorisation in terms of the National Water Act be clarified prior to the drafting and submission of the MMP.

8) The development of this document has been done in such a way so as to meet the requirements of both this Department as the competent authority in terms of the NEMA EIA Regulations, 2014 (as amended), as well as the requirements of the delegated water authority, regarding general authorisation considerations for sections 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998), to ensure alignment between the two authorities when defining or adopting the MMP.

9) In situations where a Water Use Licence Application (WULA) is required by the water authority regarding the proposed activities within a MMP, this will not prevent the proponent from submitting a request for a MMP to be defined or adopted by the Department.

10) Unless protected by law, all information contained in, and attached to this document, shall become public information on receipt by the competent authority.

11) A duly dated and originally signed copy of this document together with one hard copy and one electronic copy of the MMP must be posted to the Department at the postal address given below or delivered to the Registry Office of the Department.

12) A copy of the final defined/adopted MMP and cover letter **must** be submitted to the responsible water authority.

13) **NOTE: Adopting or defining the MMP does not absolve the** proponent **from complying with any applicable legislation or the general "duty of care" set out in Section 28(1) of the NEMA that states, *"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment*." (Note: When interpreting this "duty of care" responsibility, cognisance must be taken of the national environmental management principles contained in Section 2 of the NEMA.**

14) **NOTE: This document can be used as a template to assist in the information required and is to be filled out in full. The Department reserves the right to request any additional information during the initial development and submission of the draft MMP.**

15) **NOTE: The Department reserves the right to not adopt the MMP and require that an application be submitted to obtain Environmental Authorisation for the respective activities. Furthermore, consideration for the review should also be aligned to the periodic reviews of the General Authorisation for sections 21 (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) to ensure continued alignment and compliance.**

## B. MAINTENANCE MANAGEMENT PRINCIPLES

1) The following are overarching principles to be used by landowners and managers when considering the development and implementation of a MMP:

    a. The anticipation and prevention of negative impacts and risks, then minimisation, rehabilitation or 'repair', where a sequence of possible mitigation measures to avoid, minimize, rehabilitate and/or remedy negative impacts is explicitly considered;
    b. Avoid and reduce unnecessary maintenance;
    c. Maintenance and management of a watercourse must be informed by the condition of the physical and ecological processes that drive and maintain aquatic ecosystems within a catchment, relative to the desired state of the affected system;
    d. Management actions must aim to prevent further deterioration to the condition of affected watercourses and, overall, be guided by a general commitment to improving and maintaining ecological infrastructure for the delivery of ecosystem services;
    e. Managers and organs of state must identify, address and, where feasible, eliminate the factors that necessitate intrusive, environmentally-damaging maintenance; and
    f. A process of continuous management improvement be applied, namely Planning; Implementing; Checking (monitoring, auditing, determine corrective action) and Acting (management review).

2) The following table provides a simple overview for the determination of the need for a MMP:

| | **Question** | **If the answer to any of the questions is YES, then a MMP may be applicable.** |
|---|---|---|
| 2.1 | Is there a watercourse on or adjacent to the property? | Yes |
| 2.2 | Has there been a history of flood damage or vandalism to the existing infrastructure or watercourse – erosion and/or sedimentation? | Yes |
| 2.3 | Is there infrastructure or any community at risk of being damaged by flooding? | No |
| 2.4 | Is the design of infrastructure considered inadequate in terms of managing the risk of flooding, erosion and/or sedimentation? | No |
| 2.5 | Would you consider an improved design to existing infrastructure to reduce maintenance needs? | No |
| 2.6 | Are there specific incidences where the watercourse is obstructed or blockages occur that alter the flow of the river during floods? | No |
| 2.7 | Is there an existing obstruction in the watercourse that has changed the flow of the river under normal conditions? | No |
| 2.8 | Is there a marked increase in the rate of erosion/sedimentation being experienced which threatens operations and assets? | No |
| 2.9 | Is there a presence of alien or bush encroachment vegetation within the watercourse and/or the presence of woody debris after flooding? | Alien vegetation within wetland areas |

3) It is important to consider that the type of maintenance required will impact on the level of assessment needed in terms of the impact the activity will have on the system and how best to mitigate the impact. Types of maintenance can broadly be classified in the following categories, with recognition that maintenance activities vary across the rural and urban context:

| Maintenance Category | Types of maintenance activities (examples only) |
|---|---|
| **Category A:**<br>Sediment removal as a result of deposition or sediment deposition as a result of erosion | • Clearing sediment or placing sediment at:<br>  o Pump hole/trench<br>  o Return flow (irrigation)<br>  o Off-take weir<br>  o Stormwater outfall<br>  o Detention/retention ponds<br>  o Canalized urban rivers<br>  o Bridges, culverts and drifts<br>• Prevent formation of islands in the channel of the river<br>• Dredging of in-stream dams |
| **Category B:**<br>Emergency repairs – urgent action required to manage risk and damage to assets | • Repair to erosion of river bank or servicing infrastructure (e.g. pipelines/roads)<br>• Removal of material built up as a result of flooding/sedimentation and increasing risk to infrastructure<br>• Address damage or replacement of infrastructure (e.g. bridge, pipeline, pump house)<br>• Manage the condition of flood protection berms, and existing structures such as gabions, canalized and stormwater systems<br>• Installing temporary gravel approaches at flood-damaged river crossings |
| **Category C:**<br>Managing alien invasive and bush encroachment plant species | • Clearing of alien invasive vegetation out of a watercourse to reduce maintenance requirements as they relate to erosion and sedimentation<br>• Management of indigenous species categorized as bush encroachment, to improve hydrological flow and reduce associated flooding impacts |
| **Category D:**<br>Rehabilitation and restoration activities for maintaining ecological infrastructure | • Development and maintenance of ecological buffering systems to improve and/or restore functioning (e.g. wetlands and stormwater detention ponds)<br>• Actively rehabilitating riparian zones through planting of locally indigenous species<br>• Bank grading and movement/removal of berms and barriers to flow |

4) The development of appropriate method statements to mitigate the impact of the maintenance needs, should be aligned within the framework of these considerations:

   a. Watercourses experience a natural process of sedimentation and erosion, with varying rates depending on the geomorphology and the integrity of the land-uses within the catchment;

b. Manipulation of the watercourse results in increased erosion and/or deposition being experienced further downstream, perpetuating greater need for manipulation and more drastic and costly maintenance interventions;

c. Locally indigenous riparian and wetland vegetation assists in the stabilization of river banks through effective root structures, while contributing to improve in-stream habitat and water quality conditions;

d. Invasive alien and bush encroachment vegetation significantly impacts on the functioning of a watercourse, often leading to increased flood associated damage, with further implications and a reduction in water quality and availability;

e. Persons undertaking maintenance activities have a responsibility to ensure a sense of duty of care is applied as prescribed within NEMA Section 28(1).

5) It is recognized that within urban areas, sedimentation and erosion rates are significantly amplified because of development in urban areas and thus systems associated with watercourses in such areas can no longer be considered as 'natural'. In such a context, the drivers of such a process are often located outside the control of the landowner or responsible authority (i.e. Municipality). Therefore, the response taken to address the needs of a maintenance management plan for a watercourse within the urban environment may be limited in mitigating the requirement for maintenance to be undertaken.

## C. REQUEST FOR THE COMPETENT AUTHORITY TO DEFINE OR ADOPT A MAINTENANCE MANAGEMENT PLAN FOR A WATERCOURSE IN TERMS OF THE NEMA, EIA REGULATIONS 2014 (AS AMENDED).

The following information must be submitted as part of the request for the competent authority to define or adopt the MMP:

## 1. PERSONAL DETAILS

Highlight the Departmental Sub-Region(s) in which the maintenance is to be undertaken. (mark the appropriate box with an 'X'). For Departmental details see Annexure A.

| REGION 1<br>(City of Cape Town Metropolitan and West Coast District) | REGION 2<br>(Cape Winelands District, Overberg District) | REGION 3<br>(Eden & Central Karoo Districts) |
|---|---|---|
| X | | |

| | | | |
|---|---|---|---|
| Name of person/authority who will undertake responsibility for the activity: | Capewinelands Aero (Pty) Ltd | | |
| Contact person (if other): | Deon Cloete | | |
| Postal address: | P.O. Box 12449, Mill Street | | |
| Telephone: | n/a | Postal code: | 8001 |
| Fax: | n/a | Cell: | +27(0) 82 339 2807 |
| Email: | d.cloete@capewinelands.aero | | |
| | | | |
| Name of person who has prepared the MMP: | Amanda Fritz-Whyte (EAP) & Olivia Brunings (Candidate EAP)<br>Input from Zutari (Bulk Infrastructure Engineers), FEN (Freshwater Ecological specialist). | | |
| Contact Person (if other): | n/a | | |
| Postal address: | PO Box 1752, Hermanus | | |
| Telephone: | 028 312 1734 | Postal code: | 7200 |
| Fax: | (086) 508 3249 | Cell: | 082 327 2100 |
| E-mail: | amanda@phsconsulting.co.za; paul@phsconsulting.co.za | | |
| Expertise of EAP | Twenty-three years' experience in Environmental Impact Assessments, Public Participation, auditing, water resource management, WULA applications and compilation of EMPrs. | | |
| EAP Registrations/Associations | IAIAsa, Pri.Sci.Nat (118385), WISA fellow; Registered EAP - 2019/367 (EAPASA) | | |
| | | | |
| Name of landowner(s) on whose behalf the plan has been developed: | Capewinelands Aero (Pty) Ltd | | |

<table>
<tr><td>Contact person(s):</td><td colspan="3">Deon Cloete</td></tr>
<tr><td>Postal address:</td><td colspan="3">P.O. Box 12449, Mill Street</td></tr>
<tr><td>Telephone:</td><td>n/a</td><td>Postal code:</td><td>8001</td></tr>
<tr><td>Fax:</td><td>n/a</td><td>Cell:</td><td>+27(0) 82 339 2807</td></tr>
<tr><td>E-mail:</td><td colspan="3">d.cloete@capewinelands.aero</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Municipality for proposed project:</td><td colspan="3">City of Cape Town Metropole</td></tr>
<tr><td>Farm name(s), erf(s) and portion number(s) etc*:</td><td colspan="3"><table><tr><th>Land portion</th><th>Landowner</th></tr><tr><td>P23 of Farm 724</td><td>Corobrik (Pty) Ltd</td></tr><tr><td>P7 of Farm 942</td><td>Buurmanskraal Boerdery (Pty) Ltd</td></tr><tr><td>RE of Farm 474</td><td>Buurmanskraal Boerdery (Pty) Ltd</td></tr><tr><td>P3 of Farm 474</td><td>Buurmanskraal Boerdery (Pty) Ltd</td></tr><tr><td>RE of Farm 724</td><td>Capewinelands Aero (Pty) Ltd</td></tr><tr><td>P10 of Farm 724</td><td>Cape Winelands Airport (Pty) Ltd</td></tr><tr><td>P4 of Farm 474</td><td>Cape Winelands Airport (Pty) Ltd</td></tr></table><br>Please refer to and for locality maps.</td></tr>
<tr><td>Magisterial District or Town:</td><td colspan="3">City of Cape Town Metropole</td></tr>
<tr><td>Name(s) of watercourse(s) in question:</td><td colspan="3">Mapped wetland systems within the CWA cadastral areas (refer Figure 1):<br>- Seep Wetland 1<br>- Seep Wetland 2<br>- Channelled Valley Bottom (CVB) Wetland 1<br>- Channelled Valley Bottom (CVB) Wetland 2<br>- Channelled Valley Bottom (CVB) Wetland 3</td></tr>
</table>

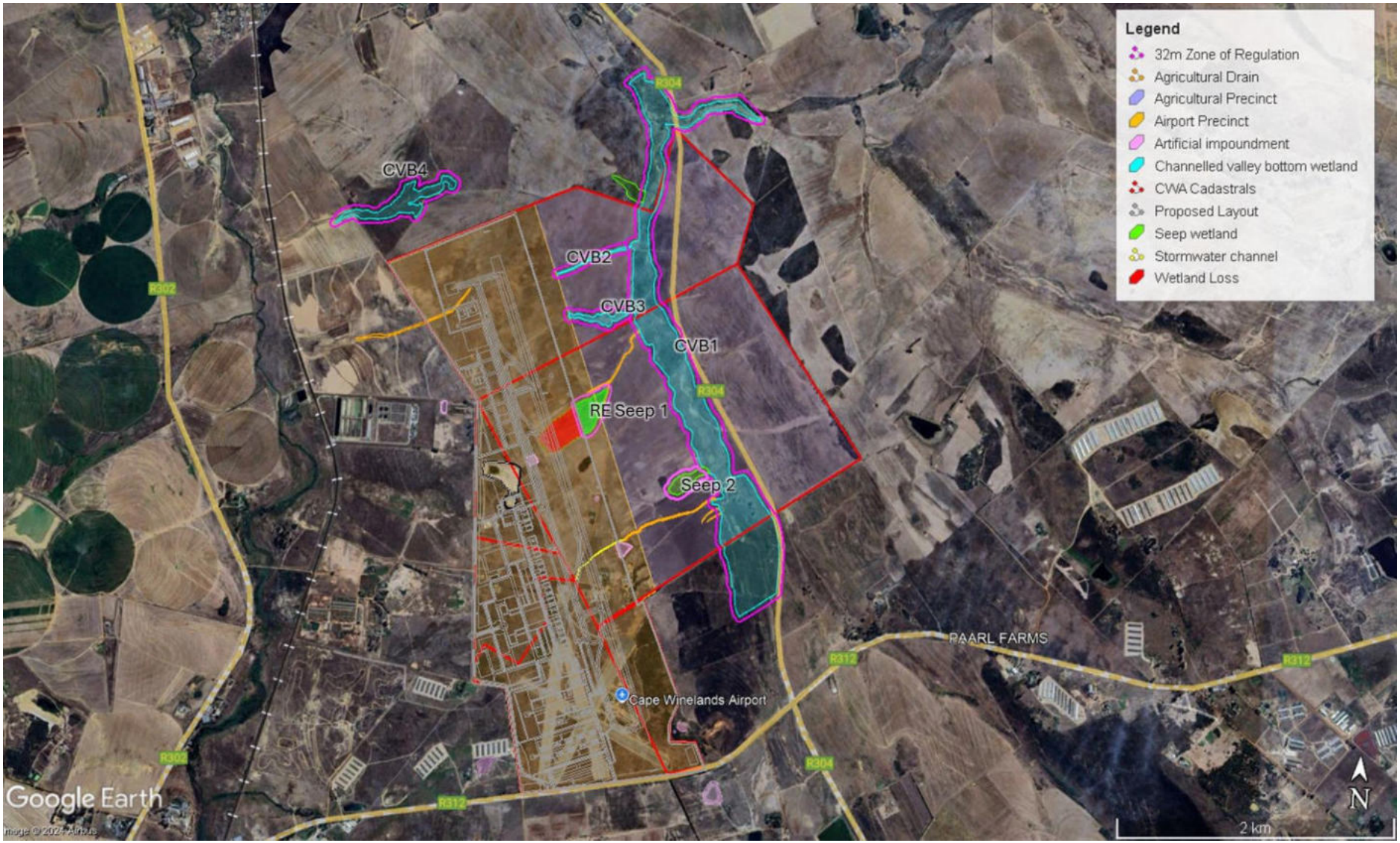


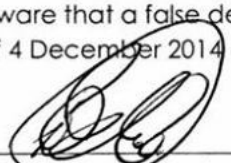

**Figure 1: The delineated extent of the watercourses and artificial features associated with the proposed development area and applicable NEMA 32m Buffers. Wetland delineations were undertaken by FEN Consulting (map produced by PHS Consulting, November 2024).**

# DECLARATION

**THE PERSON THAT WILL BE UNDERTAKING THE MAINTENANCE**

I Deon Cloete, **duly authorised** by Capewinelands Aero (Pty) Ltd thereto hereby declare that I/we:

- Request the MMP to be adopted by the Competent Authority;
- Regard the information contained herein to be true and correct for this Maintenance Management Plan;
- Am fully aware of my responsibilities in terms of the National Environmental Management Act of 1998 ("NEMA") (Act No. 107 of 1998) and that, notwithstanding the adoption of this MMP, I/we shall comply with any other statutory requirement applicable, which may include, but not limited to the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), the National Water Act, 1998 (Act No. 36 of 1998) and the Environmental Impact Assessment Regulations, 2014 (as amended) ("EIA Regulations"), in terms of NEMA;
- Am fully aware that the proposed maintenance constitutes a listed activity in terms of the NEMA EIA Regulations, 2014 (as amended) and that an environmental assessment for environmental authorisation may be required for any other listed activities not included as part of this MMP;
- Acknowledge that any activity undertaken that does not form part of the defined and adopted MMP, will be subject to the Section 24(F) of NEMA and that appropriate enforcement and compliance requirements will follow;
- Shall undertake only those tasks described in the MMP, failing which environmental authorisation will be required, where applicable;
- Shall provide the competent authorities with access to all information at my disposal that is relevant to this request;
- Shall be responsible for any costs incurred in complying with environmental legislation;
- Hereby indemnify the government of the Republic, the competent authority and all its officers, agents and employees, from any liability arising out of, inter alia, any loss or damage to property or person as a consequence of undertaking this MMP; and
- Am aware that a false declaration is an offence in terms of Regulation 48(1)(a) GN No. R. 982 of 4 December 2014 (as amended).



10 June 2025

Signature of ~~the proponent~~: Date:

Capewinelands Aero (Pty) Ltd

Name of institution/company:

**RESOLUTION – CAPE WINELANDS AERO (PTY) LTD, (Reg 2021/542277/07**

**RESOLUTION PASSED BY THE DIRECTORS OF**

**CAPEWINELANDS AERO (PTY) LTD, (Reg 2021/542277/07) ("COMPANY")**

**PASSED AT Cape Town ON 1 September 2023**

RESOLVED as a director's resolution that this Company apply to the City of Cape Town, and various other departments for all statutory authorisations and permissions in respect of various fixed properties whereby Power of Attorney has been obtained in order to develop an airport; and

RESOLVED FURTHER that Mr Deon Cloete (ID 6509295209088) in his capacity as the director of the Company be and is hereby authorised on behalf of this Company to:

(i) do all such things and sign all such other documents as may be necessary or requisite to give effect to this resolution; and

(ii) to give Power of Attorney to Paul Slabbert (Id: 7305235224082) from PHS Consulting and Jacob Hugo (Id:5903215021080) from H&A PLANNING with power of substitution with other relevant registered professionals to obtain such approvals on the Company's behalf.

(iii) in order to submit application documents, sign documents and to perform all such acts which may be necessary in relation to the following legislation as amended:

1. National Environmental Management Act, 1998 (Act No. 107 of 1998)
2. National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
3. National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004)
4. National Water Act, 1998 (Act No. 36 of 1998) Water Use Licensing and/or General Authorization
5. Water Services Act, 1997 (Act No. 108 of 1997)
6. National Heritage Resources Act, 1999 (act no. 25 of 1999)
7. Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), mine closure/removal of mining right
8. Subdivision of Agricultural Land Act (Act 70 of 1970)
9. The Western Cape Land-Use Planning Act, 2014 (Act No 3 of 2014)
10. The City of Cape Town Municipal Planning By-Law, 2015 (as amended)
11. The City of Cape Town Immovable Property By-Law, 2014 (as amended)

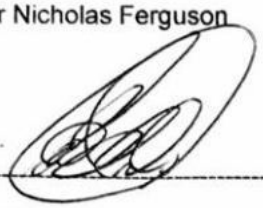
SIGNED at CAPE TOWN on 1 SEPTEMBER 2023.

As directors:

N S Ferguson

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Mr Nicholas Ferguson



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Mr Deon Cloete

M J Wilkinson

---

Mr Mark Wilkinson

# BACKGROUND AND INTRODUCTION

## 2.1. Contextual Information

This report aims to develop a Maintenance Management Plan for the proposed expansion of the existing Cape Winelands Airport. The site is located approximately 10.5km northeast of Durbanville and 25km northeast of Cape Town International Airport (CTIA) (Figure 2).

The proposed development will extend across a total of seven cadastrals namely, Portion 23 of Farm 724, RE of Farm 724, Portion 10 of Farm 724, Portion 4 of Farm 474, RE of Farm 474, Portion 7 of Farm 942, and Portion 3 of Farm 474, creating a combined area of approximately 885ha (Figure 3). Of this area, approximately 470ha will be allocated for airport development, including an airside precinct, terminal precinct, services precinct, general aviation precinct and associated landscaping (Figure 4 & Figure 5). The remaining land will remain as agricultural zones, designated as an agricultural precinct (Figure 4 & Figure 5). This agricultural precinct will feature a combination of dryland agriculture, conservation of botanically sensitive areas, and wetland offsets.

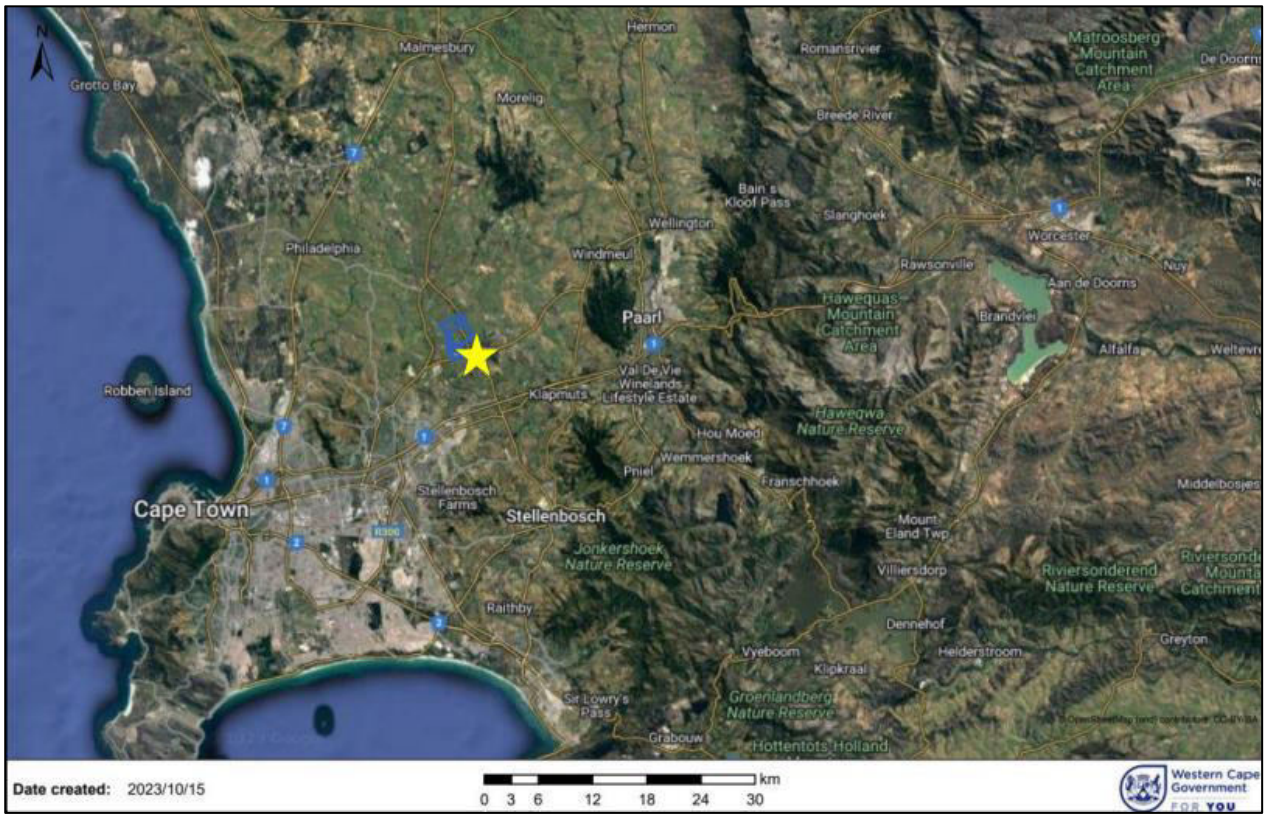



**Figure 2: Regional location of current CWA indicated by yellow star. The blue lines indicate land parcels that form part of the application area (PHS Consulting, Oct 2023)**

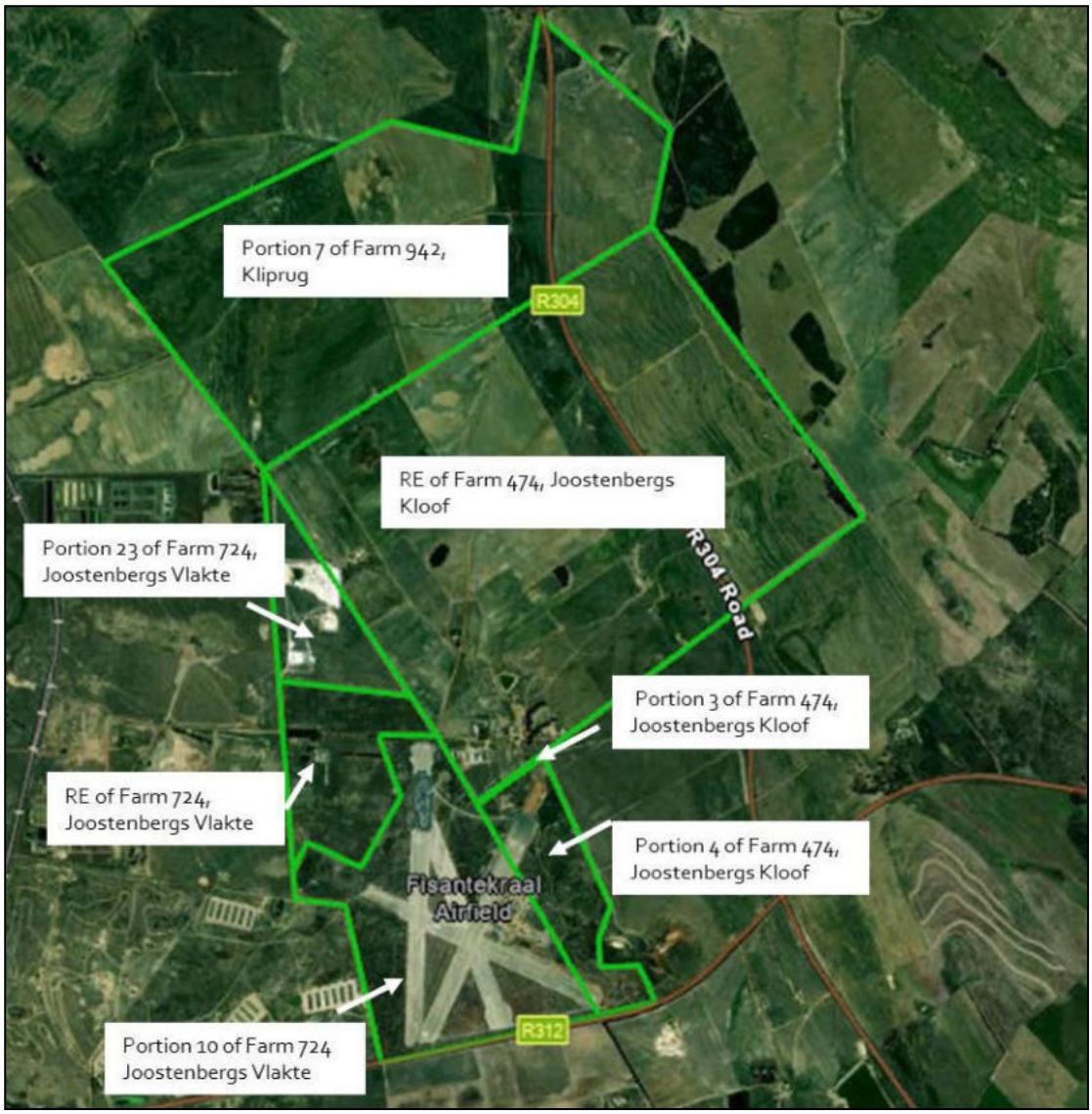



**Figure 3: Cadastrals Forming Part of Application Area (PHS Consulting, February 2024)**




**Figure 4: Phase 1 Concept SDP (Capex Projects, August 2024).**




**Figure 5: Phase 2 Concept SDP (Capex Projects, January 2025).**

The CWA site is located within Quaternary Catchment G21E in the Berg Water Management Area. The Mosselbank River is located West of the study area, and the Klapmutsrivier North of the site (refer Figure 2). Both rivers are considered largely modified.

A freshwater ecological site verification was undertaken in 2022 by FEN Consulting and the following watercourses were identified (refer Figure 1):

- A channelled valley bottom (CVB) wetland (hereafter referred to as CVB wetland 1) associated with the unnamed tributary of the Klapmuts River was identified bisecting the eastern portion of the study area, west of the R304;
- Two CVB wetlands (CVB wetlands 2 and 3) were identified within the northern portion of the study area and are linked to CVB wetland 1. The upper reach/western portions of the two CVB wetlands were also identified to encroach into the airport precinct;
- Another CVB wetland (CVB wetland 4) was identified North of the study area.
- Two seep wetlands were identified within the central western portion of the study area. One of these seep wetlands is directly linked to CVB wetland 1, while the other is indirectly linked via an agricultural drain;
- Several stormwater channels (some with concrete channels and others with excavated earth channels) and agricultural drains (usually with excavated earth channels) that convey surface water runoff (predominantly from the cultivated areas) into the identified freshwater systems, including into CVB wetland 1. It is possible that some of these agricultural drains may have functioned as natural watercourses in the past, but due to the high degree of land use transformation, agricultural activities and historical mining activities they now only function as drainage channels.
- Two artificial impoundments, one isolated and relic and the other connected to CVB wetland 1 via a stormwater channel and agricultural drain, and a quarry associated with historical open-pit clay mining activities were identified.

### 1.2. Scope of proposed project

An overview of the proposed SDP is provided in Figure 4 and Figure 5

*Airside Precinct Development*

In Phase 1, the airport will comprise of one runway, which will be at an orientation of 01-19 and a length of 3.5km and will be constructed to serve up to Code 4F instrument operations.

This runway will be shared by all operators, including scheduled commercial as well as general aviation, where intersection take-off points will be introduced on the runway to improve efficiency for general aviation operations.

The airside runway development in Phase 1 will also include, but not be limited to, airside systems such as CAT III Instrument Landing System (ILS), Precision Approach Path Indicator, Glidepath Antennas, Meteorological Systems, Airfield Ground Lighting (AGL) and Remote Digital Control Tower Systems. Aircraft parking stands range from ICAO Code B up to ICAO Code F stands. As part of the Development, 11 MARS stands (21 code C equivalent stands) is foreseen.

In Phase 2 the airport development strategy is based on the continued development of the various precincts based on market demand with the main runway (Figure 6) still shared by all operators, including scheduled commercial as well as general aviation.

Airside service roads will be constructed to provide access to airport assets for vehicles such as buses, ground service equipment and maintenance vehicles. An airport security fence will be erected in line with aviation security standards.

In addition to the runway development, the following airside, terminal and landside developments are proposed as part of the proposed airport expansion:

- Passenger & Cargo Terminals
- Aircraft Hangers & Services
- Aircraft Parking Aprons
- Airside Service Roads
- Internal & External Road Infrastructure
- Runways, Taxiways & Taxi lanes
- Airport Security Fence
- VIP Processing Facility
- Hotel
- General Aviation & Fixed Base Operations Facilities
- Airport Support Facilities
- Bulk Fuel Storage Facility
- Petrol Filling Station
- Cargo Facility
- Airport Maintenance Facility
- Ground Support Equipment Maintenance Facility
- MRO (Maintenance, Repair & Overhaul) Facility
- Inflight Catering Facility
- Solar PV Plant & Biodigester
- Potable Water & Sewage Treatment Infrastructure
- Stormwater Management Infrastructure
- Airport Operations Centre
- Air Traffic Control Centre

*Landside Developments*

The landside development will include the following:

- Access, egress (departure) and an internal vehicular road system
- Drop & go facilities which will allow passengers to drop passengers off close to the passenger terminal building
- Public transport facilities
- Car rental facilities
- Vehicular parking (multi-storey parking, at-grade parking)
- Pedestrian walkways
- Billboards (indoor & outdoor, static & electronic)
- Droneport & vertiports

*Commercial Developments*

Included in the Development, and in addition to aeronautical development, are commercial developments. Approximately 350 000m² of lettable area will be provided for. The terminal precinct encompasses a terminal plaza with a landmark hotel building, aviation museum, amphitheatre, offices, and MICE (Meetings, Incentives, Conferences, & Exhibitions) developments along the landside access road to the terminal. Included in the aeronautical hub functions are hangars, aviation clubs, an aviation training centre, workshops, light manufacturing, logistics, warehousing, and food processing.

*Access*

There is existing access through the existing Cape Winelands Airport. Main access proposed is from the South off Lichtenburg Road (R312) and from the West off Klipheuwel Road (R302).

### 1.3. Purpose of the MMP

The purpose of this MMP is to ensure that any environmental impacts associated with proposed maintenance activities within the regulated areas of watercourses and designated wetland offsets are effectively managed, mitigated, and minimized. Possible maintenance is anticipated, associated risk identified, and these are mitigated/ managed to minimise the impact. It also provides clear guidance to the person responsible for the maintenance in future to avoid possible transgressions in terms of NEMA listed activities. In this way maintenance is also minimised and directional when it occurs.

### 1.4. Listed Activities

This MMP is applicable to the following listed activities in terms of NEMA:

| Description of listed activity | Description of maintenance activities |
|---|---|

| | |
|---|---|
| *EIA Regulations Listing Notice 1 of 2014 (as amended)*<br>**Activity 19, Listing Notice 1**: The infilling or depositing of any material of more than 10 cubic meters into, or the dredging, excavation, removal or moving of soil, sand, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving-<br>(a) will occur behind a development setback;<br>(b) is for maintenance purposes undertaken in accordance with a maintenance management plan;<br>(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;<br>(N.B. Points (d) and (e) does not apply as these activities fall within the coastal zone) | Ongoing sediment removal from stormwater ponds, infrastructure, and areas upstream of existing roads within wetland areas may be necessary to maintain drainage, with additional removal potentially required following heavy rains. |
| *EIA Regulations Listing Notice 3 of 2014 (as amended)*<br>**Activity 12, Listing Notice 3:** The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a MMP.<br>**i. Western Cape**<br>i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;<br>ii. Within critical biodiversity areas identified in bioregional plans;<br>iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas<br>iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or | During the operation of the proposed development, maintenance of infrastructure such as fences, pipelines, and roads within 32m of designated wetland offset areas may be required. These maintenance activities could also involve the removal of rehabilitated indigenous vegetation to access and repair infrastructure. |

| | |
|---|---|
| v. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister.<br>(NB. Point iii does not apply as this activity falls within the coastal zone) | |

The MMP must form part of all contractual documents for maintenance projects in the future. The adoption of the MMP by DEA&DP will require that the applicant/ landowner and all appointed contractors must comply with the requirements therein. Any amendments/ changes/ upgrades to the MMP required will require submission to and approval by DEA&DP.

### 1.5. Description of Proposed Maintenance Activities

a) Infrastructure associated with onsite wetlands

Limited infrastructure and associated maintenance activities are proposed within 32m from the onsite wetlands. This includes perimeter fence which traverse Seep Wetland 1 and runs adjacent (>32m) to CVB Wetland 2 and 3. Additionally, service infrastructure (bulk water pipeline & stormwater infrastructure) encroaches into the 32m NEMA ZoR from onsite wetlands.

Maintenance activities for fences and water pipelines focus on ensuring structural integrity, preventing blockages, and managing surrounding vegetation. Routine inspections are essential to identify wear, damage, leaks, or obstructions. Repairs often involve replacing damaged or broken sections, tightening loose fasteners, or addressing corrosion. Vegetation removal and excavation/trenching may be needed to conduct the necessary repairs or replacements. For fences, removing overgrown vegetation prevents damage and maintains clear access. Water pipelines require routine cleaning to prevent blockages and maintain flow.

b) Wetland offset areas

Seep wetland 1 located within the airport precinct will be partially lost as a result of the proposed development. The proposed development activities will result in loss of approximately 6.74ha of wetland habitat. When accounting for indirect impacts, the total loss extends to 7.44ha (Figure 6). A freshwater offset has been developed to compensate for the loss of freshwater habitat (FEN, Wetland Offset Study and Implementation Plan, February 2025). The proposed offset involves rehabilitating the remaining seep wetland habitat (3.68ha) in the eastern part of the airport precinct along with a portion of CVB Wetland 1 (36.2ha) further East of the airport precinct into which the seep wetland drains (via an agricultural drain)(Figure 6). In addition, the agricultural drain connecting the seep

wetland to the CVB wetland is also earmarked for rehabilitation (Figure 6). Offset consideration is being done in consultation with the CoCT, Cape Nature, the DEA&DP and the DWS.

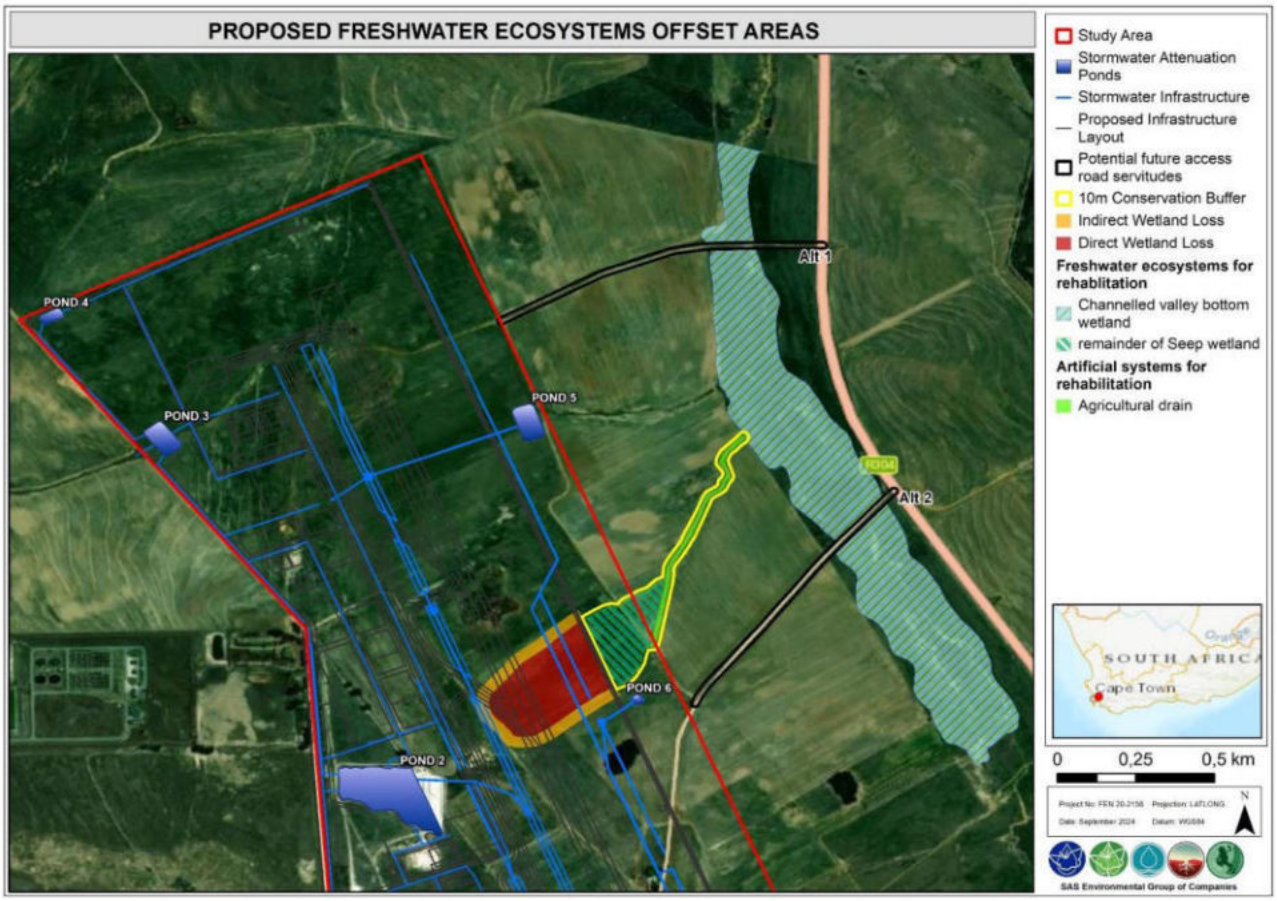



**Figure 6: Extent of wetland to be lost (7.44ha) vs identified wetland areas to be rehabilitated (Draft Wetland Offset Study and Implementation Plan, February 2025)**

The freshwater specialist recommends extensive rehabilitation work within CVB wetland 1, the agricultural drain, and surrounding areas to meet the Wetland Offset requirements and achieve a Category D Present Ecological State (PES) over the long term. In contrast, the seep wetland requires less extensive restoration.

Key rehabilitation activities identified include:

- Removing alien invasive plants (AIPs) and harvesting native wetland plants for revegetation.
- Addressing gully and headcut erosion, and regrading sections of the CVB wetland and agricultural drain.
- Revegetating the restored wetland areas and agricultural drain.
- Implementing stormwater management measures for the site.

The rehabilitation is envisaged to take no more than one year with minor potential aftercare and maintenance where interventions took place. Maintenance activities for the wetland offset include establishing a monitoring program to regularly assess water quality, hydrological parameters, wetland health, and key ecological indicators to maintain and improve the wetland's condition. This

includes plans for addressing issues like stormwater blockages and changes in vegetation health. An adaptive management plan will be implemented that allows for adjustments stormwater management, erosion control, and other practices based on monitoring results and evolving environmental conditions. All rehabilitated wetlands and associated 15m/16m operational buffers must be maintained in the desired ecological state (PES Category D).

Maintenance activities for wetland offset areas will involve ongoing monitoring and targeted removal of alien invasive plants (AIPs) to mitigate erosion and sedimentation impacts. Continuous monitoring and maintenance should cover all areas where AIPs have been cleared, with an additional five-year annual control program to address re-sprouting and reduce the existing alien seed bank. Following this period, the need for AIP control will be reassessed through adaptive management practices based on actual conditions as managed by the Alien Invasive Vegetation Management Plan developed for the proposed development (PHS Consulting, March 2025). Control measures within the 32meter regulated buffer around wetlands must be undertaken in accordance with the measures outlined in the Wetland Offset Study and Rehabilitation Plan (FEN, February 2025) and must include necessary follow-up treatments after initial removal.

To ensure the long-term effectiveness of the remediation efforts for head-cut and gully erosion in CVB Wetland 1 and the associated agricultural drain, active maintenance is required. This involves regular monitoring for signs of erosion and sedimentation, with interventions as needed. While no major remediation work is expected, regular oversight will assist with ensuring that the integrity of the initial rehabilitation efforts is maintained. If erosion or sediment deposition is observed, the underlying causes must be identified, and appropriate control measures implemented. Additionally, the offset wetlands should remain free from dumped waste and debris; any discarded materials must be promptly removed manually.

Areas that have been revegetated with indigenous plants will need ongoing monitoring throughout their establishment, with replanting carried out as needed. It is anticipated that there will be loss of some planted saplings during the rehabilitation phase. To maximize success of revegetation efforts, additional plants should be added one year after rehabilitation, prior to the rainy season. For the first three years following construction, saplings should be replanted annually during the winter months. Additionally, since the wetlands and surrounding areas are grazed by resident cattle, regular monitoring for signs of damaged grazing is essential, with prompt action taken to address any damage observed.

In addition to the planned rehabilitation and maintenance of wetland offsets, storm events may cause damage to onsite wetlands that will require targeted restoration. After heavy rains, wetland areas downstream of roads should be inspected for silt and debris accumulation. Prompt manual removal of debris and excess sediment will help preserve the natural flow, protecting water quality and vegetation from long-term impacts.

c) Maintenance associated with stormwater infrastructure

The proposed stormwater drainage network is based on a dual stormwater system, consisting of a major and a minor network, conveying stormwater generated on site via pipes and overland flow routes into seven (7) dry attenuation ponds with engineered layerworks and one (1) wet detention pond, positioned at strategic locations along the proposed CWA development site boundary (Figure 7). The proposed stormwater infrastructure also includes a series of dry swales that will serve to convey stormwater.

The basic stormwater design principles used to inform the concept design of stormwater infrastructure for the CWA site can be best described as follows:

- The natural drainage direction of stormwater of the site will remain unchanged as the site generally falls in a South to North direction with outfalls positioned strategically along the eastern and western boundaries.
- The minor system will comprise of open drains, an underground piped network complete with channels, inlet catchpits, oil separators, manholes and outlet structures sized to accommodate stormwater runoff from the roads, buildings, and other hard surfaced area for at least minor storm events up to the 1:5-year RI storm.
- The major system will comprise of roads and on-site overland flow paths which will operate in conjunction with the minor system to accommodate stormwater runoff from roofs and other hard surfaced areas for major storm events up to and including the 1:50-year RI storm.
    - The design levels allow for on-site overland flow routes in the event of a blockage or failure of the minor system.
- Where no on-site overland flow paths exist to accommodate run-off from major storm events, the underground piped network will be sized to accommodate run-off for major storm events (up to the 1:50 year).
- The overland flow routes on the CWA site are designed to safely convey the 1:100-year storm event towards the ponds situated along the boundary of the site. From there formal overland escape routes, in the form of pond overflows, will be designed to convey peak runoff from the 1:100-year storm which cannot be handled by the above proposed stormwater system before discharging into the adjacent infrastructure.

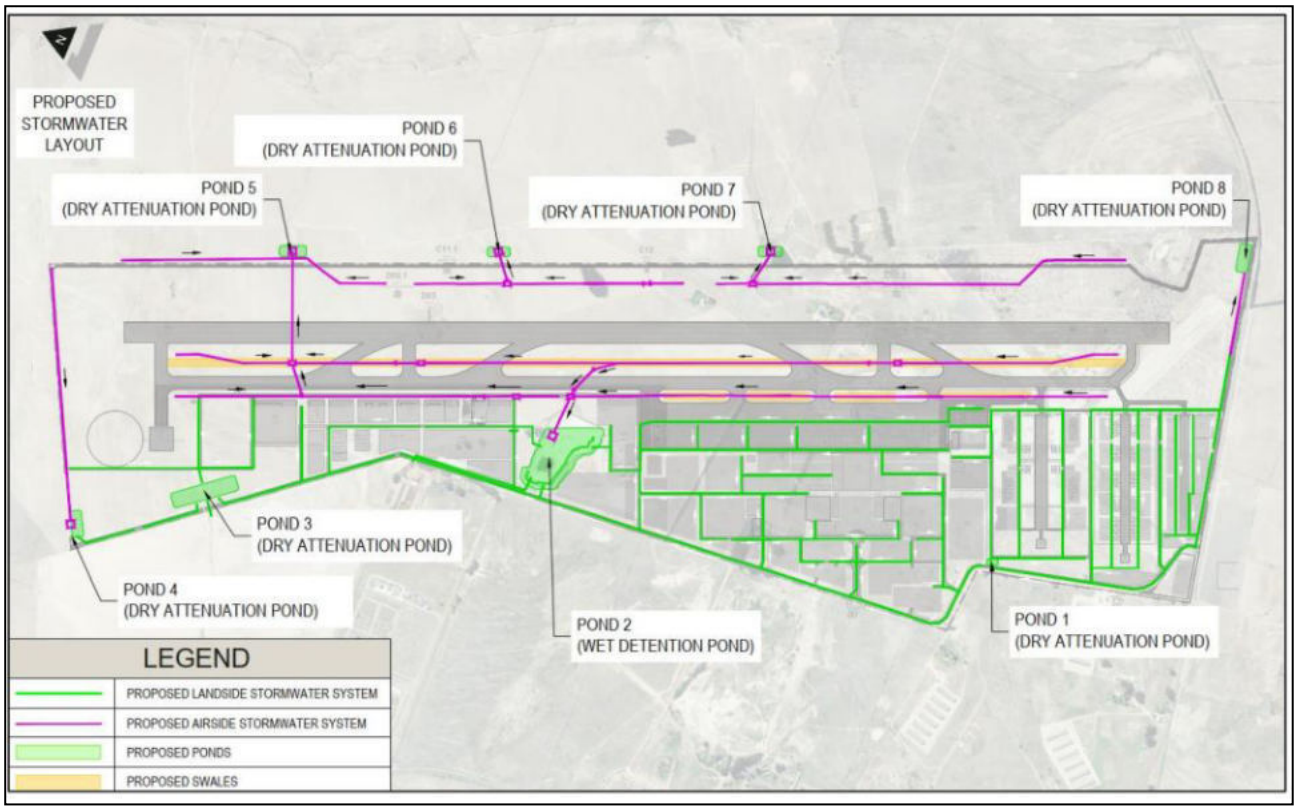



**Figure 7: Proposed stormwater management layout (Zutari, Stormwater Management Plan, September 2024)**

The proposed stormwater infrastructure, including dry attenuation ponds, stormwater pipes, and dry swales, will require ongoing maintenance activities within the 32m Zone of Regulation (ZoR) from wetlands. The maintenance activities will include:

- Monthly Litter and Debris Removal: Regular removal of sand, litter, and refuse from stormwater infrastructure, including kerbs and channels.
- Pipe Maintenance: Monthly removal of refuse from pipes, along with sand and silt using high-pressure jetting.
- Vegetation Management: Monthly management of vegetation to maintain design levels.
- Annual Cleanup: Removal of dead vegetation within and around the stormwater infrastructure before the growing season begins.
- Inspection of Covers and Frames: Monthly inspections of covers and frames, with replacement, repositioning, or repairs as needed.
- Embankment Inspections: Monthly or post-rain inspections of embankments, reshaping them if required to restore the original slope.
- Headwall Inspections: Monthly or post-rain inspections of headwalls, removing any blockages and trimming natural vegetation for unobstructed drainage.
- Inlet, Outlet, and Basin Inspections: Monthly checks for overflows, blockages, and sediment accumulation, with necessary corrective actions taken.
- Sediment Removal: Annual (or as required) removal of sediment from inlets, outlets, and forebays.

- Forebay and Outlet Inspection: Semi-annual inspections of the sedimentation forebay and outlet apron, especially before the first seasonal rains, to remove any accumulated silt and debris, ensuring proper disposal at suitable landfill sites without introducing silt into the stormwater system.
- Vegetation Replanting: Replanting or reseeding in degraded areas as needed and pruning plants for optimal stormwater management.
- Repair and Maintenance of Infrastructure: Prompt repairs of any erosion or damage to the stormwater infrastructure, ensuring design levels are maintained, which may involve vegetation removal, excavation, reshaping, and replanting.
- Headwall Maintenance in Dry Swales: Monthly removal of refuse from headwalls in dry swales, along with sand and silt removal using high-pressure jetting.

d) Maintenance associated with access and maintenance roads

A maintenance road will be constructed along the eastern boundary of the study area and two existing gravel access roads currently traverse CVB Wetland 1. Maintenance activities for gravel roads will involve several key tasks to ensure their safety, functionality, and longevity:

- Inspection and Reporting: Conducting regular inspections to assess the overall condition of the road, identifying issues that require attention, and documenting any necessary repairs.
- Grading: Grading of the road surface will likely be necessary to maintain a smooth and even driving surface, addressing ruts and washboarding caused by weather and vehicle traffic.
- Drainage Management: Regular inspection and maintenance of drainage ditches, culverts, and cross-drainage structures will be essential to prevent water accumulation and erosion. This includes clearing debris and sediment from these areas.
- Infrastructure Repairs: Timely identification and repair of potholes, erosion and other surface irregularities will help prevent further damage, erosion and potential for sedimentation of downstream wetlands.
- Vegetation Control: Removal of overgrown vegetation and weeds along the road edges.
- Flood Damage Repair: After a storm event, roads should be inspected for washouts, erosion, and structural damage. Where damage is found, eroded areas should be filled with compacted gravel or soil and the surface should be regraded to restore safe access and prevent further erosion.

### 1.6. MMP process project team

| Team member | Expertise | Role |
|---|---|---|
| Amanda Fritz-Whyte | EAP – MMP compilation | Compilation of MMP |
| Olivia Brunings | Candidate EAP – MMP compilation | Compilation of MMP |
| Zutari | Project Engineer | Compilation of Stormwater Management plan |
| FEN | Freshwater Ecologist | Compiled Freshwater Ecological report, Wetland offset report |
| Deon Cloete | Landowner Representative responsible for implementation of MMP | Input into MMP |

### 1.7. Roles and Responsibilities

This Maintenance Management Plan (MMP) forms a subsidiary component, as Annexure 16, of the overarching Environmental Management Plan (EMPr) for the proposed development. For a comprehensive overview of the roles and responsibilities, please refer to Section 3 of the EMPr.

The responsibility for implementing the MMP lies with the Environmental Management Division of the Cape Winelands Airport as stated in the Section 3.3 of the EMPr.

## 2. DEFINITIONS OF TERMS AND ACRONYMS

**Definitions:**

"**Activity**" means an activity identified in any notice published by the Minister or MEC in terms of section 24D(1)(a) of the Act as a listed activity or specified activity. Activity in this document refers to the activities as listed in Listing Notice 1, 2 and 3 of the Environmental Impact Assessment Regulations, 2014 (as amended).

"**Bush Encroachment**" means stands of plants of the kinds specified in column 1 of Table 4 of the Conservation of Agricultural Resources Act (Act No. 43 of 1983) where individual plants are closer to each other than three times the mean crown diameter.

"**Diverting**" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, cause the instream flow of water to be rerouted temporarily or permanently.

"**Ecological Infrastructure**" refers to naturally functioning ecosystems that deliver valuable services to people, such as water and climate regulation, soil formation and disaster risk reduction.

"**Estuary**" has the meaning assigned to it in the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)

"**Flood event**" is the event where land is inundated by the overflowing of water from a river channel and where this event causes significant damage to infrastructure or results in watercourse erosion and/or sediment deposition.

"**Flow-altering**" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, alter the instream flow route, speed or quantity of water temporarily or permanently.

"**General Authorisation**" in this document refers to the General Authorisation in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) or Section 21(i) (GN. 509 of 26 August 2016).

"**Impeding**" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, hinder or obstruct the instream flow of water temporarily or permanently, but excludes the damming of flow so as to cause storage of water.

"**Indigenous vegetation**" refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.

"**Maintenance**" means actions performed to keep a structure or system functioning or in service on the same location, capacity and footprint.

"**Maintenance Management Plan**" means a management plan for maintenance purposes defined or adopted by the competent authority.

"**River Management Plans**" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), any river management plan developed for the purposes of river or storm water management in any municipal/metropolitan area or described river section, river reach, entire river or sub quaternary catchment that considers the river in a catchment context.

"**River reach**", a length of river characterised by a particular channel pattern and channel morphology, resulting from a uniform set of local constraints on channel form. A river reach is typically hundreds of meters in length.

"**Stretch**" a section of watercourse, delineated between two or more mapped coordinates, within which proposed maintenance activities are to take place as guided by a MMP.

"**Thalweg**" refers to the line of lowest elevation within a valley or watercourse.

"**Watercourse**" means:

(a) a river or spring;

(b) a natural channel in which water flows regularly or intermittently;

(c) a wetland, lake or dam into which, or from which, water flows; and

any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse as defined in the National Water Act, 1998 (Act No. 36 of 1998); and a reference to a watercourse includes, where relevant, its bed and banks.

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

**Acronyms:**

| | |
|---|---|
| CBA | Critical Biodiversity Area |
| CVB | Channelled Valley Bottom |
| DEA&DP | Department of Environmental Affairs & Development Planning |
| DWS | Department of Water & Sanitation |
| EAP | Environmental Assessment Practitioner |
| EIA | Environmental Impact Assessment |
| GA | General Authorisation, in terms of the National Water Act, 1998 (Act No. 36 of 1998) |
| GN | Government Notice |
| HGM unit | Hydrogeomorphic unit |
| MEC | Member of Executive Council |
| MMP | Maintenance Management Plan |
| NEMA | National Environmental Management Act, 1998 (Act No. 107 of 1998) |
| NEMBA | National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) |
| NFEPA | National Freshwater Ecosystem Priority Areas |
| NWA | National Water Act, 1998 (Act No. 36 of 1998) |
| PES | Present Ecological State |
| PPP | Public Participation Process |
| REC | Recommended Ecological Category |
| RI | Rapid Intensification |
| RQO's | Resource Quality Objectives |
| SANParks | South African National Parks Authority |
| WCBSP | Western Cape Biodiversity Spatial Plan |
| WUA | Water Users Association |
| WULA | Water Use Licence Application |

# 3. ENGAGEMENT PROCESS

## 4.1. AUTHORITY ENGAGEMENT

Please indicate (with an 'x') which of the following authorities have been consulted to provide input based on the proposed maintenance activities:

- X Department of Water and Sanitation (as an I&AP and as CMA)
- X Catchment Management Agency
- X CapeNature
- ☐ SANParks
- X Western Cape Department of Agriculture, Directorate: Land Use Management
- X Local Municipality (City of Cape Town)
- X Heritage Western Cape
- ☐ Department of Agriculture, Forestry and Fisheries
- X Department of Environmental Affairs & Development Planning
- ☐ Other (please list):
  - X West Coast District Municipality
  - X Swartland District Municipality
  - X Cape Winelands District Municipality
  - X Western Cape Transport and Public Works
  - X DEA&DP: Waste Management Directorate
  - X DEA&DP: Pollution and Chemical Management

The above authorities will be consulted for their input during the EIA process PPP and comments received will be captured in a Comments and Responses report to be submitted with the final EIA to DEA&DP. Amendments to the MMP will be included in the final MMP submitted for approval to DEA&DP.

## 4.2. PUBLIC PARTICIPATION

The following public participation recommendations, regarding the different scale or geographical extent of the request, are as follows. If no, then motivation must be given as to why a particular process was not undertaken.

***Single or Multiple properties / WUA / IB / local authority applying for a single MMP to cover a stretch of a watercourse <u>longer than 1 kilometer (>1000 meters) OR</u> a catchment or sub-catchment area***

| | | |
|---|---|---|
| (i) Given written notice to the owner(s) or person(s) in control of the land if the person(s) undertaking the maintenance activity(ies) is not the owner or person in control of the land. | ***Yes*** | ***POA for P7/942, RE/474; P3/474 and P23/724 in place*** |
| (ii) Given written notice to non-participating adjacent landowners (up to 1km upstream and downstream from furthest upstream and downstream maintenance site and opposite side of the riverbanks) of the development of the | ***Yes*** | ***Electronic communications to adjacent landowners as*** |

| | | |
|---|---|---|
| MMP. *This must also include general notice to adjacent WUA or IB of the proposed MMP development if application is made by a WUA or IB.* | | ***part of Scoping & EIA PPP.*** |
| (iii) Stakeholder meeting held for all participating and non-participating landowners, in which details and methodology of MMP is presented. A minimum of two meetings are required, to present on the development of the plan and a final draft version of the plan. | ***Yes*** | ***A 1st Open public meeting was held on 8 May 2024, explaining the extent of watercourses and wetlands to be affected, and assessed as part of the development.***<br><br>***Adjacent landowners to provide comment on the MMP as part of EIA PPP which will consist of a minimum of two commenting periods.***<br><br>***A 2nd Open day held on 20 November 2024 during EIA Phase to enable stakeholders to engage re MMP and with specialists and to make comment to EAP.***<br><br>***3rd Open day held on 15 April 2025 to enable stakeholders to engage re MMP and with specialists and to make comment to EAP.*** |
| (iv) Given written notice to any organ of state having jurisdiction in respect of any aspect of the activity(ies) proposed within the development of the MMP. | ***Yes*** | ***Electronic communications sent to organs of state as per Scoping & EIA PPP. Meeting and engagement also held with DWS.*** |
| (v) Provide written notice and confirmation to the relevant Water Users Association (WUA) or Irrigation Board (IB), of the development of the MMP (*if a MMP is not requested and managed through a WUA/IB).* | ***Yes*** | ***DWS included as I&APs for Scoping & EIA PPP. No irrigation board in this area.*** |
| (vi) Describe any other measures taken to inform the public about this MMP. A complete list of measures that are in place to deal with interactions with the public, if it becomes | ***Yes*** | ***- Site notices placed as part of Scoping & IA Phase.*** |

| | | |
|---|---|---|
| necessary and required by the competent authority during implementation of the project, must be provided for. | | ***- Advert placed in Tygerburger to inform potential IAPs of Scoping & IA Phase and MMP and opportunity to comment for a two 30 day PPP periods and an additional 45 day PPP period***<br><br>***- Email and sms communication to all registered IAPs for the project.***<br><br>***- Hard Copy of documents placed in Fisantekraal library.***<br><br>***- Copy of EIA and MMP and all other documentation placed on PHS Consulting website for two separate 30 day commenting periods as well as an additional 45 day commenting period*** |

Please refer to Appendix 40 of the EIAR for a detailed breakdown of all the PPP undertaken to date.

# 5. DATA COLLECTION AND ASSESSMENT

## 5.1. Activities during Maintenance Phase

The following activities will be undertaken during the maintenance phase of the proposed development:

- General maintenance and repairs to perimeter fences. This includes replacing damaged sections, securing loose fasteners or treating areas affected by corrosion.
- Maintenance and repairs to water pipelines including replacing damaged sections, securing loose fittings, or treating corrosion.
- Excavation or trenching may be required to facilitate necessary maintenance works such as replacement of fence posts or pipeline repairs.
- Vegetation and debris removal from areas where maintenance work is required.
- Vegetation management to maintain stormwater infrastructure capacity and road visibility and prevent potential damage from overgrown vegetation.
- Erosion control measures associated with the dam, its infrastructure and areas exposed during vegetation removal
- Periodic flushing or scouring of pipelines to maintain capacity and address the build-up of organic materials.
- Disturbance of instream habitat and potentially increased risk of erosion because of periodic vegetation removal to maintain ecological integrity of the natural areas onsite
- Upkeep of rehabilitated offset wetlands including replanting indigenous vegetation if required, addressing erosion and sedimentation that may arise.
- Silt removal from stormwater ponds and associated stormwater infrastructure. This work will likely require using an excavator or similar equipment both within and around the ponds.
- Removal of
- Gravel road maintenance will involve regular inspections to identify issues and grading and pothole repair to keep the surface even.
- Drainage features, such as ditches and culverts, will be cleared regularly to prevent erosion.

**PLEASE NOTE:** The information provided in this section is largely obtained from the Detailed EIA Phase Freshwater Ecological Assessment by FEN Consulting (February 2025) as provided in Appendix A of this report. The Risk Matrix for the S21(c) and (i) activities is provided in the Freshwater Ecological report and used for the water use applications and registrations associated with the maintenance activities. The Terms of Reference for the specialist appointment is also provided for in Appendix A.

Additionally, please consult the Wetland Offset Monitoring Plan included in Appendix B of this document (FEN, Draft Wetland Offset Study and Implementation Plan, January 2025). Appendix C provides the coordinates for all sites where maintenance activities will be conducted.

## 5.2. Catchment context:

The proposed development site is located within the Breede-Olifants Water Management Area, quaternary catchment G21E. According to the FEPA database, the sub-quaternary catchment is not currently considered important in terms of fish or freshwater ecological conservation. However, the NGI river line vector dataset for the Western Cape does indicate several perennial and non-perennial drainage lines within the vicinity of the study area (Figure 8). The Mosselbank River is located West of the study area, and the Klapmuts River North of the site. Both rivers are considered largely modified (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

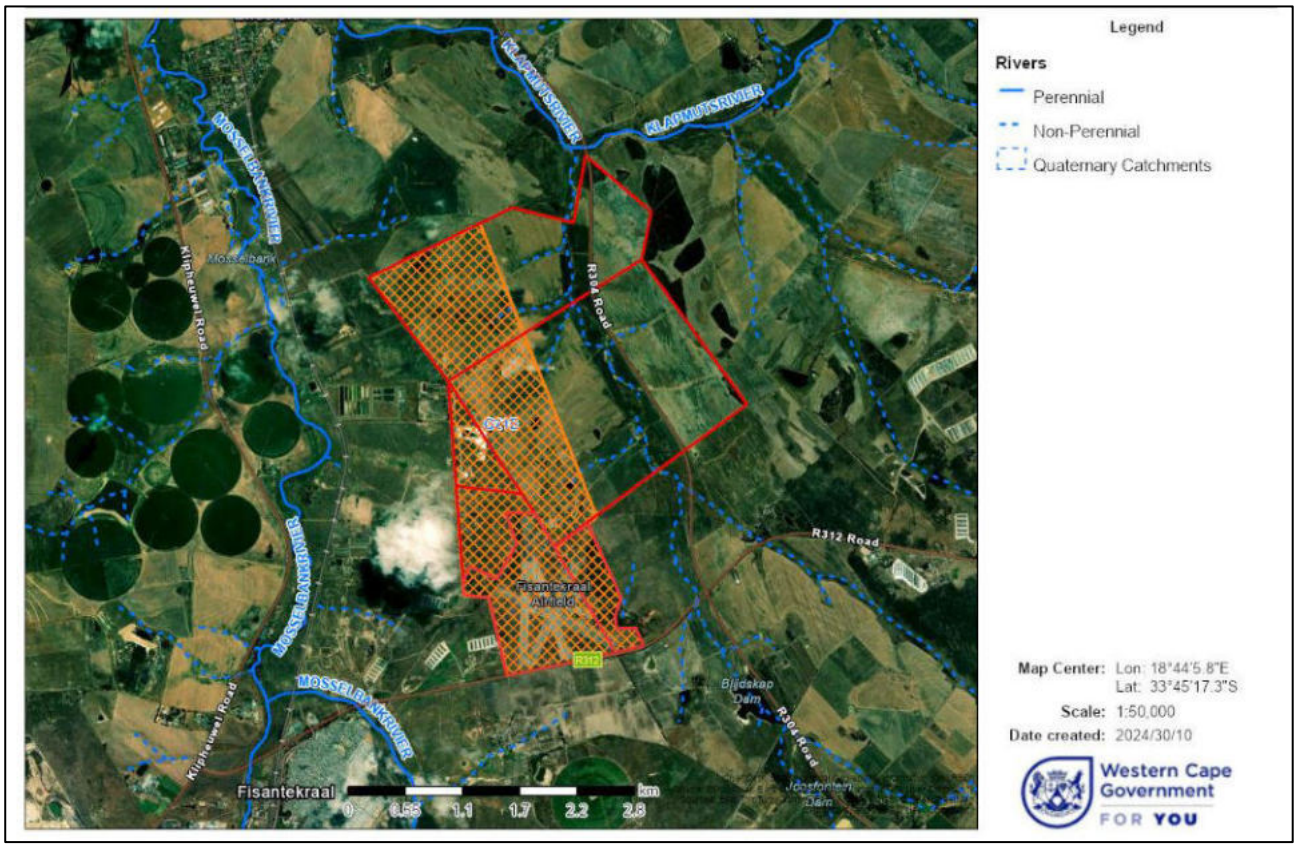



**Figure 8: Development area (hatched orange) and cadastrals (red outline) in relation to identified rivers and drainage lines in the area (PHS Consulting, CapeFarmMapper, October 2024).**

### 5.3. Context in terms of the Berg Resource Quality Objectives

The proposed CWA is located within Quaternary Catchment G21E which falls within what used to be the Berg WMA. While draft resource quality objectives (RQO) are available for the Berg Catchment, Quaternary Catchment G21E is not listed. Quaternary Catchment G21E is located within the Diep River Catchment IUA. Where RQO have been listed for quaternary catchments within the Diep River Catchment, the target ecological category ranges between C and D.

### 5.4. Regional and National Conservation context

To establish a comprehensive regional and national conservation context, various national and provincial wetland databases were consulted during the desktop assessment of the site. Key resources included the NFEPA 2011 wetlands database (Figure 9 & Figure 10), the National Wetlands Map 5 (included in Figure 11), and the CoCT 2017 wetland dataset (Figure 12 - Figure 14). An overview of the desktop information gathered from these datasets is presented in Table 1.

**Table 1: Desktop data (from desktop databases only) relating to the characteristics of the freshwater ecosystems associated with the study and investigation areas (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

| Aquatic ecoregion and sub-regions in which the study area is located | | Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database | |
|---|---|---|---|
| Ecoregion | South Western Coastal Belt | | |
| Catchment | Berg/Bort/Potberg | River FEPA | The study area is located within a sub-quaternary catchment currently not considered important in terms of fish or freshwater ecological conservation. |
| Quaternary Catchment | G21E | | |
| WMA | Berg | | |
| subWMA | Lower Berg | NFEPA Wetlands (Figure 9) | According to the NFEPA database (2011), no natural wetlands are located within the study area. One artificial seep wetland is indicated within the central eastern portion of the study area. This artificial seep wetland is considered to be in a critically modified ecological condition (Class Z3). Three artificial wetland flats are located within the investigation area. These artificial wetlands are also considered to be in a critically modified ecological condition (Class Z3). During the site assessment, all artificial wetlands were identified as artificial impoundments not associated with any natural freshwater ecosystems. |
| **Dominant characteristics of the South Western Coastal Belt Ecoregion Level II (24.05) (Kleynhans *et al.*, 2007)** | | | |
| Dominant primary terrain morphology | Moderately Undulating Plains, Hills | | |
| Dominant primary vegetation types | West Coast Renosterveld, Mountain Fynbos, Sand Plain Fynbos, Central Mountain Renosterveld | | |
| Altitude (m a.m.s.l) | 100 – 500 | Wetland Vegetation Type (Figure 10) | The majority of the study area is situated within the West Coast Shale Renosterveld wetland vegetation type, while the south eastern and central northern portions of the study area are located within the West Coast Silcrete Renosterveld. The central western portion of the study area is located in the Southwest Sand Fynbos wetland vegetation types. All three wetland vegetation types are considered Critically Endangered as per Mbona *et al.* (2015). |
| MAP (mm) | 400 – 500 | | |
| The coefficient of Variation (% of MAP) | 25 – 35 | | |
| Rainfall concentration index | 30 – 55 | | |
| Rainfall seasonality | Winter | NFEPA Rivers (Figure 9) | As per the NFEPA database (2011), there are no rivers located in the study area. The Mosselbank River is located approximately 1 km west of the study area (based on the centre line of the river). According to the NFEPA database (2011), the Mosselbank River is considered to be in a largely modified ecological condition (Class D). The Klapmuts River is located approximately 1.1 km north east of the study area. According to the NFEPA database (2011), the Klapmuts River is considered to be in a largely modified ecological condition (Class D). |
| Mean annual temp. (°C) | 16 – 18 | | |
| Winter temperature (July) | 6 – 20 | | |
| Summer temperature (Feb) | 14 – 30 | | |
| Median annual simulated runoff (mm) | 60 – 250 | | |
| **National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 11) (National Wetland Map 5 is included in the NBA)** | | | |
| According to the NBA 2018: SAIIAE, three natural seep wetlands are located within the study area. The seep wetlands indicated within the study area are considered to be in a largely and critically modified ecological condition (Class D/E/F), are indicated as being affected by mining, are considered to be critically endangered according to the Ecosystem Threat Status (ETS), and poorly protected according to the ecosystem protection level (EPL). Eight more natural seep wetlands are located within the investigation area, five of which are located directly adjacent to the western boundary of the study area. According to the available database, these seep wetlands range from being considered to be in a moderately modified (Class C) to a largely and critically modified (Class D/E/F) ecological condition, and one is impacted by roads. Five of the seep wetlands are considered vulnerable according to the ETS, and well protected according to the EPL, while the remaining three are considered to be critically endangered according to the ETS and poorly protected according to the EPL. The Mosselbank River is located approximately 1 km west of the study area and is considered to be in a largely modified ecological condition (Class D), critically endangered according to the ETS and not protected according to the EPL as per the NBA dataset. | | | |

| Importance of the study area according to the City of Cape Town wetlands Dataset (2017) (Figure 12 and Figure 13) | |
|---|---|
| The CoCT Wetlands Dataset (2017) indicates three natural seep wetlands and a natural depression wetland within the north eastern and central portion of the study area. Additionally, eight natural seep and four depression wetlands are indicated within the investigation area, including five seep wetlands located directly adjacent to the central western boundary of the study area (corresponding with the findings from the NBA (2018)). The seep wetlands within the study area and three of the eight seep wetlands within the investigation area, are considered to be Critical Ecological Support Areas (CESA) according to the CoCT Wetlands Dataset (2017). CESA are unselected areas which host natural vegetation and considered essential for ecological support for Critical Biodiversity Areas and protected sites. The depression wetlands in the study and investigation areas, and the remaining two seep wetlands in the investigation area are categorised as Other Ecological Support Areas (OESA). OESAs are lower ranking artificial wetlands and lowest ranking natural and semi-natural wetlands. OESA wetlands should be managed for maintenance of ecological functioning within and around the wetland. | |
| **City of Cape Town Biodiversity Network (2017) (Figure 14)** | |
| The south eastern portion of the study area is located in an area classified as a CBA 1b of terrestrial importance. CBA 1b are irreplaceable good and fair condition sites that host critically endangered vegetation of good and fair quality. These sites are required to achieve biodiversity targets, and any loss of these areas is a permanent and irrevocable loss. Portions within the southern extent of the study area are classified as CBA 2 of terrestrial importance. CBA 2 are restorable irreplaceable sites that host critically endangered vegetation and sometimes associated with rivers and wetlands of restoration condition. CBA 2 are required to meet national biodiversity targets. A small portion within the south eastern extent of the investigation area is classified as an Other Ecological Support Area). | |
| **National web based environmental screening tool (2020) (Figure 15)** | |
| The screening tool is intended for pre-screening of sensitivities in the landscape to be assessed within the Environmental Impact Assessment (EIA) process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. | The majority of the study area is located in an area considered to be of **low aquatic biodiversity** importance. Scattered portions within the study area are considered to be areas of **very high aquatic biodiversity** sensitivity due to the presence of wetlands and CESA as identified by the CoCT wetlands Dataset (2017). The sensitivity of some of the freshwater ecosystems was disputed. Refer to **Appendix E** for more information. |

**CBA = Critical Biodiversity Area; CESA = Critical Ecological Support Area; CR = Critically Endangered; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; EN = Endangered; m.a.m.s.l = Metres above mean sea level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Area; OESA = Other Ecological Support Area; PES = Present Ecological State; WMA = Water Management Area.**

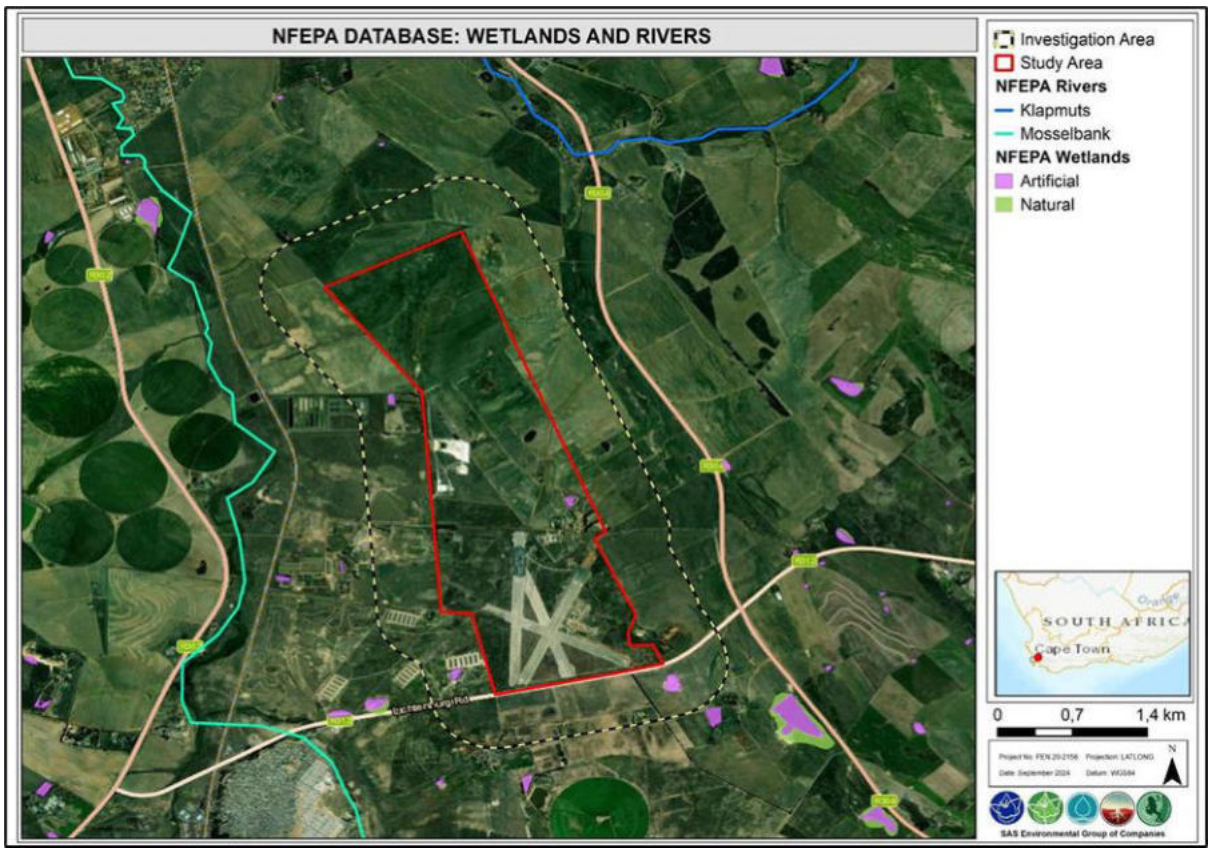



**Figure 9: Rivers and natural and artificial wetlands associated with the study and investigation areas, according to the NFEPA database (2011) (FEN Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

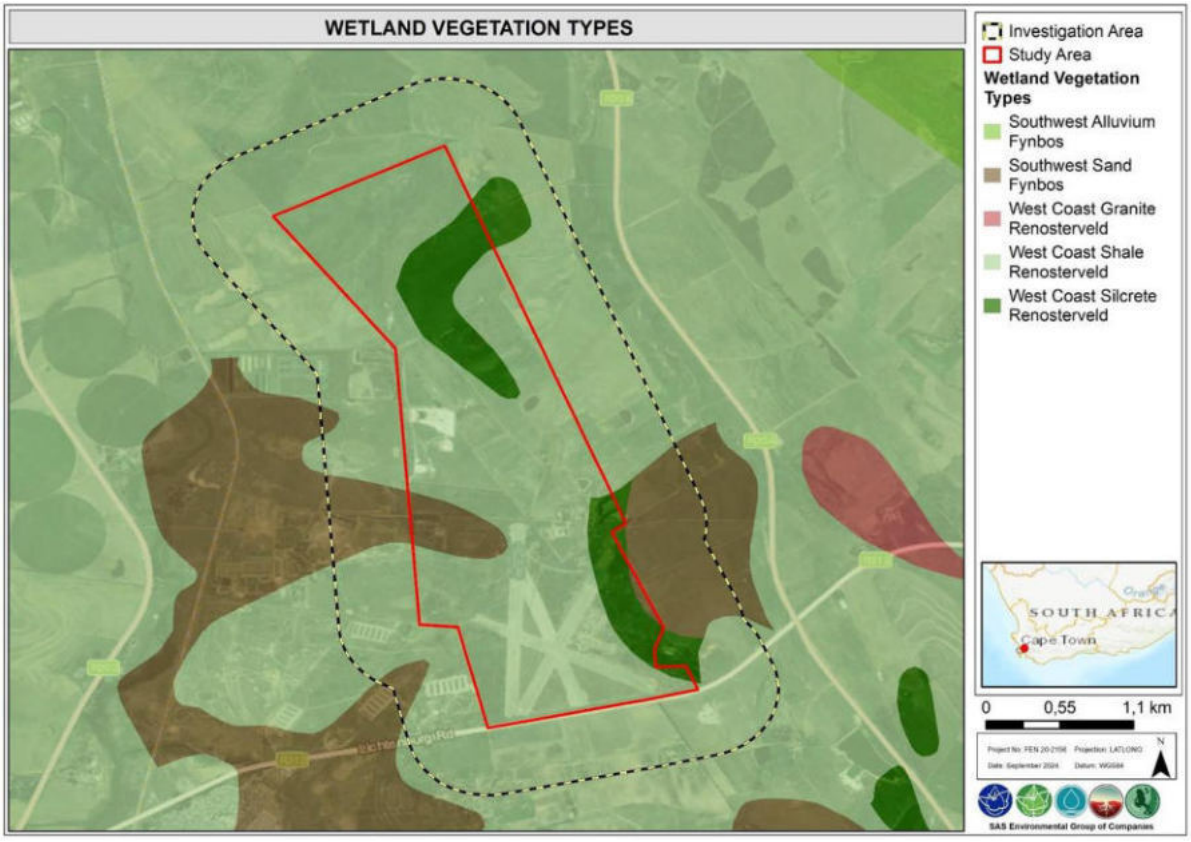



**Figure 10: Wetland vegetation types associated with the study and investigation areas according to the NFEPA database (2011) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

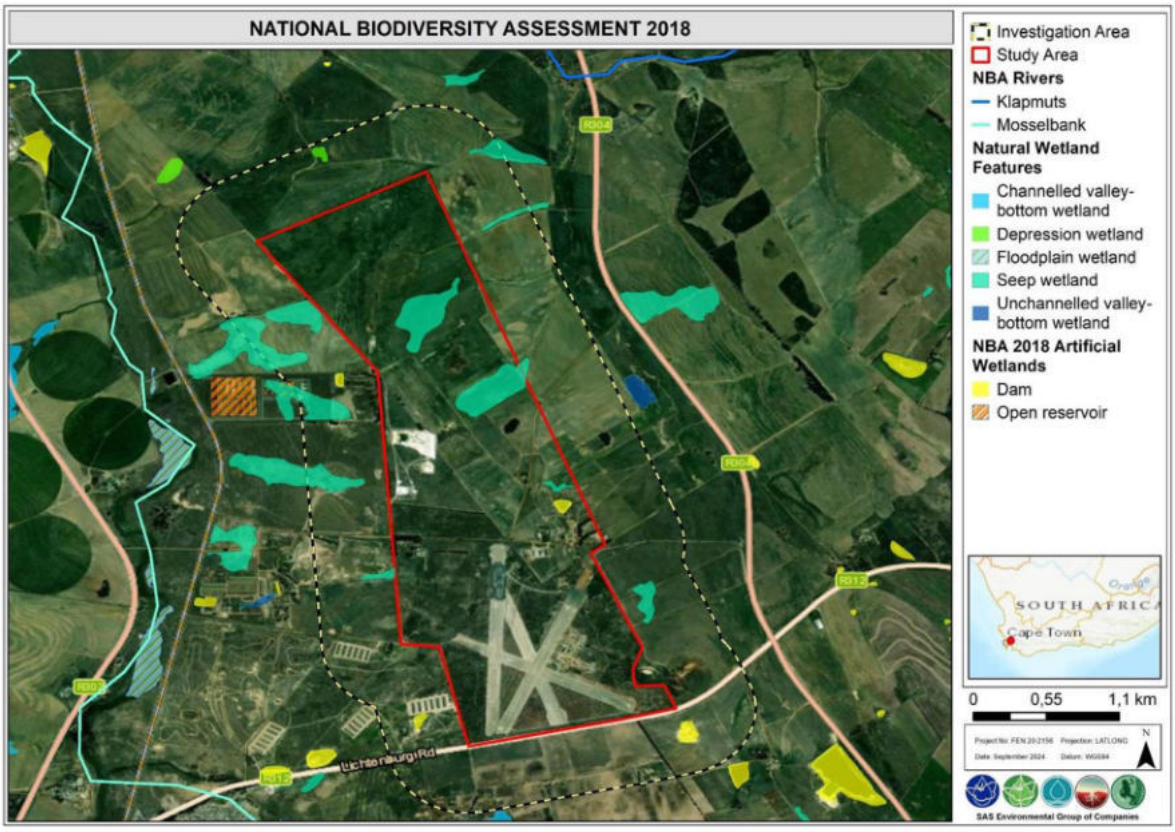



**Figure 11: Wetlands and rivers associated with the study and investigation areas according to the National Biodiversity Assessment database (2018) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

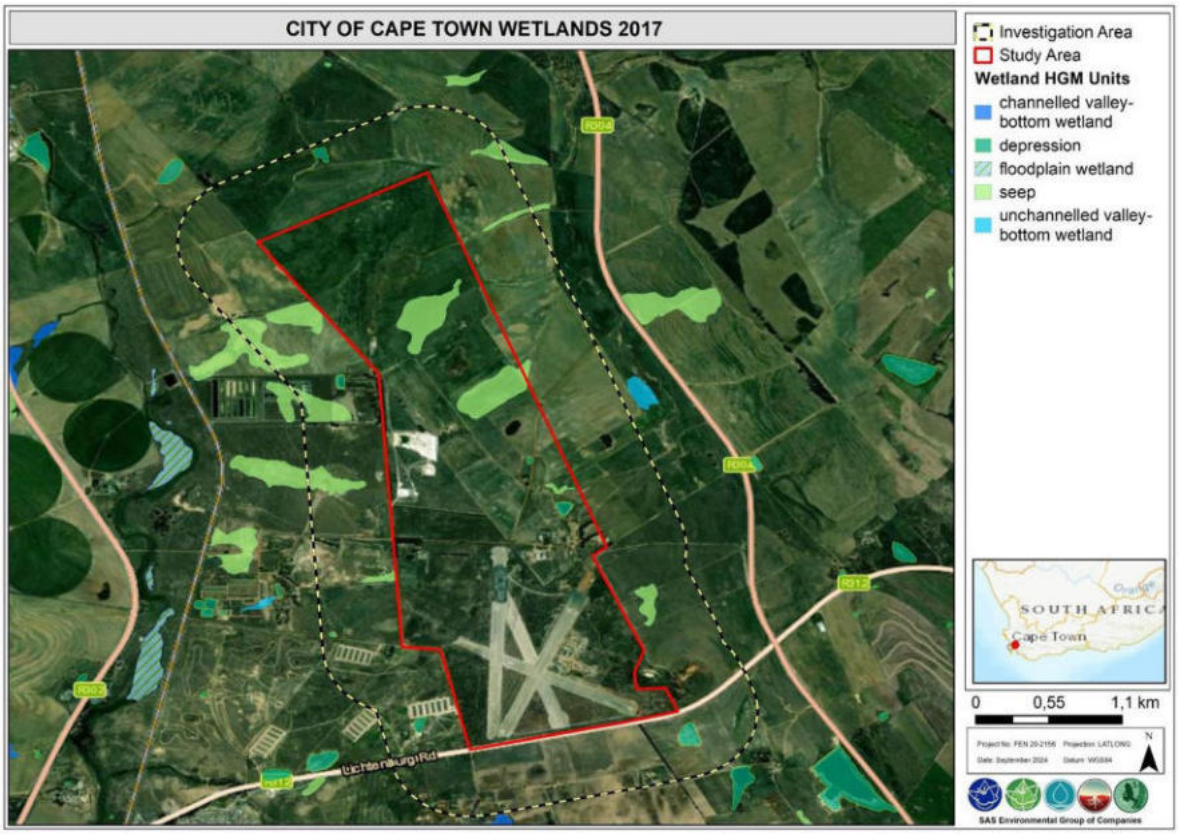



**Figure 12: Wetlands identified by the City of Cape Town Wetlands Dataset (2017) to be associated with the study and investigation areas (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

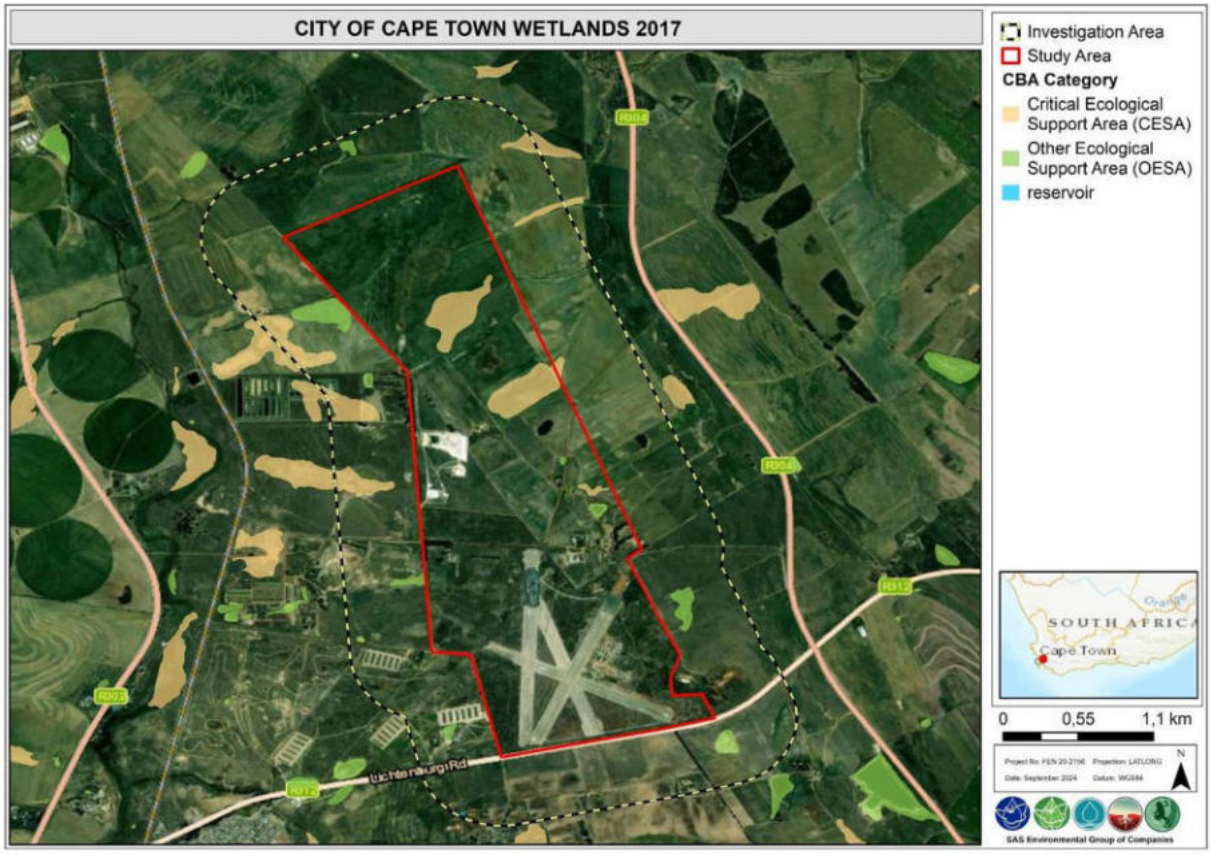



**Figure 13: The ecological importance categories of the wetlands in the study and investigation areas according to the City of Cape Town Wetlands (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

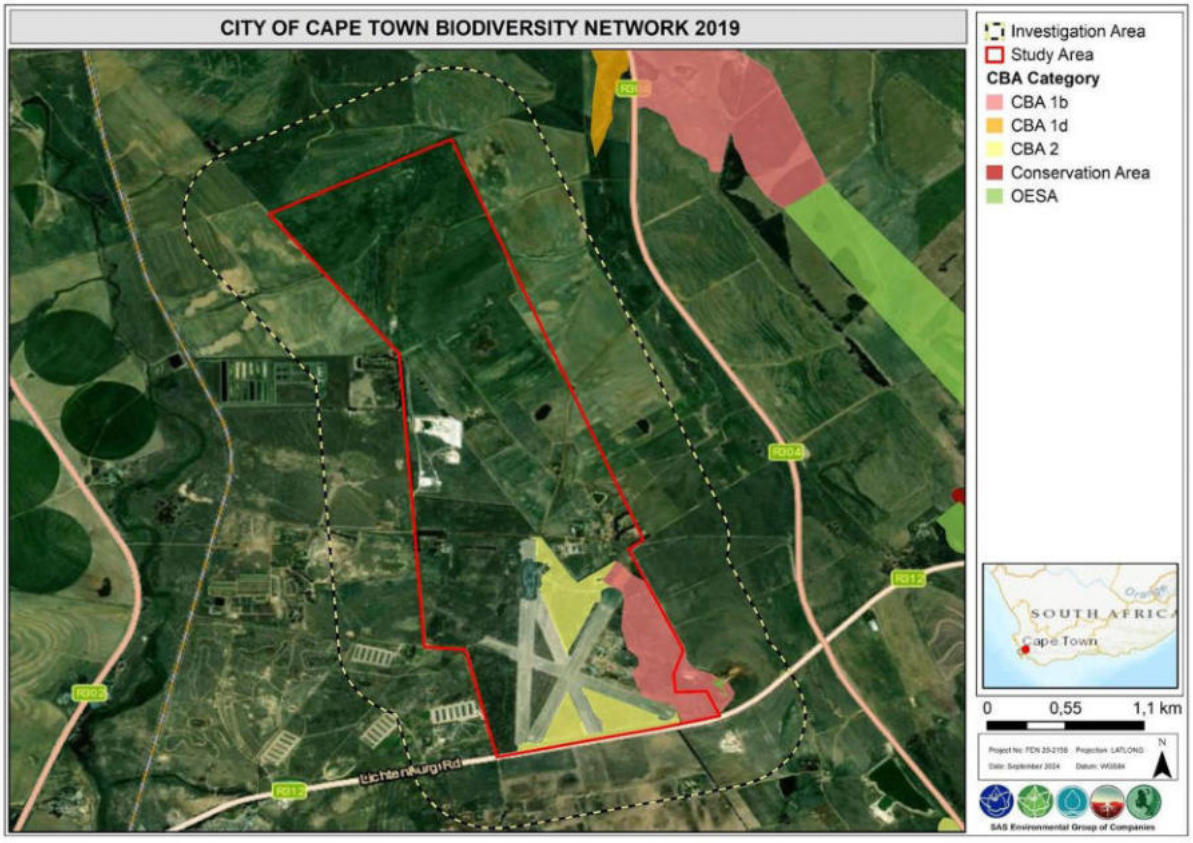



**Figure 14: Areas of ecological importance associated with the study and investigation areas according to the City of Cape Town Biodiversity Network (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

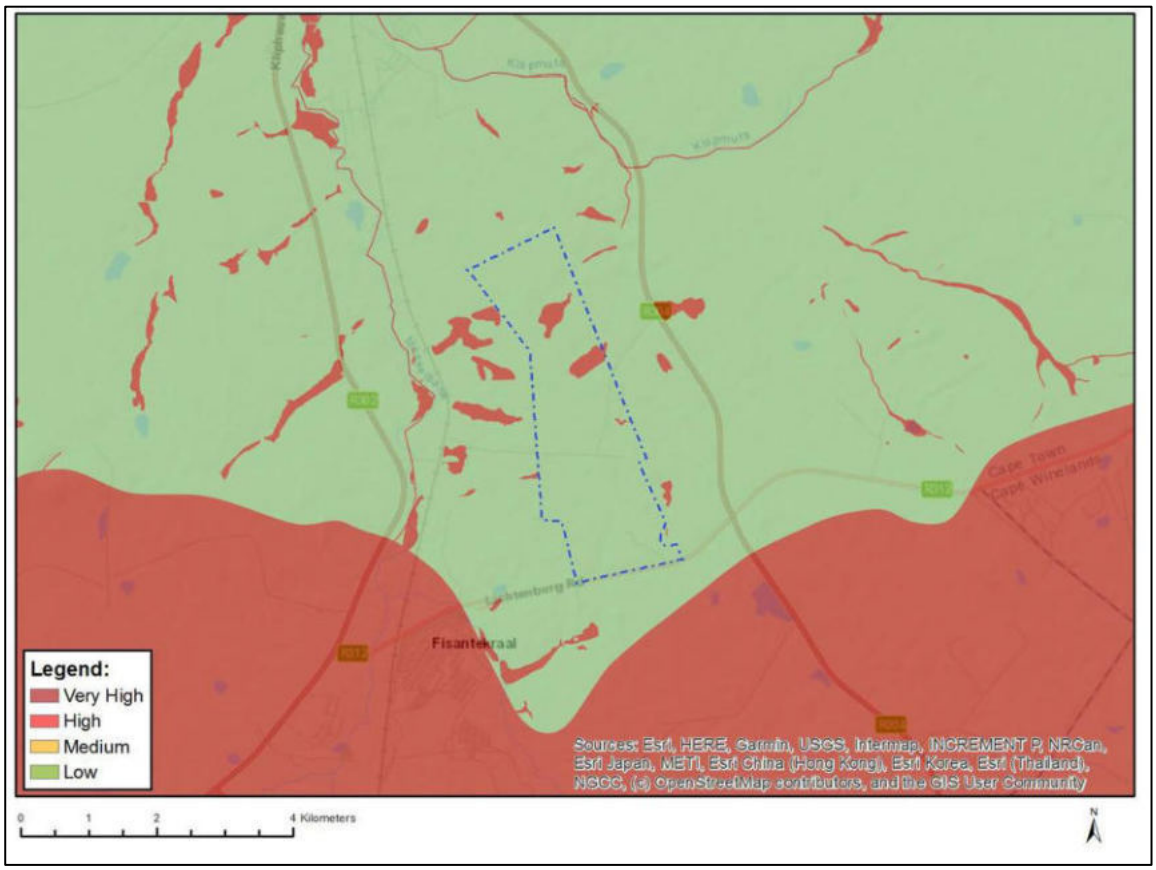



**Figure 15: Map of relative aquatic biodiversity theme sensitivity for the proposed CWA development's affected properties according to the National (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

### 5.5. Watercourses associated with the proposed expansion of the Cape Winelands Airport

Overview

Field verification confirmed the presence of a single seep wetland (Seep 1) within the central portion of the proposed airport precinct (Figure 16) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). This seep wetland is indirectly linked, via an agricultural drain, to a channelled valley bottom (CVB) wetland located to the east and outside of the freshwater study and investigation areas (Figure 16). In addition to the onsite wetland, the following natural freshwater features were identified within 500m from the proposed airport precinct (investigation area) (Figure 16):

- A large CVB wetland system, CVB wetland 1, was identified running parallel with the eastern boundary of the investigation area, with only a small portion located within 500m from the proposed development area. This wetland is associated with the unnamed tributary of the Klapmuts River.
- Two smaller CVB wetlands (CVB wetland 2 and CVB wetland 3) linked to CVB wetland 1 were identified immediately East of the proposed development area. Neither of these two wetlands encroach into the development area.

- A fourth CVB wetland, CVB wetland 4) was identified North of the study area.
- Lastly, an additional seep wetland (Seep 2) was identified approximately 310m East of the study area and is directly linked to the CVB wetland 1.

Although numerous wetlands were identified within the investigation area, only a representative subset of those directly impacted by the proposed CWA development underwent quantitative assessment. This includes seep wetland 1 and CVB wetlands 2 and 3, where seep wetland 1 and CVB wetland 2 served as proxies for their nearby counterparts due to similar ecological conditions. CVB wetlands 1 and 4 were assessed qualitatively, given their distance from the study area and low risk of impact; however, CVB wetland 1 was also evaluated in greater detail within the Wetland Offset Study, as it was identified as a suitable site for offsetting.

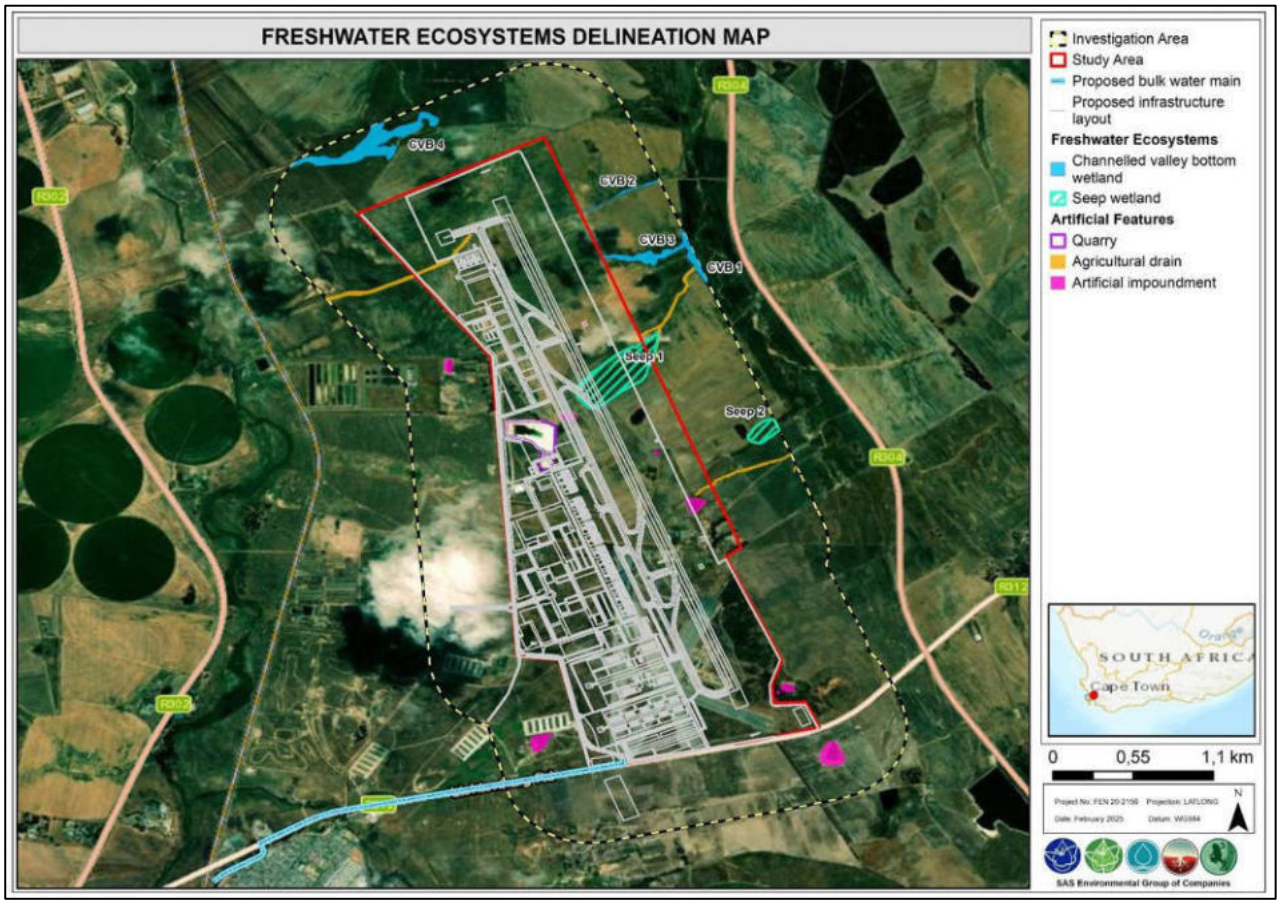



**Figure 16: Map depicting the delineated extent of the freshwater ecosystems and artificial features associated with the study and investigation areas (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

CVB Wetland 1

CVB wetland 1 originates approximately 4km South of the proposed development area and flows in a generally northerly direction across adjoining farmland, eventually joining the Klapmuts River to the North and outside of the investigation area.

CVB wetland 1 has been impacted by land use changes in the upstream catchment and direct habitat impacts. The disturbance created by agricultural activities has had a significant impact on the vegetation associated with CVB wetland 1. Wetland vegetation has been removed from the temporary and seasonal zones of the wetland to make way for cultivated fields. Although the vegetation composition is considered significantly disturbed, CVB wetland 1 still provides habitat to support obligate wetland species such as *Juncus sp*. and *Phragmites australis* but also AIPs including *P. clandestinum* and *Acacia saligna* (Port Jackson).

CVB wetland 1 acts as an important migratory corridor within the largely transformed landscape and plays an important role in maintaining hydrological functioning and connectivity in the landscape. CVB wetland 1 can thus be considered to have an ecological importance on a local scale. However, CVB wetland 1 is not considered to be sensitive to changes in the landscape due to historical and ongoing impacts.

The CVB wetland (termed CVB wetland 1 in FEN, 2025) was indicated to be in a seriously modified state (PES Category E) and indicated to have a moderate Ecological Importance and Sensitivity (EIS), based on the following assumptions:

- The wetland is within Critically Endangered terrestrial and wetland vegetation types, and very rare, although limited natural vegetation in the wetland remains;
- The wetland is a tributary of the Klapmuts River, which drains surface runoff from the adjacent agricultural areas toward the Klapmuts River in the north-eastern portion of the focus area;
- According to Scientific Terrestrial Services (STS; 2023a), *Grus paradisea* (Blue Crane - Vulnerable) is considered likely to pass through or utilise this CVB wetland for foraging while breeding likely takes place in adjacent cultivated fields; and
- The PES of the wetland is estimated to be seriously modified.

The WET-EcoServices model determined a moderately low to moderate supply importance for sediment trapping, nutrient and toxicant assimilation, food for livestock and cultivated foods, whereas the demand importance for regulating services, particularly sediment trapping and nutrient assimilation is considered high. This is attributed to the current land use of the greater area in which the CVB wetland is located, which is predominantly agricultural. The demand for biodiversity maintenance is moderate as a result of the critically endangered vegetation type in which the CVB wetland is located. The moderately high carbon storage demand importance of the CVB wetland stems from the potential of the wetland to store carbon.

After integrating the supply and demand importance scores for the central wetland, the model determined an overall moderate importance for sediment trapping and a moderately low to low importance for nutrient and toxicant assimilation, and food for livestock, yet a very low ecoservice provision for cultural and other provisioning services.



**Figure 17: Representative photographs of CVB wetland 1. (Top) The topographical setting of the CVB wetland 1 (blue dashed line) in a valley bottom position between two distinct and highly cultivated valley side slopes; (Bottom left) Vegetation composition of the CVB wetland hosting facultative wetland species such as Juncus sp. but also AIPs including P. clandestinum; (Bottom right) Active grazing by cattle noted within the CVB wetland (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

Seep Wetland 1 and Seep Wetland 2

Seep 1 and Seep 2 are both located on the side-slope of a valley, on gently sloping land dominated by extensive cultivation, with unidirectional movement of material (soil and water) down-slope. Agricultural activities in the catchment of the seep wetlands have resulted in a decrease in vegetation cover, and an increase in soil disturbance and erosion. This has in turn resulted in a moderate increase of sediment supply to the receiving wetlands.

The vegetation composition of the seep wetlands has been replaced by ruderal and opportunistic AIPs such as Kikuyu Grass, which is heavily grazed, and no longer representing the natural vegetation (Figure 18). These seep wetlands are considered of low/marginal ecological importance and sensitivity due to their seriously modified ecological state. These seep wetlands may be regarded of importance due to hydrological connectivity in the landscape through their connection with the larger CVB wetland 1. In addition, the identified seep wetlands are classified as a CESA. Therefore, although significantly disturbed, these seep wetlands still act as a natural corridor within a highly

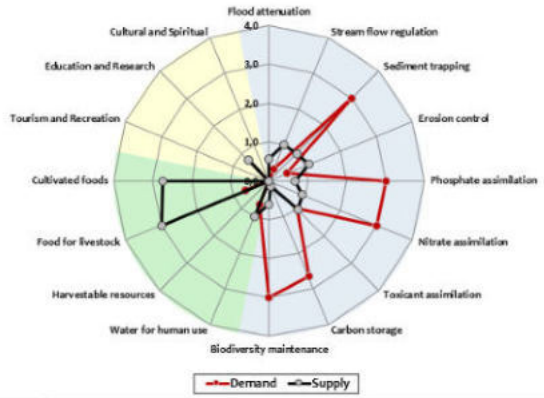
transformed landscape, which makes these wetlands important in terms of overall wetland conservation in the area.

Table 2 below provides a summary of the field verification findings for Seep Wetland 1 and Seep Wetland 2, covering key aspects of freshwater ecology, including hydrology, geomorphology, and vegetation. The table details the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS), Recommended Ecological Category (REC), Resource Management Objectives (RMO), and Ecosystem Service provision for each wetland.



**Figure 18: Overview of the vegetation component of the seep wetland 1. Patches of the alien grass species *P. clandestinum* were identified in the seep wetland, of which in some cases, can be distinguished from the surrounding cultivated terrestrial areas (as indicated by the yellow dashed line) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

**Table 2: Summary of the results of the seep wetlands 1 and 2 associated with the proposed CWA development (The ecological condition of seep wetland 2 is based on the representative assessment of seep wetland 1.) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph for seep wetland 1:<br> 
</td><td colspan="2">Freshwater ecosystem characteristics (hydraulic regime, geomorphology and sediment balance, water quality and habitat and biota):<br><br>Agricultural activities in the catchment of the seep wetlands have resulted in a decrease in vegetation cover (thus an increase in bare surface areas) and in the disturbance and erosion of soil. This in turn results in a moderate increase of sediment supply to the receiving wetlands. The vegetation composition of the seep wetlands has been replaced by ruderal and opportunistic AIPs such as C. clandestinus, which is heavily grazed, and no longer representing the reference vegetation species of the local biome (Figure 32). The hydrology of the seep wetlands is driven by lateral flows in the landscape with some groundwater inputs, evidenced by the presence of ferricrete and perched aquifers as indicated by GEOSS (2023). Excess sediment was also noted in the wetland, likely as a result of the land use of the surrounding landscape, which is predominantly cultivation.</td></tr>
<tr><td>PES discussion</td><td>PES Category: D (Largely Modified)<br>The wetlands have been modified as a result of direct and indirect impacts associated with extensive cultivation in the wetlands' catchment. This includes alteration to the hydrological regime (altered distribution and retention patterns) of the wetlands and altered geomorphology and sediment balance resulting in increased sediment transfer to the wetlands. Vegetation composition of the wetlands have also been seriously modified as a result.</td><td>EIS discussion</td><td>EIS Category: Low/ marginal<br>The EIS of the seep wetlands can be considered to be low/marginal due to their largely modified ecological state. Their EIS is attributed to their importance in the landscape, particularly due to the protection status of the wetland vegetation type (critically endangered West Coast Silcrete Renosterveld and West Coast Shale Renosterveld). The wetlands are also important for streamflow regulation, particularly during the winter rainfall period, considering their connectivity to the downgradient CVB wetland 1, but the wetlands do not provide direct human benefits, other than limited harvestable resources and cultivated foods services.</td></tr>
<tr><td>Ecoservice provision</td><td>Ecoservice Provisioning: 0,4 (Very Low)<br>The overall ecoservice provision of the wetlands are considered very low, with the exception of sediment trapping, nitrate assimilation and cultivated food services for which a low importance was determined. This is based on the agricultural landscape in which the wetlands are located as well as the critically endangered state of the wetland vegetation type. The wetlands are however considered of moderate importance for food for livestock considering its agricultural catchment.</td><td>REC Category and RMO</td><td>REC: Category D (Largely modified)<br>BAS: Category D<br>RMO: Maintain<br>Existing agricultural activities surrounding in the wetlands have likely contributed to the impact of decades' worth of impacts on the wetlands. The proposed CWA development will result in a 6.74 ha loss of the seep wetland 1. A wetland offset investigation is being undertaken to mitigate the loss of wetland habitat.</td></tr>
<tr><td>Extent of modification</td><td colspan="3">High (seep wetland 1)<br>The proposed CWA will result in the loss of 6.74 ha of wetland habitat due to the construction of the runway over the seep wetland 1. Furthermore, stormwater release into seep wetland 1 will also pose a risk to the ecological functioning of the wetland. As a result, wetland offsetting should be investigated to account for the 6.74 ha of wetland that will be lost. With the implementation of control measures (as described in Section 8 below) and that construction activities associated with the proposed development is conducted during the dry, summer season, the impacts arising from the proposed activities can be localised, effectively reduced and managed. Due to the approximate location of the seep wetland 2 relative to the study area (~320 m east of the study area), the impact to seep wetland 2 is considered negligible considering that stormwater from the proposed development will be contained in stormwater attenuation ponds prior to release into the surrounding environment.</td></tr>
<tr><td rowspan="2">Impact Significance and Business Case:</td><td colspan="3">Moderate (with the implementation of control measures) (particularly seep wetland 1 – 6.74 ha loss)</td></tr>
<tr><td colspan="3">The activities associated with the proposed development pose a 'Moderate' risk to the overall integrity of seep wetland 1 as a result of the anticipated construction and operation of the CWA that will result in the loss of 6.74 ha of wetland habitat. As a result, wetland offsetting is being investigated to account for the 6.74 ha of wetland that will be lost. Careful planning of the stormwater management and surface runoff of the proposed CWA development is also imperative to ensure the impact to the hydraulic regime of the remaining extent of the wetland is not further impaired by significant stormwater influxes, and water quality impacts are minimised. It is imperative that adherence to the site-specific control measures provided in this report as well as general good construction practice are adhered to.</td></tr>
</table>

CVB Wetland 2 and CVB Wetland 3:

CVB wetlands 2 and 3 originate from the cultivated slopes to the East of the proposed development area. These CVB wetlands generally flow in an easterly direction towards the larger CVB wetland 1. CVB wetlands 2 and 3 have been heavily modified as a result of the surrounding cultivation and grazing practices. The seasonal and temporary zones of these wetlands have been replaced by cultivated fields and infilling from farm roads. At present, these CVB wetlands exist as narrow and straightened channels surrounded by cultivated fields.

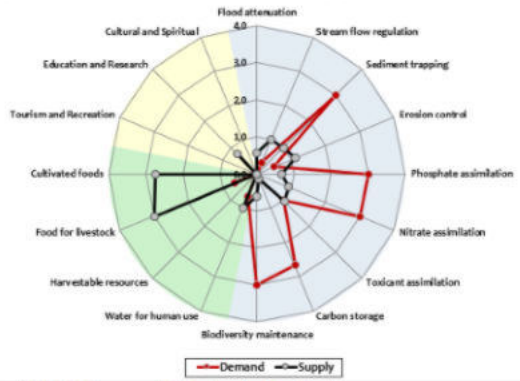
While CVB wetlands 2 and 3 are relatively small and disturbed, they still offer habitat and may be important for attenuating high velocity flows from the upstream catchment and filtering the water (albeit limited) before it enters the larger downstream CVB wetland 1.

Table 3 below provides a summary of the field verification findings for Seep Wetland 1 and Seep Wetland 2, covering key aspects of freshwater ecology, including hydrology, geomorphology, and vegetation. The table details the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS), Recommended Ecological Category (REC), Resource Management Objectives (RMO), and Ecosystem Service provision for each wetland.



**Figure 19: Representative photographs of CVB wetlands 2 and 3. (Top left) An overview of CVB wetland 2 and (Bottom left) CVB wetland 3, both surrounded by cultivated fields and farm roads; (Top right and bottom right) Vegetation composition of CVB wetland 2 (top) and CVB wetland 3 (bottom) hosting a facultative wetland species Juncus sp. AIPs including P. clandestinum are also present in CVB wetland 3 (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

**Table 3: Summary of the results of the channelled valley bottom (CVB) wetlands 2 and 33 associated with the proposed CWA development (The ecological condition of CVB wetland 3 is based on the representative assessment of CVB wetland 2) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).**

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph of the CVB wetland 2:<br> 
</td><td colspan="2">Freshwater ecosystem characteristics (hydraulic regime, geomorphology and sediment balance, water quality, habitat and biota):<br><br>CVB wetlands 2 and 3 have been heavily modified as a result of the surrounding cultivation and grazing practices. The wetlands are driven by lateral flows from the immediate catchment and interflow. These CVB wetlands have experienced excessive erosion due to the surrounding agricultural setting and lack of substantive vegetation in and around the wetlands. The soil of the wetland is characterised by soft plinthic B horizons. The above have resulted in altered geomorphic integrity and sediment balance as a result of increased bare areas surrounding the wetlands, thus increased sediment input into these receiving wetlands. Reaches of the CVB wetlands historically extended more westwards within the study area (Figure 17 and Figure 18). The CVB wetlands have been fragmented by an existing farm road and only extend downgradient of the road, owing to land use transformation in the study area and surrounds, with the headwaters of the wetlands now formalised as drainage channels, with no wetland indicators (in terms of soil and vegetation) observed within the study area[4]. Vegetation of the wetlands have been significantly altered with little indigenous vegetation remaining. Nevertheless, the wetlands are still considered important as breeding habitat for bird (including Grus paradisea (Blue Crane)), invertebrate and amphibian species as it acts as an important migratory corridor due to high levels of connectivity in a largely transformed landscape (refer to STS, 2023).</td></tr>
<tr><td>PES discussion</td><td>PES Category: E (Seriously Modified)<br>The CVB wetlands are in a seriously modified state due to surrounding cultivation and grazing practices. The seasonal and temporary zones of these wetlands have been replaced by cultivated fields and infilling from farm roads thereby resulting in reduced vegetation cover and surface roughness (Figure 29). Both CVB wetland 2 and CVB wetland 3's extent have been significantly reduced and currently exist as narrow and straightened channels surrounded by cultivated fields (Figure 30). As such the extent of the wetlands have been significantly reduced and modifications to the existing channel have resulted in altered water and sediment distribution and retention patterns within the wetlands. In addition to the above, on-site impacts associated with the ongoing agricultural activities have resulted in a loss of habitat diversity and the proliferation of AIPs.</td><td>EIS discussion</td><td>EIS Category: Low/marginal<br>The EIS of the CVB wetlands can be considered to be low/marginal due to their largely modified ecological state. Their EIS is attributed to their importance in the landscape, particularly due to the protection status of the wetland vegetation type (critically endangered West Coast Silcrete Renosterveld and West Coast Shale Renosterveld) as well as providing numerous regulating and supporting benefits – e.g. streamflow regulation, considering their connectivity to the downgradient CVB wetland 1. The wetlands provide limited direct human benefits, particularly harvestable resources and cultivated foods services. The wetlands however are likely to provide important breeding and foraging habitat for numerous fauna (STS, 2023).</td></tr>
<tr><td>Ecoservice provision</td><td>Ecoservice Provisioning: 0,4 (Very Low)<br>The overall ecoservice provision of the wetlands are considered very low, with the exception of sediment trapping and cultivated foods services for which a low importance was determined. This is based on the agricultural landscape in which the wetlands are located as well as the critically</td><td>REC Category and RMO</td><td>REC: Category D (Largely Modified) (Improve) BAS: Category D (Improve) RMO: Improve<br>The method to determine RMO states that the ecological condition of the CVB wetlands must be maintained. However, according to Malan and Day (2012), a PES Category E is considered unacceptable and therefore, it is recommended that no further degradation to these wetlands be permitted as a result of the proposed activities. The rehabilitation of the wetlands to improve the PES falls beyond the scope of</td></tr>
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| | endangered state of the wetland vegetation type. The wetlands are however considered of moderate importance for food for livestock considering its agricultural catchment. The wetlands also play an important role in maintaining hydrological functioning and connectivity in the landscape and attenuating high velocity flows and can thus be considered to have an ecological importance on a local scale. | | works and property rights of the proponent. Therefore, effort should be directed to ensuring that the proposed CWA development remains outside the delineated extent of the wetlands and their conservation buffer, if at all possible. Careful planning of stormwater management must be undertaken to ensure the hydraulic regime of the receiving environment is retained and not further impaired by stormwater peaks. |
| **Extent of modification** | Low<br>With the exception of the fences, maintenance road and stormwater release into CVB wetland 3, no significant or long-term modifications are anticipated to the CVB wetlands as a result of the proposed CWA development since the proposed development will remain outside of the recommended 15 m conservation buffer of the wetlands. Stormwater release into the surrounding area also pose a risk to the ecological functioning of the wetlands, albeit to a limited extent. With the implementation of control measures, ensuring that stormwater is managed effectively (as described in Section 8 below) and that construction activities associated with the proposed development is conducted during the dry, summer season, the impacts arising from the proposed activities can be localised, effectively reduced and managed. | | |
| **Impact Significance and Business Case:** | **Low** (with the implementation of control measures)<br>The activities associated with the proposed development pose a 'Low' risk to the overall integrity of the CVB wetlands as a result of the anticipated construction and operation of the CWA within at least ~ 255 m of the wetlands (with the exception of one of the dry attenuation ponds directly upgradient of the CVB wetland 3). Careful planning of the stormwater management and surface runoff of the proposed CWA development particularly at CVB wetland 3 is imperative to ensure the impact to the hydraulic regime is not impaired by significant stormwater influxes, and water quality impacts are minimised. It is imperative that adherence to the site-specific control measures provided in this report as well as general good construction practice are adhered to. | | |

## 6. RISKS ASSOCIATED WITH NOT IMPLEMENTING THE MMP

The following risks were identified should the MMP not be implemented:

1) Uncoordinated maintenance of stormwater infrastructure and roads could lead to degradation of infrastructure, possible erosion over time and even failure through neglect.
2) Ad hoc clearing to provide access for maintenance work could lead to siltation downstream and water quality impairment downstream.
3) Alien vegetation encroachment into sensitive buffer areas due to non-removal or ineffective methods.
4) Possible siltation of stormwater structures over time.
5) Water quality impacts caused by spillage from heavy vehicles accessing sensitive areas for cleaning purposes.
6) Loss of riparian vegetation from heavy vehicles through movement within sensitive buffer areas, outside of demarcated access routes.
7) Water quality impairment and siltation downstream if maintenance work conducted during wet season, or if silt removed is placed too close to drainage lines.

## 7. METHOD STATEMENT

6.1 The method statement must provide a step-by-step plan (which may include a schematic diagram etc.) to inform the responsible person(s) on the process and actions to take in a sequential and logical manner, which aims to reduce the impact of undertaking the activity within a reasonable timeframe and cost.

6.2 A method statement should be compiled for each individual activity given the likely specific circumstances and conditions of a site requiring maintenance. However, in situations whereby uniform conditions and circumstances are evident for multiple sites requiring the same type of activity, a method statement can be given for a specific type of activity to be undertaken at multiple sites given the aforementioned requirements.

6.3 The detail of the method statement will be assessed by the Department and other relevant regulatory authorities to ensure actions that are taken are such that they do not perpetuate increased incidences of erosion/deposition of material.

6.4 Time periods must be given within which the maintenance actions contemplated need to be implemented. An indication must be made whether maintenance actions will be repeated, e.g. clearing of silt/debris from under a bridge annually or after flood events.

6.5 The following serves as a general guide required to minimise the spatial impact of the maintenance activity:

- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects must be strictly controlled.
- Repairs and maintenance should be undertaken within the dry season, except for emergency maintenance works.
- Where at all possible, existing access routes should be used. In cases where none exist, a route should be created through the most degraded area avoiding sensitive/indigenous vegetation areas.
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas.
- Appropriate sanitation facilities must be provided onsite for the duration of the construction, operational and maintenance phases of the development.

- An adequate number of waste and "spill" bins must be provided throughout the construction, operational and maintenance phases of the development.
- When machinery is involved, ensure effective operation with no leaking parts and refuel outside of the riparian area, at a safe distance from the watercourse to manage any accidental spillages and pose no threat of pollution.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practised near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- All spills should they occur, should be immediately cleaned up and treated accordingly.
- At no time should the flow of the watercourse be blocked (temporary diversions may be allowed) nor should the movement of aquatic and riparian biota (noting breeding periods) be prevented during maintenance actions.
- No new berms may be created.
- In circumstances which require the removal of any top soil, this must be sufficiently restored through sustainable measures and practices.
- Concerted effort must be made to actively rehabilitate repaired or reshaped banks with indigenous local vegetation.
- No deepening of the watercourse beyond the original, pre-damage determined thalweg, unless such deepening is directly related to the natural improved functioning and condition of such a watercourse.
- The build-up of debris/sediment removed from a maintenance site may:
    - be utilised for the purpose of in-filling or other related maintenance actions related to managing erosion, which form part of an adopted MMP;
    - not be used to enlarge the height, width or any extent of existing berms;
    - not be deposited anywhere within the watercourse or anywhere along the banks of a river where such action is not part of the proposed maintenance activity (ies). Material that cannot be used for maintenance purposes must be removed out of the riparian area to a suitable stockpile location or disposal site. Further action and consideration may be required where the possibility of contaminated material may occur, such as in urban watercourses.

- The use of foreign material, such as concrete, rubble, woody debris and/or dry land based soil, is strictly prohibited from being used in maintenance actions, unless for the specific purpose of repairs to existing infrastructure, coupled with appropriate mitigation measures.
- On completion of the maintenance action, the condition of the site in terms of relative topography should be similar to the pre-damaged state (i.e. the shape of the riverbank should be similar or in a state which is improved to manage future damage). This ultimately dictates that the channel, banks and bed cannot be made narrower, higher or deepened respectively. Exceptions are considered for systems involved with the management of stormwater and improvements for water quality within the urban context.

**The following method statements have been developed for maintenance activities required within the 32m regulated area of a wetland:**

1) Monitoring, maintenance, and repair of fences
2) Inspection and servicing water pipelines
3) Disturbance of instream habitat and potentially increased risk of erosion as a result of periodic alien vegetation removal.
4) Maintenance of rehabilitated wetland offsets.
5) Monitoring, maintenance and repairs of stormwater infrastructure including sediment removal, litter management, erosion control etc.
6) Upkeep and repairs of maintenance and access roads.

**MS1: Monitoring, maintenance, and repair of fences**

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| **Description of activity** | A perimeter fence is proposed around the airport precinct. This fence will cross Seep Wetland 1. Maintenance activities will prioritize preserving the fence's structural integrity, which may require replacing damaged sections, securing loose fasteners, or treating areas affected by corrosion. To replace fence posts, maintain clear access, and prevent potential damage from overgrown vegetation, selective vegetation removal or limited excavation may be carried out where necessary. |
| **Actions** | The following general sequence of actions are required:<br>1. Identify and demarcate the area of fence line to be repaired/ replaced.<br>2. Clear area of debris or vegetation in order to access the fence (if required).<br>3. Replace/ repair fence portion and remove old debris or materials.<br>4. Rehabilitate disturbed areas, remediate any erosion and suitably loosen any compacted soil.<br>5. Reshape areas and/or replant as required. |
| **Impacts of actions** | The following potential impacts may result from the proposed maintenance activities:<br>• Potential fragmentation of the freshwater ecosystems caused by the property fences.<br>• Proliferation of AIP species within the disturbed freshwater ecosystems.<br>• Potential loss of indigenous vegetation as a result of maintenance works.<br>• Disturbance to and compaction of soil resulting in erosion.<br>• Potential conveyance of sediment laden stormwater into the freshwater ecosystems |
| **Severity of impacts** | If all mitigation measures are implemented the severity of the impact will be Low. |
| **Measures to mitigate the severity of the impact** | • Conduct routine maintenance to minimize the risk of infrastructure failures that could necessitate more extensive work within regulated wetland areas.<br>• Only existing roadways should be utilized during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands. |

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| | • No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works within wetlands must be undertaken by foot, or the relevant authorizations obtained beforehand.<br>• Any AIPs within the maintenance area must ideally be removed prior to the initiation of soil disturbing maintenance activities. This will assist in reducing the long-term AIP management requirements.<br>• The soil within 15m of the freshwater ecosystems must be suitably loosened on completion of maintenance activities and revegetated to prevent erosion.<br>• Stockpiling of excavated materials may only be temporary (i.e. may only be stockpiled during the period of maintenance at a particular site). Soil must be stockpiled on the upgradient side of the excavated area to avoid sedimentation of the downgradient areas.<br>• Excavated areas must be backfilled as soon as infrastructure has been installed/repaired in any given section to reduce potential erosion of exposed soil.<br>• Limit routine maintenance activities to the dry summer months as far as possible.<br>• As far as possible, physical movement in the freshwater ecosystems by personnel must be limited. |
| **Remedial measures** | There are no additional remedial mitigation measures other than those listed above if implemented in full. |
| **Method of Access** | Existing access roads should be utilised as far as possible. |
| **Period of activity** | The period of the maintenance management activity will vary depending on the level of maintenance required. The activity will be ongoing. |

**MS2: Inspection and servicing of water pipelines**

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| **Description of activity** | Service infrastructure, including a bulk irrigation and fire water pipeline, is planned near the onsite wetlands. Maintenance efforts will focus on maintaining the structural integrity of these pipelines and preventing blockages. Typical repairs may involve replacing damaged sections, securing loose fittings, or treating corrosion. Vegetation removal and excavation or trenching will be required to facilitate these repairs or replacements. Routine cleaning of water pipelines is also essential to avoid blockages and ensure consistent flow. |
| **Actions** | The following general sequence of actions are required:<br>1. Identify and demarcate area of pipeline to be repaired/ replaced;<br>2. Clear area of debris or vegetation in order to access pipeline if required;<br>3. Replace/ repair pipeline and remove old pipeline debris or materials;<br>4. All water/material discharged from the pipeline should be collected directly into a tank or other waterproof collection device and disposed of appropriately where it will not contaminate any watercourse or soils;<br>5. Rehabilitate disturbed areas, remediate any erosion areas identified, suitably loosen any compacted and remove siltation if required;<br>6. Reshape areas and/or plant as required. |
| **Impacts of actions** | The following potential impacts may result from the proposed maintenance activities:<br>• Maintenance or repairs of the service infrastructure could result in similar impacts as those experienced during service installation:<br>o Disturbances of soil potentially leading to increased AIP proliferation, and in turn to altered freshwater ecosystem habitat.<br>o Earthworks could be potential sources of sediment, which may be transported as runoff into the freshwater ecosystems. |

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| | ○ Potential fragmentation of freshwater habitats.<br>○ Potential loss of indigenous vegetation as a result of maintenance works.<br>○ Potential disturbance to hydrological functioning and activity of the freshwater ecosystems.<br>○ Disturbance to and compaction of soil resulting in erosion.<br>• Periodic flushing of pipelines to maintain capacity and address the build-up of sediment and other materials could result in the passage of water, sediment or sewage into any of the watercourses identified within the site/investigation area resulting in water quality impacts.<br>• If a portion of the pipeline(s) ruptures under pressure or while carrying flows, then passage of sediment and/or sewage might enter nearby watercourses resulting in water quality impacts.<br>• Potential eutrophication of water as a result of enriched water draining into the freshwater ecosystems |
| **Severity of impacts** | If all mitigation measures are implemented the severity of the impact will be Low. |
| **Measures to mitigate the severity of the impact** | • Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater.<br>• Conduct routine maintenance to minimize the risk of infrastructure failures that that could lead to substantial environmental impacts, avoiding the need for extensive interventions within regulated wetland areas.<br>• Implement the wetland monitoring programme outlined within the FEN Wetland Offset Study and Implementation Plan (February 2025).<br>• A Service Infrastructure Management Plan should be compiled which details the frequency in which service infrastructure must be serviced.<br>• An emergency plan must be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of a pipeline.<br>• Only existing roadways should be utilized during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands. |

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| | • No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works within wetlands must be undertaken by foot, or the relevant authorizations obtained beforehand.<br>• Any AIPs within the maintenance area must ideally be removed prior to the initiation of soil disturbing maintenance activities. This will assist in reducing the long-term AIP management requirements.<br>• The soil within 15m of the freshwater ecosystems must be suitably loosened on completion of maintenance activities and revegetated to prevent erosion.<br>• Stockpiling of excavated materials may only be temporary (i.e. may only be stockpiled during the period of maintenance at a particular site). Soil must be stockpiled on the upgradient side of the trench to avoid sedimentation of the downgradient areas.<br>• Trenches must be backfilled as soon as infrastructure has been installed/repaired in any given section to reduce potential erosion of exposed soil.<br>• Limit routine maintenance activities to the dry summer months as far as possible.<br>• As far as possible, physical movement in the freshwater ecosystems by personnel must be limited.<br>• No stormwater generated during construction may be directly released into the freshwater environment.<br>• Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer.<br>• Any erosion, sedimentation or other damage to watercourses caused because of the above incidents / activities should be rectified immediately, with rehabilitation activities potentially including removal of sediment, reshaping of banks and replanting where it is deemed necessary |
| **Remedial measures** | There are no additional remedial mitigation measures other than those listed above if implemented in full. |
| **Method of Access** | Existing access roads should be utilised as far as possible. |
| **Period of activity** | The period of the maintenance management activity will vary depending on the level of maintenance required. The activity will be ongoing. |

**MS3: Disturbance of instream habitat and potentially increased risk of erosion as a result of periodic alien vegetation removal**

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| **Description of activity** | Disturbance of instream habitat and potentially increased risk of erosion because of periodic vegetation removal to maintain ecological integrity of the natural areas onsite. |
| **Actions** | The following general sequence of actions are required to remove and control the alien vegetation:<br>1) Identify alien invasive species;<br>2) Cutting or pulling of target plants, or application of appropriate herbicide;<br>3) Treatment of plant remainders with appropriate herbicide or treatment of herbaceous plants that cannot be manually removed;<br>4) Removal of plant material from the wetland and surrounding conservation area;<br>5) Follow-up work to prevent regrowth and the production of seed remaining in the soil; and<br>6) Revegetation of areas with indigenous vegetation where necessary. |
| **Impacts of actions** | The following potential impacts may result from the proposed maintenance activities:<br>- Disturbance to aquatic habitat and vegetation and potential risk of erosion.<br>- Disturbance to and compaction of soil resulting in erosion.<br>- Potential increase in sedimentation of watercourses located downslope. |
| **Severity of impacts** | If all mitigation measures are implemented the severity of the impact will be Low - if revegetation with indigenous species and follow-up control takes place, a low to moderate positive impact could be expected. |
| **Measures to mitigate the severity of the impact** | • Identify alien plants to be removed.<br>• Avoid trampling or clearing indigenous vegetation by using established paths where possible.<br>• Clear alien vegetation according to the described alien vegetation removal methods for each invasive species as provided in the Alien Vegetation Management Plan developed for the site (PHS Consulting, March 2025). Detailed herbicides/biological control recommendations are also provided on the Working for Water website: |

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| | http://www.dwaf.gov.za/wfw/. Kikuyu should be poisoned with a foliar herbicide (e.g. Agil) during the summer growing season (before end March).<br>• When using herbicides, it is essential to apply the correct herbicide, in the right dose, at the right time, using the correct application method. Use only registered herbicides, follow manufacturer's instructions on the label, and wear the appropriate protective clothing during handling.<br>• Remove cleared alien vegetation from the aquatic features and dispose of at a suitable point.<br>• Where necessary revegetate cleared areas with suitable indigenous vegetation. Planted areas may require irrigation and care for a period following planting. The irrigation requirements will be determined by the season in which planting takes place, and the plant species planted. Planting of the new vegetation at the start of the wet season can assist in ensuring that the new vegetation is kept wet whilst establishing itself.<br>• Ongoing monitoring and clearing of regrowth of alien plants within these areas will be required. |
| **Remedial measures** | There are no additional remedial mitigation measures other than those listed above if implemented in full. |
| **Method of Access** | Existing access roads should be utilised as far as possible. |
| **Period of activity** | The period of the maintenance management activity will vary depending on the level of infestation. The activity will be ongoing. |

**MS4: Maintenance of wetland offsets.**

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| **Description of activity** | Routine monitoring and selective replanting of indigenous vegetation will help ensure healthy growth and prevent invasive alien plants (AIPs) from competing with native species. Regular observation of grazing impacts from resident cattle will also be useful for identifying any necessary maintenance, enabling timely adjustments to support vegetation health. Periodic checks for erosion and sedimentation within offset wetlands will allow for early intervention if needed. |
| **Actions** | The following general sequence of actions are required:<br>1. Conduct regular monitoring in offset wetland as outlined within the Wetland Offset and Implementation Plan (FEN, February 2025).<br>2. Identify areas of concern. These are areas that are affected by disturbances such as: erosion, waste dumping, alien vegetation encroachment, soil compaction, senescence of indigenous vegetation.<br>3. Should areas of concern be noted, identify and address the cause.<br>4. Clear the affected area of debris and remove excess sediment (if required) and AIPs.<br>5. Reshape and revegetate the disturbed/eroded area as required in line with the Wetland Offset and Implementation Plan (FEN, February 2025). |
| **Impacts of actions** | The following potential impacts may result from the proposed maintenance activities:<br>• Proliferation of AIP species within the disturbed freshwater ecosystems.<br>• Disturbance to and compaction of soil resulting in erosion.<br>• Potential conveyance of sediment laden stormwater into the freshwater ecosystems |
| **Severity of impacts** | If maintenance activities are implemented in full along with all mitigation measures, a low to moderate positive impact can be expected. |

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| **Measures to mitigate the severity of the impact** | • Monitor wetlands that will potentially be impacted by the proposed CWA development to ensure that the PES drivers and receptors are maintained, and where possible improved accordance with the REC and RMO.<br>• Only existing roadways should be utilized during monitoring, maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands.<br>• No vehicles are permitted to enter the freshwater ecosystems. Any maintenance work within wetlands must be undertaken on foot.<br>• Any AIPs within the maintenance area must ideally be removed prior to the initiation of soil disturbing maintenance activities. This will assist in reducing the long-term AIP management requirements.<br>• The soil within 15m of the freshwater ecosystems must be suitably loosened on completion of maintenance activities and revegetated to prevent erosion.<br>• After sediment removal, promptly revegetate with indigenous species to reduce the spread of invasive species and prevent erosion.<br>• Wherever possible, schedule sediment removal and erosion control activities during the dry summer months to minimize impact on aquatic life and water quality. |
| **Remedial measures** | There are no additional remedial mitigation measures other than those listed above if implemented in full. |
| **Method of Access** | Existing access roads should be utilised as far as possible. |
| **Period of activity** | The period of the maintenance management activity will vary depending on the level of maintenance required. The activity will be ongoing. |

**MS5: Monitoring, maintenance and repairs of stormwater infrastructure including sediment removal, litter management, erosion control etc.**

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| **Description of activity** | To maintain stormwater infrastructure effectively, sediment removal will be essential to prevent accumulation that could reduce the functionality of stormwater ponds. This work will likely require using an excavator or similar equipment both within and around the ponds. Additionally, managing litter and vegetation is also necessary for optimal performance. Regular vegetation trimming will occur in channels, which may cause temporary localized habitat disturbance and potential sedimentation or increased turbidity in downstream water systems. |
| **Actions** | The following general sequence of actions are required:<br>1) Access stormwater ponds/channels with heavy vehicle (if required).<br>2) Remove silt and place on area adjacent to pond/channel.<br>3) Cut back vegetation from the channel/channel and place temporarily adjacent to channels on the bank area<br>4) Remove and dispose of vegetation and silt in suitable area<br>5) Rehabilitate area adjacent to pond/channel from where heavy vehicles gained accessed or where silt/vegetation was placed. |
| **Impacts of actions** | The following impacts are anticipated because of undertaking the removal activity:<br>• Sedimentation / increased turbidity into downstream systems.<br>• Maintenance activities within or in close proximity to stormwater ponds and channels can cause water quality impairment through operation of heavy vehicles (e.g. as result of fuel spills or leakage).<br>• Localised habitat disturbance in the channels and potential biota loss; |
| **Severity of impacts** | If all mitigation measures are implemented the severity of the impact will be Low |
| **Measures to mitigate the severity of the impacts** | <u>Essential mitigation measures:</u><br>• Undertake maintenance activities during the dry summer months only.<br>• All vehicles are to remain within existing roads or previously determined routes, no new roads should be developed without prior authorisation. No indiscriminate movement of machinery within wetlands is allowed. |

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| | • Ensure that all excavators and other vehicles remain outside wetland systems and cross the drainage lines only on the existing road.<br>• Dispose of sediment outside of any watercourses or other areas of ecological sensitivity, and such that it will not wash into such watercourses.<br>• Ensure appropriate maintenance and refuelling of machinery and the appropriate containment of hazardous substances and chemicals (if required) at least 50m from the nearest watercourse, on a bunded surface.<br>• Restrict maintenance activities to outside of bird breeding season (November to end of March).<br>• Restrict vehicle and machinery operation to previously disturbed areas and ensure that material stockpiles are set-back from the watercourse by a minimum distance of 32m.<br>• Cobbles must be placed on all outlet structures and indigenous vegetation established to bind the soil of the bed, to prevent erosion and assist with energy dissipation.<br>• Prior to the onset of the winter rainy season, all stormwater infrastructure must be desilted, and any debris must be removed.<br>• Regular inspection of the stormwater outlet structures must be undertaken (specifically prior to the winter rains and after large storm events) to ensure unobstructed flow and monitor the occurrence of erosion. If erosion has occurred, it must immediately be rehabilitated through stabilisation of the embankments and revegetation, where applicable.<br>• All pipelines and attenuation ponds must be regularly cleaned, and all outlet structures (if any) checked to ensure there is no debris/blockages.<br>• The likelihood of erosion at the discharge points can be reduced provided that a higher surface roughness is implemented in the area from the discharge points down to the delineated freshwater ecosystems, allowing for water to enter the seep wetland 1, CVB wetland 3 and the surrounding environment at a lower velocity. This can be achieved through the placement of cobbles and ensuring that the area surrounding each discharge point is suitably vegetated. |
| **Remedial measures** | There are no additional remedial mitigation measures other than those listed above if implemented in full. |

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| **Method of Access** | Existing access roads should be utilised as far as possible. |
| **Period of activity** | The period of the maintenance management activity will vary depending on amount and frequency of siltation. The activity will be ongoing. |

**MS6: Upkeep and repairs of maintenance and access roads.**

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| **Description of activity** | Gravel road maintenance will involve regular inspections to identify issues and grading to keep the surface even. Drainage features, such as ditches and culverts, will be cleared regularly to prevent erosion, while potholes and erosion will be promptly repaired. Vegetation along road edges will be controlled, and any flood-related damage will be repaired after storms to maintain road access and prevent further erosion. |
| **Actions** | The following general sequence of actions are required:<br>1. Identify maintenance activities required.<br>2. Clear area of debris, sediment or vegetation from the area if required.<br>3. Carry out necessary maintenance work.<br>4. Rehabilitate disturbed areas, remediate any erosion and suitably loosen any compacted soil.<br>5. Reshape areas and/or replant as required. |
| **Impacts of actions** | The following potential impacts may result from the proposed maintenance activities:<br>• Proliferation of AIP species within the disturbed areas.<br>• Potential loss of indigenous vegetation as a result of maintenance works.<br>• Disturbance to and compaction of soil resulting in erosion.<br>• Potential conveyance of sediment laden stormwater into the freshwater ecosystems |
| **Severity of impacts** | If all mitigation measures are implemented the severity of the impact will be Low. |
| **Measures to mitigate the severity of the impact** | • Conduct routine maintenance to minimize the risk of infrastructure failures that could necessitate more extensive work within regulated wetland areas.<br>• Only existing roadways should be utilized during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands. |

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| | • No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works within wetlands must be undertaken by foot, or the relevant authorizations obtained beforehand.<br>• Any AIPs within the maintenance area must ideally be removed prior to the initiation of soil disturbing maintenance activities. This will assist in reducing the long-term AIP management requirements.<br>• The soil within 15m of the freshwater ecosystems must be suitably loosened on completion of maintenance activities and revegetated to prevent erosion.<br>• Stockpiling of excavated materials may only be temporary (i.e. may only be stockpiled during the period of maintenance at a particular site). Soil must be stockpiled on the upgradient side of the excavated area to avoid sedimentation of the downgradient areas.<br>• Excavated areas must be backfilled as soon as infrastructure has been installed/repaired in any given section to reduce potential erosion of exposed soil.<br>• Limit routine maintenance activities to the dry summer months as far as possible.<br>• As far as possible, physical movement in the freshwater ecosystems by personnel must be limited.<br>• Dispose of excess sediment outside of any watercourses or other areas of ecological sensitivity, and such that it will not wash into such watercourses<br>• Regular inspection culverts and drainage structures must be undertaken (specifically prior to the onset of the winter rains and after large storm events) to ensure unobstructed flow and monitor the occurrence of erosion. If erosion has occurred, it must immediately be rehabilitated through stabilisation of the road verses and revegetation, where applicable. |
| **Remedial measures** | There are no additional remedial mitigation measures other than those listed above if implemented in full. |
| **Method of Access** | Existing access roads should be utilised as far as possible. |
| **Period of activity** | The period of the maintenance management activity will vary depending on the level of maintenance required. The activity will be ongoing. |

# 8. MONITORING AND REPORTING

## 8.1. Monitoring

Capewinelands Aero (Pty) Ltd is responsible for overseeing the monitoring of maintenance and management activities under this MMP. It is critical that all management actions outlined in the plan are strictly adhered to. Regular and thorough monitoring is essential to ensure compliance with MMP specifications, identify any issues of non-conformance, and implement corrective actions to minimize risks and prevent environmental damage.

Proactive, ongoing monitoring will address potential impacts to the ecological integrity of the associated aquatic ecosystems. Key monitoring activities include:

- **Structural Integrity Checks**: Routine inspection and maintenance of service, stormwater, and linear infrastructure associated with the CWA development to ensure structural stability and prevent potential disruptions.
- **Pollution Prevention Program**: An active monitoring system should be implemented to promptly identify and mitigate potential pollution sources that could impact soil, surface water, or groundwater quality.
- **Wetland Health Monitoring**: Regular assessments of potentially impacted wetlands to ensure ecological processes and functions are preserved or improved in line with Present Ecological State (PES) and Recommended Ecological Category (REC) goals. The Wetland Offset Study and Implementation Plan (FEN, February 2025) provides specific guidelines to maintain offset wetlands within desired ecological conditions (refer Appendix B to this report).
- **Alien Invasive Plant (AIP) Management**: Implement the Alien Vegetation Management Plan (PHS Consulting, March 2025), monitoring and removing invasive species to protect native vegetation and ecosystem balance.
- **Erosion and Sedimentation Control**: Frequent visual inspections across stormwater systems, roads, and natural areas to identify erosion or sediment buildup, with prompt corrective actions to prevent habitat degradation and downstream sedimentation impacts.

Monthly inspections should be carried out by a suitably qualified individual within the CWA Environmental Management Division (EMD) to verify the condition and functionality of critical infrastructure, including stormwater systems, service infrastructure, and fences. These checks serve as quality assurance and ensure alignment with the MMP. To facilitate effective monthly monitoring, monthly walk-through inspections should be carried out. These inspections should focus on identifying areas of concern related to:

- Erosion
- Sedimentation
- Infrastructure damage
- Waste / litter dumping
- Alien vegetation encroachment
- Soil compaction

Seasonal maintenance is essential for all stormwater infrastructure and access roads. Prior to the rainy season, thorough cleaning and inspection should be conducted, including clearing all culverts and drainage channels. Annual condition assessments should be undertaken for all infrastructure within the 32m Zone of Regulation (ZoR) and associated wetlands to identify longer-term repair needs. It should however be noted that these monitoring requirements are the minimum required to facilitate the implementation of this MMP. All service infrastructure must be maintained in accordance with manufactures' instructions and no less frequently than the manufactures statutory timeframes.

All activities undertaken **outside the scope** of the MMP, will be subject to Section 24(F) of NEMA and appropriate enforcement and compliance requirements will follow.

### 8.2. Reporting

Form A below must be completed by the relevant person(s) **before** maintenance activities are undertaken and Form B below **after** a maintenance activity has been completed. Form A should be completed **at least 7 working days before** the commencement of any maintenance activity and **Form B a minimum of 3 working days after** the completion of the maintenance activity(ies). At least two photographs are required from two different points of perspective (A and B) looking at the site (coordinates of these points are required). The type and reference code relates to the relevant detail within the adopted MMP.

Capewinelands Aero (Pty) Ltd is responsible to ensure a record of all maintenance activities is recorded as per Form A & B. Copies of Form A and B must also be sent to the Provincial Department of Agriculture, Directorate: Sustainable Resource Management.

DEA&DP may, within a reasonable notice period, request to evaluate the maintenance activities and assess the maintenance sites as per the adopted MMP.

| FORM A<br><br>REPORTING FOR INTENT TO UNDERTAKE MAINTENANCE ACTIVITIES | |
|---|---|
| **Section A: Landowner Details** | |
| **Landowner Name & Surname** | |
| **Farm/Erf No** | |
| **Today's Date** | |
| **Section B: Details of proposed maintenance activity** | |
| **WUA/GA reference number:** | |
| **DEA&DP MMP reference number:** | |
| **Activity Type:** | |
| **Reference code (*make reference to MMP*):** | |
| **Footprint area ($m^2$):** | |
| **Volume of material ($m^3$):** | |
| **Equipment to be used:** | |
| **Description of method for planned activity:** | |
| **Date when work will commence:** | |
| **Date of last flood event for site:** | |
| **Note any further damage and comments regarding the state of the site:** | |
| **Section C: Photographs of activity location before maintenance** | |
| **Photo A – Before Maintenance Activities** | |
| **Coordinates:** | |
| | |
| **Photo B – After Maintenance Activities** | |
| **Coordinates:** | |
| | |

**FORM B**

**REPORTING FOR COMPLETION OF MAINTENANCE ACTIVITIES**

| **Section A: Landowner Details** | | | | |
|---|---|---|---|---|
| **Landowner Name & Surname** | | | | |
| **Farm/Erf No** | | | | |
| **Today's Date** | | | | |
| **Section B: Details of proposed maintenance activity** | | | | |
| **WUA/GA reference number and DEA&DP reference number for MMP.** | **Activity Type:** | **Reference code (*make reference to MMP*)** | **Footprint area ($m^2$)** | **Volume of material ($m^3$)** |
| **WUA/GA reference number:** | | | | |
| **DEA&DP MMP reference number:** | | | | |
| **Activity Type:** | | | | |
| **Reference code (*make reference to MMP*):** | | | | |
| **Footprint area ($m^2$):** | | | | |
| **Volume of material ($m^3$):** | | | | |
| **Equipment to be used:** | | | | |
| **Description of method for completed activity and if commence date changed:** | | | | |
| **Date activity completed:** | | | | |
| **Date of last flood event for site:** | | | | |
| **Note any challenges or difficulties experienced in following the MMP method statement** | | | | |
| **Section C: Photographs of activity location after maintenance** | | | | |
| **Photo A – Before Maintenance Activities** | | | | |
| **Coordinates:** | | | | |
| | | | | |
| **Photo B – After Maintenance Activities** | | | | |
| **Coordinates:** | | | | |
| | | | | |

**Appendix A: Detailed EIA Phase Freshwater Ecological Assessment (FEN, February 2025)**

(Please refer to Appendix 7 to the Environmental Impact Assessment Report)

**Appendix B: Draft Wetland Offset Study and Implementation Plan (FEN, January 2025)**

(Please refer to Annexure 7 of Appendix 39 to the Environmental Impact Assessment Report)

## Appendix C: MMP maintenance coordinates

| Description | Coordinates | | Comments |
|---|---|---|---|
| Perimeter Fence (Figure A) | Latitude | 33°45'2.26"S | Start |
| | Longitude | 18°44'13.63"E | |
| | Latitude | 33°45'11.01"S | End |
| | Longitude | 18°44'17.92"E | |
| Maintenance Road (Figure A) | Latitude | 33°45'2.26"S | Start |
| | Longitude | 18°44'13.63"E | |
| | Latitude | 33°45'11.01"S | End |
| | Longitude | 18°44'17.92"E | |
| Access Road 1 (Existing northern access road) (Figure B) | Latitude | 33°44'24.37"S | Start |
| | Longitude | 18°44'39.33"E | |
| | Latitude | 33°44'32.66"S | End |
| | Longitude | 18°44'6.09"E | |
| Access Road 2 (Existing southern access road)(Figure A) | Latitude | 33°44'50.01"S | Start |
| | Longitude | 18°44'46.38"E | |
| | Latitude | 33°44'56.87"S | End |
| | Longitude | 18°44'39.61"E | |
| Dry Attenuation Pond 5 (Figure B) | Latitude | 33°44'42.23"S | Adjacent to CVB 3 (Includes associated stormwater infrastructure) |
| | Longitude | 18°44'9.46"E | |
| Proposed Sprinkler Main Fire Water (Figure A) | Latitude | 33°45'2.63"S | Start |
| | Longitude | 18°44'13.44"E | |
| | Latitude | 33°45'10.78"S | End |
| | Longitude | 18°44'17.01"E | |
| Wetland Offset – RE Seep Wetland 1 (Figure A) | Latitude | 33°45'3.32"S | Incl. ongoing AIP removal |
| | Longitude | 18°44'19.67"E | |
| Wetland Offset – CVB Wetland 1 (Figure A) | Latitude | 33°44'55.78"S | Incl. ongoing AIP removal |
| | Longitude | 18°44'43.97"E | |
| Wetland Offset – Agricultural Drain Point 1 (Figure A) | Latitude | 33°44'58.42"S | Rehab adjacent to Seep Wetland 1 |
| | Longitude | 18°44'23.33"E | |
| Wetland Offset – Agricultural Drain Point 2 (Figure A) | Latitude | 33°44'44.62"S | Rehab adjacent to CVB 1 |
| | Longitude | 18°44'30.68"E | |
| CVB Wetland 2 | Latitude | 33°44'27.34"S | AIP Removal |
| | Longitude | 18°44'15.33"E | |
| CVB Wetland 3 | Latitude | 33°44'42.19"S | AIP Removal |
| | Longitude | 18°44'20.97"E | |
| Seep Wetland 2 | Latitude | 33°45'20.47"S | AIP Removal |
| | Longitude | 18°44'46.87"E | |

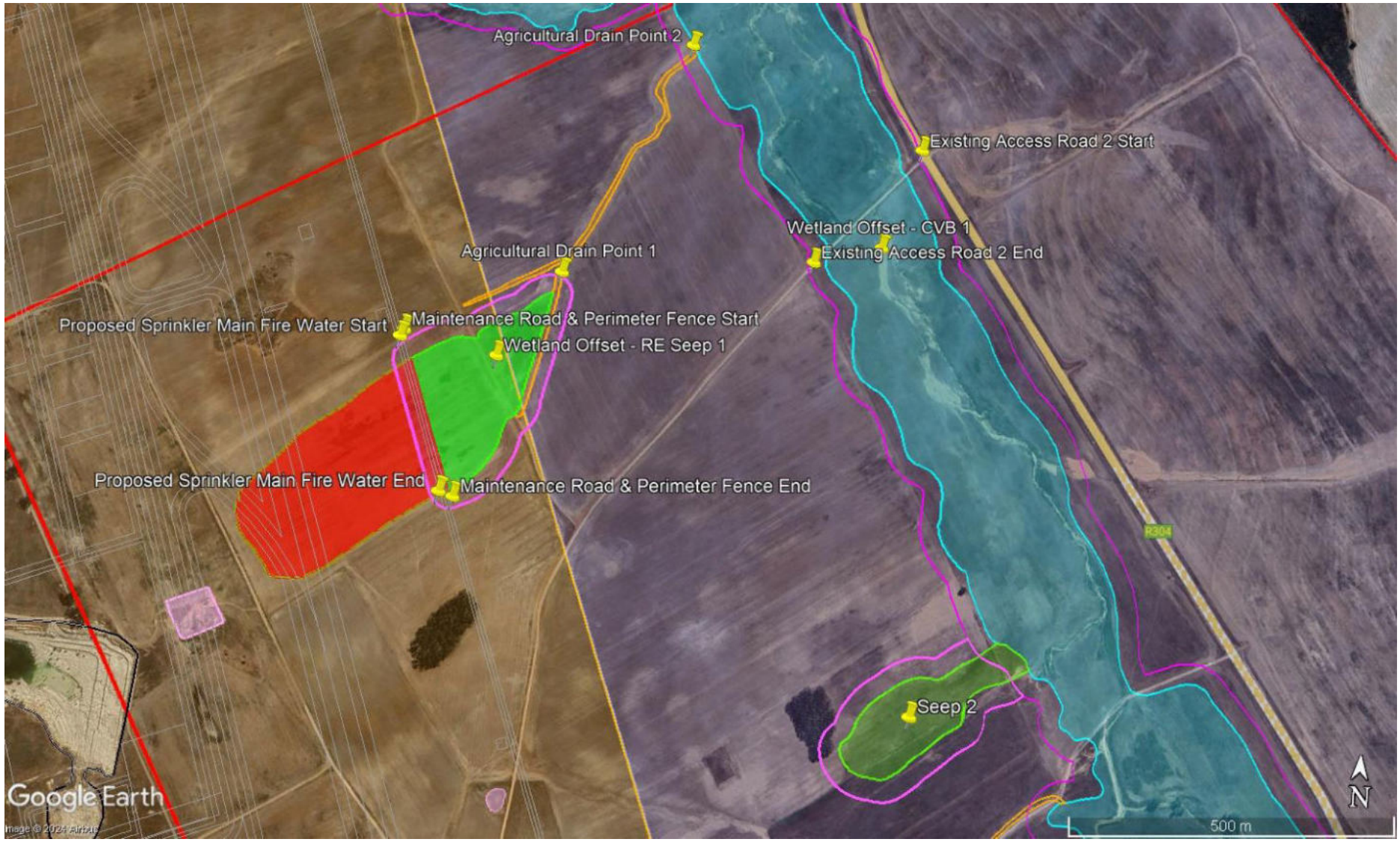



**Figure A: MMP Southern Coordinates**

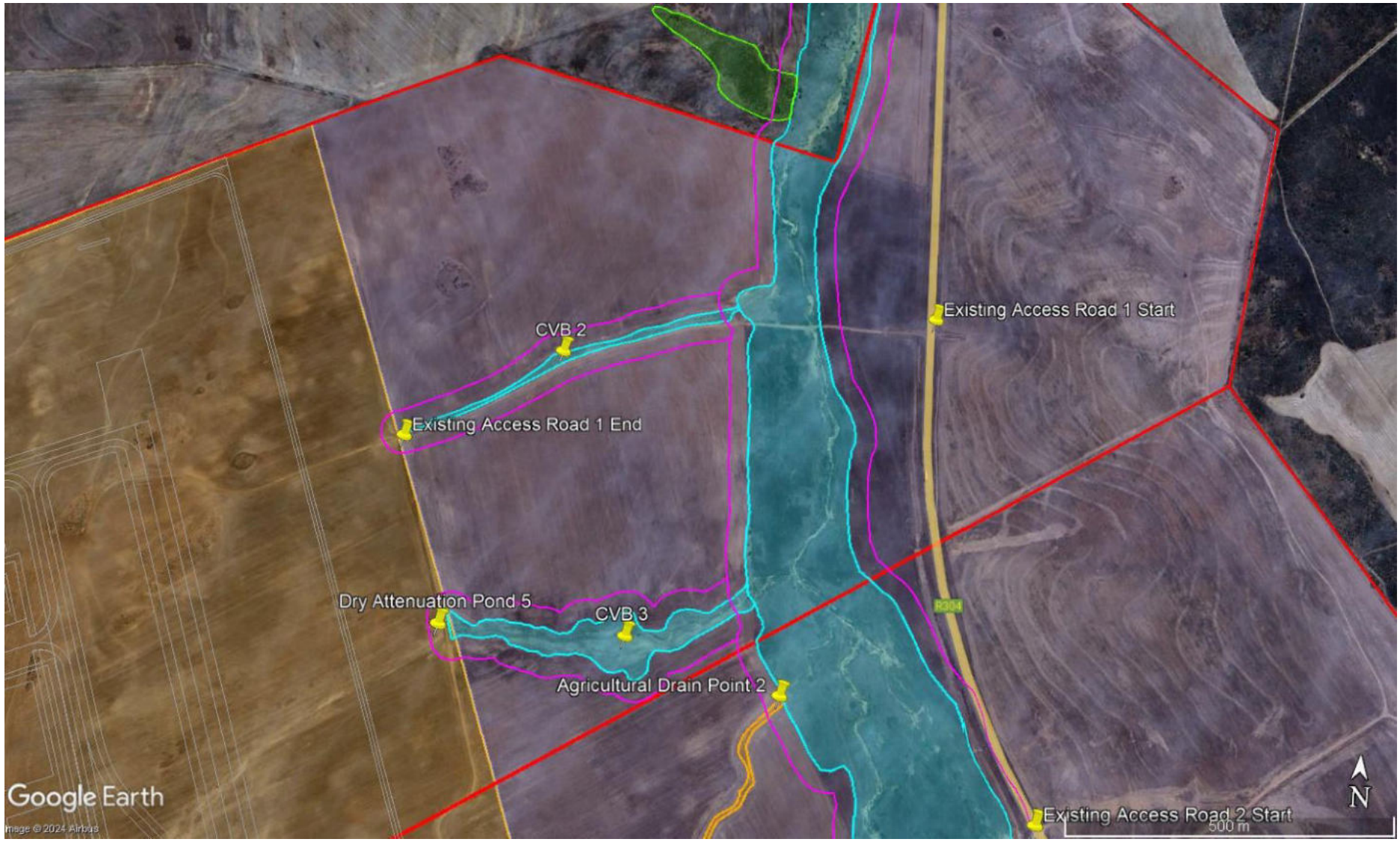



**Figure B: MMP Northern Coordinates**

# ANNEXURE 17: GROUNDWATER MANAGEMENT PLAN

(This will be a condition of approval if Environmental Authorisation/ WULA is obtained)

# ANNEXURE 18: BIODIVERSITY OFFSET REPORT

# MARK BOTHA

CONSERVATION STRATEGY TACTICS & INSIGHT


## Cape Winelands Airport – Biodiversity Offset Report




Compiled for: PHS Consulting, Hermanus

Client: Capewinelands Aero (Pty) Ltd.

Revision 2

20 June 2025


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**Report Title:** Cape Winelands Airport : Biodiversity Offset Study

**Date:** June 2025

**Version:** Revision 2 incorporating comments from CCT and CapeNature

**Document type:** Report for submission with Final EIA

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**Client & Principal funding agent:** Capewinelands Aero (Pty) Ltd

**EAP**: PHS Consulting – Amanda Fritz-Whyte & Paul Slabbert

# Declaration

I, Mark Botha, the appointed independent specialist, hereby declare that I:

• am an independent specialist service provider with experience in spatial biodiversity planning, assessing impacts and designing and negotiating biodiversity offsets for government and corporate clients since 2011 and act as independent specialist in this application;

• perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

• regard the information contained in this report, as it relates to this offset study, to be objective, true and correct within the framework of assumptions and limitations;

• do not have and will not have any business, financial, personal or other interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations 2014, and amendments 2017, NEMA 2020 Procedures for the assessment and minimum requirements for reporting on identified environmental themes in terms of Sections 24(5) (a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation, and any specific environmental management act;

• declare that there are no circumstances that may compromise my objectivity in performing such work;

• have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;

• will comply with the Act, Regulations and all other applicable legislation and have no, and will not engage in, conflicting interests in the undertaking of the activity, and undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; or the objectivity of any report, plan or document to be prepared by me for submission to the competent authority;

• all the particulars furnished by us in this form are true and correct; and realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Yours truly,



*Pr.Sci.Nat* 20 June 2025

Acronyms and Definitions

| | | | | |
|---|---|---|---|---|
| BioNet | CCT's Biodiversity Network | | MFMA | Municipal Finance Management Act |
| CBA | Critical Biodiversity Area | | NEMBA | NEM: Biodiversity Act. Act 10 of 2004 |
| CCT | City of Cape Town | | NEMPAA | National Environmental Management: Protected Areas Act (Act 57 of 2003) |
| CR | Critically Endangered | | PA | Protected Area |
| CREW | Custodians of Rare & Endangered Wildflowers | | PBO | Public Benefit Organisation |
| CWA | Cape Winelands Airport | | PFMA | Public Finance Management Act (Act 1 of 1999) |
| EA | Environmental Authorisation | | PHS | Environmental Assessment Practitioner for CWA |
| EA | Environmental Assessment Practitioner | | RESA | Runway End Safety Area |
| EN | Endangered | | SANBI | SA National Biodiversity Institute |
| IAP | Invasive Alien Plant | | SCC | Species of Conservation Concern |

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# 1. Introduction

A consortium plans to build a new airport and associated infrastructure on the old Fisantekraal airfield (see Figure 1) and extending the runway to accommodate larger aircraft and multiple logistics and support operations. Given the size and location, there are inevitable impacts on threatened biodiversity – which already cannot meet their conservation targets. There is almost no greenfield site in the larger Cape metropole that would not impact on Critically Endangered (CR) or Endangered (EN) ecosystems – especially for an impact of this scale.

Impacts on CR ecosystems are difficult to mitigate. South Africa has adopted guidance that explores an "Ecological Compensation" approach – the mitigation of residual impacts on currently protected areas or irreplaceable biodiversity. This aspect of biodiversity offsets policy is not well developed and is best designed on a case-specific basis.

Although offsets generally and ecological compensation specifically are an important but under-utilised mitigation tool in South Africa, they are not to be used lightly. Impacts on critically endangered ecosystems have been strongly discouraged since offsets guidance first emerged in South Africa. Almost all references confirm that offsets (as a last resort mitigation measure) can only be used to attempt to remedy High or Very High significant impacts of a development IF that development is indispensable, required, and/or otherwise socially desirable. The compensation offered should not positively affect the decision to permit the impact in the first place. An inability to locate or implement a suitable offset or effective, acceptable, proportional ecological compensation can, however, have a negative impact on a decision.

However, there is little guidance on the acceptability of ecological compensation for impacts on CR ecosystems or Critical Biodiversity Areas (CBAs) where the impact itself is very small and only assessed as of Medium or Low Negative significance, and the conservation outlook for the impacted system is bleak. While these impacts could be interpreted as fatal flaws, they are also geographically very limited and on sites in rather poor condition. I take no view on the need and desirability of this Cape Winelands Airport (CWA) but assume that it is a necessary and supported development proposal for the region on its own merits.

This report confirms the scope and quantum of the biodiversity impact from the proposed CWA, provides an analysis and prioritises possible offset sites, and explores and proposes required likely implementation arrangements, should the CWA be authorised. It sets out the components of implementation arrangements that should be concluded prior to commencement.

## 2. Assumptions and limitations

- The direct and indirect impacts are adequately mapped and assessed by the specialists, and that no cryptic species worthy of separate offset measures will be impacted.
- As with most major complex, highly contingent infrastructure projects, there have been numerous changes to layouts and footprints. This includes minor elements (such as perimeter security roads) that may marginally impact on sensitive features. I must assume that the final layout plan and clearing accords with the Spatial Development Plan version 13 as of 22 August 2024 and that no material impacts eventualise. Please note that some maps in this report may be derived from earlier iterations of layouts, although the actual impact figures are accurate.
- There is no realistic chance for restoration of the renosterveld and sand plain fynbos ecosystems adjacent to the runway, the RESA and other operational features of the airport. While some individuals of CR species may persist, the ecosystem that supports their populations in the long term will be lost. This is a risk averse and precautionary approach to offset calculation.
- This study only investigates the terrestrial ecosystem impacts – the wetland impacts and offset are subject to a separate analysis and proposal (FEN 2024). Where possible and prudent, the two offset processes have been developed in cognisance of each other.
- No faunal impacts were assessed or proposed to require offset-type mitigation.
- As with most offset studies, the final choice of site and securing of an implementation partner is out of my control, and subject to multiple contingent factors, including successful authorisation and surviving of any legal challenge. While the site options and implementation arrangements proposed here have already been largely secured and financial arrangements are in process of being concluded, they cannot be guaranteed. For this and other reasons, it is strongly advised that any authorisation include carefully crafted conditions to ensure the ultimate success of offset mitigation – regardless of the proposals herein. Guidance is provided as to what this might look like.

## 3. Context

The receiving environment is typical of the Cape Lowlands, with highly fragmented remnant ecosystems in various stages of neglect and moderate to poor ecological condition. Offsets are difficult to make work in this context – but the corollary is that the long-term prognosis for effective ecological function and persistence of species of conservation concern is very low without dedicated offset (or other conservation) interventions and budgets.

As the impacted ecosystems are nominally designated as CR (Swartland Silcrete Renosterveld, Swartland Shale Renosterveld or EN (Swartland Granite Renosterveld), the Biodiversity Offset Guideline (DFFE 2022) indicates that the appropriate mitigation is technically 'Ecological Compensation' –

although the modality is identical to a biodiversity offset. These terms will therefore be used interchangeably in this report.

The primary objective of "Ecological Compensation" should be to secure and improve management of the closest analogue to the impacted biodiversity in a way that contributes maximally to the persistence of important biotic features in the landscape. In South Africa, this implies a focus on securing CBA areas within Protected Area (PA) expansion priority focus areas, or other local priorities identified and mapped by specialists and conservation authorities. The CWA is located in the Klipheuwel Corridor of the CCT's BioNet[1]. There is some misalignment between the BioNet's mapping and designation of CBAs and priority remnant habitats and those identified by the Botanical and Freshwater Specialists' report – this report adopts the specialists' recommendations and has ground-truthed the impacted (and offset) sites.

It is not likely to be able to defensibly "trade up" for impacts on two of the most CR ecosystems in South Africa. Other sites 16km to the North do not conserve the same vegetation or SCC component, although have substantial numbers of other SCC and unique and very rare habitats which are demonstrably under greater threat of imminent extirpation. It is conceivable to propose offsets in these sites, but this would require authorities' approval and intricate management and protection arrangements.

Species mitigation for many fynbos species relying on tight mutualisms or specific ecological processes (e.g. suitable return interval and intensity fire regimes) is difficult. Where possible, search and rescue of propagation material for all listed species by trained professionals is encouraged. Where prudent, this material can be reestablished in or near the offset sites on suitably protected and managed portions to improve the species chance of persistence. Offset site selection, design and management regime should incorporate management actions to improve survival of these species.

No faunal impacts were assessed or proposed to require offset-type mitigation.

Wetland impacts were moderate and are the subject of a separate specialist report and offset process. Although coordination and alignment between the terrestrial and wetland specialists has been pursued, it has been agreed with all parties that there is little utility in co-locating these offset measures.

[1] An updated version of the BioNet was released for comment after this report was submitted. There is no fundamental change to the status of the impact and receiving environment and the botanical specialist report findings still hold.

# 4. Impact & Offset metrics

Two patches of Very High botanical sensitivity were identified in the study area, each of about 1.6ha in extent. The northern one (Swartland Silcrete Renosterveld) is located within the proposed development area (just over 50% of it is within the runway alignment which unfortunately cannot be altered due to civil aviation constraints, the remainder in the Runway End Safety Area (RESA) which must have all rocks and woody plants removed), whilst the southern one (Swartland Shale Renosterveld) is just outside the development area (Helme 2023). It's unclear how much will finally be impacted, so this offset report assumes complete loss given the likely adjacent disturbance associated with airport operations, mowing, lack of burning etc.

The Botanical Impact Assessment Report (Helme March 2024) found: "*any mapped areas of remnant habitat that are lost to development should be offset by formalised conservation of high conservation priority examples of the same habitat in the region, at minimum ratios of 20:1 (for non-pristine habitat) and 30:1 (for better quality examples; as per Dept. of Forestry, Fisheries & Environment offset guidelines, 2022). Preliminary estimates suggest that 1.0ha of Very High sensitivity vegetation (partly degraded; exact extent to be confirmed) will need to be offset at a ratio of at least 20:1, and 2.3ha of Medium sensitivity at a ratio of about 10:1, and the 1.3ha of High sensitivity vegetation at about 15:1. This means that a total offset of at least 63ha (plus ongoing environmental management budget for this) will be required..*"

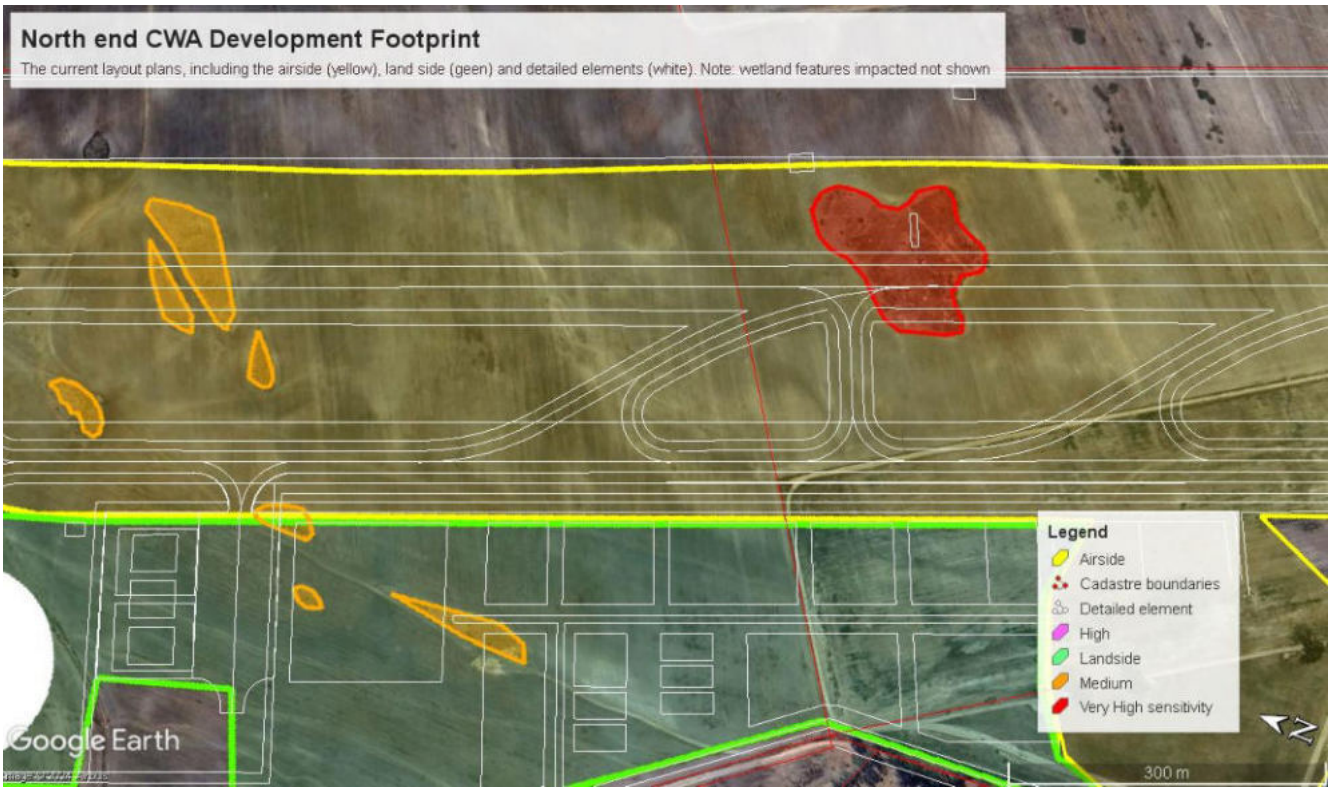



*Figure 1. Botanical sensitivity map for the northern part of the study area, with airside layout and detailed elements superimposed. From Helme (2023). New layouts (August 2024) do not affect the major impact calculation metrics. Note North Arrow indicator to the left. The removal of rock and other incompatible material from the RESA is assumed to cause complete loss of biodiversity features in the yellow airside area. Replanting*

*some of the species of conservation concern within this zone is possible if mowing can be avoided. Rescue to other habitat analogues is likely better, more dependable mitigation.*

The impact sites were visited on 4 May 2024, and I concur with the Botanical Specialist's findings. Although some of the northern Silcrete remnant may be left in the RESA, this report assumes its entire loss for offset calculation purposes. The condition of the impacted areas and their likely persistence (even if the CWA development does not proceed) is low, and the offset metrics of impact area, condition, and thus the ultimate offset liability is conservative, cautious and risk aversely calculated. Note that the impacted, highly degraded Renosterveld seep wetland is subject to a separate Specialist Report and Offset Process conducted by FEN (2024).

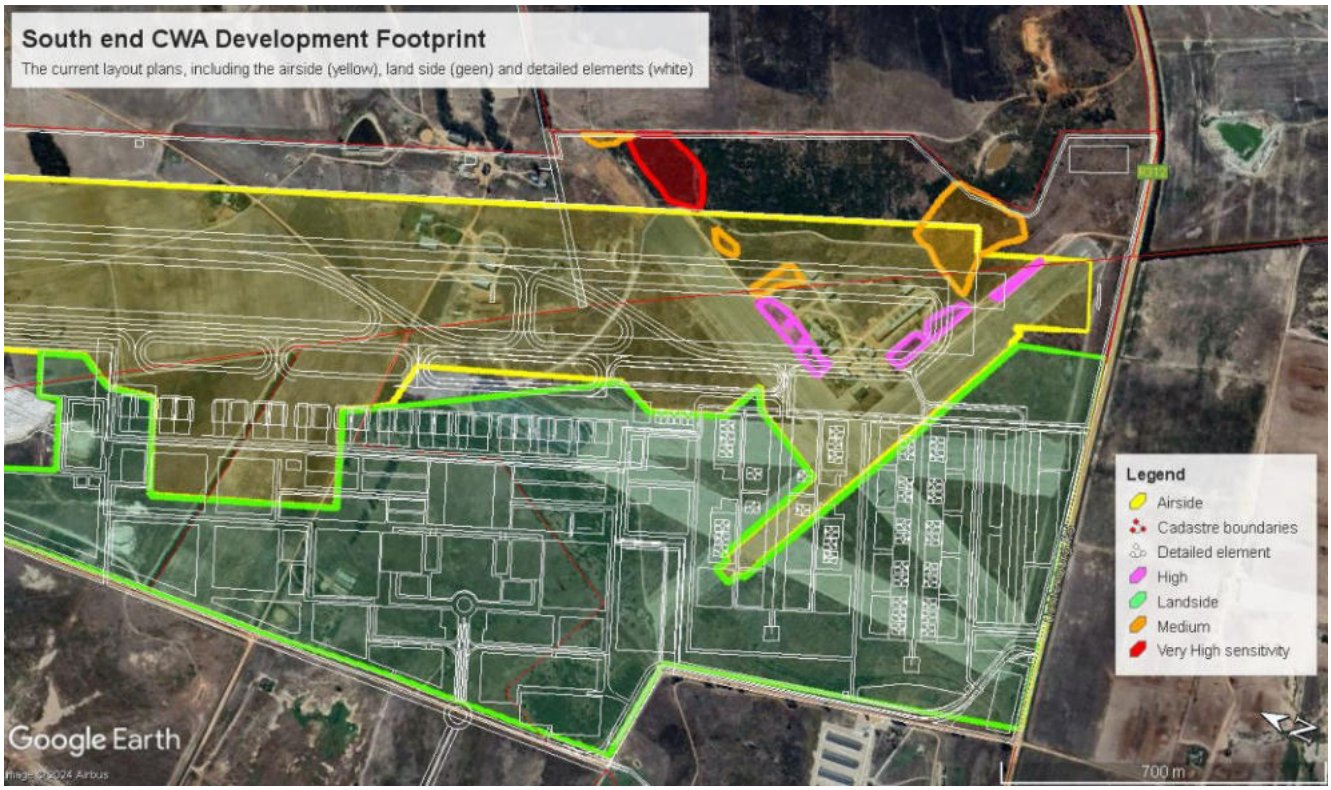



*Figure 2. Botanical sensitivity map for the southern part of the study area. All unshaded areas within the study area indicated are of Low sensitivity. From Helme (2023) and layout from Aug 2024. The offset calculation assumes the Very High Botanical Sensitivity area is avoided by all infrastructure, access road and firebreak development. New layouts and site development must ensure that these sensitivities are avoided. Note North Arrow indicator to the left*

Given the very fine grain transitions between the underlying ecosystems, veld age and the poor condition of the vegetation it is difficult to accurately ascribe the loss to a specific vegetation type with any precision. Vegetation type mapping is less accurate at mapped scale. However, for the purposes of this offset report, I concur with the botanical specialist that given SCC occurrence and soil observation, Swartland Silcrete Renosterveld and Swartland Shale Renosterveld are the primary types requiring ecological compensation. The High Sensitivity impacted areas adjacent to the existing Fisantekraal airport may, however, have been more closely related to Swartland Granite Renosterveld. Regardless, the primary determinant of candidate offset sites should be representations

of these three types. No other biodiversity priority area or planning features were identified as requiring offsets.

Choice of suitable offset ratios is informed by the underlying Ecosystem Status (in this case all CR, with one (Granite) possibly EN), Protection Level (in this case Not Protected – Skowno et al 2019), and condition of the impacted site. Starting ratios for all impacts must thus be 30:1. This ratio is moderated down by the condition of the impacted sites – according to the table below. The justification for the condition modifiers is predominantly based on either the very poor condition (modified down to 33%) or moderate condition of the impacted sites (modified down by 50%). The Silcrete remnant patch is in moderate condition, although heavily invaded and grazed, and is completely isolated from any substantial surrounding patch – thus the ratio is modified down to 66% of the starting ratio provided for in guidance.

| ***Feature (all in Swartland Silcrete, Shale & possibly Granite Renosterveld)*** | ***Size (ha)*** | ***Gazette Ratio*** | ***Condition modifier*** | ***Final Ratio*** | ***Offset Required*** |
|---|---|---|---|---|---|
| Northern Silcrete Remnant. Moderate condition, V high significance | 1,7 | 30:1 | 66% | 20 | 34 |
| Mown grassy meadows along existing runways, poor to moderate, High significance | 1,33 | 30:1 | 50% | 15 | 20 |
| Remnant Renosterveld patches within or overlapping airside layout, Medium significance, poor to v poor condition | 2,3 | 30:1 | 33% | 10 | 23 |
| **Total Terrestrial Offset required (ha)** | **5.3** | | | | **77** |

*Table 1. Specific biodiversity features impacted, affected area, starting gazetted ratio, habitat condition modifier, and final offset ratio and area calculation. Note that Helme's (2024) calculations exclude around 0,7 ha of the Northern Silcrete remnant which is outside the runway footprint – this is included in these calculations.*

Comprehensive floral species impacts in these CR ecosystems are difficult to quantify given the cryptic nature of some, the absence of primary ecological drivers from the ecosystem which triggers life cycles (especially underlying burning regime) and invasion by woody trees. However, I have no reason to doubt the Botanical specialist's findings and assessment. Search and Rescue type mitigation must be informed by SANBI's guidance for experts in this regard, as well as professional implementation.

My guidance is that the following species mitigation should be incorporated in any ecological compensation type interventions if not catered for in the botanical specialist's recommendations:

| ***Species of Conservation concern*** | ***Status*** | ***Required Intervention (From Helme 2024; this Report)*** |
|---|---|---|

| | | |
|---|---|---|
| *Leucadendron verticillatum; About 60 plants NE of old runway* | Critically Endangered | Secure population on site on southern very high sensitivity site, regularly remove all threatening IAP and increase habitat protection and condition offsite for known occurrences |
| *Podalyria microphylla* | Critically Endangered | Search & Rescue to a habitat analogue from very high sensitivity area at northern end of runway. If deemed feasible by specialist, replant on ferricrete/silcrete area (even if surface rock removed for RESA), and increase habitat protection and condition offsite for known occurrences |
| *Ficinia* sp nov Rare in ferricrete patch in northern area | Not yet assessed | Search & Rescue from northern end of site to habitat analogue. If deemed feasible by specialist, replant on ferricrete/silcrete area (even if surface rock removed for RESA), and increase habitat protection and condition offsite for known occurrences |
| *Babiana odorata*; About 10 plants close to entrance gate; | Endangered | increase habitat protection and condition offsite for known occurrences |
| *Leucospermum grandiflorum* Two dead plants | Endangered | Granite species. Required mitigation unclear |
| *Restio rigoratus* | Endangered | Search & Rescue to habitat analogue. increase habitat protection and condition offsite for known occurrences |
| *Lampranthus leptaleon;* Only 3 plants in SE area; | Endangered | Search & Rescue to habitat analogue. increase habitat protection and condition offsite for known occurrences |
| *Drosanthemum hispifolium* About 10 plants on northern edge; | Vulnerable | Search & Rescue to habitat analogue. increase habitat protection and condition offsite for known occurrences |
| *Xiphotheca lanceolata* | Vulnerable | Increase habitat protection offsite for known occurrences |
| *Metalasia octoflora* | Vulnerable | Increase habitat protection offsite for known occurrences |
| *Muraltia macropetala* | Vulnerable | Increase habitat protection offsite for known occurrences |
| *Gladiolus watsonius* About 30 plants in SE area; | Near Threatened | Search & Rescue to habitat analogue |

*Table 2. Species of conservation concern likely to be impacted, their status and proposed mitigation measures. Adapted from Helme (2024)*

Summary of the criteria for the biodiversity offset is that the site(s) need to:

- secure at least 77 ha of Swartland Renosterveld, on shale, or granite or silcrete.
- include options for rehabilitation of degraded ecosystems and be able to receive species from Search and Rescue operations.
- create corridors or expand existing conserved areas where at all possible
- house viable populations of *Leucadendron verticilatum, Podalyria microphylla, Ficinia* sp nov., and preferably as many of the other EN species impacted.
- Be able to be declared as a protected area in perpetuity and be effectively managed.

However, given the geographical layout and biodiversity patterns and noting that many of the otherwise potential offset site landowners may not be willing to consider offsets on their properties, it may be difficult to secure an offset site that meets all the above criteria perfectly.

# 5. Candidate site selection

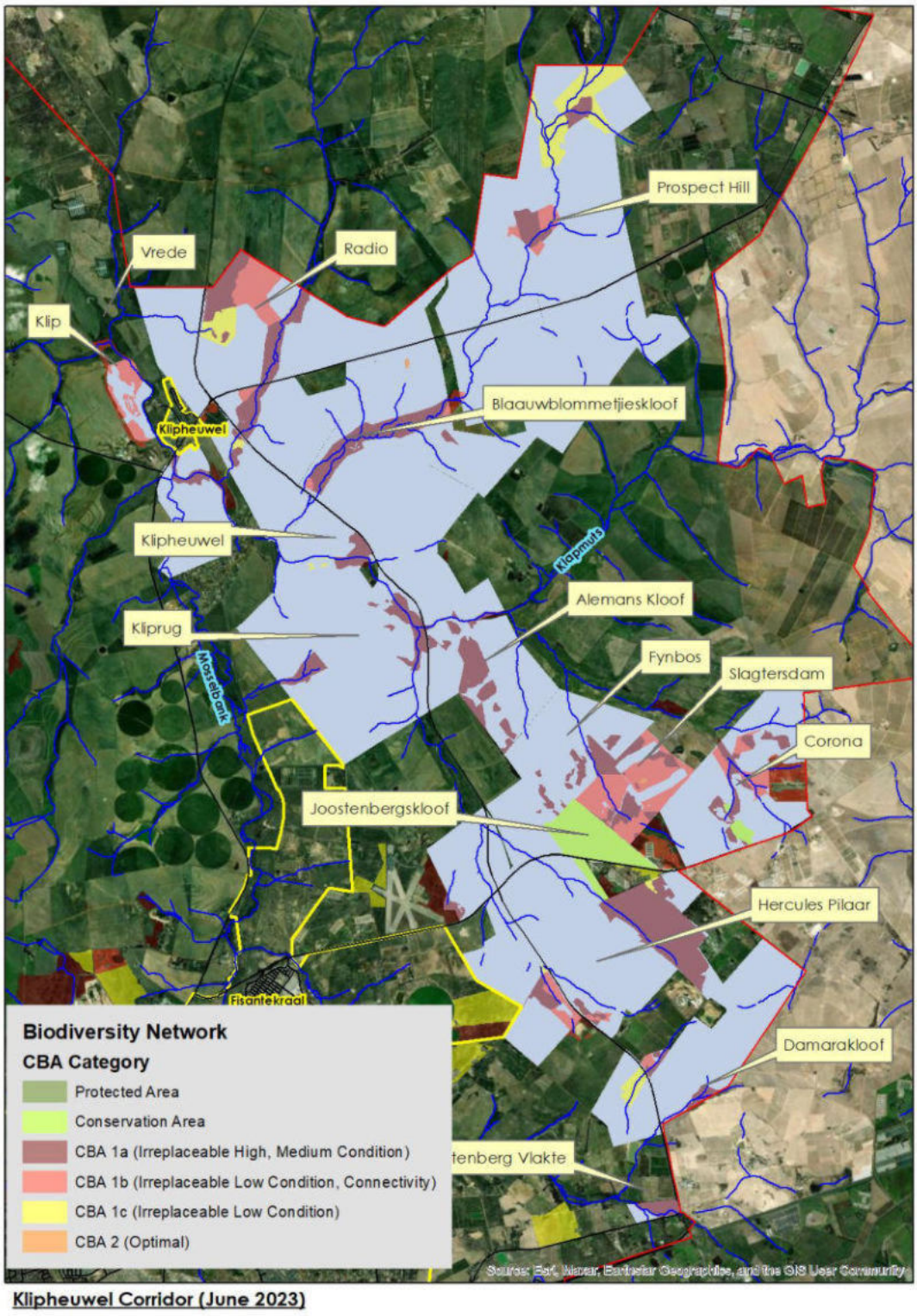



*Figure 3. The Klipheuwel corridor node of the Biodiversity Network of the City of Cape Town. Stewardship efforts have been active here for decades, with only 1 site (Joostenbergkloof) effectively being secured on the lowest tier. Acquisition attempts for conservation have been unsuccessful. Long term prognosis for many flat sites, especially with accessible resources under them, is not good. Options do exist to secure offset sites >70 ha.*

Several sites were assessed for suitability for the CWA offset on recommendation by the proponent, EAP, regional flora specialists, and authorities. These included:

*Table 3. A shortlist of possible offset candidate properties, their size and biodiversity features, and sufficiency to offset CWA impacts in the mode of Ecological Compensation.*

| ***Site*** | ***Size*** | ***Comments*** | ***Suitability*** |
|---|---|---|---|
| Renosterkop Nature Reserve 1334 Paarl | 158 ha Natural ptn | Boland granite – not analogous, already protected | No |
| Ruitevallei RE 483 Paarl | <140 ha natural | Boland granite – not analogous. Impacted by trails | No |
| Woodlands 874 ptn 19 Paardeberg | 460 ha | Boland granite – not analogous. Has L. grandiflora | No |
| Kliprug & Klipheuwel Farms | <50 ha | Interesting vegetation, dissimilar to impact site but contains other SCC. Subject to other Offset | Insufficient by itself but could contribute |
| Stonehaven "Rockridge" on Zanddam Re/ 479 | ≈140 ha. Poor condition remnant | Little IAP, but much weedy, grassy invasion. Has SCC and rehabilitation promise | Insufficient by itself but could contribute |
| Blaauwblommetjieskloof RE of 941 | 68 ha | Very dissimilar to impact site. Interesting for other reasons | Insufficient by itself |
| *Alemanskloof (RE/ 473) and Fynbos Farm (RE/ 472 and ptn 2/472* | 64 ha combined all remnants | Closest analogue to impact site. Not big enough. Would need substantial rehabilitation and connectivity to qualify | Insufficient by itself, but an option |
| Hercules Pilaar (1242) | 108 ha (North), 3 ha 15ha (West) remnants | Large enough, opportunity for restoration and connectivity. Main remnant doesn't contain all SCC | Yes, requires remnants for sufficiency |

Two additional sites proposed by regional Botanical Specialists (Ismail Ebrahim (SANBI) and Rupert Koopman (Pvt)) were considered but are provisionally rejected unless authorities approve trading up for threat mitigation:

1- "Vlakfontein" - being ptn 1 of 881 (Morganwagt) and the northern and extreme eastern ptn of Woodlands (RE/874). This is a well-known CREW flora site on granitic sands and under pressure from sand mining. Lots of SCC are known and monitored on this site but it remains among the most precarious in the Swartland.

2- "Doornkraal" being the koppies with remnant Swartland Granite Fynbos on Doornkraal RE/832 and Morgenwagt 3/881. These sites are potentially floristically more related to Malmesbury than Fisantekraal. Latter is possibly under less threat than others closer to CWA.

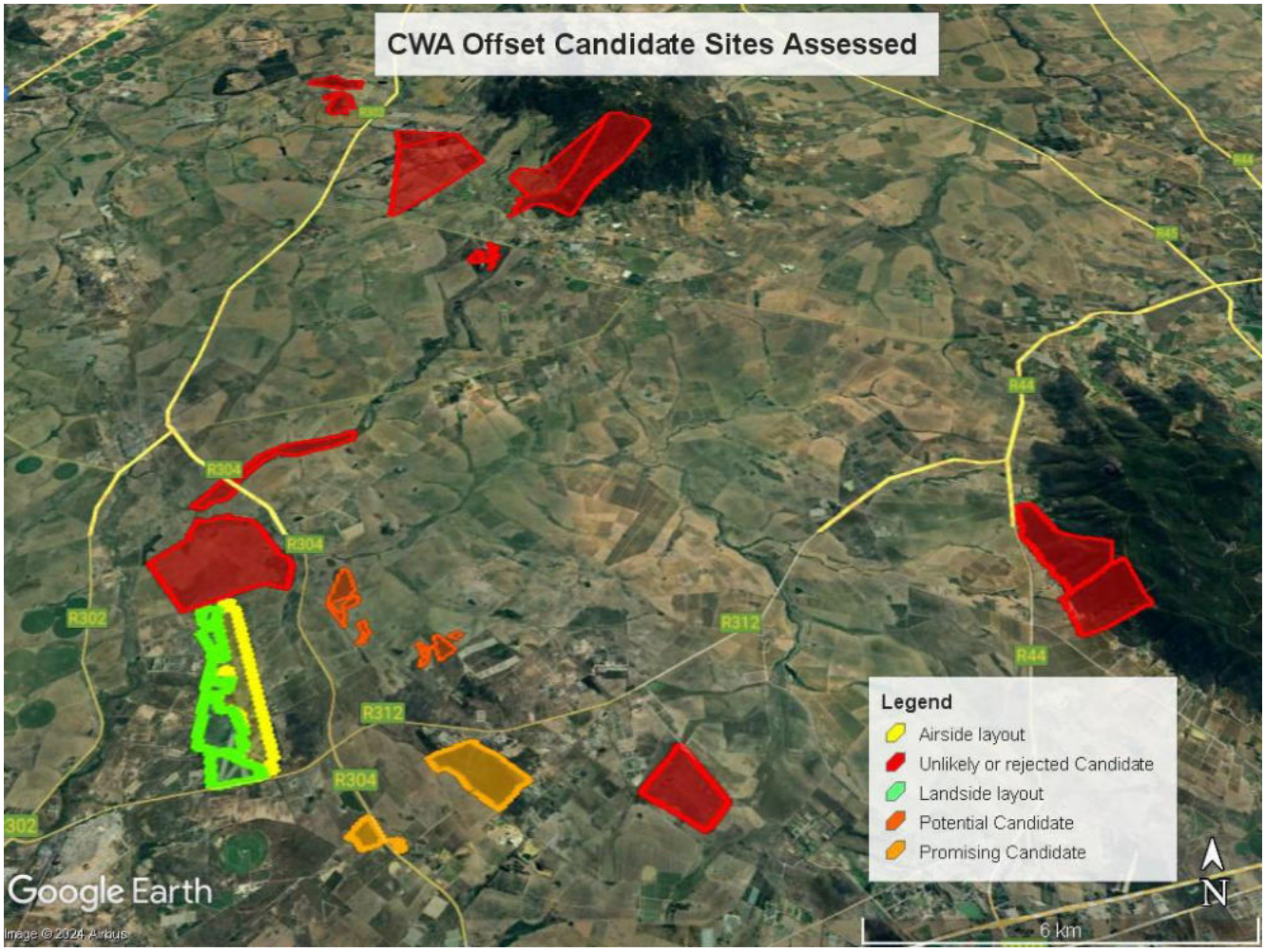



*Figure 4. The suite of possible candidate sites assessed to offset the impacts of the CWA. Most were rejected on grounds of floral dissimilarity, some were already deemed to be conserved, or in poor condition with little opportunity for recovery. Two sites remain as priorities for further investigation/development.*

## 6. Prioritising candidate sites

After the initial screening and consultation with authorities, a short list was prepared based on potential biodiversity contribution. These sites were visited to establish the similarity with the impact site, presence of the impacted SCC (or of other CR & EN SCC that require conservation action), as well as a perspective on their possible ecological management outlook and persistence. This removed several of the proposed candidates as they were insufficiently analogous to the CWA site, or suffered from external threats or were already effectively conserved.

A final scan of options, as well as discussions with CCT biodiversity management staff and two local botanical specialists not involved in the CWA assessment yielded two candidates for shortlisting. The prioritisation was based on landowner willingness and implementation feasibility.

The priority candidate site of Hercules Pilaar has sufficient available land with Swartland Renosterveld (primarily shale with some silcrete) and has around 30 ha of degraded Renosterveld which was last ploughed >30 years ago. It would meet all the offset requirements, within reason, provided for in the National Guideline. The site also contains two smaller remnants with significant concentrations of the

impacted CR & EN SCC, excepting the *Ficinia*. The property is under threat from development, especially from neighbouring industrial operations and the expanding urban areas. Conservation Stewardship efforts have been effectively stalled since 2012. The applicant has secured an agreement with the owner to use this site as an offset.

A second candidate site has almost sufficient habitat and supports most of the impacted SCC, with options to restore small patches in between remnants. There is good reason to be confident that if the first candidate site, for some unforeseen reason, cannot be secured, then this one would be an adequate replacement, provided rehabilitation of corridors between the remnants was undertaken. Both candidates would increase the currently conserved area and create ecological corridors for long term species movement and adaption, as well as facilitating improved fire management.

If for some reason these two candidates are not acceptable to CapeNature, CCT and DEA&DP, then further alternatives will need to be proposed by the authorities which would satisfy the 'Ecological Compensation' considerations.

## 7. Implementation arrangements

The proposed model for offset implementation was developed around current conservation action in the Klipheuwel Corridor in the City's BioNet. Given the extreme threat to the remnant vegetation and the nascent BioNet protection node developing, it appears prudent to pursue outright acquisition and declaration of the site as a Nature Reserve (or possibly Protected Environment) if possible in the long term. A binding Letter of Intent commitment has been concluded between the applicant and the owner of Hercules Pilaar covering a long-term lease agreement/conservation servitude with an accompanying management agreement. This would require the landowner to declare the site as a nature reserve if the listed activities of the CWA are authorised. This is seen as the only mechanism to secure the biodiversity features until acquisition and declaration becomes possible. Agreements have been developed in draft format to execute the intent on receipt of successful authorisation.

Regarding management for the site, the CCT is currently the only active conservation agency managing sites or looking to extend the PA network, and coordination with them is important for synergy and long-term efficacy. However, there are numerous challenges in funding the city team directly. These include: i) the constraints and inflexibility of the MFMA and procurement frameworks to meet the nimble response required in conservation management; and ii) the CCT Biodiversity Branch does not have the capacity or desire to manage site-based endowments.
As management negotiations with landowners are being finalised, it is unclear what roles they would wish to play if they elect to eventually subdivide or sell sections of their properties to be declared. Professional and capacitated service providers are often better placed to handle management of remnants with intricate management (such as prescribed burning regimes and invasive species control) and will need to assist the owners.

The applicant will have a large environmental management responsibility around the airport site – including almost all the kinds of interventions that need to be carried out on the offset site (Fencing and security, controlled burns, invasive plant control, erosion and rehabilitation etc). They have elected to include offset site management under the purview of their environmental management team, and thus the EMPr can be updated to include the relevant offset site interventions and timelines set out in this report. This enables an ECO to asses compliance with offset site management requirements, and to update the site management plan as circumstances dictate.

The EMPr will effectively become the Biodiversity Offset Management Plan for the site, until such time as it is declared a Nature Reserve, and a compliant Management Plan is submitted to the MEC for approval.

The specific management requirements, the level of effort required and return frequency, have been set out in a more detailed budget and are summarised in Table 4). The projected 30 yr costing of this budget was used to determine the Net Present Value of any penalty required to be paid by the applicant to ensure site management for the duration of the liability period. This is calculated in Table 5 in the annex.

As an extra means of security, a PBO (the Endangered Wildlife Trust) has agreed to play the role of site manager in the instance that the applicant fails or is unable to meet its offset obligations. The mechanism to achieve this security is two-fold:

1. By suspending the authorisation for the Airport (as the EA would be valid for a substantial period to cover certain operational aspects of the listed activities)
2. To include as a condition of authorisation, a penalty provision outlining the requirement for the applicant to lodge an endowment with the PBO for this site's management equivalent. This penalty could be equivalent to the Net Present Value of the remaining management costs and would be in addition to any other administrative penalty that the competent authority deems necessary.

The PBO would be required manage this endowment fund efficiently to build a non-sinking fund that can cover management interventions on site or in the adjacent Klipheuwel Corridor post the 30-yr period for the CWA.

A detailed budget has been drawn up for the priority candidate site using accurate and current actual unit costs incurred by the CCT for specific management actions as well as some additional staff capacity to undertake specific tasks. If required, this can then be applied to the second site with minor, non-substantive tweaks to input metrics. The following management interventions are catered for, and were considered to be satisfactory for maintaining and improving site condition. These form the basis for the Biodiversity Offset Management Plan when the site is declared:

*Table 4. Proposed management interventions on the priority candidate site, their metrics, costs and frequency*

| 7% | Inflation | length | width | | | | |
|---|---|---|---|---|---|---|---|
| **#** | ***Intervention*** | ***Unit / Dist*** | ***Unit/ Dist*** | ***Cost/ unit*** | Est. 2025 cost | ***Repeats in 30yr*** | ***Assumptions*** |
| 1 | Firebelt brush cut | 3000m | 6m | 3,8 *R/m²* | R73 188 | annually | annual bush-cutter & tractor for accessible portions, Teams & brush cutters for steeper slopes. Team costs = R3,80 sqm |
| 2 | Prescribed burn | 1150m | 800m | R1 957 | R192 600 | four X | burn half site every 8 years. ~~Assumes CoCT covers 40- 50% costs~~ |
| 3 | FPA membership | 107 ha | | | R2 301 | annually | required for risk / liability management |
| 4 | IAP clearing | 108 ha | 5% | R200/ha | R23 112 | three X | clear large seeding trees, at least every 10 yrs |
| 5 | IAP follow up | 108 ha | 1% | R100/ha | R11 556 | 15 X | clear seedlings and saplings every other yr |
| 6 | Fence Maintenance | 4000m | | R2/m | R8 560 | annually | annual fence fixing |
| 7 | Head cut /erosion control | 40sqm | | R80/sqm | R3 424 | three X | decadal check and erosion control, especially at dams / after heavy rain |
| 8 | Audit | 108 ha | | R100/ha | R11 556 | annually | required for risk / liability management |
| 9 | Field Ranger | 2/5time | | | R160 000 | | Employed by CWA, report to ECO |
| 10 | Management fee | 9% | | | R40 787 | annually | If this must be executed by an PBO and not the applicant |
| 11 | Contingency | 5% | | | R22 671 | annually | |
| | Total | | | | R516 060 | | For FY 2025. Each yr differs |

The applicant will submit the signed Landowner agreement to secure the priority site with the Final EIR. As executing these agreements is beyond my control and fine scale management responsibilities for the site must still evolve, it is impossible to commit to time frames for final arrangements. Therefore, a suspensive condition of authorisation is proposed binding the applicant to achieve certain outcomes to satisfy the attainment of offset outcomes and thus compliance with the National Guideline. This is proposed below.

## 8. Offset condition

The following condition of authorisation is proposed for consideration by the competent authority. It is assumed that the EA will have a relatively long validity period (as it covers certain operational aspects of the activity), and thus the offset condition could be enforced relatively easily:

1- Prior to commencement, the applicant must conclude an offset implementation agreement(s) with a suitable person or organisation that secures in perpetuity, through suitable legal protection mechanisms, an area (or areas) meeting the following criteria:

- be within the Klipheuwel Corridor region of the City of Cape Town's Biodiversity Network, or if proof of no such site being available is provided, then another priority area acceptable to the City's Biodiversity Management branch and CapeNature,
- contain in aggregate not less than 77 ha of Swartland Renosterveld (or closely related ecosystems) in good ecological condition,
- host populations of at least 50% of the impacted species of conservation concern, as evidenced by a suitable botanical or protected area site assessment,
- be rezoned to open space for conservation or equivalent zoning
- if not able to be declared as a protected area for any reason, then the site must have a servitude registered over it in favour of the applicant and/or City of Cape Town reserving for them the rights of ownership that may otherwise impact negatively on the persistence of biodiversity on the site.

2- The applicant must include in its EMPr for the listed activities, the required interventions to protect, rehabilitate and manage the biodiversity offset site, including but not limited to the following:

- Management plans and costs for invasive alien plant control, firebelt establishment, prescribed burns, ecological rehabilitation, ecological auditing and other matters that may be necessary for the proper management of the offset site as a nature reserve.
- Oversight responsibility for site management for the entire 30 yr duration of the offset management liability.
- Sufficient provision to ensure that these costs are catered for over a minimum of thirty years, and ideally in perpetuity.

3- Should the applicant fail to execute such an implementation agreement prior to commencement with the activities, or fail to effectively manage the site through compliance with the applicable management plan, then:

- This authorisation is immediately suspended, and the applicant may be liable for administrative penalties and/or other sanction under NEMA in addition to compliance with this offset condition; and
- In addition to any other administrative penalties that may be determined, a sum of R8 million becomes immediately payable to the Endangered Wildlife Trust, to establish a, or augment an existing, fund for the management of the offset site and adjacent priority conserved areas in the Klipheuwel Corridor not currently in City ownership. The priorities for deploying the funds must be determined in consultation with the DEA&DP and CoCT Biodiversity Management Branch.

# 9. Conclusion

The Cape Winelands Airport has modest impacts on Critically Endangered biodiversity which cannot be effectively mitigated through any means other than a biodiversity offset. This report has explored the terrestrial biodiversity component and is augmented by a parallel process for wetland offsets. Through the onsite delineation provided by the specialist and application of ratios provided in the relevant Guideline, the offset is determined to be not less than 77 hectares of Swartland Renosterveld on Shale, Silcrete/Ferricrete or Granite. Where possible, the offset site should support those impacted species of conservation concern and provide opportunities for restoration and establishment/reinforcement of existing populations of at least the CR species. Site contribution to improved ecosystem function is desirable where design and other constraints allow.

At least two candidate sites were located that substantially satisfy the offset requirements, and negotiations with landowners are concluded for the priority site. Only once the agreement is executed can the ultimate protection mechanism be implemented. However, this report provides minimum requirements that must be met to ensure alignment with good practice and reigning regulatory guidance. A preliminary costing exercise, based on management interventions and likely intervention unit costs, has been developed to inform the requisite implementation arrangements.
At least one PBO has indicated a willingness to host and administer an endowment to manage the site and surrounding priority areas for the minimum 30-year liability period, and to disburse funds to City of Cape Town or other partners to undertake site management.

A proposed condition of authorisation is presented for consideration by the competent authority, which stipulates the offset outcomes to be achieved, indicators or sufficient performance, possible parameters of implementation arrangements, as well as penalties for non-compliance with the offset requirements.

# 10. References

City of Cape Town (2023). *Spatial Trends & Implementation Tracking.* Dept Urban Planning & Design. Publication 1.0 June 2023. https://resource.capetown.gov.za/documentcentre/Documents/City%20research%20reports%20and%20review/UPD_Spatial_Trends_Report.pdf

DFFE (2023). *National Biodiversity Offset Guideline*. Government Gazette 23 June 2023. No. 48841.

FEN (2024). *Detailed EIA phase Freshwater Ecological Assessment.* Submitted as part of the EIA and WUL authorisations for the Cape Winelands Airport. Report Reference FEN 20-2156. March 2024

Helme N (2023). *Botanical Scoping Study For Proposed Cape Winelands Airport, Fisantekraal, Western Cape*. Submitted to PHS Consulting, 23 October 2023.

Helme N (2024). *Botanical Impact Assessment For Proposed Cape Winelands Airport, Fisantekraal, Western Cape*. Submitted to PHS Consulting, version of March 2024. (final version not available at time of writing)

Skowno, A.L., Raimondo, D.C., Poole, C.J., Fizzotti, B. & Slingsby, J.A. (eds.). 2019. *South African National Biodiversity Assessment 2018 Technical Report Volume 1: Terrestrial Realm*. South African National Biodiversity Institute, Pretoria.

# 11. Record of Consultations and Meetings

- 15 May 2024. CCT Biodiversity Management Branch. On Site – Farm 1242, Klipheuwel Corridor sites
- 24 May 2024. CCT Biodiversity Management Branch. Meeting on Management options for key candidate offset sites.
- 7 June 2024. CapeNature, DEA&DP, CCT. Online meeting to provide an overview of offset process, outcomes to date, landowner and implementation agreements, and next steps prior to Report submission.
- 22 August 2024. CCT, Client, Offset Candidate Landowner. In person meeting to negotiate the terms of a letter of intent to secure (purchase or lease) a prospective offset area, and the required terms of a lease agreement to be concluded.
- Several meetings were held online in July and August 2024 between the Client and various PBO offset management fund service providers. As at time of writing, funding agreements were being drafted.

# 12. Annex 1. Curriculum Vitae Extract

**SELECTED PROJECT SPECIFIC REFERENCES:**

1. **Offset Specialist Consultant – UNDP & DFFE BIOFIN Offset Banking Modality for Expansion of PAs. Sept 2022 – Current.** Provide leadership and specialist support to SANParks and other management authorities to set up proactive offset schemes, price offset credits appropriately, provide training and input into the Offset technical community of practice, and policy and operational procedures guidance. Contact: Jeff Manuel SANParks Jeffrey.manuel@sanparks.org.za; Pam Kershaw DFFE PKershaw@dffe.gov.za ; Nokutula Mhene UNDP BIOFIN Project Management nokutula.mhene@undp.org

2. **Offset Specialist – Hermanus CBD Bypass Feb 2021 – Current.** Assess and determine offset requirements for impacts on the protected area, advise and align national, provincial and local government officials on the options and policy principles of offsetting around protected areas. Quantify offset/ecological compensation cost, opportunities to facilitate transfers in line with the PFMA and MFMA, and imperatives for managing offset site in terms of GIAMA, and NEMPA, and related operational matters. Contact: Willem Moolman Willem.Moolman@westerncape.gov.za. Or Dr Coral Birss, CapeNature 087 087 3197

3. **Strategic Biodiversity Offset – Namakwa SEZ, Namaqualand & Richtersveld 2020-22.** Manage specialist consultant, review existing baseline information, liaise with relevant taxa and regional/subject specialists. Compile offset report, present risk analysis and strategic offset implications to NCEDA and partners. Clarify PFMA constraints and opportunities for securing offset site. Contact: Hendrik Louw, Acting CEO NCEDA. 081 3232533

4. **Ecological Compensation advisor – TGME Underground Mine Project, Pilgrims Rest 2019 – 22**. Coordinate various consultants and EAP. Develop Ecological compensation framework and budgets, and present to regulators and I&APs. Compile Compensation Report. Negotiate acceptability of compensation package with DFFE and DWS, MTPA. Contact. Jacques de Triou, TGME COO. 082 9268898.

5. **Offset Specialist – Net Positive Impact Strategy: Anglo Platinum. March 2022 – March 2023.** Quantify Anglo Platinum's mine portfolio residual impact, determine appropriate offset and additional conservation action strategies, identify candidate sites and alternative management implementing entities. Liaison between specialist providers, Anglo Group and Platinum leads. Contact: Jurie Human (Platinum) or Warwick Mostert (Group) Warwick.Mostert@angloamerican.com .

6. **Offset Specialist – Black Rock Mine Operations. May 2021 – Current.** Assess and determine offset requirements for impacts (current and forecast) from BRMO's operations at Hotazel. Locate suitable offset sites, manage the team engaging with landowners. Conclude purchase agreements with landowners and Management arrangements with implementing party. Contact: Wilhemina Ngcobo: Black Rock Mine General Manager. Or Botshelo Moses (Environment Manager) Assmang.

7. **Offset Specialist – Komas/Gromis WEF, Namaqualand 2020 -2021.** Manage offset assessment, compile report, negotiate with DAEARDLR, DFFE, SANParks on suitable parameters, sites etc. Contact: Elsabe Swart – Environmental Research, DAEARDLR, Kimberly: Mercia Grimbeek, Enertrag SA. Mercia.Grimbeek@enertrag.co.za

8. **Lead consultant - Streamlining Biodiversity Offset implementation in the Northern Cape. 2017-2020.** Project for DENC and Wilderness Foundation Africa. Highlighted spatial aggregation possibilities and decision-making support protocols to simplify offsets and improve predictability. Contact: Kerry Purnell Kerry@wfa.africa

9. **Offset Specialist – Kap Vley Wind Farm.** Juwi Energy and DENC. **February 2018 –Feb 2020.** Review offset proposals, confirm adequacy and accuracy of original Offset report. Expert Opinion on alternative implementation mechanisms and additionality. Facilitate negotiations between juwi, DENC, SANParks and WWF-SA, and develop a proactive implementation model to reduce risk for energy developers. Contact Steyn de Vos for Reference. Steyn.devos@juwi.co.za 082 388 4738

10. **Offset Specialist and lead Negotiator –** Zirco Roodeheuwel Mine**. Jan 2016 – Dec 2017**. Review previous specialists' offset studies, submit a professional perspective on their accuracy and veracity. Develop and

conclude an implementation agreement between the parties, implementing agencies and commenting authorities. Contact Mark McKinney for reference. 082 900 5640 or m.mckinney@aeolus-resources.com

11. **Team leader – Biodiversity Offset for the N2 Wild Coast Toll Highway**. CCA and SANRAL **Jan 2014 – May 2016.** Conceptualise the work programme; oversee external specialists, resource economists; Locate and quantify candidate offset sites and attendant rehabilitation and management plans and Budgets; Integrate terrestrial and freshwater/wetland offset requirements. Compile Offset statement and Specialist Report. Lead offset component of the Authorities Reference Group. Lead negotiations and budgeting with implementing agencies, SANRAL and National Treasury. Concluded an implementation plan and offset agreement between the parties. **September 2018- January 2022** appointed as specialist advisor to the implementation team for the Offset. Contact Fuad Fredericks for Reference ffredericks@slrconsulting.com

12. **Team leader – Gamsberg Biodiversity Offset.** Vedanta Zinc International and Black Mountain Mine. **Oct 2012 – Nov 2014 and 2019 - 2020.** Conceptualise the work programme; oversee external specialists, financial specialist; Quantify candidate offset sites and notional management plans and Budgets; Compile Offset statement and Specialist Report. Lead negotiations and budgeting with implementing agencies, DENC and Black Mountain Mine. Concluded an offset agreement between the parties.

13. **Offset Specialist – Booysendal Platinum Mine S24G and additional EMPR activities.** Northam Platinum**. April 2017 – 2020.** Review and understand the full suite of impacts from the mine, including separating historical from current impacts and liabilities. Finalise offset parameters and costs. Understand, align and synthesize various specialists' recommendations into an offset report, and draft appropriate conditions of authorisation. Provide guidance to client and legal specialists on appropriate models for implementation and concluding agreements with authorities. Negotiations between Northam and MTPA on finalising offset agreement and implementation plan.

# 13. Annex 2. Submitted Plan of Study

| Week | Task | Output | Submitted |
|---|---|---|---|
| 1 | Review draft Impact Assessments, desktop review receiving environment. Review authorities' SR comments and other correspondence. | Plan of Study | 25 Apr |
| 2 | Site visit, confirm impact areas, remnant vegetation, assess Botanical specialist calculations. Create possible candidate offset site shortlist. Visit two or more candidate sites. Solicit input from CREW project and field staff with local knowledge. | Candidate Site Shortlist | 3 May |
| 3 | Develop Offset statement, solicit input and further comment/constraints from CN, CCT Biodiversity Branch, DEA&DP (if required). Develop draft Offset Report and prepare for DEIR. Get no objections to min 2 and max 3 candidate sites. | Draft Report | 17-30 May |
| 4 | Compile minimum requirements for Offset Implementation Agreement for leading candidate sites. Advise client on options and Heads of Implementation Agreement for leading candidates, including potential management arrangements. Anonymise candidate sites if prejudicial to implementation. | Draft Implementation arrangements, Draft Offset Submission EIR | Aim for 14 June |
| 5 | Incorporate authorities & I&AP comments. | Final report, input into CRR | 13 June – 29 June |
| 6 | Finalise Offset Report, and draft condition of Authorisation for consideration. Finalise input into Implementation Agreement – if required | Final Report, Implementation agreement for negotiation | Weeks of 8 – 19 July |

# 14. Determination of management liabilities in succeeding years

*Table 5. The yearly forecast management costs, the NPV of the remaining liability period of management costs, in case of failure by the applicant to secure or safeguard the management of the offset site.*

| | | |
|---|---|---|
| **Discount rate** | 8,9% | National Treasury |
| **Inflation** | 6% | Ave CPIX 2023/4 |

2024 Baseline

| Year | Management costs | NPV remaining fees | Year | Tax Year |
|---|---|---|---|---|
| **2025** | R 516 060 | R 7 897 362 | 1 | 2026 |
| **2026** | R 311 786 | R 8 038 238 | 2 | 2027 |
| **2027** | R 558 176 | R 8 414 106 | 3 | 2028 |
| **2028** | R 356 964 | R 8 555 107 | 4 | 2029 |
| **2029** | R 399 220 | R 8 927 778 | 5 | 2030 |
| **2030** | R 408 688 | R 9 287 599 | 6 | 2031 |
| **2031** | R 457 067 | R 9 669 134 | 7 | 2032 |
| **2032** | R 467 907 | R 10 031 941 | 8 | 2033 |
| **2033** | R 523 296 | R 10 415 233 | 9 | 2034 |
| **2034** | R 535 707 | R 10 772 319 | 10 | 2035 |
| **2035** | R 655 239 | R 11 147 671 | 11 | 2036 |
| **2036** | R 613 331 | R 11 426 258 | 12 | 2037 |
| **2037** | R 685 934 | R 11 775 278 | 13 | 2038 |
| **2038** | R 702 203 | R 12 076 295 | 14 | 2039 |
| **2039** | R 785 326 | R 12 386 387 | 15 | 2040 |
| **2040** | R 1 381 920 | R 12 633 555 | 16 | 2041 |
| **2041** | R 899 120 | R 12 253 030 | 17 | 2042 |
| **2042** | R 920 444 | R 12 364 409 | 18 | 2043 |
| **2043** | R 1 737 438 | R 12 462 477 | 19 | 2044 |
| **2044** | R 1 053 817 | R 11 679 567 | 20 | 2045 |
| **2045** | R 1 288 954 | R 11 571 442 | 21 | 2046 |
| **2046** | R 1 206 515 | R 11 197 629 | 22 | 2047 |
| **2047** | R 1 349 336 | R 10 880 323 | 23 | 2048 |
| **2048** | R 1 381 339 | R 10 379 245 | 24 | 2049 |
| **2049** | R 1 544 855 | R 9 798 720 | 25 | 2050 |
| **2050** | R 1 581 495 | R 8 988 459 | 26 | 2051 |
| **2051** | R 1 768 705 | R 8 066 183 | 27 | 2052 |
| **2052** | R 1 810 653 | R 6 857 954 | 28 | 2053 |
| **2053** | R 2 024 990 | R 5 496 511 | 29 | 2054 |
| **2054** | R 3 780 486 | R 7 252 007 | 30 | 2055 |

# ANNEXURE 19: NOISE MITIGATION AND MANAGEMENT PLAN

(This will be a condition of approval if Environmental Authorisation is obtained)

## ANNEXURE 20: PERMITS AND LICENSES

(This section is updated as permits and licences are issued e.g. the Environmental Authorisation is included here, should it be granted.)